VOLUME I

Remedial Investigation/ Feasibility Study Work Plan

Former Grumman Settling Ponds (Operable Unit 3 – Bethpage Community Park), Bethpage, New York.
NYSDEC Site # 1-30-003A

Revised: March 8, 2006

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Infrastructure, environment, buildings

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1. Introduction

This Remedial Investigation/Feasibility Study (RI/FS) Work Plan has been prepared by ARCADIS G&M Inc. (ARCADIS) with input from Dvirka and Bartilucci Consulting Engineers (D&B) on behalf of Northrop Grumman Systems Corporation (NGSC), and is being submitted pursuant to Section II of the Order On Consent (Consent Order or CO) Index # W1-0018-04-01 that was executed by the New York State Department of Environmental Conservation (NYSDEC) and NGSC, effective July 4, 2005 (NYSDEC 2005a). The CO required that an RI/FS be conducted for the present day Bethpage Community Park property (referred to in this Work Plan as the Park). The Park, which was termed the "Former Grumman Settling Ponds Area" and designated as Operable Unit 3 (OU3) by the NYSDEC, and the Plant 24 Access Road are collectively referred to herein as the Site[1]. The Park has been owned and operated by the Town of Oyster Bay since 1962, but historically was part of the former Grumman Aerospace Corporation, Bethpage Facility (the Bethpage Facility). The Bethpage Facility is listed in the NYSDEC Registry of Inactive Hazardous Waste Disposal Sites in New York as Site No. 1-30-003A with a classification of "2".

The general objectives of the OU3 RI/FS process are, as follows:

- Determine the nature and extent of the constituents of potential concern (COPCs) and assess potential impacts to the public health, welfare, and the environment caused by the release or potential release of COPCs at or from the Site.

- Develop and evaluate alternatives for remedial action, if needed, to prevent, mitigate, or otherwise respond to or remedy a release or potential release of COPCs at or from the Site by conducting an FS.

- Compile all related (i.e., current and previous) data from NGSC, the New York State Department of Health (NYSDOH)/NYSDEC, and the Town of Oyster Bay (Town) into one, comprehensive RI Report.

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[1] Plant 24 Access Road is not part of OU3, but for the purposes of this document it is considered part of the Site.

- Evaluate the need for an Interim Remedial Measure (IRM) and, if needed, evaluate potential technologies for and propose an IRM.

- Incorporate all elements of an RI/FS, as set forth in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, the National Contingency Plan (NCP), the United States Environmental Protection Agency (USEPA) Guidance Document, entitled Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, dated October 1988, and any subsequent revisions thereto, in effect at the time this RI/FS Work Plan is submitted, and appropriate USEPA and NYSDEC technical and administrative guidance documents (including the following: NYSDEC 1990; NYSDEC 1994; NYSDEC 1998; NYSDEC 2002).

This RI/FS Work Plan provides the framework for the activities to be conducted as part of the RI/FS for the Site, as required by the CO, and includes the following elements:

- A summary of the previous investigations and phases of the RI that have been completed prior to the preparation of this RI/FS Work Plan is presented in Section 2.0, which includes the site description and history, previous investigations, and the environmental setting;

- The Conceptual Site Model (CSM) presented in Section 3.0;

- Preliminary Applicable or Relevant and Appropriate Requirements (ARARs)/New York State Standards, Criteria, and Guidelines (SCGs) and preliminary Remedial Action Objectives (RAOs) discussed in Section 4.0;

- Phase 1 of the RI was conducted from May 2004 to June 2005. The approach and goals for Phase 2 of the RI and the FS discussed in Section 5.0;

- The proposed Scope of Work for the RI/FS Work Plan presented in Section 6.0;

- The Project Management Plan and anticipated schedule presented in Section 7.0;

- References cited in this Work Plan listed in Section 8.0;

- The following appendices:
  - Appendix A – Field Sampling Plan
  - Appendix B – Quality Assurance Project Plan
  - Appendix C – Health and Safety Plan
  - Appendix D – Citizens Participation Plan
  - Appendix E – Geophysical, Soil, and Groundwater Data from RI Phases 1, 1A, and 1B (conducted by ARCADIS)

2. Site Description and Background

Much of the information related to site description and background that is presented in Sections 2.1 and 2.2, of this Work Plan was originally presented in the December 2003 Field Report - Town of Oyster Bay, Bethpage Community Park, Investigation Sampling Report, prepared by D&B on behalf of NGSC. Sections 2.3.1 to 2.3.3 of this Work Plan summarize the findings of previous phases of the RI that were completed by D&B and ARCADIS, as well as related investigations performed by other parties.

The Site location is shown on Figure 1. Historical operations, current adjoining streets and properties, and current site features and structures are shown on Figure 2.

2.1 Park History

The land that comprises the current Bethpage Community Park was primarily farmland and was purchased by the Grumman Aircraft Engineering Corporation (a predecessor of NGSC) in 1941. During its ownership of the property, manufacturing operations were not undertaken, and buildings and structures were not erected by Grumman Aircraft Engineering Corporation (Grumman).

On October 17, 1962, the Park property was donated by Grumman to the Town of Oyster Bay for exclusive use as parkland. Shortly after Grumman donated the land to the Town, the Town commenced construction and other work on the site. The Park structures, as they are known today, were built by the Town without any Grumman involvement. However, Grumman was allowed to continue to discharge the non-toxic

liquid waste it was placing on the Park property and to continue to place clean fill on the property until such activities would, in the Town's opinion, impede development of the property (per October 16, 1962 correspondence from Town Board of Oyster Bay).

2.1.1 Former Grumman/NWIRP Operations

The December 2003 report that was prepared by D&B provides a description of former Grumman/NWIRP operations, based on interpretation of aerial photographs and other information (D&B 2003).

2.1.2 Current Site and Project Area Description

The present-day Bethpage Community Park is operated by the Town of Oyster Bay. The Park is comprised of approximately 18 acres, and is located adjacent to the northeast portion of the NGSC Bethpage Facility. The Park is open year-round and contains two swimming pools, ice rink, offices, parking lot, picnic and playground areas, tennis courts, paddleball courts, basketball court, shuffleboard courts, horseshoe pits, baseball field, bicycle rack areas, and a stormwater recharge basin. Adjoining the Park property to the south is the Plant 24 Access Road, which is a partially asphalt-paved/partially grassed area that runs east-west along the Park southern boundary. The Plant 24 Access Road is owned by NGSC. The Park and NGSC Plant 24 Access Road are collectively referred to in this Work Plan as the Site.

The Site is located adjacent to the northeast portion of the NGSC Bethpage Facility, and is bordered by Cherry Avenue Extension and the Robert Plan Company Building to the north, Stewart Avenue and Bethpage High School to the east, residential areas to the south, and a second Robert Plan Company Building (former NGSC Plant 24) to the west. Other properties owned by NGSC, including the McKay Field property, ballfields and former nursery areas are located to the west. Further to the west are the NWIRP Site, the north campus of the NGSC Facility, and the former Occidental Chemical Corporation (OCC)/RUCO Polymer Site (the latter is a federal Superfund site).

2.2 Environmental Setting

This section of the Work Plan provides a brief, physical description of the Site, the local geology, and the area hydrogeology.

2.2.1 Topography and Physical Features

The Site is approximately 120 feet above mean sea level and, topographically, is generally flat. Most of the Site has been fully developed and serves as the Park, with unpaved areas covered by grass or ornamental landscaping. The recharge basin and portions of the Park perimeter are overgrown.

2.2.2 Local Geology

In general, the geology at the Site, from land surface down to the basal Magothy Formation, consists primarily of sand with interbedded lens of silt, clay, and gravel. The uppermost sequence of these sediments is part of the Upper Pleistocene glacial outwash deposits, while the lower geologic sequence comprises the Magothy Formation. The Upper Pleistocene deposits in this area of Long Island tend to be coarser than the underlying upper portion of the Magothy Formation. Within the Magothy Formation, the deposits tend to become finer with depth, except for the basal Magothy, where sand and gravel deposits are more prevalent. Geologic cross sections of this area indicate a high degree of stratification of these deposits (ARCADIS Geraghty & Miller, Inc., 2000). Vertical profile borings (described in Section 2.3 of this work plan) drilled at the Site indicate that a clay lens, with the upper surface encountered from approximately 36 to 46 feet below land surface (ft bls) and ranging in thickness from approximately 1 ft to greater than 20 ft, was detected at the Site (and extending off-site to the west) underlying the recharge basin, the former Sludge Drying Beds, the former Rag Pit, the central to southeastern portion of the ballfield, and the western portion of the parking lot.

A description of regional geology is presented in the RI Report, prepared September 1994, for the former Grumman Aerospace Corporation, Operable Units 1 and 2 (Geraghty & Miller, Inc. 1994).

2.2.3 Area Hydrogeology

The principal aquifers underlying the project area are the Upper Glacial deposits and Magothy Formation; these hydrogeologic units are in direct hydraulic connection with each other. Groundwater in the Upper Glacial deposits and Magothy Formation occurs under unconfined conditions at and near the Site (although the Magothy Formation in other areas of Long Island can exhibit semi-confined conditions; the degree of confinement increases with depth due to stratification of the numerous silt and clay

lenses). Within the project area, the average horizontal hydraulic conductivity of the Upper Glacial deposits is approximately 270 feet per day (ft/d); with an anisotropy of approximately 10:1 (horizontal to vertical, respectively). The average horizontal hydraulic conductivity of the Magothy Formation in the project area is approximately 50 ft/d, with an anisotropy ratio of approximately 100:1 (horizontal to vertical, respectively) (Geraghty & Miller, Inc. 1994).

Depth to groundwater at the Site is approximately 55 ft bls. Water-level elevation data collected in the area of the Site indicate a resultant direction of shallow groundwater flow that is horizontally south-southeasterly and vertically, slightly downward. Local water-level elevations obtained from water-table wells located at the site (measured by D&B [Dvirka & Bartilucci Consulting Engineers, 2003]) indicate that the on-site groundwater flow direction in the shallow zone is consistent with the south-southeasterly horizontal regional direction of groundwater flow.

Natural surface water features do not exist in the project area. The on-site stormwater recharge basin may produce local, water-table mounding during intense storm events, however no data currently exist to verify this. The next closest recharge basin are the NWIRP recharge basins located west of the Site.

Wells within a half-mile radius of the Site (and one further away) are shown on Figure 3. Off-site groundwater pumping reportedly occurs at the following locations:

- Approximately 1,000 ft to the northeast of the eastern Site boundary is Well N-4175. This is an irrigation well screened from 54 to 69 ft bls.

- Approximately 2,000 ft to the northeast of the eastern Site boundary is the Bethpage Water District (BWD) Adams Avenue Wellfield. The wellfield is comprised of Wells N-6078 (Well #9), N-8767 (Well #7), and N-8768 (Well #8). The wells are screened from 225 to 275 ft bls, 579 to 640 ft bls, and 605 to 678 ft bls, respectively. Well N-6078 has reportedly been abandoned due to unacceptable water quality.

- Approximately 3,000 ft to the east of the eastern Site boundary is the BWD BGD Plant. This facility has a single well (N-9591), that is screened from 616 to 682 ft bls.

2.3 Previous Investigations

This section of the Work Plan summarizes the previously completed phases of the RI at the Site as well as investigations completed by the Town and the State on or near the Site. Such previously-collected data have been considered during preparation of this Work Plan and will be documented in the final RI Report (see Section 6.2.10). Appendix E of this Work Plan provides the analytical data and summarizes the scope of work completed during Phases 1, 1A, and 1B of the RI, performed by ARCADIS (discussed further below). Investigative work performed by D&B and other parties is selectively shown on Figure E-1 (Appendix E); the results of these investigations are summarized below and incorporated herein by reference.

2.3.1 Soil Investigations

This section summarizes the following completed soil investigations that were performed at/near the Site: (1) the Navy, the Town, and on behalf of NGSC (by D&B and ARCADIS), collectively as part of Phase 1 of the RI, (2) by the Town as part of their Construction Area investigation (i.e., field investigation that is associated with the Town's planned independent redevelopment of the Park), and (3) by NYSDOH in conjunction with NYSDEC and the Nassau County Department of Health (NCDOH) for the off-site soil investigation.

Five soil investigations have been conducted at the site. The first four investigations occurred in November 1994 (by the Navy), April 1998 (by Eder Associates on behalf of Town of Oyster Bay) and in March 2002 and May 2002 (by D&B on behalf of NGSC). The 2002 D&B investigations are fully described by D&B in the December 2003 report. In summary, the following was found: in the November 1994 and April 1998 investigations, which had limited sampling locations on the Site (i.e., one sample was collected by the Navy in 1994, five samples were collected by Eder in 1998) samples were analyzed for polychlorinated biphenyls (PCBs); exceedences of the Technical and Administrative Guidance Memorandum #4046 (TAGM) Recommended Soil Cleanup Objectives (RSCOs) were not detected. The March and May 2002 investigations covered larger areas of the Site (i.e., 79 borings and exposure points in March 2002; 12 borings and 8 exposure points in May 2002), and samples collected were analyzed for PCBs and Resource Conservation and Recovery Act (RCRA) metals. PCBs and several RCRA Metals (i.e., arsenic, cadmium, chromium, and mercury) were detected above RSCOs in March 2002; in May 2002, PCBs were detected above the RSCO (Dvirka and Bartilucci Consulting Engineers, 2003).

Based on the above results and discussions with the NYSDEC and NYSDOH, it was determined that additional investigation was needed. Hence, in May/June 2003, the third investigation by D&B (fifth investigation overall) (which primarily focused on soil but included the installation/sampling of three monitoring wells – see Section 2.3.2 herein) was performed. In summary, a total of 28 soil borings were advanced and sampled. Three of the borings were converted to the three groundwater monitoring wells and groundwater samples were collected (see Section 2.3.2 herein). Soil samples from the soil borings were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs, Target Analyte List (TAL) metals, and hexavalent chromium. In summary, the following findings and conclusions, as provided in the D&B report with respect to soil, were made:

- Based upon the analytical results of the soil samples collected, the vertical extent of impacted soil ranges from 8 to 34 ft bls in the baseball field area and up to 12 ft bls along the perimeter of the baseball field area. The maximum depth of impacted soil in the south playground area is 12 ft bls. The horizontal extent of impacted soil is summarized as follows: To the south and west, impacts exceeding RSCOs were detected to the boundaries of the Park. Impacts to the north and east were limited to the baseball field area. The following constituents were detected in soil samples exceeding RSCOs:

    - VOCs: acetone; m,p-xylene; o-xylene; toluene; and 1,1-dichloroethane

    - SVOCs: benzo(a)anthracene; chrysene; benzo(b)fluoranthene; benzo(k)fluoranthene; benzo(a)pyrene; dibenzo(a,h)anthracene; pentachlorophenol; 4-methylphenol; and phenol

    - PCBs: Total PCBs

    - Metals: arsenic, barium, cadmium, chromium, hexavalent chromium, copper, lead, magnesium, mercury, nickel, selenium, and zinc

- The soil sample screening and analytical results showed no indication that soil located in the Park is a continuing source of the chlorinated VOCs that were detected in downgradient groundwater samples (Section 2.3.2) since residual concentrations of VOCs were not detected in the soil samples and elevated photoionization detector (PID) readings were not encountered (Dvirka and Bartilucci Consulting Engineers, 2003).

In July and September of 2002 and April 2003, the NYSDOH, in conjunction with the NYSDEC and the NCDOH, collected surface and subsurface soil samples from select residential properties located south of the Plant 24 Access Road, between Stewart Avenue and 11th Street. A total of 56 surface soil samples and seven subsurface soil samples were collected from 27 residences and analyzed for PCBs to determine if elevated PCB concentrations (above the RSCO) were present. The analytical results of the soil samples indicated that PCB concentrations ranged from non-detect to 56 milligrams per kilogram (mg/kg) in the surface soil, and 0.02 mg/kg to 16 mg/kg in the subsurface soil. Based on these results, the NYSDOH recommended that soil remediation should be conducted at three residences and further PCB delineation should be conducted at a fourth residence (NYSDOH 2004).

ARCADIS did not collect soil samples during Phases 1 and 1A of the RI. ARCADIS performed sampling of soil for VOCs and SVOCs in selected Phase 1B vertical profile borings (VPBs) in May and June 2005. The complete description of field methodology used for VPB sampling is provided in Appendix A; analytical protocols used and parameters analyzed for are provided in Appendix B. The analytical results of soil samples collected are summarized in Appendix E. Based on the Phase 1B RI results, the area near the former Rag Pit and, to a lesser extent, several of the other former operational areas were preliminarily identified as a potential source(s) of chlorinated VOCs. Additionally, the results of geophysical surveying conducted around proposed sample locations for utility clearance indicated the presence of subsurface anomalies on the Plant 24 Access Road and in the Park (see Appendix E). Furthermore, a bluish-green material was encountered (from approximately 1 to 6 ft bls) on the Park at VPB VP-9 (thin lenses with trace amounts of a similar material were also reportedly identified in the Park during the previous investigations performed by D&B [Dvirka and Bartilucci Consulting Engineers, 2003]). Total mass analysis of the material indicated trace levels of VOCs, SVOCs, and PCBs. Metals detected included: calcium, chromium, aluminum, magnesium, mercury, iron, and zinc. The same parameters were also analyzed for using the Toxicity Characteristic Leaching Procedure (TCLP); the results indicated only the presence of metals (see Appendix E) with no exceedences.

During 2005, the Town performed investigations of soil in and near the proposed, on-site Construction Area, results of which are documented in two subsequent reports in November and December 2005 (H2M 2005a; H2M 2005b). The results of these investigations have been considered in the preparation of this Work Plan, and the data from the associated reports will be incorporated into the final RI Report.

2.3.2 Groundwater Investigations

As part of the May/June 2003 groundwater investigation performed by D&B, three monitoring wells (BCPMW-1, BCPMW-2, and BCPMW-3 – see Figure E-1) were installed, and groundwater samples were collected from these and the three existing wells near the Site. Groundwater samples were analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, PCBs, hexavalent chromium (total and dissolved), and TAL metals (total and dissolved). The VOCs detected in excess of Class GA Groundwater Standards, along with the highest detected concentration, include: vinyl chloride (VC) (70 micrograms per liter [µg/L] [estimated]); 1,1-dichloroethene (1,1-DCE) (44 µg/L); 1,1-dichloroethane (1,1-DCA) (18 µg/L); cis-1,2-dichloroethene (cis-1,2-DCE) (5,300 µg/L); 1,1,1-trichloroethane (1,1,1-TCA) (6 µg/L); and trichloroethene (TCE) (1,800 µg/L). The analytical results of the groundwater samples collected from the three off-site monitoring wells (two located upgradient of the Park) coupled with the groundwater samples collected from the three on-site monitoring wells indicated the presence of significant concentrations of chlorinated VOCs in groundwater in the Park. As a result, further investigation was recommended to determine the potential source of the chlorinated VOCs detected in groundwater (Dvirka and Bartilucci Consulting Engineers, 2003).

In accordance with NYSDEC work plan approvals, Phase 1 of the OU3 RI was initiated in July 2004 (by ARCADIS) focusing on the characterization of groundwater quality at the Site. To move the OU3 RI forward on an expedited basis while the OU3 CO was being negotiated, ARCADIS submitted letter-format Work Plans to NYSDEC for review and approval, and following receipt of NYSDEC approval these Work Plans were implemented. As of the writing of this Work Plan, on-site RI Phases 1, 1A, and 1B have been completed. The proposed work scope for Phase 2 of the RI is described in Section 6 of this Work Plan.

As part of the Phase 1 RI (consisting of Phases 1, 1A, and 1B), a total of 32 VPBs were installed on-site. The detailed scope and rationale for the Phase 1 VPBs has been documented in previously approved letter work plans to NYSDEC (specifically, ARCADIS G&M, Inc., 2004a; 2004b; and 2005a).

The Phase 1 RI VPB installation process involved using Hollow Stem Auger (HSA) drilling methodology and temporary well groundwater sampling methodology to advance the VPB and collect groundwater samples. Split-spoon soil samples were collected at specified intervals from the water table (approximately 55 ft bls) to total

depth. Geophysical logging (natural gamma) of the VPB boreholes was performed to supplement hydrogeologic information gained from split-spoon samples. Groundwater samples were submitted for analysis for the TCL VOCs (and SVOCs for selected VPBs). The complete description of field methodology is provided in Appendix A, analytical protocols and parameters are provided in Appendix B, and the analytical results are summarized in Appendix E.

Based on interpretation of available aerial photographs, specific areas at the Site may have been used for waste disposal, and as such, the Phase 1 RI VPBs were proposed in or near these areas. Furthermore, if these areas were an active source (s), it was believed that the highest concentrations in groundwater would occur at, or immediately below, the water table. Therefore, by drilling and sampling VPBs to 110 ft bls (approximately 50 feet below the water table) it was believed that impacted groundwater, if it existed, would be detected. Additionally, two deeper VPBs were drilled and sampled to determine the approximate maximum VOC plume depth on the Park and the Plant 24 Access Road.

The Phase 1 RI field effort was performed from June to October 2004 and included the installation of 12 on-site VPBs. VPBs VP-1 to VP-8 and VP-10 to VP-12 were drilled and sampled along the hydraulically downgradient side (southern edge) of the NGSC Plant 24 Access Road adjacent to and south of the Park and VPB VP-9 was installed in the Park. The Plant 24 Access Road VPBs were intended to define the lateral extent of groundwater impacts at the Site boundary, the concentrations of VOCs potentially migrating off site, and potentially define the vertical extent of groundwater impacts. One VPB installed on the NGSC Plant 24 Access Road (VP-3) was installed immediately downgradient of the location of existing Well BCPMW-3, which is the monitoring well where the highest observed VOC concentrations had been detected on-site prior to the Phase 1 RI. Ten of 12 VPBs were installed to a depth of approximately 110 ft bls, while two VPBs (one in the Park and one on the Plant 24 Access Road) were drilled to 300 ft bls.

Subsequent to completion of Phase 1, RI Phases 1A and 1B were proposed, approved, and carried out. VPBs proposed for RI Phases 1A and 1B were installed as east-west transects within the Park. Each subsequent work phase was dynamically developed based on a review of previously collected data with the goal of defining the lateral and vertical limits of on-site total VOC (TVOC)-impacted groundwater, while also attempting to identify the area(s) of the potential source(s) of VOC-impacted groundwater.

In general, the results of RI Phases 1, 1A, and 1B indicate that there is an on-site plume of VOC-impacted groundwater that is approximately 1,100 ft wide (west to east along the Plant 24 Access Road and Park southern boundary), extending from the water table to 150 ft bls at the southern boundary of the Site. VOCs detected exceeding NYSDEC SCGs in on-site groundwater include the following: 1,1,1-TCA; 1,1-DCA; 1,1-DCE; chloroform; cis-1,2-DCE; tetrachloroethene (PCE); TCE; VC; toluene; bromomethane; and xylenes. Additionally, a clay lens, ranging in thickness from approximately 1 foot (in the western parking lot area) to greater than 20 feet (west of the recharge basin) (see Section 2.2 herein), was detected during Phases 1A and 1B underlying the areas of the recharge basin, the former Sludge Drying Beds, the Rag Pit, the central to southeastern portion of the ballfield, and a portion of the parking lot.

In June 2005, the Town performed an investigation of groundwater through the installation and sampling of groundwater from four monitoring wells (CAMW-1, CAMW-2, CAMW-3, and CAMW-4; see Figure E-1). The results of this investigation are documented in reports, dated November and December 2005 (H2M 2005a; H2M 2005b). The results of the groundwater sampling are consistent with the findings of Phases 1, 1A, and 1B of the RI.

2.3.3 Soil Gas Investigation

As part of the Phase 1A RI, ARCADIS drilled and sampled four soil gas points (SGPs) along the NGSC Plant 24 Access Road. At each SGP location, three soil gas samples were collected; single samples were collected at approximately 5, 15, and 40 ft bls. The samples were submitted for laboratory analysis of VOCs. Analytical results indicate that TCE and 1,3-butadiene were detected above USEPA Site-Specific Soil Gas Screening Concentrations. Results of this soil gas investigation were submitted to NYSDEC in the June 2005 report, entitled Summary of Soil Vapor Sampling Results, Bethpage Community Park – Operable Unit 3 (ARCADIS G&M, Inc., 2005b). The complete description of methodology is provided in Appendix A; analytical protocols and parameters are provided in Appendix B.

In June 2005, the Town performed an investigation of soil gas at the Park, which was documented in two subsequent reports in November and December 2005 (H2M 2005a; H2M 2005b). The analytical results of these samples indicated the presence of various VOCs in soil gas within the Park. ARCADIS, on behalf of NGSC, provided technical comments regarding the findings and conclusions related to the Town's soil gas investigation (see NGSC letter of January 13, 2006 [NGSC 2006]).

3. Conceptual Site Model

Based upon the analytical results of previous investigations, the current Conceptual Site Model (CSM) has been developed and is provided below. A review of existing reports, available data, historical information, and on-site impacts to soil, soil gas, and groundwater has been completed as part of the development of the CSM.

Based on the above, the following CSM was developed:

- **On-Site Soils:**
  - Metals: Various metals were detected in soil samples (primarily chromium, mercury, and zinc) in the area of the Sludge Drying Beds and/or Rag Pit.
  - VOCs: Various VOCs (primarily including toluene; TCE; cis-1,2-DCE; and 1,1,1-TCA) were detected in soil samples in the areas of the Rag Pit and Fire Training area.
  - SVOCs: Various SVOCs (primarily including, phenol, benzo(a)anthracene, benzo(a)pyrene, and chrysene) were detected in soil samples in the areas of the Rag Pit, Fire Training area, and current Parking lot.
  - PCBs: PCBs were detected in soil samples (primarily including Aroclor – 1242 and Aroclor – 1254). PCBs were detected sporadically throughout the Site, but were predominantly located in the ballfield area.

Based on available data (see Appendix E), the "bluish-green" material identified in VPB VP-9 does not appear to be a current source of VOC or SVOC impacts to groundwater.

- **Off-Site Soils:**
  - PCBs: PCBs were detected in shallow soil samples collected by the NYSDOH from select residential properties located south of the Plant 24 Access Road between Stewart Avenue and 11th Street (Section 2.3.1). With the exception of a single residence, PCB impacts to soil have been delineated (NYSDOH 2004).

There are various hypothetical mechanisms that could result in the off-site detection of PCBs that potentially include stormwater runoff, fugitive dust, or activities associated with the construction and/or occupancy of the residences (e.g. owner-applied chemicals, nearby transformers, or developer activities).

- **On-Site Soil Gas:**

  - VOCs: The detections of VOCs in on-site soil gas samples collected from the Plant 24 Access Road by ARCADIS indicate the potential for volatilization of VOCs to occur from the water table and/or from an on-site source area(s) (e.g., the subsurface clay that underlies the Rag Pit and Sludge Drying Beds is suspected to contain source-strength VOCs due to preliminary VPB data and its proximity to suspected overlying sources). Other VOCs have also been detected in soil gas on the Park property by the Town.

The source of soil gas impacts has not been confirmed.

- **Off-Site Soil Gas:**

  - Off-site soil gas has not been investigated as part of the previous phases of the RI described above. The Phase 2 RI will involve the collection of samples to the south and east of the Site on public rights-of-way to determine whether VOCs are present in off-site soil gas and to provide information to update the relevant portion of the CSM.

- **On-Site Groundwater:**

  - Metals: The detection of various metals (primarily arsenic, chromium, iron, and lead) in groundwater indicates the potential for impacts from the Sludge Drying Beds, Rag Pit and/or Fire Training area.

  - VOCs: The detections of various VOCs above SCGs (primarily TCE; cis-1,2-DCE; VC; 1,1-DCE; and 1,1-DCA) in groundwater samples indicate potential impacts from the Rag Pit, Fire Training, and/or current parking lot areas. Results of individual VOCs analyzed for in on-site groundwater were as high as approximately 200 milligrams per liter (mg/L). Furthermore, the available groundwater quality data suggest that there

may be a continuing source(s) of VOCs near the former Rag Pit, as the highest on-site concentration of VOCs was detected at the water table in this area. A potential candidate for this continuing VOC source is the clay lens that was identified in previous phases of the RI and that underlies former operational areas as well as the current recharge basin. A portion of this clay appears to be periodically in contact with the water table during seasonal water-level fluctuations. The clay may also be "flushed" by stormwater that is discharged to the on-site recharge basin. If sorbed VOCs are present at source-strength concentrations (close to or greater than 1 percent of solubility) within or on top of the clay, such VOCs could represent a continuing source of impacts to groundwater through periodic de-sorption and dissolution processes. Furthermore, the detection of the VOCs listed above, which are known breakdown products of the VOCs (TCE and 1,1,1-TCA) detected in soil samples, are an indication that biologic and/or abiotic degradation may be occurring within the subsurface zone. This degradation is likely fueled by the presence of toluene (detected in soil). The area within and near the subsurface clay lens detected underlying the former Sludge Drying Beds, Rag Pit, and recharge basin is a suspected location for such degradation to occur.

- Perchlorate: No evidence of perchlorate usage or impacts has been documented at the site. There have been detections in groundwater samples collected from nearby public supply wells operated by the BWD that are located northeast of the site. Sampling for perchlorate has been added to the RI to respond to a NYSDEC request.

- SVOCs: The identification of SVOCs (primarily phenol, naphthalene, and bis-2ethylhexylphthalate) in groundwater samples indicates potential impacts from the area of the Rag Pit.

- PCBs: PCBs have not been detected in groundwater samples.

- **Off-Site Groundwater**

  - There are no known on- or off-site groundwater receptors.

  - The observed site-related groundwater contamination may be co-mingled with impacted groundwater from the west (i.e., from Operable Unit 2, which is

comprised of the NGSC, NWIRP, and former OCC/RUCO Polymer VOC groundwater plumes) (Geraghty & Miller, Inc. 1994).

- If the site-related plume is present off site, it is expected to migrate off-site in the shallow groundwater, but will progressively increase in depth with distance from the site due to regional hydrogeologic processes and pumping influences. Based on the available data, the mobile COPCs in groundwater are VOCs. In general, mobile COPCs dissolved in groundwater will migrate beneath the site within the unconsolidated aquifer deposits at almost the same velocity as groundwater. This is because mobile COPC migration relative to groundwater flow is not slowed appreciably by sorptive processes. Conversely, SVOCs, PCBs, and inorganic constituents (i.e., metals) are expected to tightly sorb to the soil matrix and remain relatively immobile.

- The dynamics of the groundwater flow system provide the hydraulic mechanism for mobile COPC migration in the subsurface. Both horizontal and vertical groundwater flow contribute to the three-dimensional migration potential of the mobile COPCs. The factors and forces controlling this movement include physical aquifer properties (e.g., hydraulic conductivity, porosity, etc.) and the hydraulic gradients (partially a function of recharge [precipitation], pumping wells, and regional groundwater flow conditions). The primary direction of groundwater flow at the site is to the south/southeast. Based on anisotropy ratios of 10:1 and 100:1 within the Upper Glacial and Magothy Formation, respectively, it is expected that the horizontal component of flow would significantly dominate the vertical direction of flow. Proximal to areas of aquifer recharge (e.g., recharge basins) or discharge (e.g., pumping wells), however, the vertical component of flow could, locally, be accelerated.

- Based on currently available site data, the potential for mobile COPC migration is highest to the south/southeast within the upper portions of the saturated groundwater system. Additionally, based on modeling conducted by the United States Geological Survey (USGS), the long-term, historical use of the Plant 3 Recharge Basins (which are located west of the site on the adjacent NWIRP Facility) to recharge about 50 percent of the historical non-contact cooling water pumped at the Bethpage Facility (this pumping varied over time from 8 to 14 million gallons per day [MGD]) appears to have resulted in a more easterly component of horizontal groundwater flow across the site in the past (see Figure 21 in USGS [1995]). Use of the Plant 3 Recharge Basins for

production-related discharges was discontinued in approximately 1995. Therefore, if mobile COPCs in groundwater have migrated off site it would be expected that the mobile COPCs would be present south-southeast and, possibly, also east of the site, and occur from the water table through the mid- to lower portions of the Upper Glacial aquifer, or, further off site, within the upper Magothy aquifer.

This CSM will be re-evaluated and revised (as needed) as additional data are collected for the Site.

4. Preliminary ARARs/SCGs

The selection of ARARs/SCGs for the site will be consistent with the requirements of the NCP (USEPA 1990) and USEPA Guidance (USEPA 1988). In addition, New York State regulatory guidance, such as the Technical Guidance for Site Investigation and Remediation, Technical and Operational Guidance Series Memoranda, and TAGM, and related guidance documents will be considered in the evaluation/selection process.

The approach for identifying the potential ARARs/SCGs begins during the RI. ARARs/SCGs can be characterized as chemical-specific, action-specific, or location-specific requirements. Chemical-specific ARARs/SCGs are health-based or risk-based numerical values that may define acceptable exposure levels and be used in establishing remediation goals. Location-specific ARARs/SCGs are restrictions based on the concentrations of hazardous substances or the conduct of activities in a specific area. Action-specific ARARs/SCGs are technology- or activity-based requirements or limitations on actions to be taken with respect to the hazardous waste.

Because of the iterative nature of the RI/FS process, the identification of ARARs/SCGs and remedial technologies will continue throughout the RI/FS as the understanding of the Site conditions and potential remedial technologies evolves.

5. RI/FS Work Plan Approach and Goals

This section of the Work Plan describes the approach, rationale, and goals for the RI/FS.

5.1 Remedial Investigation Approach

To successfully meet the RI objectives in an effective and efficient manner, a dynamic investigative approach will be used for the Phase 2 RI. As such, it was determined that the data collected during the investigations performed by D&B and others prior to 2004 and RI Phases 1, 1A, and 1B, in conjunction with third party data sources, were adequate to characterize the existing on-site conditions. Following this evaluation, an assessment was made as to the potential for COPCs (primarily VOCs) to migrate off-site. Based on the available data, there appears to be the potential for off-site migration of COPCs. Therefore, the existing off-site data were used, in conjunction with available on-site data, to develop the Phase 2 RI scope of work proposed in this Work Plan. This dynamic approach guarantees that the most complete and recent data set is embedded within the decision-making process so that a complete and focused Phase 2 RI is performed. This approach does not slow or limit the RI process, but rather provides a sound technical basis for the field efforts based on the best available data.

In particular, this RI/FS Work Plan provides a detailed scope of work for investigating soil, soil gas, and groundwater on- and off-site to meet the stated goals of the Phase 2 RI (see below). The Phase 2 RI data will be evaluated after it has been received, reviewed, and validated. Subsequent activities associated with Phase 2A of the soil RI (see Section 6.2.1.1.1) and other additional investigations that may be needed to meet the Phase 2 RI goals will be proposed in a Phase 2 RI Work Plan Addendum(s) to NYSDEC. This additional work will be implemented, with NYSDEC approval, as part of the Phase 2 RI.

5.2 Phase 2 RI Goals

The following are the specific goals of the Phase 2 RI and FS:

- Define the on-site and off-site hydrogeologic framework within the impacted and adjacent areas.

- Delineate the three-dimensional extent of impacted soil in the vadose zone on-site (including data collected by the Town), identify potential source areas, and determine if a continuing source(s) of impacts to groundwater are present.

- Obtain additional information on the presence of VOCs in soil gas in the vadose zone on-site. Determine whether VOCs are present in off-site soil gas immediately east and south of the site on public rights-of-way.

- Characterize and delineate the three-dimensional extent of VOCs in groundwater on- and off-site.

- Fully develop the list of COPCs for the site.

- Determine potential receptors and exposure pathways associated with potential exposure to soil and groundwater.

- Determine if additional data collection efforts are warranted (in addition to that specified for Phase 2A soil RI – see Section 6.2.1.1.1) to meet Phase 2 RI goals. If additional data collection efforts are warranted beyond that described in Section 6.2.1.1.1, then include such efforts in a Work Plan addendum to the NYSDEC. If no such additional effort is required, then prepare Phase 3 RI Work Plan Addendum (Section 6.2.3)

- Develop sufficient data that, in conjunction with IRM pre-design data, will support the design and implementation of a groundwater IRM (a separate IRM work plan will be prepared at a later date; see Section 6.2.2).

5.3 Feasibility Study Approach

Based on the knowledge of existing information pertaining to the Site physical setting and COPC type and distribution from previous investigations (Section 2), it is anticipated that a focused feasibility study (FFS) will be developed. It is expected that the FFS will result in a streamlined decision-making process related to the selection of the preferred final remedy. The FFS will include evaluation of a short-list of applicable remedial technologies that have been demonstrated to be effective in meeting the FS criteria. The remedial alternatives that will be developed and presented in the FFS will incorporate any IRM(s) that may have been implemented.

6. RI/FS Tasks

This section describes the proposed RI efforts for Phase 2 of the RI.

6.1 Scoping the RI/FS

The scoping process, for the purpose of identifying and defining the RI/FS tasks described below, included the following:

- Visits to the site and surrounding area;
- Evaluation of the CO requirements and relevant State and Federal guidance documents;
- Evaluation of existing reports and data for the site and surrounding area.

6.2 Remedial Investigation

This section of the Work Plan describes the proposed work scope for the Phase 2 RI. The work scope proposed for Phase 2 includes investigations both on-and off-site. Tables 1 to 5 and Figures 4 to 6 of this Work Plan provide additional information and justification for the scope of work presented in this section.

Field sampling, laboratory analysis, and field work for the Phase 2 RI will be conducted in accordance with the protocols described in the Sampling and Analysis Plan (SAP), as described below and documented, in detail, in Appendix A (Field Sampling Plan [FSP]); Appendix B (Quality Assurance Project Plan [QAPP]); Appendix C (Health and Safety Plan [HASP]), and Appendix D (Citizen Participation Plan [CPP]).

The specific activities of the proposed Phase 2 RI are summarized, as follows:

- Drill and sample soil borings at various locations in the vadose zone on-site, conduct geophysical surveying, and excavate test pits, as needed, on-site.
- Drill and sample soil gas points in on-site and off-site (on public rights-of-way south and east of the site), in vadose zone soil.
- Drill and install piezometers and monitor piezometers on a periodic basis for the presence of perched water and collect perched water samples, as appropriate.

- Drill VPBs and collect soil samples, perform borehole geophysics, and collect groundwater samples from various horizons within the Upper Glacial and Magothy aquifers on- and off-site.

- Collect groundwater samples from existing monitoring wells on-and off-site.

- Based on an evaluation of data collected above, assess the need for additional investigation efforts (as part of the Phase 2 RI). Prepare Phase 2 RI Work Plan Addendum(s) to propose additional activities as specified in Phase 2A soil RI as well as other additional investigation that may be needed to meet Phase 2 RI goals.

- If additional activities are not needed to meet Phase 2 RI goals, then prepare the Phase 3 RI Work Plan Addendum.

- Collect sufficient data to support the design and implementation, if needed, of a groundwater IRM.

6.2.1 Phase 2 Remedial Investigation

The following subsections of this Work Plan describe, in detail, the rationale for the proposed Phase 2 RI scope of work. The scope of work is presented in detail in Tables 1 to 5 and on Figures 4 to 6. Detailed field methodology is provided in Appendix A (FSP). QA/QC procedures and protocols, analyte lists, analytical methods, and sampling handling procedures are provided in Appendix B (QAPP). Health and safety procedures are provided in Appendix C (HASP). Community outreach and participation activities are provided in Appendix D (CPP).

6.2.1.1 Proposed Phase 2 Soil Remedial Investigation

The proposed Phase 2 soil RI consists of two parts (i.e., Phases 2A and 2B). The Phase 2A soil RI will be conducted by D&B. The Phase 2B soil RI will be conducted by ARCADIS.

6.2.1.1.1 Proposed Phase 2A Soil Remedial Investigation

Based on the results of the soil sampling programs undertaken by D&B (Section 2.3.1), and further scrutiny of the historical aerial photographs, Phase 2A of the RI has been

developed to meet the previously-stated RI objectives. The proposed Phase 2A RI field investigation to be undertaken within the Park includes the following activities:

- Geophysical surveying
- Surface and subsurface soil sampling
- Excavating and sampling of test pits, if warranted.

The proposed soil boring locations are presented on Figure 4. A description of each boring to be advanced during this program, as well as the corresponding soil samples and constituents of analysis, are provided in Tables 2 through 5. The detailed rationale for the various elements of the Phase 2A RI is as follows:

Geophysical Survey

Based on the aerial photographs, the current ballfield area shows evidence of historical activities. A geophysical survey will be conducted within this area utilizing a combination of ground penetrating radar, magnetometry and/or resistivity methods. The purpose of the geophysical survey is to identify the boundaries of historical Site features (e.g., Sludge Drying Beds), locate potential pockets of residual waste/sludge (if any), locate potential sources, and determine whether low permeability lenses are present that may affect contaminant migration. It is believed that the survey is capable of observations to a depth of approximately 50 ft bls; however, field conditions may limit the depth observed by the survey.

Test Pits

Following completion of the geophysical survey, a geophysical survey report will be prepared (by the geophysical survey subcontractor) and reviewed. Significant subsurface anomalies (i.e., those greater than 2-ft in diameter) identified during the geophysical survey may be investigated with test pits. A Phase 2 RI Work Plan Addendum may be prepared, based on this review, and may include the following components associated with a proposed test pits program: (1) location(s), (2) dimensions (i.e., length, width, depth), 3) excavation, backfilling, and site restoration plans, (4) soil sample locations, (5) soil sample collection methodology, (6) soil sample analytes, (7) contingency plans (as appropriate), and (8) materials management

methodology. Following NYSDEC approval of the Phase 2 RI Work Plan Addendum, the test pit program may be performed as part of the Phase 2 RI.

Soil Borings

Tables 2 through 5 summarize the proposed scope of work, including the minimum soil boring depths and proposed analyses. Figure 4 shows the proposed and existing soil boring locations.

The soil borings will be advanced utilizing the hollow stem auger (HSA) methodology. Since excavation activities were historically conducted within the Park property (Section 2), it is unclear what the depth of potentially impacted soil may be within these areas. It is, therefore, not known how deep the soil borings will be or how many soil samples will actually be collected for laboratory analysis during the field program. The total depths of the proposed soil borings have been estimated for the purposes of this Work Plan but will be determined in the field based on visual observations and instrumentation. The total depths of the soil borings will be determined by the on-site field geologist. At a minimum, the soil borings will be advanced to the depth of undisturbed native soil. Once native soil is reached, additional drilling may be performed at each soil boring location to achieve the following:

- The minimum depth specified in Table 2 for each boring; or

- soil that does not exhibit evidence of contaminant impact such as visual appearance of staining and/or discoloration, or PID readings above background concentrations. Soil borings will be advanced until two consecutive "visually clean" sample intervals are retrieved that do not exhibit PID readings above background PID concentrations, or until the water table is reached (i.e., approximately 55 ft bls).

Continuous split-spoon sampling will be performed and soil samples will be lithologically logged at 2-foot intervals in each proposed soil boring. The number of samples collected in each proposed soil boring has been estimated for the purposes of this Work Plan but will be determined in the field based on visual observations and instrumentation. In addition to the analyses specified in Tables 2 through 5, soil samples retrieved will be screened in the field with a PID. If field PID readings above background concentrations are detected in any boring, then the soil sample exhibiting the highest field PID reading, as well as the deepest soil sample collected from that

boring will be analyzed in the laboratory for VOCs and SVOCs. In addition, soil samples exhibiting field PID readings of 50 parts per million (ppm) or greater above background concentrations will also be analyzed in the laboratory for VOCs and SVOCs.

The following text describes the rationale and objectives for investigating each on-site area:

North Area

Proposed Soil Borings B-26 and B-27 will be advanced near the tennis courts to delineate contamination previously detected at these locations.

South Playground Area

Proposed Soil Borings B-24A, B-28, and B-29 will be advanced in the south playground area to delineate contamination previously detected at this location.

Ball Field Area

Proposed Soil Borings B-7A, B-12A and B-30 to B-39 will be advanced in the ball field area to delineate contamination previously detected at this location.

Former Fire Training Area

Proposed Soil Borings B-40, B-41, and B-42 will be advanced in the former Fire Training area (including the small pit formerly located within this area) to delineate contamination previously detected at this location.

Parking Lot Area

Proposed Soil Boring B-43 will be advanced in the parking lot area based on the results of the Town's investigation to delineate contamination previously detected at this location.

West of Park and Plant 24 Access Road

Proposed Soil Borings B-44 though B-49 will be advanced on NGSC-owned property west of the Park and Proposed Soil Borings B-50 through B-55 will be advanced on the NGSC Plant 24 Access Road portion of the site to delineate contamination previously detected at these locations.

Off-Site

NGSC is aware of the January 8, 2004 letter from the NYSDOH to the NYSDEC requesting soil remediation at three of the residences located south of the Plant 24 Access Road and further delineation at an additional residence (NYSDOH 2004). At this time, NGSC is not in a position to undertake this work.

6.2.1.1.2 Phase 2B Soil Remedial Investigation

In developing the proposed Phase 2B soil RI work scope, ARCADIS used the current CSM, the understanding of the soil and groundwater quality at the site, as well as the understanding of current and historical site usage. The locations of the proposed Phase 2B soil RI soil borings are shown on Figure 5 and drilling and sampling activities and associated rationale are described in Tables 1 and 5.

The proposed scope of work for the Phase 2B soil RI consists of the drilling and sampling of approximately 14 soil borings. Alternatively, consideration is being given to use of cone penetrometer testing (CPT) coupled with borehole geophysics and use of membrane interface probes (MIPs). A final decision to select the most appropriate drilling and sampling methodology to be used will be made (and provided to NYSDEC) prior to the conduct of the work.

The Phase 2B RI soil borings will be advanced to the bottom of the clay lens (total of 14 proposed soil borings, identified as Soil Borings CL-1 to CL-14, see Figure 5 and Tables 1 and 5). Based on previous investigations, the top of the clay is expected to range from about 36 to 46 ft bls and be up to 20 feet or greater in thickness. Soil borings will be either (1) drilled by the HSA method with split-spoon samples collected at 5-ft intervals from land surface to 10 ft above the expected top of the clay and then continuously to total depth, or (2) advanced by the CPT method utilizing MIPs (if the CPT/MIP method is selected, the number and location of borings will be

modified to form a grid pattern covering the area within and near the suspected source area(s). Additional details will be provided prior to implementation).

For the HSA method, split-spoon soil samples will be logged by the on-site ARCADIS field geologist for lithologic description, and soil samples will be field screened for VOCs by head space analysis (via PID). Two soil samples from each boring (i.e., the highest PID readings above and in the clay) will be submitted to the laboratory for analysis of TCL VOCs and TOC. Single Shelby Tube samples will be collected from the clay lens from generally every other boring drilled in the clay (total of seven Shelby Tubes). Shelby Tube samples will be sent to the laboratory for analysis of porosity, moisture content, vertical permeability, bulk density and fraction organic carbon (f_{oc}). As the results of the Phase 2B RI become available, the data will be evaluated and, based on the results obtained, additional or fewer borings/samples may be installed/collected. One soil boring in the recharge basin may be utilized to serve as the borehole for a piezometer (see below).

For the CPT/MIP method, the CPT rig will be utilized to obtain a continuous profile of soil lithology, resistivity, pore pressure, and permeability (parameters may be modified, as needed) using a combination of selective continuous coring (to verify soil lithology versus the CPT output) and geophysical techniques (e.g., natural gamma, resistivity, and/or temperature). CPT borings will also be used to provide a vertical profile of VOC concentrations in the unsaturated zone using screening methods that employ a combination of the following techniques: PID, flame-ionization detector (FID), and/or electron-capture detector (ECD). The methods described above will also be used to determine depth to groundwater, saturation of low-permeability zones, depths/locations of source-strength VOCs, and, if perched water is present on the clay upper surface. Confirmatory soil sampling will be performed in a representative number of borings as follows: two soil samples from each boring sampled (i.e., the highest field screening readings above and in the clay) will be submitted to the laboratory for analysis of TCL VOCs and TOC (sampling analytes, intervals, and frequency may be modified to meet RI goals). The MIPs will be used to speciate the VOCs detected and quantify total VOC concentrations in a continuous vertical profile from land surface to total depth. The total depth of CPT/MIP boreholes will be approximately 55 ft bls. In addition, a representative number of Shelby Tube samples will also be collected in select borings.

6.2.1.2 Proposed Phase 2 Soil Gas Remedial Investigation

The Phase 2 soil gas RI includes sampling in on-site and off-site areas (i.e., south and east of the Site on public rights-of-way). Soil Gas Point (SGP) locations, presented below, are fully described in Table 1 and are shown on Figure 5. Field methodologies are presented in Appendix A. Analytical protocols and QA/QC procedures are provided in Appendix B. Health and Safety issues are addressed in Appendix C. Community outreach and participation activities are described in Appendix D.

6.2.1.2.1 Proposed Phase 2 On-Site Soil Gas Investigation

To further characterize and evaluate the potential for vapor intrusion related to constituents in on-site groundwater and subsurface soil, ARCADIS proposes to collect additional soil gas samples on-site. Preliminary information from VPB sampling and the proximity of suspected sources to the on site clay lens indicates that the clay, which is predominantly above the water table (Section 2), may be a continuing source of VOC impacts to soil gas. SGPs drilled by the Town and ARCADIS further from this clay also exhibit elevated concentrations of VOCs, which may indicate a potential contribution to VOCs in soil gas from impacted groundwater as well.

SGP locations will be co-located with Phase 1 RI VPB locations and will focus on gathering data near VPBs with both high and low VOC concentrations. A total of six SGP locations will be sampled near completed VPBs VP-3, VP-9, VP-19, VP-22, VP-24, and VP-27. This information will be used to characterize soil gas conditions in the horizontal plane. To characterize conditions vertically, at each sample location, soil gas samples will be collected from three depths; approximately 50 ft bls (immediately above the water table), 35 ft bls, and 8 ft bls. These depths will provide information on soil lithology, soil gas concentrations close to the groundwater table, above the clay lens, and at the approximate depth of a typical basement. The specific depths to be sampled will be modified, as needed, in the field based on the depth to groundwater and the location of the clay lens. A single duplicate sample will be collected from one location, to be randomly determined. An ambient air sample will also be obtained coincident with the soil gas samples for a total of 20 vapor samples. Soil samples will be obtained from the specified depths for lithologic characterization prior to sampling (via separate borehole if necessary).

While these sampling locations may be adjusted based on site-specific conditions, they were initially selected because they allow an evaluation versus a representative

distribution of contaminant concentrations previously detected in subsurface soil and groundwater. Collectively, these six locations will help define the extent of soil gas movement (i.e., diffusion) within the site boundaries. Moreover, collecting soil gas samples from multiple depths will provide data for determining if a concentration gradient exists, which would confirm whether the groundwater is the source of the soil gas or whether other vadose zone sources should be considered. If soil gas data from multiple depths do not demonstrate decreasing concentrations with decreasing depth, ARCADIS will consider whether the clay lens is influencing soil gas movement. Additional sampling may be necessary to fully characterize this effect and would be proposed as part of the Phase 2 RI Work Plan Addendum.

6.2.1.2.2 Proposed Phase 2 Off-Site Soil Gas Investigation

As stated in the CSM (Section 3), preliminary information from soil gas sampling along the Plant 24 Access Road indicates that soil gas may be migrating off-site. Based on this information and as requested by NYSDEC and NYSDOH, soil gas sampling off-site will be conducted south of the site, along Sycamore Avenue, and east of the site, along Stewart Avenue, along public rights-of-way. These SGP samples are specifically focused on determining if VOC-impacted soil gas is present in the vadose zone near residences along Sycamore Avenue and the Bethpage High School located on Stewart Avenue, along public rights-of-way. A total of six locations will be sampled along on public rights-of-way, on Sycamore Avenue (SGP-100 through SGP-105). These locations were selected to provide information on the potential horizontal extent of soil gas impacts as well as potentially characterize worst case conditions near areas known to exhibit elevated groundwater VOC concentrations. Along Stewart Avenue, a total of two locations will be sampled near the Bethpage High School (SGP-106 and SGP-107). These SGPs were selected to determine whether soil gas is present in areas east of the site along the public rights-of-way.

In addition to identifying the horizontal extent of soil gas, it is also important to characterize soil gas conditions vertically. While all off-site soil gas samples will be collected at 8 ft bls, at two locations (SGP-101 and SGP-103), soil gas samples will also be collected from approximately 50 ft bls (immediately above the water table) and 20 ft bls. These additional sampling depths will provide information on soil gas concentrations close to the groundwater table and illustrate if attenuation is occurring. All 8-ft depth samples will obtain information on soil gas at the approximate depth of a typical basement. A total of 12 soil gas samples will be collected, excluding QC samples. At both Sycamore Avenue and Stewart Avenue transects (along Town rights-

of-way), a single duplicate sample will be collected from one location, to be randomly determined. An ambient air sample will also be obtained coincident with the soil gas sampling on Stewart Avenue and two ambient air samples will be collected coincident with the soil gas sampling on Sycamore Avenue, for a total of three ambient air samples. The specific depths to be sampled may be modified, as needed, in the field based on soil type, depth to groundwater, and the location of subsurface utilities or other obstructions.

Soil samples will be obtained from the specified depths for lithologic characterization prior to sampling (via separate borehole if necessary).

6.2.1.3 Phase 2 Groundwater Remedial Investigation

The Phase 2 groundwater RI will be performed by ARCADIS and will be conducted in a focused manner, as further described in the RI goals stated in Section 5.2. Based on the results of VPB installation and sampling of existing wells, as stated in this Work Plan, additional VPBs may be proposed (via Phase 2 RI Work Plan Addenda) and implemented as part of the Phase 2 RI. Based on an evaluation of the on- and off-site data obtained a Phase 3 RI scope of work (i.e. permanent monitoring wells) will be proposed (Section 6.2.3).

The proposed Phase 2 groundwater RI consists of the installation of five VPBs on-site, the sampling of 11 existing on- and off-site monitoring wells, the installation of a maximum of five on-site piezometers and sampling of perched water (if present), and the installation and sampling of a minimum of six off-site VPBs. The existing data collected and interpretations made to this point were used to determine the best locations for the VPBs and piezometers proposed herein. Data from the previously-installed, on-site VPBs indicated that VOC-impacted groundwater has likely migrated off-site and, therefore, there is justification for the drilling and sampling of off-site VPBs. The locations of the proposed VPBs and existing monitoring wells are shown on Figures 5 and 6. Preliminary piezometer locations are shown on Figure 5; final locations will be determined in the field based on the actual elevation of the top of the clay and the presence of perched water (if any). Tables 1 and 5 provide the complete description/rational for the proposed scope of work.

6.2.1.3.1 Proposed Phase 2 On-Site Groundwater Investigation

Existing Monitoring Well BCPMW-3 and VPB VP-3 are located approximately 150 ft and 300 ft, respectively, from existing VPB VP-27 and appear to be located directly downgradient of VP-27, based on the understanding of the current, shallow horizontal groundwater flow direction. The highest TVOC concentration in VP-27 (304.6 mg/L) was the sample collected at the water table. The TVOC concentration in Well BCPMW-3 (a water-table well) is more than 98 percent lower than the TVOC concentration from a similar horizon in VP-27. In VP-3, the shallowest (located near but not at the water table) groundwater sample collected had the highest TVOC concentration at that sample location, but it was more than 99 percent lower than the maximum TVOC concentration in VP-27. Either subsurface degradation processes are contributing to this substantial decrease in TVOC concentration (Section 3), over a relatively short horizontal distance, or Well BCPMW-3 and VP-3 are not ideally positioned to intersect the highest TVOC concentrations migrating from the VP-27 area. Furthermore, at existing VPB VP-19, which is 24 ft east of a line approximating the current groundwater flow direction from VP-27, the highest TVOC concentration was 19 µg/L, which is more than 99 percent lower than the maximum TVOC concentration in VP-27. The TVOC concentration in VP-19 may be biased-low in part due to its proximity to the clay lens or the sampling intervals may not have been sufficiently spaced to intersect the plume emanating from beneath the clay.

To determine whether the existing VPB locations and sampling intervals were sufficient to detect impacted groundwater migrating from the VP-27 area, additional on-site VPBs are proposed. The proposed Phase 2 on-site groundwater RI will consist of the drilling and sampling of five VPBs and up to five piezometers, and the sampling of seven on-site existing monitoring wells (performed concurrent to the sampling of four off-site existing monitoring wells – Section 6.2.1.3.2). As part of the on-site VPB program, a total of three VPBs (identified as VPBs VP-3A, VP-19A, and VP-27A) will be drilled and sampled at the approximate locations of completed VPBs VP-3, VP-19, and VP-27. The other two on-site VPBs (VPBs VP-3B and VP-3C) will be drilled about 50 ft east and west of completed VPB VP-3, respectively. Proposed VPBs VP-3B and VP-3C will be drilled to approximately 10 ft below the water table and groundwater samples will be collected. Depending on the data obtained during the VPB drilling, the number of VPBs installed, locations, and/or sampling intervals may be modified.

Existing Monitoring Wells B30MW-1, BCPMW-2, BCPMW-3, CAMW-1, CAMW-2, CAMW-3, and CAMW-4 will be sampled concurrent with the four selected off-site monitoring wells (see Section 6.2.1.3.2) during the next semi-annual event (which is

performed as part of Operable Unit 2 approved groundwater monitoring program; ARCADIS G&M, Inc., 2001) following approval of this Work Plan.

A maximum of five piezometers (PZ-1 through PZ-5) will be installed. The piezometers will likely be installed at low elevations on the clay upper surface or where soil samples indicate saturated conditions to maximize the likelihood of encountering perched water and/or free-phase liquids (if present). Depth to water in the piezometers will be measured periodically to include the typical high-water time of the year (i.e., March/April) and after significant rain events for a period up to one calendar year after completion. If sufficient water accumulates in some or all piezometers the water will be sampled.

6.2.1.3.2 Proposed Phase 2 Off-Site Groundwater Investigation

In developing the proposed Phase 2 off-site groundwater RI work scope, ARCADIS used the current CSM (Section 3) as well as the NYSDEC-accepted, three-dimensional groundwater flow model (which had previously been developed by ARCADIS for the NGSC Bethpage Facility – Operable Unit 2) to determine the approximate locations and depths that impacted groundwater beneath the site may have migrated off-site.

Currently, in conjunction with implementation of the approved remedy for Operable Unit 2 (OU2), NGSC operates a five-well remedial pump-and-treat system that prevents off-site migration of impacted groundwater from the NGSC and NWIRP Bethpage Facilities. Remedial Well 19 (also referred to as Well ONCT-3), which is one of the five OU2 remedial wells, is the closest remedial well to the Site. The modeled capture zone of Well 19 is shown on Figure 6. When pumped in concert with the other remedial wells and public supply wells within the model domain, the capture zone of this well extends to the site and beyond to the north (that portion of the capture zone north of the site is not shown on Figure 6). This capture zone is reflective of a pumping rate of 700 gallons per minute (gpm) (which is the remedial design pumping rate) and, as displayed, would capture impacted groundwater currently leaving the Site and impacted groundwater that previously left the Site that is still within the capture zone boundaries. A portion of the Phase 2 off-site groundwater RI will evaluate the extent, to which, Well 19 is currently serving to hydraulically contain impacted groundwater from the Site.

Current shallow groundwater flow direction in the area of the Site is south-southeast (Figure 6). This flow direction is predominantly a result of the regional groundwater

flow gradient, non-use of the recharge basins on the NWIRP site for other than stormwater discharges, and pumping of the remedial wells associated with the on-site portion of the OU2 Groundwater Remedy. However, due to historical pumping and recharge to basins on the adjacent NGSC and NWIRP sites, it is assumed that groundwater flow in the Site area was reoriented such that flow was generally more easterly across the Site until about 1995 when use of the Plant 3 Recharge Basins, adjacent to the Site, was discontinued for production-related discharges. This historical flow component may have resulted in an easterly groundwater flow component in the general vicinity of Broadway and therefore a more complex plume distribution off-site than would be envisioned if groundwater had maintained its current flow direction historically.

Of the off-site deep VPBs proposed (VP-100 through VP-104), initially, VPBs VP-100 and VP-101 will be drilled and sampled. The other three VPBs shown on Figure 6 (VP-102, VP-103, and VP-104) may be drilled if certain criteria are met (see below) based on the results of VP-100 and VP-101. Additionally, other VPBs may also be proposed, as appropriate, following evaluation of the extant data. Because a large portion of the area south of the site, where the off-site section of the VOC plume may exist, is currently controlled/contained by the pumping of Remedial Well 19, plume definition is less critical there than to the east and possibly further south.

Proposed VP-100 is planned to intersect the central part of the VOC plume that may be migrating from the Park under current flow conditions. Proposed VP-101 is proposed to intersect the portion of the plume that may have migrated from the site under historical groundwater flow conditions. Recalling that the industrial/non-contact cooling water discharges to the recharge basins west of the site was discontinued approximately 10 years ago, the groundwater flow direction in the post-1995 time frame would have been following the regional south-southeast flow direction. Potentially impacted groundwater that may have migrated to the east of the site just prior to cessation of recharge basin usage (1995), would have flowed in a south-southeasterly direction after 1995. After 1995, un-impacted groundwater would be "flushing" through the area just to the east of the site and that condition would result in the potential for "near-site" groundwater to the east to be "clean", even though impacted groundwater may have flowed through this area pre-1995. In consideration of this scenario, VP-101 is located at what is considered a sufficient distance south to intersect the historical portion of the plume, if it exists.

VP-102 will be drilled and sampled, contingent on the groundwater analytical results from VP-100. If the results of VP-100 indicate that non-detectable or trace concentrations of site-related VOCs are present, indicating that the central part of the plume has not been penetrated, then VP-102 would be drilled and sampled. Conversely, if elevated levels of site-related VOCs are detected in VP-100, suggesting that the central portion of the plume has been detected, then VP-102 would not be drilled and sampled.

VP-103 will be drilled and sampled contingent on the groundwater analytical results of VP-101. If the results from VP-101 suggest the presence of site-related VOCs to the east of the Well 19 capture zone, then VP-103 will be drilled to further define the plume portion potentially outside of the capture zone. If VP-101 groundwater analytical results indicate no or trace levels of site-related VOCs or compounds not related to the site, then VP-103 will not be drilled and sampled, and instead VP-104 would be drilled and sampled. The purpose of VP-104 would be to determine, in the absence of a portion of the plume related to the historical groundwater flow pattern, if site-related VOCs have migrated south of the capture zone of Well 19 along the current groundwater flow path.

As stated in the CSM (Section 3), if the site-related VOC plume is present off site, it is expected to be shallow near the Site and progressively increase in depth with distance from the Site. To evaluate this four shallower, near-Site VPBs (VPB-105 through VP-108) will be drilled in the area at or north of Maple Avenue to characterize VOC concentrations near the site at such shallower depths.

In addition to sampling groundwater from the VPBs mentioned above and the seven existing on-site wells (Section 6.2.1.3.1), groundwater from off-site existing Monitoring Wells HN-40S, HN-40I, HN-42S, HN-42I will be sampled during the next OU2 monitoring event that follows approval of this Work Plan. Wells HN-40S, HN-40I, HN-42S, HN-42I are currently monitored by ARCADIS in accordance with the NYSDEC-approved OU2 Groundwater Monitoring Plan (ARCADIS G&M, Inc., 2001). Sampling these wells the analytes specified will yield information regarding the following: (1) degradation activity sidegradient of the TVOC-impacted groundwater, and (2) sidegradient COPC concentrations.

6.2.2 IRM Pre-Design Data Collection

As part of a preliminary evaluation of remedial technologies that may be suitable to serve as a groundwater IRM at the Site, additional laboratory analytical parameters will be added to the proposed groundwater sampling of selected existing on-site wells and proposed VPBs. Table 6 provides the list of additional parameters. Figure 5 shows the locations of wells/VPBs to be sampled for this activity. The results of the IRM pre-design groundwater sampling will be utilized in the development of the IRM Work Plan (to be provided under separate cover).

6.2.3 Phase 3 Remedial Investigation

Phase 3 of the RI will include the drilling, installation, and development of permanent monitoring wells and the collection of hydraulic and groundwater quality data on- and off-site. A Phase 3 RI Work Plan Addendum will be prepared after the data from Phase 2 of the RI have been received and validated. The Phase 3 Work Plan Addendum will include goals for the Phase 3 RI, the proposed scope of work, updated list of site-related COPCs, field sampling and QA/QC methodologies that have not been provided herein, pertinent previous RI data, updated project schedule, and technical justification for the scope of work proposed. In general, a sufficient number of permanent monitoring wells will be drilled, installed, and sampled to meet the RI/FS objectives as stated in Section 1 herein. As part of the monitoring performed under Phase 3 of the RI, sufficient hydraulic data will be developed to determine the current direction of groundwater flow within the various hydrogeologic zones of concern at and near the Site. The Work Plan Addendum will be submitted for NYSDEC approval and will be implemented after such approval is received.

It is expected that, at the conclusion of Phase 3 of the RI, sufficient data will have been collected to allow for the development of RI conclusions. At such time, the field work component of the RI process will conclude and the RI Report will be prepared.

6.2.4 Data Analysis and Management

Samples will be analyzed in accordance with the analytical methods listed in the QAPP (Appendix B). The chemistry data will be transferred from the laboratories and maintained in a database format (GIS-KEY). The laboratories will provide Electronic Data Deliverables (EDDs), which will be uploaded directly into the database.

For analytical samples associated with the RI, the laboratories will produce NYSDEC Analytical Services Protocol (ASP) Category B deliverable packages and will produce Contract Laboratory Program (CLP)-type data packages that will contain all information needed for formal validation of the data. Data validation will be performed on 5 percent of the data (20 percent for the Phase 2A RI soil quality data) in accordance with USEPA Region II Standard Operating Procedures (SOPs) (USEPA 2001; USEPA 2003). These procedures are specific with regard to evaluation of holding time, surrogate and spike recoveries, precision of duplicate measurements, instrument performance, blank contamination, compound identification, and compound quantification. Data will be qualified as necessary in accordance with the SOPs. Additional information is provided in the QAPP (Appendix B). Following completion of the above validation, data usability summary reports (DUSRs) will be prepared by ARCADIS and D&B and appended to the RI Report.

6.2.5 Site Characterization Deliverables

Following full evaluation and analysis of the field and analytical data, a determination will be made as to the validity of the CSM. If it is determined that additional on- or off-site characterization is necessary, then the Phase 2 RI Work Plan Addendum(a) will be prepared and submitted to the NYSDEC. Following completion of Phase 2, Phase 3 of the RI will be proposed as the Phase 3 RI Work Plan Addendum and implemented with NYSDEC approval (see Section 6). The comprehensive RI Report, would be submitted following completion of Phase 3 of the RI and full evaluation of data collected; this submittal and subsequent approval by the NYSDEC will conclude the RI process.

6.2.6 Sampling and Analysis Plan

The Sampling and Analysis Plan (SAP) is the umbrella document that consists of Appendices A through D. The SAP includes the following required elements:

- The FSP (Appendix A) defines sampling and data gathering methods consistent with NYSDEC DER-10 and the "Field Methods Compendium," OSWER Directive 9285.2-11 (draft June 1993).

- The QAPP (Appendix B) describes the quality assurance and quality control protocols necessary to achieve the initial data quality objectives.

- The HASP (Appendix C) protects persons at and near the site during performance of the RI/FS (in accordance with 29 CFR 1910).

- The CPP (Appendix D) was developed in accordance with New York Environmental Conservation Law, hazardous waste site regulations (6 NYCRR Part 375) and Citizens Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook (NYSDEC1998).

In addition to the above, the components of the SAP are also consistent with the requirements of NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC 2002).

6.2.7 Evaluation of Data Gaps and Refining RI/FS Objectives

As previously described, this RI will be performed in a dynamic fashion. During the course of the data collection and evaluation tasks described in previous sections, remaining or new data gaps may be identified. If clear and pertinent data gaps are identified, they will be addressed in a work plan addendum(a) the NYSDEC for addressing the data gaps during the Phase 2 RI, with the goal of limiting the interruption in the field work.

Following NYSDEC acceptance of the Phase 2 RI, Phase 3 of the RI will be developed (Section 6.2.3).

6.2.8 Human Health Exposure Assessment

Upon completion of data collection and analysis, in accordance with DER-10, a qualitative exposure assessment will be performed and an exposure assessment report will be prepared to be included with the RI Report. The assessment will focus on identifying areas and COPCs, evaluating actual or potential exposure pathways, characterizing the potentially exposed receptors, and identifying how any unacceptable exposure pathways might be eliminated/mitigated.

6.2.9 Interim Remedial Measure Work Plan

Based on evaluation of the data obtained by the various parties, NGSC has determined that an IRM to address on-site groundwater is appropriate. NGSC has initiated the IRM process and will prepare a work plan pursuant to the provisions of the CO and in

accordance with the protocols of NYSDEC (NYSDEC 2005b). Additional information pertaining to the IRM pre-design data collection is provided in Section 6.2.2. Project schedule is shown on Figure 8 of this Work Plan. Relevant CPP activities are provided in Appendix D.

6.2.10 Remedial Investigation Report

Once sufficient information is collected to complete the RI and address the RI objectives, as described in Section 1.0 herein, then the RI Report will be prepared and submitted to the NYSDEC for review. The report will incorporate relevant data generated on behalf of NGSC and by third parties, as discussed above, and will be written following applicable USEPA and NYSDEC guidance, and will be consistent with the requirements of the Consent Order (CO) for OU3.

6.3 Feasibility Study

Once the RI has been approved by the NYSDEC, it is anticipated that an FS will be performed in accordance with USEPA and NYSDEC guidelines and the CO. The FS process will be coordinated with the IRM process (Section 6.2.9) and will include a preliminary screening of alternatives, followed by a FFS that includes the evaluation of remedial alternatives for the site that are appropriate under CERCLA, NYSDEC TAGMs, Technical and Operational Guidance Series (TOGs), and the NCP. At a minimum, alternatives will be evaluated for their ability to eliminate or mitigate significant threats to public health and the environment presented by hazardous waste disposed at the site through the proper application of scientific and engineering principles.

6.3.1 Preliminary Screening of Alternatives

The "Preliminary Screening of Alternatives Letter Report" will be prepared as a deliverable prior to finalizing the RI Report. The schedule for completion of the "Preliminary Screening of Alternatives Letter Report" is shown on Figure 8 of this Work Plan.

6.3.2 Focused Feasibility Study

It is anticipated that a Focused Feasibility Study (FFS) will be developed in coordination with the IRM process and will be submitted to the NYSDEC for the

purpose of obtaining NYSDEC agreement on a short-list of potential remedial alternatives prior to conducting the full analyses. It is anticipated that this approach will streamline FS efforts and NYSDEC decisions related to a preferred remedy.

The FFS will be submitted to the NYSDEC following approval of the RI report.

6.3.3 Detailed Analysis of Alternatives

A detailed analysis of alternatives described in the FFS will be performed. The analysis of each remedial alternative will be based on an evaluation of the nine criteria established in the NCP and NYSDEC TAGM #4030.

Data developed from the RI would be entered into the groundwater model (Section 6.2.1.3.2) to assist with the evaluation of the various remedial alternatives (Section 6.3).

6.3.4 Feasibility Study Report

It is anticipated that an FS Report will be completed following completion of the IRM Report, Preliminary Screening of Remedial Alternatives, and detailed comparative analysis evaluation of the remedial action alternatives. The FS report will summarize the results of Tasks 6.3.1 to 6.3.3 above, and will provide detailed information for each alternative to facilitate the identification of a preferred remedial approach for the site.

7. Project Management Plan

Organizational charts for ARCADIS and D&B for the RI/FS are presented on Figures 7a and 7b, respectively.

Mr. Steve Scharf will serve as the NYSDEC Project Manager for efforts conducted by D&B and ARCADIS.

Mr. Mike Wolfert (ARCADIS) will have overall responsibility for the performance of the RI/FS, its deliverables, schedule, and budget. Mr. Carlo San Giovanni will serve as ARCADIS's Project Manager and be the primary contact to Steve Scharf. Messrs. David Stern and Bill Wittek P.E. will serve as RI and FS Task Managers, respectively. Mr. Doug Smolensky C.P.G. will serve as Project Advisor for contaminant hydrogeology and groundwater modeling, as necessary. Ms. Donna M. Brown will

serve as lead data validator for ARCADIS-collected data. Ms. Nadine Weinberg will support the RI as the Risk Assessor.

Mr. Brian M. Veith, P.E., a Vice President of D&B, will act as the Project Director and will be responsible for project coordination and interfacing with the NYSDEC Project Manager. Acting as the Project Advisor to Mr. Veith will be Mr. Richard M. Walka, a Senior Vice President of D&B. Mr. Michael R. Hofgren will act as the Project Manager and will coordinate all project activities, including scheduling and interfacing with NGSC. Project Staff performing the field work and report preparation will be Mr. Keith S. Robins, Geologist, and Ms. Cheryl L. Pereira and Mr. Kevin R. Boger, Environmental Scientists. Mr. Stephen E. Tauss will act as the Health and Safety Officer for the project and Ms. Robbin A. Petrella will perform validation of the sample data.

Subcontractors used for specialty services, such as drilling, analytical laboratory, geophysics, surveying, etc. will be ones ARCADIS and D&B have relied on for similar tasks performed previously for NGSC. Any subcontractor utilized will meet the requirements of the NYSDEC.

7.1 Project Schedule

The proposed schedule to conduct the RI/FS activities described herein is provided on Figure 8. The NYSDEC will be provided with five (5) days advance notice of the commencement of field work. In general the sequence of field activities and related rationale for the Phase 2 RI and short-term RI/FS action items are as follows:

1. Prepare notifications and plans to Town in accordance with the in-place Access Agreement. Conduct pre-field planning including field verification of locations and utility mark-outs.

2. Perform on-site Phase 2 RI VPBs, on-site soil gas sampling, and Phase 2A and 2B soil RI. These data will provide information on whether further characterization of source-strength VOCs is needed, the need and potential location of piezometers, and potential sites for permanent monitoring wells.

3. Perform off-site soil gas sampling on public rights-of-way and off-site Phase 2 RI VPBs. The off-site VPBs will initiate shortly after commencing the on-site portion of the Phase 2 RI but is expected to require significantly more time to

complete due to the depth of the VPBs and access constraints. The data will provide information on the need for contingency or other VPBs off-site, and potential sites for permanent monitoring wells.

4. Collect IRM pre-design groundwater data collection in coordination with drilling and sampling of the specified VPBs and sampling of monitoring wells.

5. Prepare Phase 2 RI Work Plan Addendum and implement additional activities as specified therein during the course of the Phase 2 RI field work.

6. Prepare the Phase 3 RI Work Plan Addendum, receive agency approval, and implement Phase 3 RI.

7. Prepare and issue IRM Work Plan during the course of Phases 2 and 3 of the RI. Implement IRM in a timeframe aligned with completion of Phase 3 RI, to the extent possible.

8. Prepare and issue RI Report.

8. References

ARCADIS G&M, Inc. 2005a. Phase 1B Remedial Investigation Work Plan, Bethpage Community Park, Former Grumman Settling Ponds (Operable Unit 3), Bethpage, New York. May 16, 2005.

ARCADIS G&M, Inc. 2005b. Summary of Soil Vapor Sampling Results, Bethpage Community Park – Operable Unit 3. June 2005.

ARCADIS G&M, Inc. 2004a, Data Report for Phase I Groundwater Remedial Investigation, Former Grumman Settling Ponds, Operable Unit 3, Bethpage, New York. December 1, 2004.

ARCADIS G&M, Inc. 2004b, Proposal to Conduct Groundwater Investigation, Former Grumman Settling Ponds, Operable Unit 3, Bethpage, New York. June 3, 2004.

ARCADIS G&M, Inc. 2001. Draft-Final Operable Unit 2 Groundwater Monitoring Plan, Northrop Grumman Corporation/NWIRP Sites, Bethpage, New York. NYSDEC Site #s 1-30-003A and B. May 11, 2001.

ARCADIS Geraghty & Miller, Inc. 2000. Groundwater Feasibility Study, Grumman Aerospace-Bethpage, NY Site #130003A and Naval Weapons Industrial Reserve Plant Bethpage, NY Site #130003B.

Dvirka and Bartilucci Consulting Engineers. (D&B) 2003. Town of Oyster Bay Bethpage Community Park Investigation Sampling Program, Bethpage, New York. December, 2003.

Geraghty & Miller, Inc. 1994. Remedial Investigation Report, Grumman Aerospace Corporation, Bethpage, New York. Revised September 1994.

Holzmacher, McClendon, and Murrell, P.C. (H2M)., 2005a. Investigation Report and Remedial Action Plan, Town of Oyster Bay Bethpage Community Park Interim Remedial Measure – Construction Area. Prepared for: Town of Oyster Bay Department of Public Works. November 2005.

Holzmacher, McClendon, and Murrell, P.C. (H2M)., 2005b. Supplemental Investigation Report, Town of Oyster Bay Bethpage Community Park Interim Remedial Measure – Construction Area. Prepared for: Town of Oyster Bay Department of Public Works. December 2005.

New York State Department of Environmental Conservation (NYSDEC), 2005a, Order on Consent Index # W1-0018-04-01, Site # 1-30-003A, July 4, 2005.

New York State Department of Environmental Conservation (NYSDEC), 2005b, Division of Environmental Remediation Policies, Technical and Administrative Guidance Memorandum (TAGM), 4000 Series TAGMs. July 2005.

New York State Department of Environmental Conservation, 2002 (NYSDEC), Draft DER-10 Technical Guidance for Site Investigation and Remediation, December.

New York State Department of Environmental Conservation (NYSDEC), 1998, Inactive Hazardous Waste Disposal, NYS 6NYCRR Part 375. January 1998.

New York State Department of Environmental Conservation (NYSDEC), 1994, Technical and Administrative Guidance Memorandum #4046, Determination of Soil Cleanup Objective and Cleanup Levels. January 1994.

New York State Department of Environmental Conservation (NYSDEC), 1990, Selection of Remedial Actions at Inactive Hazardous Waste Sites, Technical and Administrative Guidance Memorandum #4030. May 1990.

New York State Department of Health (NYSDOH) 2004. Letter to John Cofman, Lead Engineer, Northrop Grumman Corporation. Re: Northrop Grumman Corporation Site, Nassau County Site ID# 1-30-003A-OU3, former Northrop Grumman Settling Ponds. February 12, 2004.

Northrop Grumman Systems Corporation (NGSC). 2006, Letter to S. Scharf of NYSDEC. Re: Northrop Grumman Systems Corporation Comments, Town of Oyster Bay Bethpage Community Park Investigation Report & Remedial Action Plan, Bethpage, New York. January 13, 2006.

U.S. Environmental Protection Agency, 2003. Index to EPA Test Methods, April 2003 revised edition, 2003.

U.S. Environmental Protection Agency (USEPA), 2001. Region II RCRA and CERCLA Data Validation Standard Operating Procedures (SOPs), CLP Organics Data Review and Preliminary Review, SOP HW-6, Revision 12, March 2001.

U.S. Environmental Protection Agency (USEPA). 1993. Field Methods Compendium. Draft June 1993.

U.S. Environmental Protection Agency (USEPA), 1990, National Oil and Hazardous Contingency Plan (NCP), EPA/40 CFR Part 300, March 1990.

U.S. Environmental Protection Agency (USEPA), 1988, Guidance For Conducting Remedial Investigations and Feasibility Studies Under CERCLA, EPA/540/G-89.004.October.

U.S. Geological Survey (USGS), 1995, Water-Resources Investigations Report 92-4148, Three-Dimensional Advective Transport of Volatile Organic Compounds In Ground Water Beneath An Industrial/Residential Area Of Nassau County, New York, D. Smolensky and S. Feldman.

Table 1. Summary of Proposed Phase 2 Remedial Investigation and Rationale, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park), Bethpage, New York.

Description of Activity and Referenced Figure Location Identification	Proposed Sample ID	Proposed Total Depth (ft bls)	Proposed Groundwater Sampling Intervals	Proposed Groundwater Analysis	Proposed Soil Sampling Intervals (ft)	Proposed Soil Analysis	Proposed Geophysical Logging	Proposed Soil Gas Sampling Depths (ft)	Proposed Soil Gas Analysis	General Rationale
Phase 2A - Soil Remedial Investigation (Figure 4)										
See Tables 3, 4, and 5										
Phase 2B - Soil Remedial Investigation (Figure 5)										
Current Recharge Basin	CL-1 / PZ-5	60[1]	--	--	continuous[1]	Geotechnical[3], VOC[2], TOC[2]	Yes[9]	--	--	Sampling of the clay is necessary to confirm the absence or presence of VOC, clay morphology and physical characteristics. This information will assist in the evaluation of the CSM i.e., if there are VOCs in the clay, and if the morphology and physical characteristics of the clay are such that it could act as a source of groundwater VOCs. Where appropriate, sampling will coincide with known historical operational areas as well as suspected low points along the clay upper surface.
	CL-2	60[1]	--	--	continuous[1]	VOC[2], TOC[2]	Yes[9]	--	--	
Former Fire Training Area	CL-3	60[1]	--	--	continuous[1]	Geotechnical[3], VOC[2], TOC[2]	Yes[9]	--	--	
	CL-4	60[1]	--	--	continuous[1]	VOC[2], TOC[2]	Yes[9]	--	--	
Current Ballfield	CL-5	60[1]	--	--	continuous[1]	Geotechnical[3], VOC[2], TOC[2]	Yes[9]	--	--	
Former Rag Pit	CL-6	60[1]	--	--	continuous[1]	VOC[2], TOC[2]	--	--	--	
Former Northeast Sludge Drying Bed	CL-7	60[1]	--	--	continuous[1]	Geotechnical[3], VOC[2], TOC[2]	Yes[9]	--	--	
	CL-8	60[1]	--	--	continuous[1]	VOC[2], TOC[2]	Yes[9]	--	--	
Former Northwest Sludge Drying Bed	CL-9	60[1]	--	--	continuous[1]	Geotechnical[3], VOC[2], TOC[2]	Yes[9]	--	--	
	CL-10	60[1]	--	--	continuous[1]	VOC[2], TOC[2]	Yes[9]	--	--	
Former Short Stop Sludge Drying Bed	CL-11	60[1]	--	--	continuous[1]	Geotechnical[3], VOC[2], TOC[2]	Yes[9]	--	--	
	CL-12	60[1]	--	--	continuous[1]	VOC[2], TOC[2]	Yes[9]	--	--	
Former West Area	CL-13	60[1]	--	--	continuous[1]	Geotechnical[3], VOC[2], TOC[2]	Yes[9]	--	--	
	CL-14	60[1]	--	--	continuous[1]	VOC[2], TOC[2]	Yes[9]	--	--	
Phase 2 Groundwater Remedial Investigation										
Existing On-Site Monitoring Wells (Figure 5)	B30MW-1	--	--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	--	--	--	--	--	Sampling the monitoring wells will determine whether other COPCs are present, VOC concentrations, biological/abiotic degradation conditions for upgradient/background and downgradient of the potential source area(s). Metals analyses (performed if turbidity < 50 NTU) will provide information on on-site impacts.
	BCPMW-2	--	--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	--	--	--	--	--	
	BCPMW-3	--	--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	--	--	--	--	--	
	CAMW-1	--	--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	--	--	--	--	--	
	CAMW-2	--	--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	--	--	--	--	--	
	CAMW-3	--	--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	--	--	--	--	--	
	CAMW-4		--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	--	--	--	--	--	
On-Site Piezometers (Figure 5)										
	PZ-1 [5]	--[10]	--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	continuous[1]	Lithology	--	--	--	Sampling the perched water (if it exists) will help determine if the water is a potential source of downgradient VOC concentrations and whether other COPCs are present. Metals analyses (performed if turbidity < 50 NTU) will provide information on on-site impacts. The biogeochemical analysis will help determine the biological/abiotic degradation conditions of this area.
	PZ-2 [5]	--[10]	--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	continuous[1]	Lithology	Yes[9]	--	--	
	PZ-3 [5]	--[10]	--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	continuous[1]	Lithology	--	--	--	
	PZ-4 [5]	--[10]	--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	continuous[1]	Lithology	--	--	--	
	PZ-5 [5]	--[10]	--	VOC[2], BioGeo[4], Metals [2], ClO_4^- [2]	continuous[1]	Lithology	--	--	--	
On-Site Vertical Profile Borings (Figure 5)										
	VP-3A	65	55-60 ft bls, 60-65 ft bls [5]	VOC[2], BioGeo[4], Metals[2], ClO4-[2], TOC[2]	--	--	--	--	--	Groundwater samples from Phases 1, 1A, and 1B indicated the highest VOC concentrations were predominantly detected at the water table. Several Phase 1, 1A, and 1B VPBs did not have samples collected at the water table. Phase 2 VPBs will help delineate the VOC concentrations at the water table, determine if other COPCs are present, and whether additional delineation to the east and west of VP-3 is needed to determine the fate of the high concentration of VOCs detected upgradient but not at the site boundary. TOC samples will help indicate retardation factors to be used in potential future fate and transport modeling. Metals analyses (performed if turbidity < 50 NTU) will provide additional data on potential on-site metals impacts in groundwater and will indicate potential for liberation of metals as a result of potential biodegradation-based remedies.
	VP-19A	75	55-60 ft bls, 60-65 ft bls, 70-75 ft bls [6]	VOC[2], BioGeo[4], Metals[2], ClO4-[2], TOC[2]	--	--	--	--	--	
	VP-27A	75	60-65 ft bls, 70-75 ft bls [6]	VOC[2], BioGeo[4], Metals[2], ClO4-[2], TOC[2]	--	--	--	--	--	
	VP-3B	75	55-60 ft bls, 60-65 ft bls, 70-75 ft bls [6]	VOC[2], BioGeo[4], Metals[2], ClO4-[2], TOC[2]	--	--	--	--	--	
	VP-3C	75	55-60 ft bls, 60-65 ft bls, 70-75 ft bls [6]	VOC[2], BioGeo[4], Metals[2], ClO4-[2], TOC[2]	--	--	--	--	--	

See footnotes on last page

Table 1. Summary of Proposed Phase 2 Remedial Investigation and Rationale, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park), Bethpage, New York.

Description of Activity Location Identification	Proposed Sample ID	Proposed Total Depth (ft bls)	Proposed Groundwater Sampling Intervals	Proposed Groundwater Analysis	Proposed Soil Sampling Intervals (ft)	Proposed Soil Analysis	Proposed Geophysical Logging	Proposed Soil Gas Sampling Depths (ft)	Proposed Soil Gas Analysis	General Rationale
Off-Site Vertical Profile Borings (Figure 6)										
Planned VPBs	VP-100	420[7]	water table, then 20 ft [7,8]	VOC[2], ClO_4^- [2]	--	--	Yes[9]	--	--	Deeper Phase 2 VPBs will be drilled to help delineate the vertical and horizontal extent of the off-site groundwater VOC concentrations.
	VP-101	500[7]	water table, then 20 ft [7,8]	VOC[2], ClO_4^- [2]	--	--	Yes[9]	--	--	Geophysical logging will be performed to provide a continuous profile of borehole lithology. Based on lithology in VPBs and/or groundwater quality results obtained, the depths of the groundwater sampling intervals may be modified. Based on the results of VP-100 and VP-101, contingent VPBs VP-102, VP-103 and/or VP-104 may be drilled, or possibly additional VPBs, as warranted. VPBs will also serve to update the CSM and help to determine whether other COPCs are present in off-site groundwater downgradient of the site.
Contingency VPBs	VP-102	450[7]	water table, then 20 ft [7,8]	VOC[2], ClO_4^- [2]	--	--	Yes[9]	--	--	
	VP-103	TBD[7]	water table, then 20 ft [7,8]	VOC[2], ClO_4^- [2]	--	--	Yes[9]	--	--	
	VP-104	TBD[7]	water table, then 20 ft [7,8]	VOC[2], ClO_4^- [2]	--	--	Yes[9]	--	--	
Shallow VPBs	VP-105	100 [7]	10 ft [7][8]	VOC[2], ClO_4^- [2]	--	--	Yes[9]	--	--	Shallower off-site VPBs will help determine if VOCs and whether other COPCs are present in shallower portions of the aquifer. If present, the VPBs will help characterize the nature and extent of impacted groundwater. The results will be incorporated into the CSM.
	VP-106	100 [7]	10 ft [7][8]	VOC[2], ClO_4^- [2]	--	--	Yes[9]	--	--	
	VP-107	100 [7]	10 ft [7][8]	VOC[2], ClO_4^- [2]	--	--	Yes[9]	--	--	
	VP-108	100 [7]	10 ft [7][8]	VOC[2], ClO_4^- [2]	--	--	Yes[9]	--	--	
Existing Off-Site Monitoring Wells (Figure 6)										
	HN-40S	--	--	VOC[2], ClO_4^- [2]	--	--	--	--	--	Sampling the monitoring wells will determine whether other COCPs are present and VOC concentrations in sidegradient areas. Provide additional information to update the CSM.
	HN-40I	--	--	VOC[2], ClO_4^- [2]	--	--	--	--	--	
	HN-42S	--	--	VOC[2], ClO_4^- [2]	--	--	--	--	--	
	HN-42I	--	--	VOC[2], ClO_4^- [2]	--	--	--	--	--	
Phase 2 Soil Gas Remedial Investigation										
On-Site Soil Gas Sampling (Figure 5)										
	SGP-5	50	--	--	Continuous[9]	Lithology	--	8, 35, 50	VOC[2]	The soil gas sampling is based on the results from previous sampling; the samples will help determine if gases are rising from the water table (i.e. the 50 ft bls sample) and/or the clay layer (i.e. the 35 ft bls sample); and if VOCs are present at the approximate depth of a typical basement in the surrounding area (i.e. the 6 ft bls sample). These data will be used as input to a model to predict potential exposure routes. Provide additional information to update the CSM.
	SGP-6	50	--	--	Continuous[9]	Lithology	--	8, 35, 50	VOC[2]	
	SGP-7	50	--	--	Continuous[9]	Lithology	--	8, 35, 50	VOC[2]	
	SGP-8	50	--	--	Continuous[9]	Lithology	--	8, 35, 50	VOC[2]	
	SGP-9	50	--	--	Continuous[9]	Lithology	--	8, 35, 50	VOC[2]	
	SGP-10	50	--	--	Continuous[9]	Lithology	--	8, 35, 50	VOC[2]	
Off-Site Soil Gas Sampling (Figure 5)										
	SGP-100	8	--	--	Continuous[9]	Lithology	--	8	VOC[2]	The soil gas sampling will help determine if VOCs are present in soil gas south and east of the Site on Town rights-of-way. South of the site samples are located to determine whether VOCs are present in soil gas in the area. Provide additional information to update the CSM. Soil sampling will be used to characterize off-site lithology.
	SGP-101	50	--	--	Continuous[9]	Lithology	Yes [9]	8, 20, 50	VOC[2]	
	SGP-102	8	--	--	Continuous[9]	Lithology	--	8	VOC[2]	
	SGP-103	50	--	--	Continuous[9]	Lithology	Yes [9]	8, 20, 50	VOC[2]	
	SGP-104	8	--	--	Continuous[9]	Lithology	--	8	VOC[2]	
	SGP-105	8	--	--	Continuous[9]	Lithology	--	8	VOC[2]	
	SGP-106	8	--	--	Continuous[9]	Lithology	--	8	VOC[2]	
	SGP-107	8	--	--	Continuous[9]	Lithology	--	8	VOC[2]	

See footnotes on last page

Table 1. Summary of Proposed Phase 2 Remedial Investigation and Rationale, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park), Bethpage, New York.

Footnotes:

(1) Clay is estimated to be encountered between 36 and 46 ft bls and range up to 20 ft in thickness. Soil borings will be advanced to bottom of clay utilizing HSA drilling with split-spoon samples or the CPT/MIP methodology.
If HSA/split spoon method is selected, then the following procedures will be used:
Split spoons will be collected at 5-ft intervals to 10 ft above the expected top of the clay, then continuously to depth.
One split-spoon sample will be collected from the clay and submitted for VOC and TOC analysis (based on highest PID deflection; if no deflection is detected, the deepest clay layer will be submitted). Shelby tube will be advanced to collect a sample of the clay layer for geotechnical analysis. Split spoons will be field-screened with a PID; the sample above the clay with the highest PID deflection will also be submitted for VOC and TOC analysis; if no PID deflections are detected, the sample immediately above the clay layer will be submitted.
Depending on the characteristics of the clay, the geotechnical parameters may be modified.
Soil borings will be geophysically logged using the natural gamma method, with the exception of CL-6 (adjacent to VP-27).
Piezometer split spoon sampling will be performed at 5-ft intervals to 10 ft above the expected top of clay, then continuously to depth.
If CPT/MIP Methodology is selected then the following procedures will be used:
- CPT rig will continuously log formation type, permeability, and pore pressure (other parameters and borehole geophysical techniques may be added [e.g., gamma, resistivity, and/or temperature]).
- Continuously coring and lithologic logging of samples will be performed at selected locations for comparison to CPT data.
- MIP mapping of individual VOCs and total chlorinated VOCs will be performed using one or more of the following: PID, FID, and/or ECD.
- The degree of saturation of vadose zone low-permeability zones and the presence perched water (if present) will also be determined, to the extent practicable.
- Confirmatory soil samples will be collected from selected intervals for TOC and VOC analysis.
- Soil borings using HSA methodology may also be drilled to obtain Shelby tubes and other information, depending on field conditions.
- Soil boring locations as shown on Figure 5 will be modified if CPT/MIP method is used; a grid pattern of borings is typically used; modified locations will be provided to NYSDEC prior to implementation.
- Typical CPT/MIP boring depth will be to a depth beneath the clay lens.

(2) Laboratory analysis of soil, soil gas, and groundwater samples shall be performed using one or more of the following methods (see QAPP - Appendix B for details):
- VOCs: TCL List of VOCs using NYSDEC ASP 2000 Method OLM 4.2. (soil and groundwater) or method TO-15 (soil gas - see analytes in Appendix B).
- TOC: USEPA Method 9060.
- Metals: TAL Metals using USEPA Method ILM 4.0.
- Perchlorate: USEPA Method 314.0.

(3) The following geotechnical analyses will be conducted: porosity, moisture content, vertical permeability, bulk density, and fraction organic carbon (f_{oc}).
Depending on the characteristics of the clay, the geotechnical parameters may be modified.

(4) Biogeochemical (BioGeo) sampling includes collection of field parameters (pH, specific conductance, temperature, and sulfide via spectrophotometer) and the following laboratory analyses: ethane and ethene, methane, alkalinity, nitrate, nitrite, sulfate, chloride, total iron, total manganese, dissolved iron and dissolved manganese. Analytical methods listed in the QAPP (Appendix B).

(5) Up to five piezometers will be installed using HSA to monitor perched water (if any) above the clay layer. If water is present, samples will be collected.
Samples will be analyzed for VOCs and, if high PID deflections are detected during installation, BioGeo parameters identified under (4) (minus nitrate and nitrite).

(6) For VPB VP-3A, the borehole will be advanced using HSA to a depth of approximately 10 ft into the water table.

For on-site VPBs VP-3B, VP-3C, VP-19A, and VP-27A, the borehole will be advanced using HSA Drilling to a depth of approximately 20-ft into the water table.

(7) For VPBs less than 450 ft deep, the VPB will be drilled and sampled using HSA / Temporary Well Points Methods.
Groundwater sampling will commence with collection of the sample at the bottom of the borehole and proceed upward at 20 ft intervals to 100 ft bls, then every 10 ft until the water table is reached (~55 ftbls). For VPBs that are deeper than 450 ft bls, the Mud Rotary and Hydropunch methods will be used to drill and sample the VPB, respectively.

(8) More frequent groundwater sampling may be performed based on field conditions.

(9) Macrocores will be collect on a continuous basis through a separate borehole to characterize soil type at the proposed sample depth as well as obtain additional lithologic characterization off-site. Geophysical logging will be performed on soil borings and VPBs using the natural gamma method. Resistivity logging (or equivalent) will be performed on selected SGPs.

(10) Depth of piezometers will vary based on actual depth to clay (previously encountered from 36 to 46 ft bls).

Table 1. Summary of Proposed Phase 2 Remedial Investigation and Rationale, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park), Bethpage, New York.

Definitions:

HSA	Hollow Stem Auger
CPT	Cone Penetrometer Testing
MIP	MIP Membrane Interface Probe
ft bls	feet below land surface
VPB	Vertical Profile Boring
SGP	Soil Gas Point
TCL VOC	Target Compound List Volatile Organic Compound
TOC	Total Organic Carbon
TAL	Target Analyte List
NYSDEC	New York State Department of Environmental Conservation
--	Not applicable or not performed
TBD	To be determined based on results of VP-100 and VP-101.
ClO4-	Perchlorate
PID	Photoionization Detector
FID	Flame Ionization Detector
ECD	Electron-Capture Detector
NTU	Nephelometric Turbidity Unit

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Table 2. Summary of Proposed Phase 2A Soil Remedial Investigation, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park), Bethpage, New York.

Boring IDs	Estimated Minimum Depth (feet)	Associated Area/Previous Soil Boring	Proposed Sampling Intervals	Gamma Log Proposed	Proposed Laboratory Analyses
B-7A	60	B-7/NWB	0 - 2-in, 2-in - 2-ft, 24 ft-26 ft and at 2-foot intervals from that point to final depth based on field observations to water table interface. A minimum of one sample per 5 feet of boring will be selected for analysis based on field observations.	Y	Cadmium, chromium and PCBs. VOCs and SVOCs based on field PID readings.*
B-12A	40	P-26/B-12	0 - 2-in, 2-in - 2-ft, 28 ft - 30 ft and at 2-foot intervals from that point to final depth based on field observations.	N	Cadmium, chromium and PCBs. VOCs and SVOCs based on field PID readings.*
B-17A	60	B-17	0 - 2-in, 2-in - 2-ft, 36 ft - 38 ft and at 2-foot intervals from that point to final depth based on field observations to water table interface. A minimum of one sample per 5 feet of boring will be selected for analysis based on field observations. Boring gamma logged.	Y	Cadmium, chromium and PCBs. VOCs and SVOCs based on field PID readings.*
B-24A	20	B-24	12-ft-14-ft and at 2-foot intervals from that point to final depth based on field observations.	N	SVOCs. VOCs based on field PID readings.*
B-26 and B-27	10	P-45 and P-46	0-2-in, 2-in-2ft, and at 2-foot intervals from that point to final depth based on field observations.	N	Chromium. VOCs and SVOCs based on field PID readings.*
B-28	20	B-24	0-2-in, 2-in-2ft, and at 2-foot intervals from that point to final depth based on field observations.	N	SVOCs for intervals from grade to 12 feet below grade. VOCs based on field PID readings.* Remaining samples on-hold pending analytical results of B-24A and field observations.
B-29	20	B-24	0-2-in, 2-in-2ft and at 2-foot intervals from that point to final depth based on field observations.	N	Chromium and SVOCs for intervals from grade to 12 feet below grade. VOCs based on field PID readings.* Remaining samples on hold pending analytical results of B-24A and field observations.
B-30	8	Park Western Fence Line	0-2-in, 2-in-2ft and at 2-foot intervals from that point to final depth based on field observations.	N	Chromium and PCBs. VOCs and SVOCs based on field PID readings.*
B-31 and B-32	20	Between P-26/B-12 and P-30; P-27/B-13 and P-31/B-9	0-2-in, 2-in-2ft and at 2-foot intervals from that point to final depth based on field observations.	N	Cadmium, chromium and PCBs. VOCs and SVOCs based on field PID readings.*

See footnote on last page

Table 2. Summary of Proposed Phase 2A Soil Remedial Investigation, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park), Bethpage, New York.

Boring IDs	Estimated Minimum Depth (feet)	Associated Area/Previous Soil Boring	Proposed Sampling Intervals	Gamma Log Proposed	Proposed Laboratory Analyses
B-33	30	NCB	0-2-in, 2-in-2ft and at 2-foot intervals from that point to final depth based on field observations.	N	Cadmium, chromium and PCBs. VOCs and SVOCs based on field PID readings.*
B-34	60	RP	0-2-in, 2-in-2ft and at 2-foot intervals from that point to final depth based on field observations to water table interface. Continuous sampling from grade to 40 feet. Beyond 40 feet, a minimum of one sample per 5 feet of boring will be selected for analysis based on field observations.	Y	Cadmium, chromium, PCBs, VOCs and SVOCs.
B-35	40	RP	0-2-in, 2in-2ft and at 2-foot intervals from that point to final depth based on field observations.	N	Cadmium, chromium, PCBs, VOCs and SVOCs.
B-36, B-37, B-38 and B-39	40	NEB	0-2-in, 2-in-2ft and at 2-foot intervals based on field observations.	N	Cadmium, chromium, PCBs, VOCs and SVOCs.
B-40, B-41, and B-42	30	FT, P-22/B-22 and P-20/B-22	0-2-in, 2-in-2ft and at 2-foot intervals from that point to final depth based on field observations.	N	Chromium, PCBs, VOCs and SVOCs.
B-43	20	G-7 [6)]	8'-10' and at 2-foot intervals based on field observations.	N	Chromium and PCBs. VOCs and SVOCs based on field PID
B-44, B-45, B-46, B-47, B-48 and B-49	8	West of Park boundary	0-2-in (grass areas only), 2-in-2-ft and at 2-foot intervals based on field observations.	N	Chromium and PCBs. VOCs and SVOCs based on field PID readings.*
B-50, B-51, B-52, B-53, B-54 and B-55	8	Plant 24 Access Road	0-2-in, 2-in - 2 ft and at 2-foot intervals based on field observations.	N	Chromium. VOCs and SVOCs based on field PID readings.*

See footnote on last page

Table 2. Summary of Proposed Phase 2A Soil Remedial Investigation, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park), Bethpage, New York.

(1) Town installed boring; location shown in associated reports (H2M 2005a; H2M 2005b).

* If PID readings above background concentrations are detected, then the soil sample exhibiting the highest PID reading, as well as the deepest soil sample collected from that boring, will be analyzed for VOCs and SVOCs. In addition, any soil sample exhibiting a PID reading of 50 ppm or greater above background concentrations will also be analyzed for VOCs and SVOCs.

PCBs	Polychlorinated Biphenyls
VOCs	Volatile Organic Compounds
SVOCs	Semi-Volatile Organic Compounds
PID	Photo Ionization Detector
ppm	parts per million
NWB	Northwest Sludge Drying Bed
NCB	North Central Sludge Drying Bed
NEB	Northeast Sludge Drying Bed
RP	Former Rag Pit
FT	Former Fire Training Area (including pit located within area)

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Table 3. Proposed Phase 2A Soil Remedial Investigation Work Description, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park), Bethpage, New York.

Program Element	Scope of Work Description
• Geophysical Survey	A geophysical survey will be conducted of the entire ball field area utilizing a combination of ground penetrating radar, magnetometry and/or resistivity. The survey will be conducted over an area measuring approximately 200,000 square feet and is intended to identify the boundaries of historical features (e.g., sludge drying beds, basins, etc.), locate potential sludge pockets, locate potential sources and determine whether low permeability layers are present that may affect contaminant migration.
• Surface and Subsurface Soil Sampling	A total of 34 soil borings will be advanced using the hollow stem auger/split spoon sampling system within the Town of Oyster Bay Bethpage Community Park. The soil borings will be advanced at the locations described in RI/FS Workplan Section 6 and presented on Figure 8. The borings will be advanced to field-determined depths as described in RI/FS Workplan Section 6. Soil samples will be retrieved at 2-foot intervals and logged by a qualified geologist. Soil samples will be collected for laboratory analysis at 2-foot intervals as described in Table 3. In addition, soil samples will be collected from any 2-foot depth interval deeper than the minimum boring depth specified in Table 3 that the field geologist determines is necessary. As a result, a minimum of 334 soil samples will be collected for laboratory analysis with another 12 soil samples placed on-hold at the laboratory. The soil samples collected will be analyzed for any combination of the following constituents, as described in Table 3: cadmium, chromium, PCBs, VOCs and SVOCs. The analytical methods to be utilized are specified in the QAPP section of this Work Plan (Appendix B).
• Test Pits (if necessary)	Test pits may be excavated within the ball field area at locations where the geophysical survey reveals subsurface anomalies that may indicate the locations of potential sources. Each test pit will be excavated to a maximum depth of approximately 10 feet below landsurface with a backhoe. Excavated material will be placed on polyethylene sheeting for replacement in the excavation upon completion in reverse order from removal. Compaction will be performed by the backhoe. The test pit will be logged by a qualified geologist, screened with a PID and appropriate samples collected for laboratory analysis. The backhoe bucket will be properly steam cleaned upon arrival, between test pit locations and prior to removal from the park. Additional details to be provided via Work Plan Addendum (under separate cover).

Note:
Sample count does not incude contingency analysis as described in Table 2.

PCBs	Polychlorinated Biphenyls
VOCs	Volatile Organic Compounds
SVOCs	Semi-Volatile Organic Compounds
PID	Photo Ionization Detector
ppm	parts per million

Table 4. Summary of Phase 2A Soil Remedial Investigation Sampling Program, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park), Bethpage, New York.

PROGRAM ELEMENT	Environmental Media	Location/Depth	Number of Samples*	Sampling Equipment	Laboratory Analysis**
• Surface and Subsurface Soil Sampling	Soil	Surface soil sampling (in grass areas only) and continuous sampling at 2-foot intervals until the total depth of each boring is reached at 34 locations as specified on Table 3.	194 (min.)	Decontaminated split spoon sampler.	Cadmium
			323 (min.)	Decontaminated split spoon sampler.	Chromium
			274 (min.)	Decontaminated split spoon sampler.	PCBs
			178 (min.)	Decontaminated split spoon sampler.	VOCs
			196 (min.)	Decontaminated split spoon sampler.	SVOCs

* Does not include contingency samples (Table 2) or QA/QC samples. See QAPP section of this Work Plan (Appendix B) for a summary of QA/QC samples.

** Assumes an expedited 1-week turnaround time for sample analytical results will be provided by the laboratory, unless otherwise specified. The analytical methods to be utilized are specified in the QAPP section of this Work Plan (Appendix B).

min	Minimum
PCBs	Polychlorinated Biphenyls
VOCs	Volatile Organic Compounds
SVOCs	Semi-Volatile Organic Compounds
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan

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Table 5. Master Table of Phase 2 Remedial Investigation Analytical Samples and Parameters, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park) Bethpage, New York.

Boring/VPB ID	Estimated Number of Samples	Proposed Laboratory Analyses [4]
Phase 2A (Soil)		
B-7A	9	Cadmium, chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-12A	8	Cadmium, chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-17A	7	Cadmium, chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-24A	4	SVOCs. VOCs based on PID readings.[1]
B-26	6	Chromium. VOCs and SVOCs based on PID readings. [1]
B-27	6	Chromium. VOCs and SVOCs based on PID readings. [1]
B-28	11	SVOCs for intervals from land surface to 12 ft bls. VOCs based on PID readings.[1] Remaining samples on-hold pending analytical results of B-24A and field observations.
B-29	11	Chromium and SVOCs for intervals from land surface to 12 ft bls. VOCs based on PID readings.[1] Remaining samples on-hold pending analytical results of B-24A and field observations.
B-30	5	Chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-31	11	Cadmium, chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-32	11	Cadmium, chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-33	16	Cadmium, chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-34	25	Cadmium, chromium, PCBs, VOCs and SVOCs.
B-35	21	Cadmium, chromium, PCBs, VOCs and SVOCs.
B-36	21	Cadmium, chromium, PCBs, VOCs and SVOCs.
B-37	21	Cadmium, chromium, PCBs, VOCs and SVOCs.
B-38	21	Cadmium, chromium, PCBs, VOCs and SVOCs.
B-39	21	Cadmium, chromium, PCBs, VOCs and SVOCs.
B-40	16	Chromium, PCBs, VOCs and SVOCs.
B-41	16	Chromium, PCBs, VOCs and SVOCs.
B-42	16	Chromium, PCBs, VOCs and SVOCs.
B-43	6	Chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-44	4	Chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-45	4	Chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-46	4	Chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-47	4	Chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-48	4	Chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-49	5	Chromium and PCBs. VOCs and SVOCs based on PID readings.[1]
B-50	5	Chromium. VOCs and SVOCs based on PID readings.[1]
B-51	5	Chromium. VOCs and SVOCs based on PID readings.[1]
B-52	5	Chromium. VOCs and SVOCs based on PID readings.[1]
B-53	5	Chromium. VOCs and SVOCs based on PID readings.[1]
B-54	5	Chromium. VOCs and SVOCs based on PID readings.[1]
B-55	5	Chromium. VOCs and SVOCs based on PID readings.[1]

see footnotes on last page

Table 5. Master Table of Phase 2 Remedial Investigation Analytical Samples and Parameters, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park) Bethpage, New York.

Boring/VPB ID	Estimated Number of Samples	Proposed Laboratory Analyses [4]
Phase 2B (Soil) [2]		
CL-1	2 [2]	VOCs, TOC, porosity, moisture content, vertical permeability, bulk density and foc [2]
CL-2	2 [2]	VOCs, TOC
CL-3	2 [2]	VOCs, TOC, porosity, moisture content, vertical permeability, bulk density and foc [2]
CL-4	2 [2]	VOCs, TOC
CL-5	2 [2]	VOCs, TOC, porosity, moisture content, vertical permeability, bulk density and foc [2]
CL-6	2 [2]	VOCs, TOC
CL-7	2 [2]	VOCs, TOC, porosity, moisture content, vertical permeability, bulk density and foc [2]
CL-8	2 [2]	VOCs, TOC
CL-9	2 [2]	VOCs, TOC, porosity, moisture content, vertical permeability, bulk density and foc [2]
CL-10	2 [2]	VOCs, TOC
CL-11	2 [2]	VOCs, TOC, porosity, moisture content, vertical permeability, bulk density and foc [2]
CL-12	2 [2]	VOCs, TOC
CL-13	2 [2]	VOCs, TOC, porosity, moisture content, vertical permeability, bulk density and foc [2]
CL-14	2 [2]	VOCs, TOC
Phase 2 (Groundwater)		
Vertical Profile Borings		
On-Site VPBs [7]		
VP-3A	2	VOC, SVOCs, Metals [8], Biogeochemical parameters, Wet Chemistry, ClO_4- [2], TOC
VP-3B	3	VOC, SVOCs, Metals [8], Biogeochemical parameters, Wet Chemistry, ClO_4- [2], TOC
VP-3C	3	VOC, SVOCs, Metals [8], Biogeochemical parameters, Wet Chemistry, ClO_4- [2], TOC
VP-19A	3	VOC, Metals [8], Biogeochemical parameters, ClO_4- [2], TOC
VP-27A	2	VOC, Metals [8], Biogeochemical parameters, ClO_4- [2], TOC
Off-Site VPBs		
VP-100	19	VOC, ClO_4-
VP-101	23	VOC, ClO_4-
VP-102 [3]	20	VOC, ClO_4-
VP-103 [3]	TBD	VOC, ClO_4-
VP-104 [3]	TBD	VOC, ClO_4-
VP-105	5	VOC, ClO_4-
VP-106	5	VOC, ClO_4-
VP-107	5	VOC, ClO_4-
VP-108	5	VOC, ClO_4-

see footnotes on last page

Table 5. Master Table of Phase 2 Remedial Investigation Analytical Samples and Parameters, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park) Bethpage, New York.

Boring/VPB ID	Estimated Number of Samples	Proposed Laboratory Analyses [4]
Piezometers		
PZ-1	1 [2]	VOC, Metals, Biogeochemical parameters, ClO_4^- [2]
PZ-2	1 [2]	VOC, Metals, Biogeochemical parameters, ClO_4^- [2]
PZ-3	1 [2]	VOC, Metals, Biogeochemical parameters, ClO_4^- [2]
PZ-4	1 [2]	VOC, Metals, Biogeochemical parameters, ClO_4^- [2]
PZ-5	1 [2]	VOC, Metals, Biogeochemical parameters, ClO_4^- [2]
On-Site Monitoring Wells		
B30-MW-1	1	VOC, Biogeo, Metals, ClO_4^-
BCP-MW-2 [6]	1	VOC, SVOCs, Biogeo, Wet Chemistry, Metals, ClO_4^-
BCP-MW-3 [6]	1	VOC, SVOCs, Biogeo, Wet Chemistry, Metals, ClO_4^-
CAMW-1	1	VOC, Biogeo, Metals, ClO_4^-
CAMW-2 [6]	1	VOC, SVOCs, Biogeo, Wet Chemistry, Metals, ClO_4^-
CAMW-3 [6]	1	VOC, SVOCs, Biogeo, Wet Chemistry, Metals, ClO_4^-
CAMW-4 [6]	1	VOC, SVOCs, Biogeo, Wet Chemistry, Metals, ClO_4^-
Off-Site Monitoring Wells		
HN-40S	1	VOCs, ClO_4^- [2]
HN-40I	1	VOCs, ClO_4^- [2]
HN-42S	1	VOCs, ClO_4^- [2]
HN-40I	1	VOCs, ClO_4^- [2]
Phase 2 (Soil Gas)		
On-Site Soil Gas Points [5]		
SGP-5	3	VOCs
SGP-6	3	VOCs
SGP-7	3	VOCs
SGP-8	3	VOCs
SGP-9	3	VOCs
SGP-10	3	VOCs
Off-site Soil Gas Points [5]		
SGP-100	1	VOCs
SGP-101	3	VOCs
SGP-102	1	VOCs
SGP-103	3	VOCs
SGP-104	1	VOCs
SGP-105	1	VOCs
SGP-106	1	VOCs
SGP-107	1	VOCs

see footnotes on last page

Table 5. Master Table of Phase 2 Remedial Investigation Analytical Samples and Parameters, Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park) Bethpage, New York.

Footnotes

(1) If PID readings above background concentrations are detected, then the soil sample exhibiting the highest PID reading, as well as the deepest soil sample collected from that boring, will be analyzed for VOCs and SVOCs. In addition, any soil sample exhibiting a PID reading of 50 ppm or greater above background concentrations will also be analyzed for VOCs and SVOCs.

(2) See Table 1 for rationale. Proposed Phase 2B Soil RI sample count assumes HSA/splitspoon methodology is used. If CPT/MIP methodologies are selected, then sample count and number of borings will be modified.

(3) Contingency VPB, see Table 1 for rationale and detailed list of analytes.

(4) Please refer to the QAPP (Appendix B) for the detailed list of analytical methods, QA/QC sample summary, and list of analytes.

(5) Replicate samples and ambient air samples not included in sample count (see QAPP-Appendix B).

(6) Analytical parameters for Phase 2 RI and Pre-Design Sampling specified on Tables 1 and 6, respectively.

(7) Only one of VP-3A, 3B, and 3C will be sampled for SVOCs and wet chemistry based on field readings (see Table 6 for details).

(8) If collected samples are turbid than both total and dissolved samples will be collected.

Definitions

VOC	volatile organic compound
ClO_4-	Perchlorate
PCB	polychlorinated biphenyls
SVOC	semi-volatile organic compounds
foc	fraction organic carbon
TOC	Total Organic Carbon
ft bls	feet below land surface
PID	Organic Vapor Analyzer equipped with a photoionization detector
ppm	parts per million
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
CPT	Cone Penetrometer Testing
MIP	Membrane Interface Probe

Table 6. Summary of Proposed Interim Remedial Measure Pre-Design Sampling Program,
Former Grumman Settling Ponds (Operable Unit 3 - Bethpage Community Park), Bethpage, New York.

Location Designation	VOCs	SVOCs	Metals	Wet Chemistry [3]	Perchlorate
Monitoring Wells					
BCPMW-2	[1]	Y	[1]	Y	[1]
BCPMW-3	[1]	Y	[1]	Y	[1]
CAMW-2	[1]	Y	[1]	Y	[1]
CAMW-3	[1]	Y	[1]	Y	[1]
CAMW-4	[1]	Y	[1]	Y	[1]
Vertical Profile Borings [2]					
VP-3A	[1]	Y	[1]	Y	[1]
VP-3B	[1]	Y	[1]	Y	[1]
VP-3C	[1]	Y	[1]	Y	[1]

Notes:

[1] Analytical parameter previously proposed for collection as part of Phase 2 RI and will also be used for pre-design, see Table 1 of the RI/FS Work Plan.

[2] At a minimum, each horizon within one of the three VPBs installed near Phase 1 RI VPB VP-3 will be sampled, for SVOCs and wet chemistry depending on field PID readings during drilling. The VPB exhibiting the highest PID reading will be selected for sampling of the additional constituents. If PID readings are similar or inconclusive, then VPB VP-3B will be sampled for the additional constituents.

[3] Wet chemistry parameters include: ammonia, hardness (as CaCO3), orthophosphate, total dissolved solids, and total organic carbon. Additional pre-design parameters previously specified under "Biogeochemical" in Table 1.
Other analytical methods are as follows:
VOCs: TCL VOCs using NYSDEC ASP 2000, CLP Method.
SVOCs: TCL SVOCs using NYSDEC ASP 2000, CLP Method.
Metals: TAL Metals using USEPA Method 6010/7471
Perchlorate: USEPA Method 314.0

VOC	Volatile Organic Compound
SVOC	Semi-Volatile Organic Compound
TCL	Target Compound List
TAL	Target Analyte List
NYSDEC	New York State Department of Environmental Conservation
ASP	Analytical Services Protocol
USEPA	United States Environmental Protection Agency
VPB	Vertical Profile Boring
Y	Yes
N	No

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User Name : ehughes

Date\Time : Fri, 10 Mar 2006 - 9:53am
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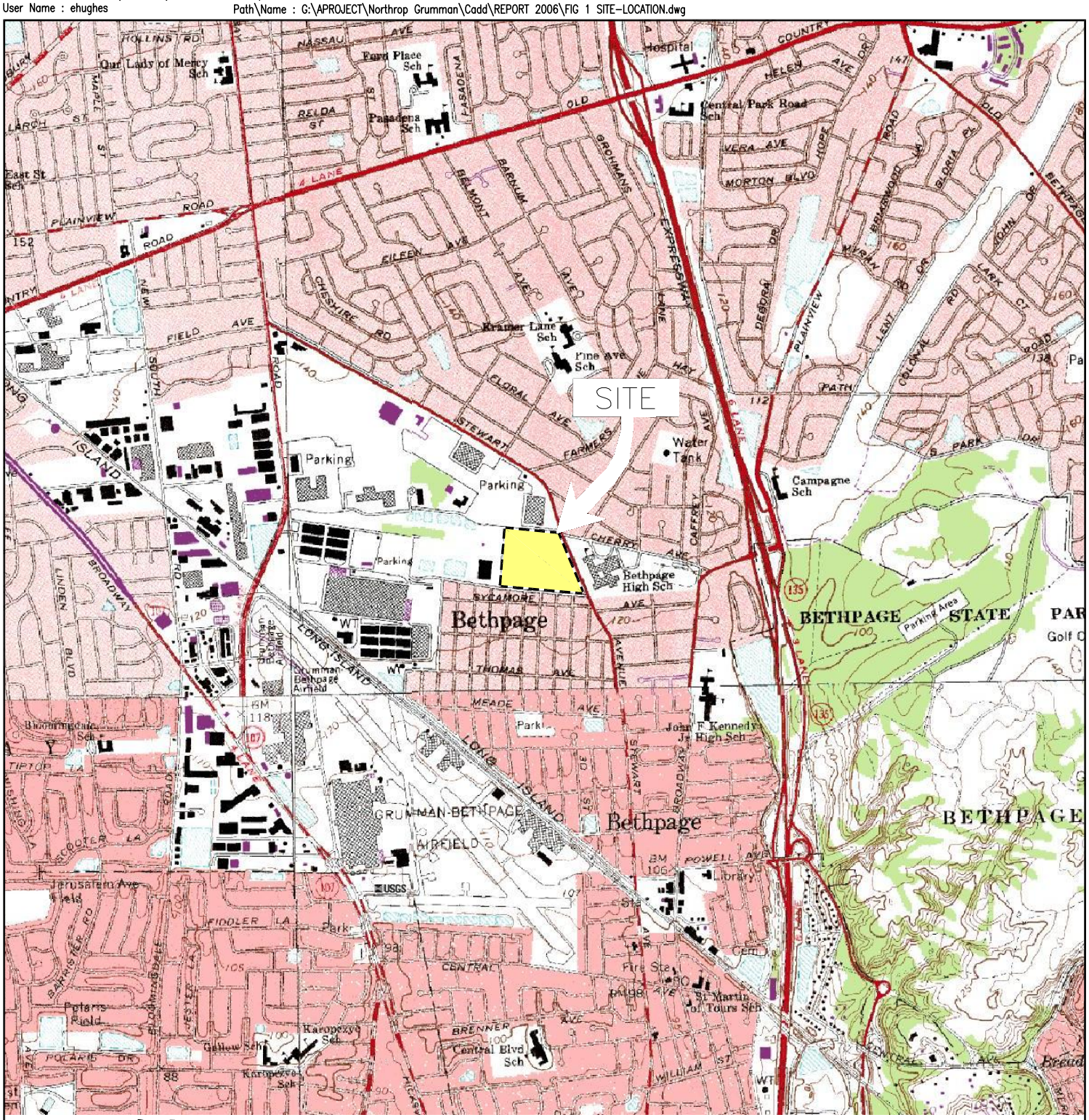
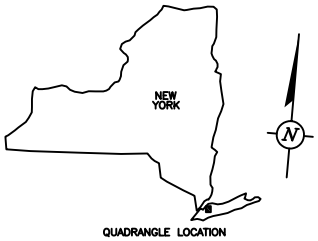




SITE LOCATION

SOURCE: USGS 7.5 MIN. AMITYVILLE QUADRANGLE, AMITYVILLE, NY. 1994
USGS 7.5 MIN. FREEPORT QUADRANGLE, FREEPORT, NY., 1994
USGS 7.5 MIN. HICKSVILLE QUADRANGLE, HICKSVILLE, NY., 1967, PHOTOREVISED 1979
USGS 7.5 MIN. HUNTINGTON QUADRANGLE, HUNTINGTON, NY. 1967, PHOTOREVISED 1979

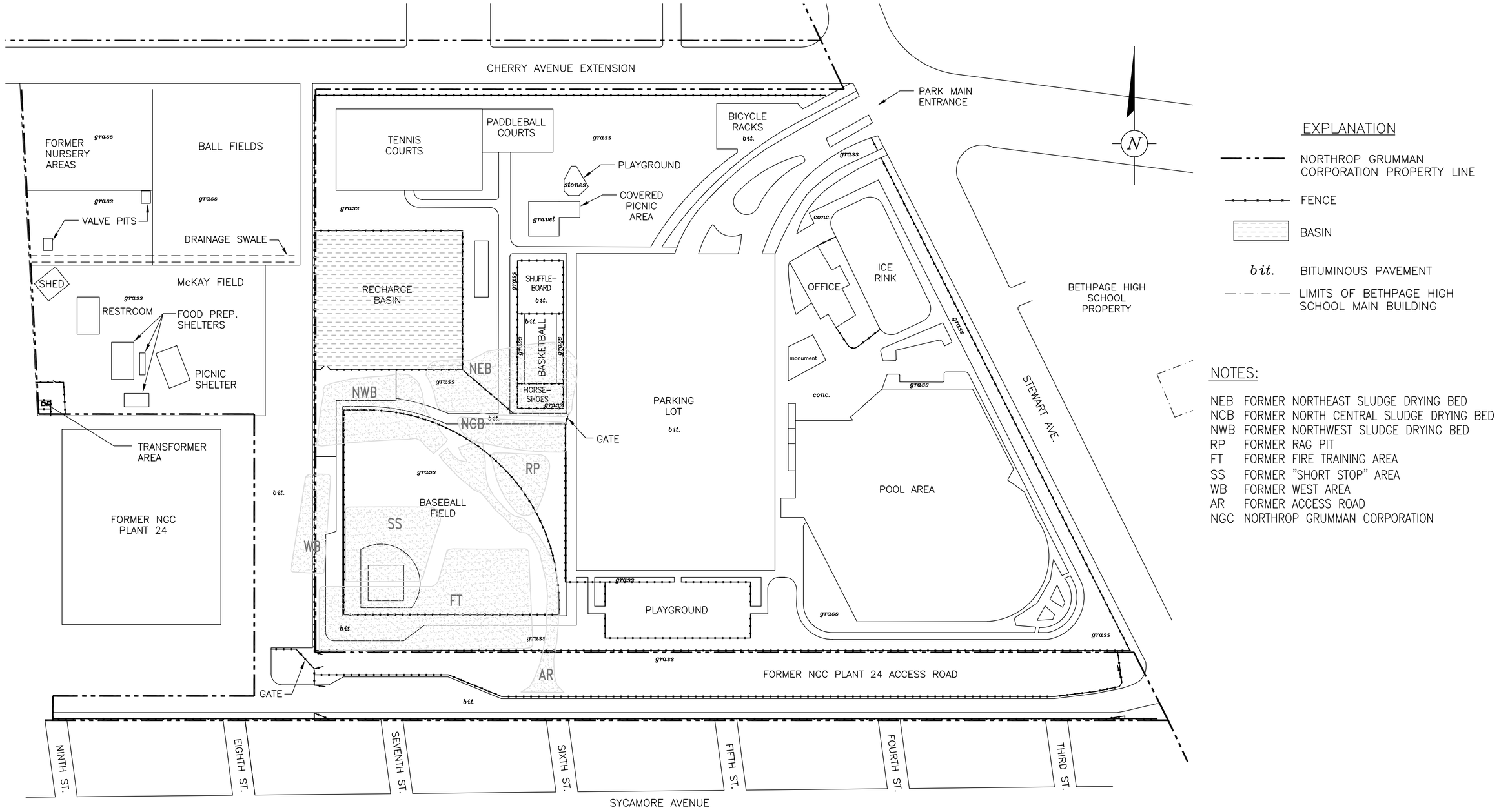
EXPLANATION

PROPERTY BOUNDARY

0 2000
SCALE IN FEET

ARCADIS
www.arcadis-us.com

PROJECT MANAGER C. SAN GIOVANNI	DEPARTMENT MANAGER M. WOLFERT	LEAD DESIGN PROF.	CHECKED BY D. STERN
SHEET TITLE SITE LOCATION FORMER GRUMMAN SETTLING PONDS OPERABLE UNIT 3 BETHPAGE, NEW YORK		TASK/PHASE NUMBER 00002	DRAWN BY E. HUGHES
		PROJECT NUMBER NY001348.0706	FIGURE 1



DRAWING REFERENCE:
DVIRKA AND BARTILUCCI 2003

NO.	DATE	REVISION DESCRIPTION	BY / CKD
0	3/8/2006	REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN	EJH / DS

0 100' 200'
SCALE: 1" = 100'

ARCADIS
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www.arcadis-us.com

PROJECT TITLE
OPERABLE UNIT 3
FORMER GRUMMAN SETTLING PONDS
BETHPAGE, NEW YORK

PROJECT MANAGER	DEPARTMENT MANAGER	LEAD DESIGNER	CHECKED BY
C. SAN GIOVANNI	M. WOLFERT		D. STERN

SHEET TITLE
HISTORICAL OPERATIONAL AREAS AND CURRENT FEATURES AND STRUCTURES

TASK/PHASE NUMBER	DRAWN BY
00002	E. HUGHES
PROJECT NUMBER	FIGURE
NY001348.0706	2

Acad Version : R16.2s (LMS Tech)
User Name : ehughes
Date\Time : Fri, 10 Mar 2006 - 10:08am
Path\Name : G:\APROJECT\Northrop Grumman\Cadd\REPORT 2006\FIG 2 PARK SITE.dwg

EXPLANATION

- PROPERTY BOUNDARY OF THE FORMER GRUMMAN AEROSPACE SITE
- PROPERTY BOUNDARY OF U.S. NAVY SITE
- LONG ISLAND RAILROAD
- DENOTES NORTHROP GRUMMAN OWNED PROPERTY (AS OF 2003)
- DENOTES U.S. NAVY OWNED PROPERTY (AS OF 2003)
- BASIN
- 6781 ▲ INDUSTRIAL WELL
- 9591 ● PUBLIC SUPPLY WELL
- 10592 ◆ OBSERVATION, MONITORING WELL
- 4175 ✸ IRRIGATION WELL
- GP-11 ✸ NORTHROP GRUMMAN OR NAVY PRODUCTION WELL
- ☐ ABANDONED OR DESTROYED WELL

DEFINITIONS:

BWD BETHPAGE WATER DISTRICT

NOTES:

1. THIS FIGURE INCLUDES LOCATIONS OF PUBLIC SUPPLY WELLS BASED ON INFORMATION REQUESTED BY ARCADIS IN SEPTEMBER 2001 LETTER.
2. BASIN LOCATIONS OBTAINED FROM USGS TOPOGRAPHIC MAPS AND INFORMATION PROVIDED BY NORTHROP GRUMMAN.
3. NORTHROP GRUMMAN PROPERTY HOLDINGS BASED ON DATA PROVIDED IN JUNE 2003.
4. LOCATION OF MONITORING WELLS INSTALLED BY DVIRKA & BARTILUCCI (D&B) AT BETHPAGE COMMUNITY PARK ARE APPROXIMATED BASED ON DATA PROVIDED BY D&B SITE PLAN, DATED DECEMBER 2003.
5. LOCATIONS OF SITE WELLS INSTALLED BY THE TOWN OF OYSTER BAY. BASED ON THE 2005 REPORTS, LOCATIONS ARE APPROXIMATE (H_2M 2005a;b).
6. PARK FEATURES ARE APPROXIMATE & SHOWN FOR REFERENCE PURPOSES ONLY.

PARK EXTENTS AND FEATURES DVIRKA AND BARTILUCCI 2003

ALL COORDINATES REFERENCED TO NORTH AMERICAN DATUM

REV.	ISSUED DATE	DESCRIPTION
0	3/8/2006	REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

KEYPLAN

0' 300' 600'
SCALE: 1" = 300'

PROJECT TITLE

LOCATIONS OF WELLS WITHIN A ONE-HALF MILE RADIUS OF BETHPAGE PARK

SHEET TITLE

OPERABLE UNIT 3
FORMER GRUMMAN SETTLING PONDS
BETHPAGE, NEW YORK

ARCADIS
88 Duryea Road
Melville, NY 11747
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SEAL	SEAL
PROJECT MANAGER: C. SAN GIOVANNI	DEPARTMENT MANAGER: M. WOLFERT
LEAD DESIGN PROF.	CHECKED BY: D. STERN
TASK/PHASE NUMBER: 00002	DRAWN BY: E. HUGHES
PROJECT NUMBER: NY001348.0706	DRAWING NUMBER: 3

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Path\Name : G:\APROJECT\Northrop Grumman\Coda\REPORT 2006\FIG 3 HALF MILE RADIUS.dwg
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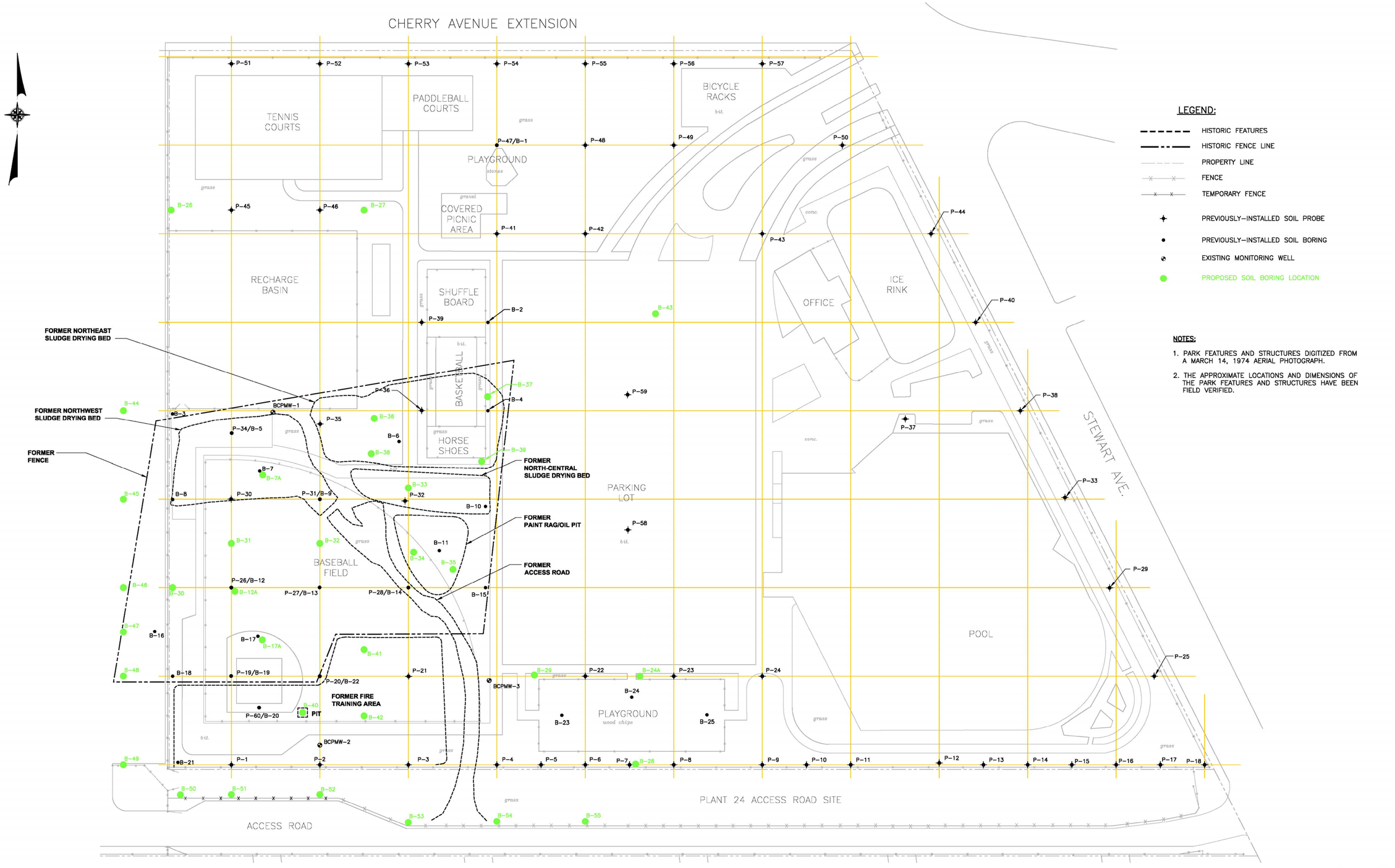
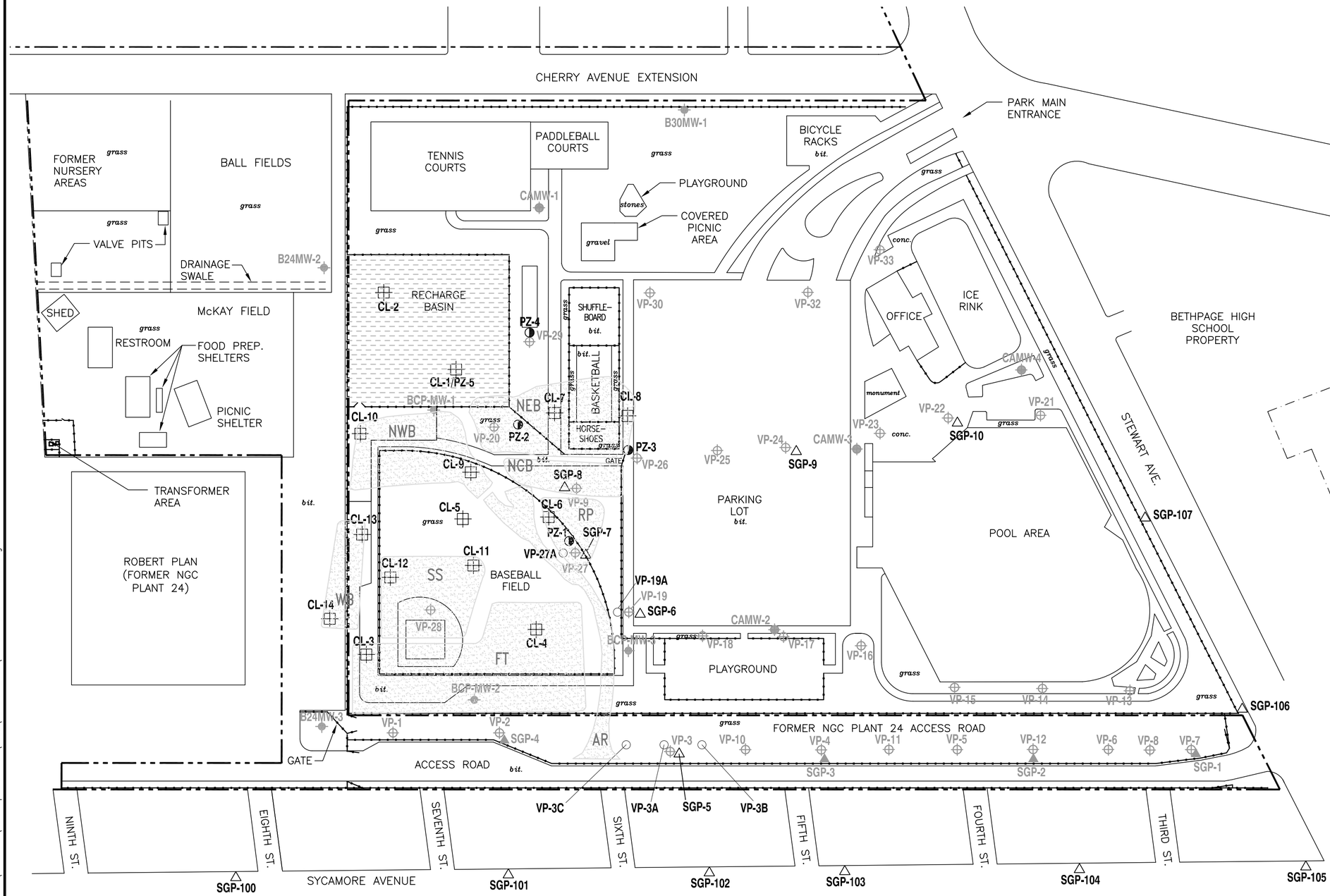


Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

TOWN OF OYSTER BAY
BETHPAGE COMMUNITY PARK
BETHPAGE, NEW YORK

REMEDIAL INVESTIGATION PROGRAM
PROPOSED SAMPLE LOCATION PLAN

FIGURE 4



EXPLANATION

- NORTHROP GRUMMAN CORPORATION PROPERTY LINE
- FENCE
- LIMITS OF BETHPAGE HIGH SCHOOL MAIN BUILDING
- BASIN
- *bit.* BITUMINOUS PAVEMENT
- BCP-MW-3 EXISTING MONITORING WELL
- VP-1 COMPLETED PHASE 1 RI VERTICAL PROFILE BORING (BY ARCADIS)
- SGP-1 COMPLETED PHASE 1 RI SOIL GAS POINT (BY ARCADIS)
- VP-27A PROPOSED PHASE 2 RI VERTICAL PROFILE BORING
- SGP-19 PROPOSED PHASE 2 RI SOIL GAS POINT
- PZ-1 PROPOSED PHASE 2 RI PIEZOMETER
- CL-6 PROPOSED PHASE 2B RI SOIL BORING (USING HSA METHODOLOGY)

NOTES:

1. COMPLETED WELL, SGP, AND VPB LOCATIONS ARE APPROXIMATE.
2. LOCATIONS OF WELLS INSTALLED BY THE TOWN OF OYSTER BAY ARE BASED ON THE 2005 REPORTS, LOCATIONS ARE APPROXIMATE (H2M 2005 a;b).
3. PROPOSED LOCATIONS REQUIRE FIELD VERIFICATION AND MAY CHANGE.
4. ANALYTICAL RESULTS FROM COMPLETED VPBs SHOWN ON FIGURE E–1 (APPENDIX E) OF THIS WORK PLAN.
5. LOCATIONS OF HISTORICAL OPERATIONS ARE APPROXIMATE.
6. PHASE 2A RI SOIL BORINGS BY D&B SHOWN ON FIGURE 4 OF THIS WORK PLAN.
7. OFF–SITE SGPs WILL BE LOCATED ON TOWN RIGHTS OF WAY.
8. IF CONE PENETROMETER TESTING (CPT)/ MEMBRANE INTERFACE PROBE (MIP) METHODOLOGY IS SELECTED, THEN THE LOCATIONS OF BORINGS CL–1 TO CL–14 WILL BE MODIFIED AND BORINGS MAY BE ADDED.

NEB FORMER NORTHEAST SLUDGE DRYING BED
NCB FORMER NORTH CENTRAL SLUDGE DRYING BED
NWB FORMER NORTHWEST SLUDGE DRYING BED
RP FORMER RAG PIT
FT FORMER FIRE TRAINING AREA
SS FORMER "SHORT STOP" AREA
WB FORMER WEST AREA
AR FORMER ACCESS ROAD
VPB VERTICAL PROFILE BORING
SGP SOIL GAS POINT
NGC NORTHROP GRUMMAN CORPORATION
D&B DVIRKA AND BARTILUCCI
RI REMEDIAL INVESTIGATION
HSA HOLLOW–STEM AUGER

DRAWING REFERENCE:
DVIRKA AND BARTILUCCI
CONSULTING ENGINEERS 2003

NO.	DATE	REVISION DESCRIPTION	BY / CKD
0	3/8/2006	REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN	

ARCADIS
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PROJECT TITLE
OPERABLE UNIT 3
FORMER GRUMMAN SETTLING PONDS
BETHPAGE, NEW YORK

PROJECT MANAGER	DEPARTMENT MANAGER	LEAD DESIGNER	CHECKED BY
C. SAN GIOVANNI	M. WOLFERT		D. STERN

SHEET TITLE
LOCATIONS OF HISTORICAL OPERATIONS AND PHASE 2 RI VPBs, SGPs, AND PHASE 2B RI SOIL BORINGS

TASK/PHASE NUMBER	DRAWN BY
00002	E. HUGHES
PROJECT NUMBER	FIGURE
NY001348.0706	5

Acad Version : R16.2s (LMS Tech)
User Name : : ehughes
Date\Time : Fri, 10 Mar 2006 – 9:59am
Path\Name : G:\APROJECT\Northrop Grumman\Cadd\REPORT 2006\FIG 5 VPB–SVP WELLS.dwg

EXPLANATION

- PROPERTY BOUNDARY OF THE FORMER GRUMMAN AEROSPACE SITE
- PROPERTY BOUNDARY OF U.S. NAVY SITE
- LONG ISLAND RAILROAD
- DENOTES NORTHROP GRUMMAN OWNED PROPERTY (AS OF 2003)
- DENOTES U.S. NAVY OWNED PROPERTY (AS OF 2003)
- RECHARGE BASIN
- LAND SURFACE PROJECTION OF THE CAPTURE ZONE OF WELL ONCT 3 (WELL 19) PUMPING AT ITS NORMAL RATE OF 700 GPM.
- CURRENT DIRECTION OF GROUNDWATER FLOW.
- LIMITS OF BETHPAGE HIGH SCHOOL MAIN BUILDING
- VP-100 PROPOSED OU3 VERTICAL PROFILE BORING
- VP-102 CONTINGENT OU3 VERTICAL PROFILE BORING
- 10592 OBSERVATION, MONITORING WELL (GRAY – SHOWN FOR REFERENCE) (BLACK – PROPOSED TO BE SAMPLED IN PHASE 2 RI)
- 6781 INDUSTRIAL WELL
- 9591 PUBLIC SUPPLY WELL
- 4175 IRRIGATION WELL
- WELL-17 NORTHROP GRUMMAN OR NAVY PRODUCTION WELL
- GP-11 ABANDONED PRODUCTION WELL
- VP-49 COMPLETED OU2 VERTICAL PROFILE BORING

DEFINITIONS:

BWD	BETHPAGE WATER DISTRICT
VPB	VERTICAL PROFILE BORING
RI	REMEDIAL INVESTIGATION
OU2	OPERABLE UNIT 2

GENERAL NOTES:

1. THIS FIGURE INCLUDES LOCATIONS OF PUBLIC SUPPLY WELLS BASED ON INFORMATION RECEIVED BY ARCADIS IN RESPONSE TO A SEPTEMBER 2001 LETTER TO WATER DISTRICTS.
2. BASIN LOCATIONS OBTAINED FROM USGS TOPOGRAPHIC MAPS (HUNTINGTON, HICKSVILLE, FREEPORT AND AMITYVILLE QUADRANGLES) AND INFORMATION PROVIDED BY NORTHROP GRUMMAN.
3. NORTHROP GRUMMAN PROPERTY HOLDINGS BASED ON DATA PROVIDED IN JUNE 2003.
4. LOCATIONS OF MONITORING WELLS INSTALLED BY DVIRKA & BARTILUCCI (D&B) AT PLANT 1 (i.e., MW-1 TO MW-6) ARE APPROXIMATE BASED ON D&B SITE PLAN, PROVIDED ON DECEMBER 19, 2002.
5. LOCATIONS OF MONITORING WELLS INSTALLED BY DVIRKA & BARTILUCCI (D&B) AT BETHPAGE COMMUNITY PARK ARE APPROXIMATE BASED ON DATA PROVIDED BY D&B SITE PLAN, DATED DECEMBER 2003.
6. APPROXIMATE LOCATIONS OF BETHPAGE PARK MONITORING WELLS INSTALLED BY THE TOWN OF OYSTER BAY ARE BASED ON THE 2005 REPORTS. (H2M 2005a;b).
7. OU3 RI ON-SITE VPBs DRILLED BY ARCADIS ARE SHOWN ON FIGURE 5.
8. PROPOSED LOCATIONS SUBJECT TO FIELD VERIFICATION AND MAY CHANGE.
9. VP-100 TO VP-104 FIELD CHECKED IN OCTOBER 2005, BUT REQUIRE CONFIRMATION.

BETHPAGE COMMUNITY PARK EXTENTS AND FEATURES DVIRKA AND BARTILUCCI CONSULTING ENGINEERS 2003

ALL COORDINATES REFERENCED TO NORTH AMERICAN DATUM 1929

REV.	ISSUED DATE	DESCRIPTION
0	3/8/2006	REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

KEYPLAN

PROJECT TITLE

OPERABLE UNIT 3
FORMER GRUMMAN SETTLING PONDS
BETHPAGE, NEW YORK

SHEET TITLE

SOUTH PROJECT AREA
SHOWING PHASE 2 RI OFF-SITE
VERTICAL PROFILE BORINGS AND
WELLS PROPOSED FOR SAMPLING

ARCADIS

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SEAL	SEAL

PROJECT MANAGER	DEPARTMENT MANAGER
C. SAN GIOVANNI	M. WOLFERT
LEAD DESIGN PROF.	CHECKED BY
	D. STERN
TASK/PHASE NUMBER	DRAWN BY
00002	E. HUGHES
PROJECT NUMBER	FIGURE
NY001348.0706	6

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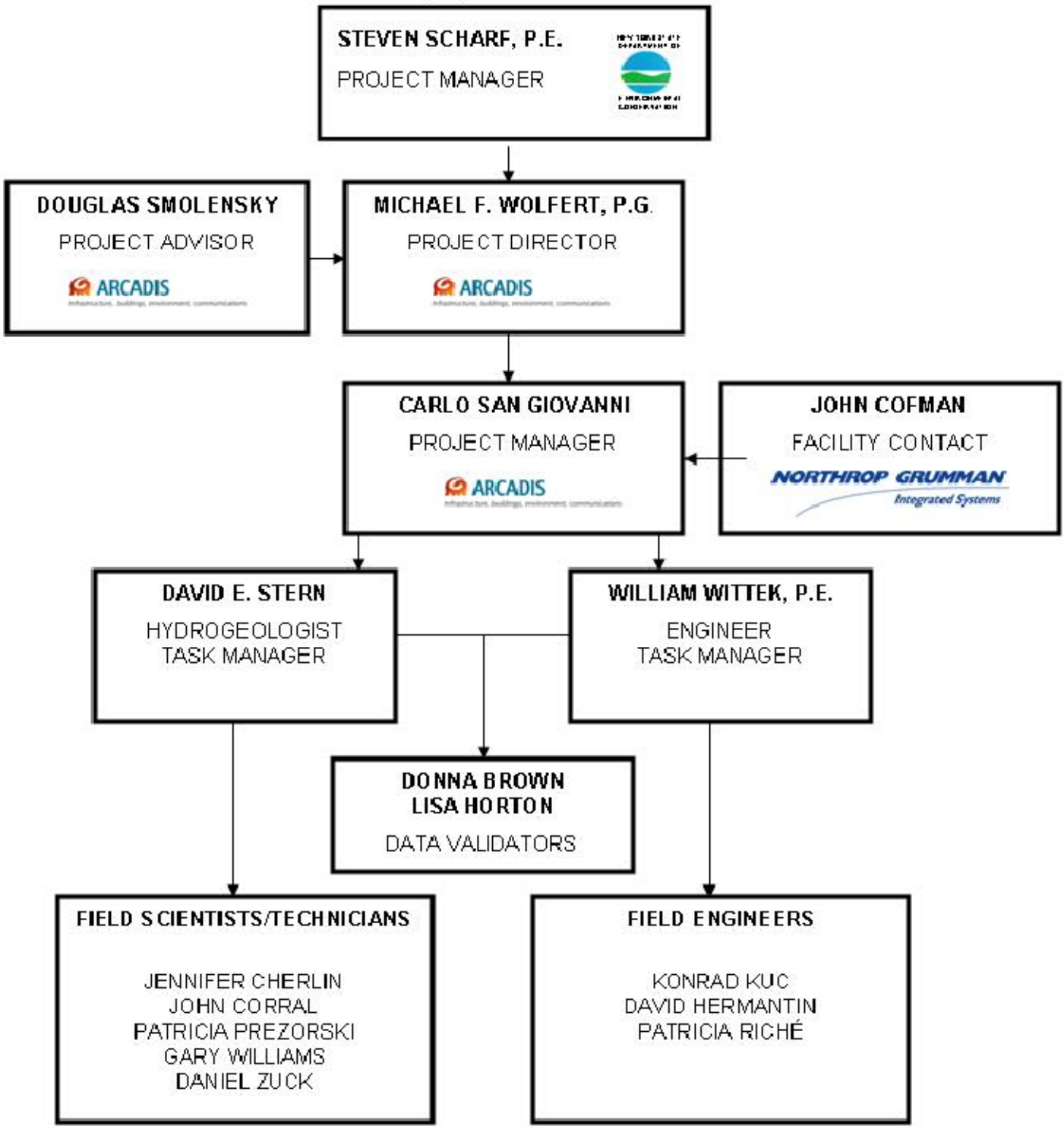
Figure 7a.
ARCADIS Remedial Investigation/Feasibility Study Project Organization Chart
Former Grumman Settling Ponds (Operable Unit 3 – Bethpage Community Park),
Bethpage, New York.



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DVIRKA AND BARTILUCCI CONSULTING ENGINEERS

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PROJECT ORGANIZATION CHART
FORMER GRUMMAN SETTLING PONDS (OPERABLE UNIT 3)
BETHPAGE, NEW YORK

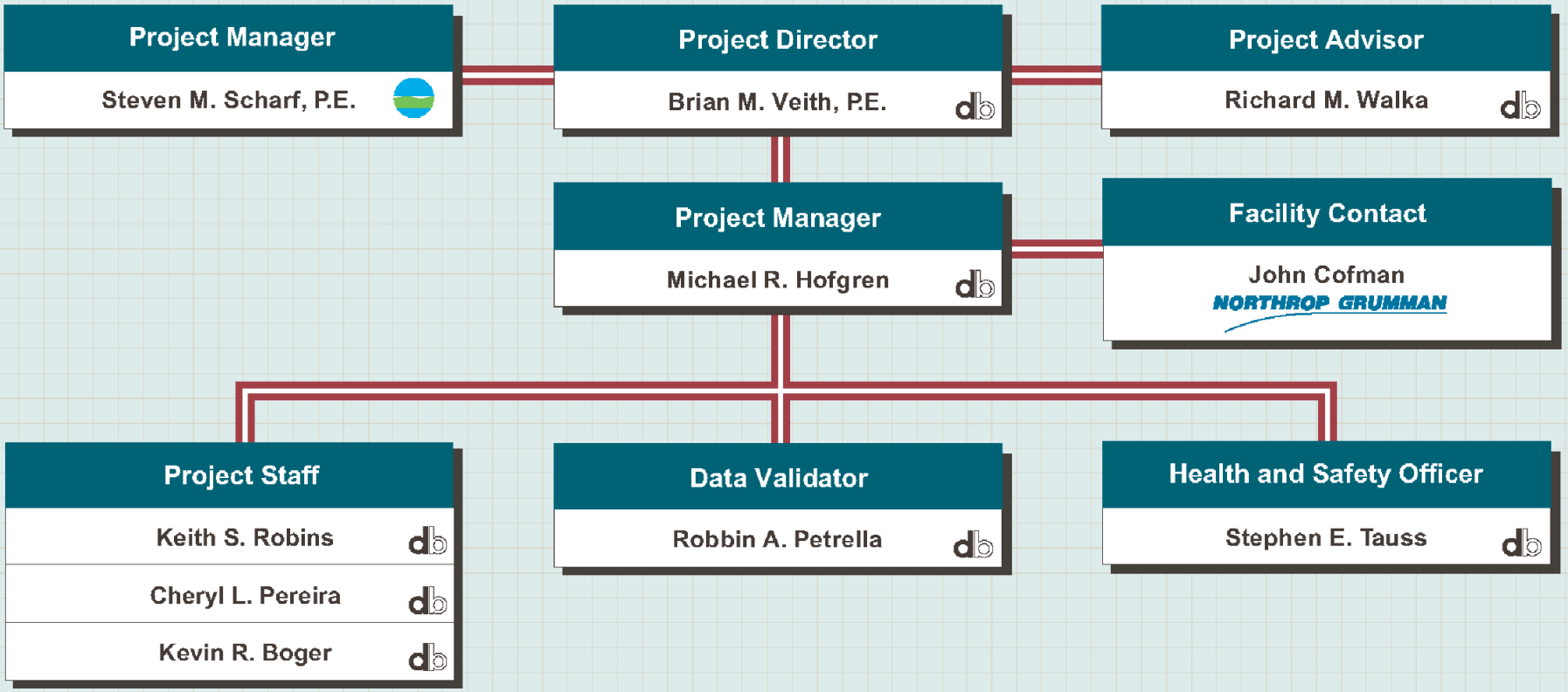
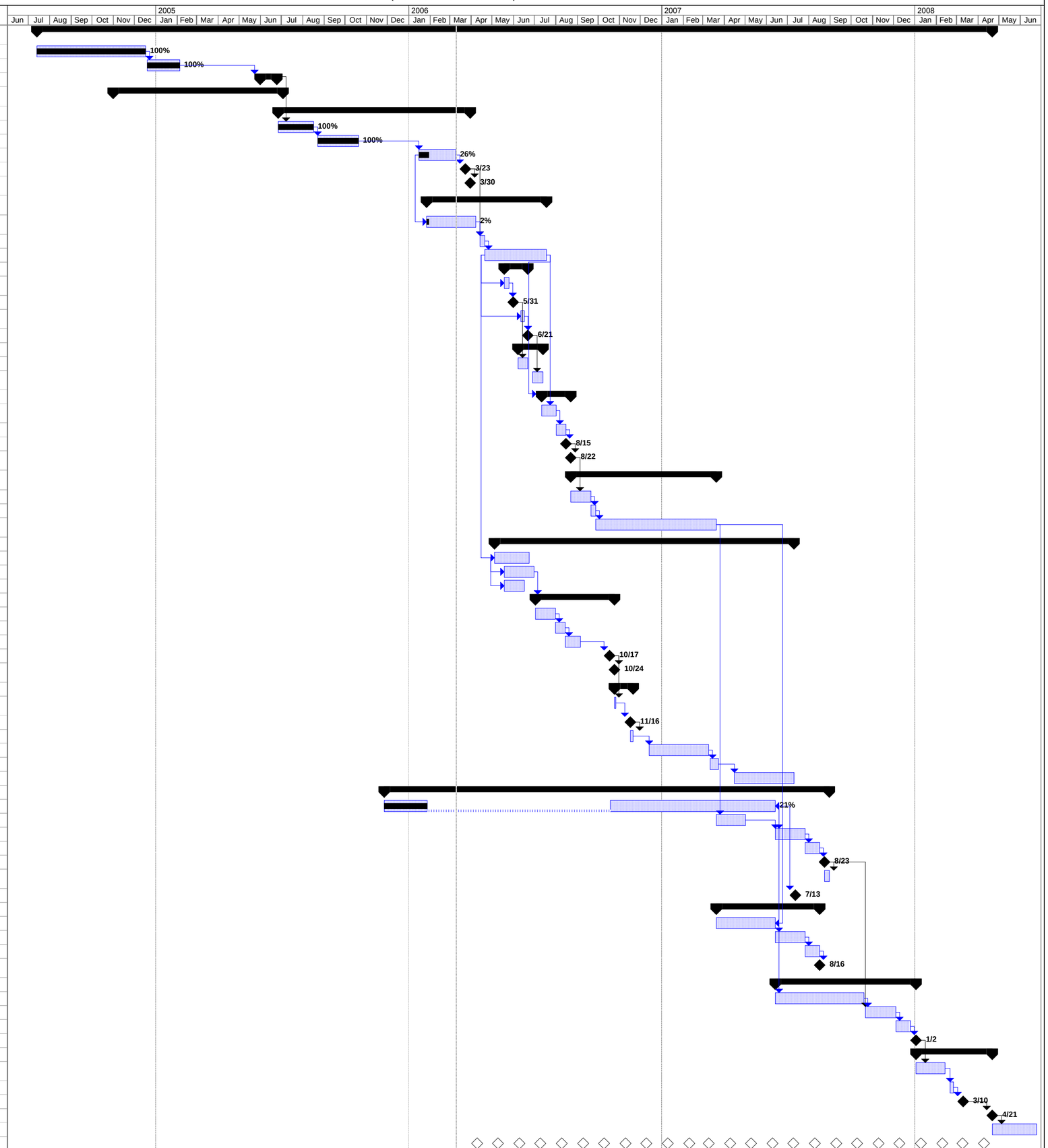


FIGURE 7b

FIGURE 8.

ANTICIPATED RI/FS PROJECT SCHEDULE
OPERABLE UNIT 3 - FORMER GRUMMAN SETTLING PONDS, BETHPAGE, NEW YORK (Revised March 8, 2006)

ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	**Former Grumman Settling Ponds (OU3 - Bethpage Community Park) RI/FS**	**971 days?**	**Wed 7/14/04**	**Mon 4/21/08**		
2	**Remedial Investigation (RI) - Phase 1**	113 days	Wed 7/14/04	Fri 12/17/04		
3	**RI - Phase 1A**	35 days	Mon 12/20/04	Fri 2/4/05	2	
4	**RI - Phase 1B**	**18 days**	**Wed 6/1/05**	**Fri 6/24/05**	**3**	
6	**Consent Order for Remedial Investigation/Feasibility Study (RI/FS)**	**175 days**	**Mon 11/1/04**	**Mon 7/4/05**		
10	**RI/FS Work Plan & Phase 1 RI Data Report**	**199 days**	**Mon 6/27/05**	**Thu 3/30/06**		
11	Prepare and Submit RI/FS Work Plan	37 days	Mon 6/27/05	Tue 8/16/05	4	
12	State Review and Comment	43 days	Tue 8/23/05	Thu 10/20/05	11	
13	Revise RI/FS Work Plan	39 days	Mon 1/16/06	Thu 3/9/06	12	
14	State Approval of RI/FS Work Plan	0 days	Thu 3/23/06	Thu 3/23/06	13FS+10 days	
15	Place RI/FS Work Plan in Document Repository & Issue Public Notice / Fact Sheet	0 days	Thu 3/30/06	Thu 3/30/06	14FS+5 days	
16	**Phase 2 RI (On-Site Soil & Soil Gas, On- and Off-Site Groundwater)**	**121 days**	**Fri 1/27/06**	**Tue 7/18/06**		
17	Secure Site Access / Issue Drilling Fact Sheet to Near-By Residents	51 days	Fri 1/27/06	Fri 4/7/06	13SS+10 days	
18	Mobilization	5 days	Fri 4/14/06	Thu 4/20/06	17,14FS+15 days	
19	Conduct Phase 2 RI Activities (4 Crews)	61 days	Fri 4/21/06	Tue 7/18/06	18	
20	**Phase 2 RI Work Plan Addenda (Incl. Data Rpt)**	**23 days**	**Fri 5/19/06**	**Wed 6/21/06**		
21	Prepare and Submit Phase 2 RI Work Plan Addendum (Test Pits, etc)	5 days	Fri 5/19/06	Thu 5/25/06	19SS+20 days	
22	State Approval of Work Plan Addendum	0 days	Wed 5/31/06	Wed 5/31/06	21FS+3 days	
23	Prepare and Submit Phase 2 RI Work Plan Addendum (Underfined Scope)	5 days	Mon 6/12/06	Fri 6/16/06	19SS+35 days	
24	State Approval of Work Plan Addendum	0 days	Wed 6/21/06	Wed 6/21/06	23FS+3 days	
25	**Phase 2 RI Addenda Work Scope**	**25 days**	**Thu 6/8/06**	**Thu 7/13/06**		
26	Conduct Test Pit Excavation (1 Crew)	10 days	Thu 6/8/06	Wed 6/21/06	22FS+5 days	
27	Conduct Undefined Phase 2 RI Addenda Scope (1 Crew)	10 days	Thu 6/29/06	Thu 7/13/06	24FS+5 days	
28	**Letter Report and Phase 3 RI Work Plan Addendum**	**30 days**	**Wed 7/12/06**	**Tue 8/22/06**	**19FS-5 days**	
29	Prepare & Submit Letter Report and Phase 3 RI Work Plan Addendum	15 days	Wed 7/12/06	Tue 8/1/06	19FS-5 days	
30	State Review and Comment	10 days	Wed 8/2/06	Tue 8/15/06	29	
31	State Approval of Phase 3 RI Work Plan Addendum	0 days	Tue 8/15/06	Tue 8/15/06	30	
32	Place Report/Work Plan Addendum in Document Repository & Issue Public Notice / Fact Sheet	0 days	Tue 8/22/06	Tue 8/22/06	31FS+5 days	
33	**Phase 3 RI - Monitoring Wells, Other Activity To Be Detern**	**145 days**	**Wed 8/23/06**	**Tue 3/20/07**		
34	Secure Site Access / Public Notification	20 days	Wed 8/23/06	Wed 9/20/06	32	
35	Mobilize	5 days	Thu 9/21/06	Wed 9/27/06	34	
36	Conduct Phase 3 RI Activities (Scope Currently Undefined)	120 days	Thu 9/28/06	Tue 3/20/07	35	
37	**Interim Remedial Measure (IRM)**	**299 days?**	**Fri 5/5/06**	**Tue 7/10/07**		
38	Pre-Design Investigation	35 days	Fri 5/5/06	Fri 6/23/06	19SS+10 days	
39	Bench Scale Test	30 days	Fri 5/19/06	Fri 6/30/06	38SS+10 days	
40	Treatability Study	20 days	Fri 5/19/06	Fri 6/16/06	38SS+10 days	
41	**Draft IRM Work Plan**	**80 days?**	**Mon 7/3/06**	**Tue 10/24/06**	**39**	
42	Prepare Draft IRM Work Plan	20 days	Mon 7/3/06	Mon 7/31/06		
43	State Review and Comment	10 days	Tue 8/1/06	Mon 8/14/06	42	
44	Revise and Submit Revised IRM Work Plan	15 days?	Tue 8/15/06	Tue 9/5/06	43	
45	State Approval of IRM Work Plan	0 days	Tue 10/17/06	Tue 10/17/06	44FS+30 days	
46	Place Final IRM Work Plan in Document Repository & Issue Public Notice / Fact Sheet	0 days	Tue 10/24/06	Tue 10/24/06	45FS+5 days	
47	**OU3 IRM Public Availability Session**	**19 days**	**Wed 10/25/06**	**Mon 11/20/06**		
48	Mail Notice of IRM Construction Public Availability Session	2 days	Wed 10/25/06	Thu 10/26/06	45FS+5 days	
49	Public Availability Session	0 days	Thu 11/16/06	Thu 11/16/06	48FS+15 days	
50	Conduct Community Outreach Site Visits	2 days	Fri 11/17/06	Mon 11/20/06	49	
51	Construction of IRM	60 days?	Thu 12/14/06	Fri 3/9/07	50FS+15 days	
52	Hydraulic Performance Testing / Startup of IRM	10 days?	Mon 3/12/07	Fri 3/23/07	51	
53	Prepare and Submit IRM Report	60 days?	Mon 4/16/07	Tue 7/10/07	52FS+15 days	
54	**RI Report**	**450 days?**	**Sun 11/27/05**	**Thu 8/30/07**		
55	Data Evaluation, Prepare and Submit RI Report	210 days?	Sun 11/27/05	Wed 6/13/07	36FF+60 days	
56	Human Health Exposure Report	30 days?	Wed 3/21/07	Tue 5/1/07	36	
57	State Review and Comment	30 days	Thu 6/14/07	Thu 7/26/07	56,55	
58	Response to State Comments	15 days	Fri 7/27/07	Thu 8/16/07	57	
59	State Approval of RI Report	0 days	Thu 8/23/07	Thu 8/23/07	58FS+5 days	
60	Place RI Report in Document Repository & Issue Public Notice / Fact Sheet	5 days	Fri 8/24/07	Thu 8/30/07	59	
61	Record Search Report Addendum	0 days	Fri 7/13/07	Fri 7/13/07	55FS+30 days	
62	**Preliminary Screening of Alternatives Report**	**105 days?**	**Wed 3/21/07**	**Thu 8/16/07**		
63	Prepare Preliminary Screening of Alt. Report	60 days?	Wed 3/21/07	Wed 6/13/07	55FF	
64	State Review and Comment	30 days	Thu 6/14/07	Thu 7/26/07	63	
65	Response to State Comments	15 days	Fri 7/27/07	Thu 8/16/07	64	
66	State Approval of Preliminary Screening of Alt. Report	0 days	Thu 8/16/07	Thu 8/16/07	65	
67	**Feasibility Study (FS)**	**140 days?**	**Thu 6/14/07**	**Wed 1/2/08**		
68	Prepare and Submit FS	90 days?	Thu 6/14/07	Fri 10/19/07	55	
69	State Review and Comment	30 days	Mon 10/22/07	Tue 12/4/07	68,59	
70	Response to State Comments	15 days	Wed 12/5/07	Tue 12/25/07	69	
71	State Approval of FS	0 days	Wed 1/2/08	Wed 1/2/08	70FS+5 days	
72	**Proposed Remedial Action Plan (PRAP)**	**78 days?**	**Thu 1/3/08**	**Mon 4/21/08**		
73	FS Placed in Document Repository & State Prepares and Issues PRAP	30 days	Thu 1/3/08	Wed 2/13/08	71	
74	Fact Sheet issued and Public Meeting Announced	3 days?	Thu 2/21/08	Mon 2/25/08	73FS+5 days	
75	State Holds Public Meeting	0 days	Mon 3/10/08	Mon 3/10/08	74FS+10 days	
76	Public Comment Period Ends	0 days	Mon 4/21/08	Mon 4/21/08	75FS+30 days	
77	**State Prepares & Issues Record of Decision (ROD)**	45 days	Tue 4/22/08	Tue 6/24/08	76	
78	**Monthly Progress Reports**	**510 days**	**Mon 4/10/06**	**Thu 4/10/08**		



Project: Bethpage Community Park Mi
Date: Fri 3/10/06

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

FIGURE 8.

ANTICIPATED RI/FS PROJECT SCHEDULE
OPERABLE UNIT 3 - FORMER GRUMMAN SETTLING PONDS, BETHPAGE, NEW YORK (Revised March 8, 2006)

16 Phase 2 RI (On-Site Soil & Soil Gas, On- and Off-Site Groundwater)
The Phase 2 RI scope and schedule was modified to respond to NYSDEC comments of October 2005.

19 Conduct Phase 2 RI Activities (4 Crews)
Task 19 Assumes limited or no interruption in Phase 2 RI and includes the preparation of a Phase 2 Work Plan Addendum(s); NGSC review/approval; NYSDEC review/approval, and implementation. Anticipated scope of work includes the excavation of test pits as part of the Phase 2A Soil RI; other activities may also be proposed. The four crews are anticipated to consist of the following: on-site soil investigation, on-site groundwater VPB installation rig, off-site VPB installation rig, and groundwater sampling "tag along" pull truck. Soil gas crew will replace the shallow VPB crew when the goals are met. Does not include the full duration of hydraulic monitoring of the piezometers, which may continue for up to a 1 year period.

37 Interim Remedial Measure (IRM)
Task 37 assumes Permeable Reactive Barrier will be selected IRM technology. Other technologies or remedial alternatives may require 6 to 8 additional months to pilot test technology as well as prepare additional technical specifications and perform competitive bidding.

40 Treatability Study
The Treatability Study is the conduct of 2, separate hydraulic pulse tests. Assumes that tests will be conducted on 2 existing wells, that the 2 wells will require 1 week of development each.

78 Monthly Progress Reports
Monthly Progress Reports prepared beginning 30 days after approval of the RI/FS Work Plan and will be submitted no later than the 10th day of each month.

Appendix A

Field Sampling Plan

ARCADIS

Appendix A

Field Sampling Plan

Former Grumman Settling Ponds
(Operable Unit 3 – Bethpage Community Park), Bethpage, New York.
NYSDEC Site # 1-30-003A

Revised: March 8, 2006

ARCADIS

David E. Stern
Senior Hydrogeologist

Carlo San Giovanni
Project Manager

Michael F. Wolfert
Project Director

Appendix A

Field Sampling Plan
Former Grumman Setting Ponds (Operable Unit 3 - Bethpage Community Park)

Northrop Grumman Systems Corporation
Bethpage, New York.
NYSDEC Site # 1-30-003A
Revised: March 8, 2006

Prepared for:
Northrop Grumman Systems Corporation

Prepared by:
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Our Ref.:
NY001348.0706.00002

Date:
March 8, 2006

Table of Contents

Attachments

1. Introduction

This Field Sampling Plan (FSP) has been prepared by ARCADIS G&M Inc. (ARCADIS) with input from Dvirka & Bartilucci Consulting Engineers (D&B) on behalf of Northrop Grumman Systems Corporation (NGSC). The FSP serves as the primary reference that describes the methods and procedures for environmental sample collection activities conducted by direction of the New York State Department of Environmental Conservation (NYSDEC) under the NYS Superfund Program for the Former Grumman Settling Ponds (Operable Unit 3 – Bethpage Community Park) (Site). This FSP is a required component of the Remedial Investigation (RI)/Feasibility Study (FS) Work Plan for the Site and was prepared pursuant to Section II of the Administrative Order on Consent (Consent Order or CO) No. W1-0018-04-01 for the Site. The CO was signed by NYSDEC on June 24, 2005 and executed July 4, 2005 (NYSDEC 2005).

This FSP is part of the Sampling and Analysis Plan (SAP), which is the umbrella document that consists of Appendices A through D of the RI/FS Work Plan. The SAP includes the following required elements:

- This FSP (Appendix A) defines sampling and data gathering methods consistent with NYSDEC DER-10 and the "Field Methods Compendium," OSWER Directive 9285.2-11 (draft June 1993) (USEPA 1993).

- The QAPP (Appendix B) describes the quality assurance and quality control protocols necessary to achieve the data quality objectives.

- The HASP (Appendix C) protects persons at and near the site during performance of the RI/FS (in accordance with 29 CFR 1910).

- The CPP (Appendix D) was developed in accordance with New York Environmental Conservation Law, hazardous waste site regulations (6 NYCRR Part 375) and Citizens Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook (NYSDEC 1998).

In addition to the above, the components of the SAP are also consistent with the requirements of NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC 2002). Various cross-references to other portions of the SAP are included, as appropriately in the following sections.

Standard operating procedures and the Community Air Monitoring Plan (CAMP) are included as Attachments A-1 and A-2 to this FSP, respectively.

1.1 Plan Organization

This FSP contains the following sections:

- Section 2: "Site Description and Background" summarizes the history of the Site.
- Section 3: "Remedial Investigation Activities" summarizes the type of sampling to be performed in accordance with the FSP.

The subsequent sections of the FSP provide procedures for the sampling activities, as follows:

- Section 4: "Pre-Field Preparation and Equipment" describes preparation and equipment needed prior to mobilization to the field.
- Section 5: "Sampling Associated with Remedial Investigation Activities" associated with the following RI activities:
  - Performance of geophysical surveying,
  - Excavation of test pits (if needed),
  - Collection of soil samples and Shelby Tubes from VPBs and soil borings,
  - Drilling of vertical profile borings (VPBs). Depending on VPB proposed depth, either the mud rotary (MR) as Hollow-Stem Auger (HSA) method will be used,
  - Collection of groundwater samples from VPBs. Two types of VPB groundwater sample collection techniques (either through temporary wells or Hydropunch®) will be used, depending on the drilling method HSA or MR.
  - Drilling of soil borings using HSA. Drilling of soil borings and determination of selected lithologic and hydrogeologic characteristics, and screening of selected and total and speciated source-strength VOC concentrations using cone penetrometer testing (CPT) /membrane interface probe (MIP) methodologies.
  - Collection of soil gas samples from temporary or semi-permanent soil gas points (SGPs) (semi-permanent SGPs may be installed if more than a single sampling event from a given SGP is desired),
  - Collection of samples of perched water from piezometers. Several methods are presented that are dependent on the well type and use,

  - Collection of samples of groundwater from permanent monitoring wells. Several methods are presented that are dependent on the well type and use,
  - Collection of hydraulic (water-level) measurements from permanent monitoring wells, and
  - Potential collection of non-aqueous phase liquid (NAPL) samples (if encountered).
- Section 6: Investigation-derived waste (IDW) sampling,
- Section 7: Sample Collection, Labeling, Handling and Analyses,
- Section 8: Field Decontamination Procedures, and
- Section 9: Waste Management and Disposal.

2. Site Description and Background

The Former Grumman Settling Ponds Site (Operable Unit 3 – Bethpage Community Park) is located on Stewart Avenue in Bethpage, Nassau County, New York. The former operations are described in the December 2003 report prepared by D&B (Dvirka & Bartilucci, 2003). The Park property was donated by NGSC to the Town of Oyster Bay in 1962. Soon afterwards, the current structures were constructed by the Town, without NGSC involvement.

The Bethpage Community Park (the Park) is owned by the Town of Oyster Bay and is comprised of approximately 18 acres. The Park is bordered by the Cherry Avenue Extension and a Robert Plan Company building to the north, Stewart Avenue to the east, the Former Plant 24 access road (owned by NGSC) to the south, and another Robert Plan Company building (former NGSC Plant 24) and the McKay Field property (owned by NGSC) to the west. The Naval Weapons Industrial Reserve Plant (NWIRP) and north campus of the NGSC Bethpage property are located west of the Site. The former OCC/RUCO Polymer Site (federal superfund site) is located further to the west. The Park and the NGSC Plant 24 Access Road collectively are referred to in the FSP as the Site.

3. Remedial Investigation Activities

The primary goals of the RI activities proposed are listed in Section 5.2 (Phase 2 RI Goals) of the RI/FS Work Plan. Sample collection efforts include obtaining various types of discrete soil samples from soil borings and VPBs, soil gas samples from SGPs, perched water from piezometers, groundwater samples from VPBs (temporary wells or

Hydropunch) and permanent wells, and IDW liquid and solid media samples for waste characterization purposes.

4. Pre-Field Preparation and Equipment

The following sections describe the preparation that will be performed and equipment that is needed prior to mobilization to the field to conduct the activities specified in the FSP. The field project team (technicians, scientists, and engineers) will be responsible for obtaining, operating, and maintaining the required equipment, collecting the samples as specified herein, and for procuring and maintaining sample containers pertinent to the collection of environmental samples. The following text describes these procedures in detail.

In general, the pre-cleaned environmental sample containers (bottles) will be provided by the analytical laboratory in accordance with procedures and requirements set forth in the QAPP (Appendix B). The sample containers will be inventoried and inspected prior to work to verify that the required containers are present and in good condition. Specific sample container inspection procedures are as follows:

- Soil gas/ambient air sample containers (i.e., SUMMA canisters), provided that are under vacuum, will be tested using a vacuum gauge to verify the correct vacuum (Section 5.8).

- Water and soil sample bottles will be inventoried and inspected to ensure that the required bottles are present, visually clean, unbroken, and have been properly preserved (see QAPP) by the laboratory.

Field equipment will be inventoried and inspected by the field team members performing the work.

The equipment listed below will be available and used during the course of all field activities conducted:

- Personal Protective Equipment (PPE) and air monitoring equipment, as defined in the HASP and CAMP.
- Health and safety forms as specified in the HASP.
- Field daily logs or bound logbook, as specified in the QAPP.
- Weighted tape measure, accurate to one hundredth of one foot.
- "Micro-90" (or equivalent) low-phosphate detergent and new scrub brushes.
- Sufficient quantities of distilled/de-ionized water.

- 4-millimeter thick plastic sheeting.
- Digital Camera.

The following additional equipment/forms shall be used during collection of soil samples for lithologic characterization and/or laboratory analysis:

- Soil Sample/Core Logs, Test Pit Log Form (if test pits performed), calibration logs, chains of custody (as specified in the QAPP), and Unified Soil Classification System ([USCS] – see Attachment A-3 of this FSP).
- Portable table for logging soil samples.
- Two, plastic 5-gallon buckets for spilt-spoon decontamination (decontamination procedures are provided in Section 8).
- Hand auger, stainless steel spoon, trowel and bowls for soil sample collection)
- Plastic coolers for sample preservation, storage, and shipment.
- Soil sample containers (dependent on analysis performed, refer to the QAPP.
- Shelby Tubes (sealant and tubes provided by Driller).

The following additional equipment/forms shall be available and used during collection of groundwater samples from permanent monitoring wells:

- Water Sampling logs, calibration logs, chains of custody, as specified in the QAPP.
- Sampling pumps, as specified by well type:
    - 2-inch diameter bladder pump, portable air compressor and controller (e.g., QED Well Wizard), portable nitrogen compressed gas tank, regulator and pneumatic tubing, or
    - Variable speed 2-inch diameter submersible pump, motor lead, support cable, submersible pump control box, and portable 110 volt or 230 volt generator.
- Centrifugal pump for aqueous IDW disposal (see Section 9).
- Electronic water-level indicator, accurate to one hundredth of one foot.
- Portable field parameter metering including pH, Conductivity, Temperature, Turbidity, spectrophotometer (latter to be used only for "Biogeochemical" sampling to be performed in selected on-site groundwater sampling – see Table 1 of the RI/FS Work Plan), and the associated calibration standards.
- Purge water flow-through cell (selected wells – see FSP Section 5.7.3)
- Purge water containers (New York State Department of Transportation-compliant 55-gallon capacity "bung-top" drums).

- Plastic coolers for sample storage and shipment.
- Disposable in-line field filters (0.45 micron).
- New 5/8-inch inner-diameter polyethylene tubing.
- Non-aqueous phase liquid (NAPL) interface probe (piezometers only).
- New, disposable, 2-inch diameter polyethylene bailers and polypropylene rope.
- Water sample containers (dependent on analysis performed, refer to the QAPP – Appendix B).

The following additional equipment shall be used during collection of groundwater samples from VPB (temporary wells or Hydropunch):

- Water Sampling logs, calibration logs, chains of custody, as specified in the QAPP (Appendix B).
- Electronic water-level indicator, accurate to one hundredth of one foot.
- Portable field parameter metering including pH, Conductivity, Temperature, Turbidity, spectrophotometer (latter for on-site "Biogeochemical" groundwater samples – see Table 1 of the RI/FS Work Plan), and the associated calibration standards.
- Plastic coolers for sample storage and shipment.
- Water sample containers (dependent on analysis performed, refer to the QAPP).
- Portable container for pump and disposable tubing staging between sampling intervals.
- Other required equipment not specified herein will be provided by the drilling subcontractor.

The following general equipment required to install a soil gas point (SGP) for collection of samples:

- Direct-push drilling rig (e.g., Geoprobe®) equipped with interconnecting lengths of 1.25-inch diameter steel probe rods and Post Run Tubing (PRT) system (tubing provided by ARCADIS) and expendable points (provided by Geoprobe contractor, one per sample).
- Chains-of-custody and Soil Gas Sample Collection Logs (see QAPP).

If the semi-permanent SGP method is selected, then the following additional equipment is required:

- Stainless-steel screen implant (Available from Geoprobe [www.geoprobe.com])

- Clean HDPE or Teflon®-lined tubing (0.5 inch O.D. x 0.375 inch I.D.) (by ARCADIS)
- Brass or stainless steel valve equipped with compression fittings (by ARCADIS)
- Morie #1 (or Filpro) filter pack sand (approximately 150 milliliters [mL] per SGP)
- Flush mount well cover (One needed per SGP)(Available from Geoprobe).
- Bentonite seal material
- Distilled water
- Sacrete concrete mix
- Clean funnel
- Parafilm laboratory-grade sealing film

If the temporary SGP method is selected, then the following additional equipment is required:

- PRT compatible expendable point holder and appropriate point popper
- PRT tubing, fittings, and all required supplies
- Commercially available clean sand or play sand

The equipment required for soil gas sample collection is presented below:

- Stainless steel 6-L SUMMA® canisters:
    - Canisters should be batch certified-clean by the laboratory.
    - Order one spare canister if possible per sampling event.
- Flow controllers that are pre-calibrated to specified sample duration (e.g., 30 minutes, 8 hours, 24 hours) or flow rate (e.g., 200 milliliters per minute [mL/min]); confirm with the laboratory that the flow controller is equipped with an in-line particulate filter and pressure gauge (order at least one extra, if possible),
- ¼-inch I.D. tubing (HDPE or Teflon® lined) (Available from McMaster-Carr [#5466K14]). Store tubing away from potential sources of contamination (fuels, solvents, etc.),
- Stainless Steel Swagelok fittings and ferrules (supplied by laboratory providing SUMMA® canisters),
- Stainless steel "T" fitting (if collecting duplicate [i.e., split] samples, also certified clean and supplied by laboratory supplying canisters),

- Portable vacuum pump capable of producing very low flow rates (e.g., 100 to 200 mL/min). Pump should be equivalent to SKC 222 series, with additional flow restrictor and effluent port if necessary,
- If vacuum pump does not have a flow gauge; calibrate with Rotameter or an electric flow sensor. Test final vacuum pump flow rate by discharging into a Tedlar bag,
- Two, small adjustable wrenches,
- Nitrile gloves, and
- Handheld barometer

The equipment required for helium tracer gas testing is presented below and may be provided by the Geoprobe subcontractor:

- Portable helium detector (Also available from U.S. Environmental Rental, MARK Model 9822) capable of monitoring percentage levels of helium,
- Helium tank with laboratory grade helium gas,
- Regulator for helium tank,
- Plastic 5-gallon bucket prepared for procedure:
    - Holes should include incoming helium line and outgoing sample line
    - Clay or other material should be used to seal around holes
- 1 mil plastic sheeting,
- ¼-inch I.D. tubing (HDPE or Teflon® lined),
- Bentonite seal material,
- Clay seal material, and
- Tedlar bags

5. Sampling Associated with Remedial Investigation Activities

The following sections describe methods for sampling associated with investigation activities. The QAPP provides additional details regarding Field Records and QA/QC samples, frequency and protocols (Section 4.1 – Field QA/QC), sample labeling (Section 4.2 – Preparation and Preservation of Sample Containers), and sample custody (Section 4.4 – Sample Custody).

5.1 Sample Locations and Schedule

The locations of soil borings proposed as part of the Phase 2A and 2B RI soil investigation are shown on Figures 4 and 5 of the RI/FS Work Plan, respectively. The locations of proposed SGPs, borings and VPBs) as well as the locations of existing monitoring wells proposed for sampling are shown on Figures 5 and 6 of the RI/FS Work Plan. The schedule for collection of the various samples is shown on Figure 8 of the RI/FS Work Plan. Depending on field conditions and other factors, the duration of the RI may change.

The number, location, and depth of permanent wells that may be proposed and installed as part of Phase 3 of the RI will be determined based on the results of the previous RI phases. Groundwater samples are expected to be collected from new monitoring wells and a subset of existing wells, as appropriate. The frequency of sampling of monitoring wells, that are to be installed in the future as part of the RI, has not been developed but will conform to a frequency that is approvable by the NYSDEC.

5.2 Geophysical Survey

A geophysical survey will be conducted by Dvirka & Bartilucci (D&B) as part of the Phase 2A soil RI utilizing a combination of ground penetrating radar, magnetometry and/or resistivity to identify subsurface anomalies. The area to be surveyed will consist of the entire ball field area (RI/FS Work Plan Figure 4). It is believed that the survey is capable of observations to a depth of approximately 50 ft bls. Attachment A-1 to this FSP provides the detailed methodology for the geophysical survey.

5.3 Test Pits

If required under the criteria specified in Section 6 of the RI/FS Work Plan, test pit excavation will be performed. The following procedure is a typical example of standard methods that could be employed to excavate a test pit using a backhoe or excavator in removal/replacement of soil. Should field conditions warrant, the following method will be expanded or modified (and provided in a Work Plan Addendum to NYSDEC):

- Verify that the test pit location is noted on location sketch.
- Verify that sampling equipment, including the backhoe/excavator bucket, is properly decontaminated.

- Remove a laboratory-supplied, pre-cleaned sample container from the sample cooler, label container with an indelible marker and fill out a Chain-of-Custody form (see QAPP).
- Remove soil from test pit location to desired depth and stage on polyethylene sheeting in order of removal (by Excavation Contractor).
- Lower the bucket into the test pit and remove soil/waste material (by Excavation Contractor).
- Immediately upon retrieval of the soil/waste material, obtain an organic vapor measurement (via PID).
- Depending upon the PID measurement, odors and visual characteristics, obtain a soil sample from the backhoe bucket with a scoop and/or wooden tongue depressor, place into the open sample container and replace the container cover.
- Fill out Test Pit Log Form (forms provided in QAPP), including a description of soil/waste with location, depth and material sampled.
- Return the sample container to the cooler.
- Backfill test pit in reverse order from removal (by excavation contractor).
- If reusable, decontaminate the sampling equipment (see procedures in Section 8).
- Place all disposable personal protective equipment and disposable sampling equipment into a 55-gallon drum or other approved container for disposal.

5.4 Soil Borings

Soil sample collection rationale for the Phases 2A and 2B soil RI are described in Sections 6.2.1 of the RI/FS Work Plan.

5.4.1 Phase 2A RI

The following methods will be used by D&B during the collection of Phase 2A RI soil samples:

Each sample location must be cleared of utilities prior to the initiation of the field activities. The following protocol will be adhered to for the collection of soil samples.

- Verify that the sample location is noted on sample location sketch.
- If a dedicated sampling device is not used, verify that the sampling equipment (e.g., split spoon) has been properly decontaminated (see Section 8).

- Remove the laboratory-supplied, pre-cleaned sample container from the sample cooler label container with an indelible marker and fill out a Chain-of-Custody form (see QAPP Attachment B-2).
- Auger into the soil to the desired depth and drive split-spoon sampler (by Driller).
- Retrieve the sampler and, immediately after opening the sampler, obtain an organic gas measurement (via PID) and describe sample in log book.
- Remove a sample aliquot from the sampler using a disposable scoop or sterile wooden tongue depressor, place aliquot into the open sample container and replace the container cover.
- The sample jar to contain the portion of the sample for volatile organic compound (VOC) analysis should be filled first, if applicable. This container must be completely filled such that there is no headspace remaining in the container.
- Once the VOC container has been filled, the remaining soil from the split spoon should be thoroughly mixed in a stainless steel bowl or on a tray covered with aluminum foil (Note: the aluminum foil must be dedicated to a specific sample and discarded following its one-time use). Once mixed, the soil should be placed in the remaining sample containers.
- Return the sample container to the cooler. Lithologically log and record observations along with the field PID readings in the bound field log book.
- If reusable, decontaminate the sampling equipment.
- Place all disposable personal protective equipment and disposable sampling equipment into a 55-gallon drum or other approved container for disposal (see Section 6 of the FSP).

5.4.2 Phase 2B RI

Soil sampling as part of Phase 2B soil RI will be performed by ARCADIS and may include the use of cone penetrometer testing (CPT) and membrane interface probe (MIP) methodologies. As currently proposed, soil sample will be collected using split spoons (Phases 2A and 2B) and Shelby tubes (Phase 2B), as further described below.

5.4.2.1 Soil Borings

For drilling of soil borings via HSA, the following activities will be performed:

1. Determine location of and avoid overhead/underground utilities, per the HASP.
2. The approximate location will be prepared and shown on a location sketch.
3. The drill rig will be mobilized to the proposed location.

4. If asphalt or concrete pavement is present, the driller will drill or core through the pavement, exposing the underlying surface soil.
5. The proposed location will be hand dug to 5 ft bls.
6. Drilling will commence, with sampling performed as specified in the RI/FS Work Plan.
7. The field geologist (in coordination with Driller) will monitor the formation drilled through evaluation of penetration rate, cuttings, and possibly collection of split spoons to verify the formation material at depth. A weighted measuring tape must be used (by Driller) to routinely check the depth of the open hole.
8. Samples will be collected for the specified analyses (see RI/FS Work Plan and QAPP for details).
9. Once soil borings are completed, the land surface elevation and locations of each of the completed soil borings will be surveyed by a NYS-licensed surveyor.
10. Boreholes will be abandoned per Section 5.5.4.

5.4.2.2 Spilt-Spoon Sampling

Discrete split-spoon soil samples will be collected using a two (2) foot long by two (2) inch outer diameter (O.D.) carbon steel split-spoon soil sampler. The general sequence of split-spoon sampler assembly, sample collection (by Driller), lithologic logging, and recordkeeping is as follows:

- Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top.
- Lower the sampler to the desired sampling depth (by Driller).
- Drive the spilt spoon through the bottom of the borehole with a 140 pound hammer dropped 30 inches vertically repeatedly (by Driller). Do not drive past the bottom of the head piece or compression of the sample will result.
- Record the length of the sampler used to penetrate the material being sampled and the number of blows, per six inches of spilt-spoon penetration, required to obtain the depth on the sample/core log sheets (by Field Geologist).
- Withdraw the sampler from the borehole and open by unscrewing the bit and head and splitting the barrel (by Driller). Record the amount of recovery and soil type on the sample/core log (by field Geologist). The soil type will be described using the classification system (or equivalent) described in Attachment A-3 of this FSP. Specific information recorded should include:

- The structure of the soils sampled, including layering/stratification features, and the dominant soil types.
- The color of soils.
- The moisture content of soils.
- Soil grain features, including grain sizes, degree of sorting, angularity, and mineralogy.
- Identification of any rock fragments, organic material, or other components

- Following collection, the split-spoon sample will be screened for VOCs using an appropriate monitoring device. Refer to the HASP for specific requirements and action levels.
- If required, samples of soil will be collected for the appropriate laboratory analysis (see QAPP).
- Residual soil will be containerized in a 55-gallon drum and the split-spoon will be decontaminated in accordance with Section 8 of the FSP.

5.4.2.3 Shelby Tube Sampling

Shelby tube sampling performed sampling procedures are similar to the split-spoon sampling procedures described above, except that a Shelby tube (provided by Driller) is used to collect the undisturbed soil sample and the sample is contained within a stainless steel or polyethylene tube.

- Upon removal of the sample from the sampler, the unfilled portion of the sleeve is cut away (polyethylene tubes only)
- Both ends of the tube are capped and sealed with paraffin wax or equivalent non-reactive substance to prevent settlement or drying of the sample.
- The Shelby tube is then appropriately labeled, handled, and analyzed as described in Section 7.1 of this FSP.

5.5 Vertical Profile Borings

This section describes the methods to collect groundwater samples from VPBs. Field conditions will dictate modifications to sampling intervals, the number and type of samples collected, and the sequence of activities performed.

Depending on the type of drilling methodology employed, the sequence of activities will vary but will generally include the following: the VPB borehole will be drilled using either hollow stem auger (HSA) or mud rotary (MR) methodology;

- for the MR method, Hydropunch® groundwater samples will be collected (in advance of the drill bit) at selected discrete intervals during borehole drilling, at the borehole terminus, the drill rods will be removed and the borehole will be geophysically logged (natural gamma method).
- for the HSA methodology, in lieu of Hydropunch® groundwater samples will be collected from a temporary well installed to full depth (total depth drilled will depend on formation material; coarser grained material will be favored over less permeable zones).

The VPB groundwater samples are intended to serve as screening-level samples that will be collected from a temporary well or Hydropunch® (grab sample) that is installed at a selected interval; therefore, temporal repeat sampling of VPB sample intervals cannot be carried out.

Groundwater samples will be analyzed for the analytes specified in the QAPP (Appendix B) and Table 1 of the RI/FS Work Plan. Additional details on VPB soil and groundwater sample collection (either via temporary well or Hydropunch®, is provided in the following subsections of this FSP.

5.5.1 Vertical Profile Boring Drilling and Temporary Well Installation

VPBs will be drilled using the HSA or MR drilling methods. If the MR drilling method is used, then VPB groundwater samples will be collected using the Hydropunch® sampling method (see Section 5.5.3 of this FSP). The following text summarizes the methods employed for HSA drilling and temporary well installation:

- Perform Steps 1 through 7 under Section 5.4.2.1.
- The temporary well will be installed preferably in high permeability deposits (i.e., sand and gravel). Once the final depth is reached, record total fluid loss during drilling, if any.
- Driller will install the temporary well, consisting of two-inch inner diameter low-carbon steel well pipe connected to a five-foot length of 0.010-slot stainless steel well screen to the specified depth in a continuous process. Once the temporary well is installed, Driller will carefully retract the augers, allowing the formation to collapse around the well. Once complete the field geologist measure and record the depth to water and measuring point stickup above land surface.

- Once the temporary well is installed, Driller will geophysically log (natural gamma ray) the borehole.
- Driller will install the temporary well cap and mobilize the rig to the next drilling location. (Depending on work progress and crew availability, the drilling rig may remain at the drilled/installed well to carry out groundwater sampling before mobilizing to the next location). Driller will perform decontamination and IDW transportation and disposal as specified in Sections 8 and 9, respectively.
- The land surface elevation and locations of each of the completed VPBs will be surveyed by a NYS-licensed surveyor.

5.5.2 Temporary Well Groundwater Sampling

The general procedure for sampling groundwater from the VPB temporary well is as follows:

- The field geologist will measure and record the static depth to water in temporary well.
- The Driller will connect the 2-inch diameter submersible pump to disposable ½-inch diameter polyethylene tubing, motor lead, and control cable (collectively referred to as the pump assembly).
- The Driller will lower pump assembly into the temporary well to a depth near the top of the temporary well screen.
- Purge a volume of water equivalent to the volume of fluid that was lost to the formation during drilling divided by the number of samples to be collected (i.e., if 100 gallons were lost more or less equally during drilling and five samples are to be collected, then 20 gallons would be purged from each sample depth), plus a volume of water equivalent to three standing well volumes of water. A single standing volume of water is calculated using the following formula:

$$V_{well} = [\text{total Depth - Depth to water}] \times 0.16^{1}$$

  The well will be evacuated at the highest sustainable constant rate. The depth to water will be periodically monitored during purging.
- Groundwater quality field parameters (pH, conductivity, and temperature) will be measured initially and after each standing well volume is evacuated by the field geologist. Groundwater sampling will commence after three consecutive readings

[1] Note: 0.16 conversion is for 2-in diameter wells only.

of field parameters are within +/- 10 percent (while not continuously increasing or decreasing). The field geologist will record all information and parameters on the appropriate Water Sampling Log (See QAPP).

- The pumping rate will be reduced to the minimum sustainable constant rate. (typically, close to 100 milliliters per minute) Groundwater samples will then be collected (see Section 7 of the FSP for sample collection procedures and the QAPP.
- Once groundwater sampling is complete, the pump assembly will be gradually removed from the temporary well, decontaminated, as specified in Section 8 of this FSP and stored in the portable container by the Driller. The temporary well will be retracted upward a specified vertical distance by the Driller and the sampling procedure described above repeated.
- Sample collection, labeling and handling procedures are described in Section 7 of this FSP.
- Decontamination will be conducted per Section 8 of this FSP.
- IDW containerization, transportation and disposal will be conducted per Section 6 of this FSP.
- Once the well has been fully retracted, the VPB borehole will be abandoned in accordance with Section 5.5.4.

5.5.3 Mud Rotary Drilling and Hydropunch® Groundwater Sampling

If MR drilling methodology is used, then MR Drilling VPB groundwater samples will be collected using a Hydropunch® by the following procedure:

- The mud rig and appurtenant equipment (mud tub, piping, pumps, and mixers) will be used. Perform Steps 1 through 7 of Section 5.4.2.1.
- The Hydropunch® sampler consists of a hollow cylindrical 4-foot length of carbon steel equipped with check valves, intake screen and seals, and a rubber sample decanter. The MR bit and rods will be removed from the borehole and the Hydropunch® will be placed in the borehole using the rig wire-line (by Driller).
- Place the lower check valve with attached screen into the bottom of the tool body and place the upper check valve in the top of the tool. Insert the disposable drive cone into the drive shoe ensuring a seal is made by the O-Ring. Place sleeve over the juncture of the drive cone and drive shoe.

- Driller will drive the sampler (with 140-lb hammer, 30-inch drop) to the specified depth and pull back approximately two (2) feet. Soil friction will hold the drive cone in place (by Driller).
- Groundwater will flow into the intake screen past the lower check valve, into the sample chamber and finally out the top check valve.
- Driller will pull the full tool to the surface (this increases the hydrostatic head within the tool and closes the two check valves).
- Driller will Invert the Hydropunch® and decant the sample through the discharge valve and tubing into the sample containers. As sample volume permits, decant remainder of sample into a 500-milliliter plastic container and record pH, specific conductance, and temperature.
- Driller will decontaminate the Hydropunch®, as specified in Section 8 of this FSP.
- The sampling procedure will be repeated until final depth is reached (per the RI/FS Work Plan).
- Sample collection, handling, and analysis procedures are described in Section 7 of this FSP.
- IDW containerization, transportation and disposal will be conducted per Section 6 of this FSP.
- The VPB borehole will be abandoned in accordance with Section 5.5.4.

5.5.4 Borehole Abandonment

Soil boring and VPB boreholes will be abandoned following NYSDEC policy once sampling is completed and the temporary well (if used) has been removed. Particular emphasis will be placed on sealing clay lenses (see Section 2 and 3 of RI/FS Work Plan), which will be done by pumping cement-bentonite grout via tremie pipe into the hollow stem augers, and removing the augers, slowly as grouting is conducted.

5.6 Piezometer Drilling and Installation

Piezometers will be drilled using HSA methodology (see Section 5.4.2.1). Materials used to construct the piezometers are as follows: Casing and screen will be constructed using 2-inch diameter, Schedule 40 PVC. Piezometer screens will be 10 ft long, 0.010-inch continuous slot, and be equipped with a 2-inch diameter, Schedule 40 PVC, 5 ft blank "sump" section at the bottom. The screen will be installed so that the sump is set 5 ft into the top of the clay, and the well will be completed as described in Table 1 of the RI/FS Work Plan. A typical construction diagram is shown in the QAPP.

5.7 Groundwater Sample Collection and Hydraulic Monitoring in Monitoring Wells and Piezometers

The following subsection of this FSP describes the procedures to be used for sampling and measuring water levels in monitoring wells and piezometers.

5.7.1 Sample Locations

As described in the RI/FS Work Plan (and summarized in Table 1 of the RI/FS Work Plan), several existing monitoring wells and piezometers (if perched water is encountered) will be sampled as part of the Phase 2 groundwater RI.

5.7.2 Hydraulic Monitoring

Hydraulic (i.e., water-level) measurements will be made using the following procedures:

1. For all monitoring locations water-level measurements will be made by measuring the depth to groundwater at each location from the surveyed measuring point.
2. The water-level measurements will be made to the nearest one-hundredth of a foot with an electronic water-level indicator probe.
3. The probe will be decontaminated between well locations using methods described in Section 8.
4. Water-level measurements and other pertinent information (e.g., well designation) will be recorded as outlined in the QAPP.
5. On-site piezometers and on-site wells will also be checked for non-aqueous phase liquids (NAPL) using an interface probe.

5.7.3 Monitoring Well/Piezometer Groundwater Sample Collection

General pre-sampling activities for wells/piezometers will be performed including accessing the well, preparing the well site for purging and sampling, and collecting initial measurements. To access the well, the protective casing will be unlocked and surficial soil will be cleaned from around the wellhead. Plastic sheeting will be placed around the well and secured at the corners. The depth to water in the well will be measured to the hundredth of a foot with an electronic water-level indicator and the total depth of the well will be sounded. Information pertinent to the purging and sampling activities will be recorded as outlined in the QAPP.

Consistent with NYSDEC-approved procedures monitoring wells will be purged using a bladder pump (some wells are equipped with dedicated bladder pumps and some wells are also equipped with dedicated inflatable packers) or a variable speed submersible pump. Groundwater samples will be analyzed for the analytes specified in the QAPP and Table 1 of the RI/FS Work Plan. Purging and sampling of groundwater will follow one of the following methods:

Monitoring wells equipped with dedicated bladder pumps and inflatable packers will be sampled as follows:

- The well volume below the packer will be calculated.
- The packer will be inflated using nitrogen gas to a pre-determined pressure based on the submergence of the packer using the following formula:

DEPTH TO PACKER:	**FEET BLS**
MINUS DEPTH TO STATIC WATER LEVEL:	**FEET BLS**
EQUALS SUBMERGENCE OVER PACKER:	**FEET**
MULTIPLY RESULT BY 0.43:	**0.43 x PSIG/FOOT**
(RESULT IN PSIG):	**PSIG**
ADD 25 PSIG:	**+ 25 PSIG**
EQUALS REGULATED PACKER INFLATION PRESSURE:	**PSIG**

- A minimum of three well volumes below the packer will be evacuated using an actuator (air compressor and controller). Field parameters (pH, specific conductance, and temperature) will be measured initially and after each volume below the packer is evacuated (turbidity will also be monitored in wells sampled for metals). Field parameters will be monitored with calibrated meters. Field meters will be calibrated daily according to manufacturer's instructions (see QAPP).
- After field parameters have stabilized to within +/- 10 percent, the purge rate will be reduced to approximately 100 ml/min and the groundwater sample will be collected directly from the pump discharge (see Section 7)
- Once sampling is complete, the well will be closed and locked, reusable equipment will be decontaminated (see Section 8), and disposable equipment will be disposed

of at the NGSC site. Purge and decontamination water will be containerized, transported, and disposed of on the NGSC site (see Sections 8 and 9).

Select deeper monitoring wells are not equipped with dedicated pumps/packers and will be purged and sampled using a non-dedicated bladder pump following United States Environmental Protection Agency (USEPA) Micropurge/low-flow protocols (USEPA 1998) as follows:

- The dedicated ½-inch diameter polyethylene tubing and remote stainless steel screen will be used.
- The non-dedicated bladder pump will be attached to the dedicated tubing/screen and the total assembly will be gradually lowered as to place the remote screen within the center of the well screen interval.
- Field parameters will be monitored in a flow-through cell using calibrated meters and will include pH, specific conductance, dissolved oxygen (DO), oxidation/reduction potential (ORP), and temperature (turbidity will also be monitored in wells sampled for metals). Field meters will be calibrated daily according to manufacturer's instructions (see QAPP). Completion of purging and therefore, the actual volume of water purged from each well will be based on the stabilization protocols described in the Micropurge method (USEPA 1998). In summary, the stabilization protocols are as follows: 1) measurements should be taken every three to five minutes; 2) stabilization is achieved after all parameters have stabilized for three successive readings; and 3) three successive readings should be within +/- 0.1 for pH, +/- 3 percent for specific conductance, +/- 10 percent for DO, +/- 10 mv for ORP, and +/- 10 percent for temperature.
- Following stabilization of field parameters, the purge rate will be reduced to approximately 100 ml/min and the groundwater sample will be collected directly from the pump discharge (see Section 7).
- Once sampling is complete, the non-dedicated pump will be gradually removed from the well and dedicated sampling equipment (e.g., tubing, bladder pump assembly and/or tubing/screen assembly) will be disconnected from the pump and the tubing/screen assembly will be secured inside the well casing. The well will be closed and locked, reusable equipment will be decontaminated (see Section 8), and disposable equipment will be disposed of at the NGSC site. Purge and decontamination water will be containerized, transported, and disposed of on the NGSC site as specified in Section 8 of the FSP.

Selected monitoring wells will be purged using a non-dedicated, variable speed, 2-inch diameter stainless steel submersible pump as follows:

- Disposable ½-inch diameter polyethylene tubing will be connected to the pump and the pump tubing assembly will be gradually lowered so as to place the pump intake within the approximate center of the well screen zone. The volume of standing water in the well will be calculated.
- A minimum of three well volumes will then be purged. Field parameters (pH, specific conductance, and temperature) will be measured initially and after each well volume is evacuated (turbidity will also be monitored in wells sampled for metals). Field parameters will be monitored with calibrated meters. Field meters will be calibrated daily according to manufacturer's instructions (see QAPP). After each field parameter has stabilized to within +/- 10 percent, the purge rate will be reduced to approximately 100 ml/min and the groundwater sample will be collected directly from the pump discharge (see Section 7).
- Once sampling is complete, the non-dedicated pump will be gradually removed from the well, the well will be closed and locked, reusable equipment will be decontaminated (see Section 8), and disposable equipment will be disposed of at the NGSC site. Purge and decontamination water will be containerized, transported, and disposed of on the NGSC site, as specified in Section 9 of the FSP.

Perched water/NAPL from piezometers will be collected and sampled using disposable polyethylene bailers and polypropylene rope by the following procedures:

1. Measure the static depth to water and determine if NAPL is present (and thickness, if present) using the interface probe.
2. If NAPL is not present, proceed with collecting a single bailer volume of water and repeat Step 1. If sufficient water re-accumulates to allow additional bailing, dispose of water, re-fill bailer, record field parameters pH, specific conductance, temperature and turbidity, and collect water sample. If water does not re-accumulate, then record field parameters and collect water sample. Water samples will be analyzed for parameters (see QAPP).
3. If NAPL is encountered it will be removed to the extent possible and containerized. Water samples will not be collected. The recovered NAPL may be analyzed for selected parameters (to be determined).

5.8 Soil Gas Sampling

Due to the highly sensitive nature of soil vapor sampling, strict precautions have been incorporated into the sampling procedure and are specified in this section. Many of these activities are universally applicable in environmental sample collection as part of safe work practices (see HASP) and quality assurance best work practices (see QAPP), such precautions are re-stated herein. Precautions are as follows:

- Sampling personnel should not handle hazardous substances (e.g., gasoline), permanent marking pens, or smoke before and/or during the sampling event.
- Sampling crew should also wear nitrile gloves when handling tubing, connectors or SUMMA® canisters to avoid potential cross-contamination.
- Care should also be taken to ensure that the flow controller is pre-calibrated by the supplying laboratory to the proper sample collection time (confirm with laboratory). Sample integrity is maintained if the sampling event is shorter than the target duration, sample integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure. Sampling personnel should record vacuum pre and post sampling, post sampling vacuum should not reach zero vacuum (2 inches of Hg is target).
- Care must be taken to maintain integrity of sampling tubing. Tubing exposed to contaminants can yield false-positive VOC concentrations (due to the low detection limits required). Consequently, do not store tubing near sources of possible contamination including fuels, solvents, exhaust, smoke, etc. Use new lengths of tubing for each sample and replace between samples.
- During helium gas tracer testing, use caution not to pressurize system, this may drive helium vapor down into SGP.
- Equipment used for sampling and tracer gas testing should also be kept clean and stored in a manner to maintain fitness for use.
- If samples from multiple depths are to be collected at a given location, separate boreholes should be advanced for each sample to be collected. Continuous coring (see RI/FS Work Plan Table 1) will be performed, as needed, to prevent smearing of the borehole wall. The shallowest sample will collected first to determine the sampling sequence. Sample boreholes should be separated by a minimum of 5 feet (field conditions may warrant slight modifications in borehole locations).

5.8.1 Soil Gas Sampling

If a semi-permanent SGP is selected (i.e., more than one round of sampling is needed), then the following methodology should be followed:

1. Advance an assembly consisting of interconnected lengths of decontaminated 1.25-inch-diameter steel drive rods, affixed with an expendable PRT system point holder and expendable PRT system point at the downhole end, to the desired sampling interval.
2. When the desired sample depth is reached, attach the stainless steel sampling implant to the appropriate tubing. Pre-cut tubing and leave approximately 4 feet of extra tubing. Plug the open end of the tubing to avoid contamination.

3. Remove pull cap from probe rod and lower sample tubing down inside of probe rod until the implant hits the drive point.
4. Rotate tubing counterclockwise while exerting a gentle downward force to engage PRT threads. When threads are fully seated, pull up gently on tubing to test proper thread engagement. Retract probe rods (12 inches) while pushing down on the Teflon® tubing.
5. When retracted 12 inches, use funnel to pour Morie #1 filter pack sand down inside of probe rod to surround outside of Teflon® tubing. Use tubing to stir and settle sand into SGP. Approximately 150 mL of sand should fill space around implant.
6. Retract probe rods an additional 18 to 24 inches and pour in bentonite seal material. Chasing the bentonite with distilled water may be necessary.
7. Continue retracting probe rods and begin to fill in gas point with Sacrete or other concrete mix. Retract probe rod 18 to 24 inches at a time and add concrete mix after each retraction as previous step.
8. Finish sample gas point installation by securing PVC valve on exposed Teflon® tubing; installing flush cap and marking location.
9. Neatly coil extra Teflon® tubing inside of well cap and cover gas point.
10. Proceed with soil gas collection.

If a temporary SGP with PRT system is to be installed the following procedure should be followed:

1. Advance an assembly consisting of interconnected lengths of decontaminated 1.25-inch-diameter steel drive rods, affixed with an expendable PRT system point holder and expendable PRT system point at the downhole end, to the bottom of the desired sampling interval.
2. When the desired sample depth is reached, retract the sampling assembly approximately 6 inches (or greater if necessary), allowing the expendable point to fall off, and creating a void in the subsurface for soil gas sample collection. Remove pull cap of probe rod and position direct-push rig to allow collection of sample.
3. Fit PRT tubing with PRT adaptor, secure connection with Parafilm (film does not contact sample) and fit PRT adaptor with O-ring.
4. Insert PRT tubing into steel drive rod. Work tubing to bottom of drive rod until contact with expendable point holder is made. Cut PRT tubing, leaving two feet of extra tubing outside of probe rod.

5. Grasp PRT tubing and apply downward pressure while rotating counterclockwise to engage threads with point holder. When threads are fully seated, pull up gently on tubing to test proper thread engagement.
6. Proceed with soil gas sample collection (With PRT system no bentonite sealing material is required; the system is airtight).

The following methodology should be followed for preparation of SUMMA®-Type canister and initiation of the collection of the sample:

1. Record the following information from the site; if necessary (contact the local airport or other suitable information source to obtain the information):
   a. Wind speed and direction;
   b. Ambient temperature;
   c. Barometric pressure; and
   d. Relative humidity.
2. Connect a short piece of tubing to the sampling port using a Swagelok fitting.
3. Check the seal established around the soil gas probe by using a tracer gas (e.g., helium). Once the seal in integrity has been verified, additional trace gas testing may not be conducted.

The tracer gas procedures are as follows:

   a. Punch a small hole in sheeting to accept sample port. Hole should be tight around port.
   b. Place plastic sheeting on ground surrounding sample port.
   c. Place clean bucket (open side to ground) over sample port.
   d. Check seal with plastic sheeting, should be tight.
   e. Seal bucket to plastic sheeting with clay sealing material.
   f. Insert incoming helium line into pre-drilled hole in bucket.
   g. Pull sample collection tube through pre-drilled hole in bucket.
   h. Fill bucket with helium gas (use caution not to pressurize system, this may drive helium gas down into gas point)

4. Connect a portable vacuum pump to the sample tubing. Purge 1 to 2 (target 1.5) volumes of air from the gas point and sampling line using a portable pump [purge volume = 1.5 $\pi r^2 h$] at a rate of approximately 100 mL/min.

a. After purging 1.5 volumes of air from the gas point, collect some of purge air in Tedlar bag for helium analysis.

b. Check purged air for helium contamination with portable helium detector.

c. Air purged from system must maintain < 10 % helium.

5. If seal around sampling port appears adequate based on helium test, remove the brass plug from the SUMMA® canister and connect the flow controller with in-line particulate filter and vacuum gauge to the SUMMA® canister. Do not open the valve on the SUMMA® canister yet. Record in the field notebook and the COC the flow controller number with the appropriate SUMMA® canister number.

   a. If seal is not adequate, troubleshoot for leaks and re-test using helium tracer gas.

   b. Do not take sample until tracer gas requirements are met (< 10 % helium in purged air).

6. Connect the clean Teflon® sample collection tubing to the flow controller and the SUMMA® canister valve. Record in the field notebook the time sampling began and the canister vacuum.

7. If required, collect duplicate sample by attaching second SUMMA® canister with stainless steel "T" fitting.

8. Connect the unoccupied end of the Teflon® tubing to the tubing protruding from subsurface sampling port.

9. Open the SUMMA® canister valve and collect sample.

10. Photograph the SUMMA® canister, capturing the sample ID if possible. Also photograph canister and surrounding area, capture any available landmarks for future use in photographic logs (e.g. buildings, roads, etc).

The following methodology should be followed for completion of SUMMA®-Type sampling:

1. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the required sampling interval (e.g., 30 to 60 minutes).

2. Record the final vacuum measurement. Close the valve on the SUMMA® canister to cease sample collection. The canister should have a minimum amount of vacuum (approximately 2 inches of Hg or slightly greater).

3. Record the date and local time (24-hour basis) of valve closing in the field notebook, Soil Gas Sample Collection Log, and COC (see forms in QAPP).

4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install the brass plug on the canister fitting, and tighten with the appropriate wrench.
5. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment. Apply custody seals if required by field sampling plan.
6. Complete the appropriate forms and sample labels as directed by the laboratory.
7. Ship the container to the laboratory (via overnight carrier [e.g., Federal Express]) for analysis.

Once the soil gas sample has been collected, the temporary gas points will be abandoned by removing the drive rods, and filling the resulting hole with clean sand. If sampling semi-permanent SGP, affix PVC valve on Teflon® tubing, replace flush mount cap, and mark location of SGP with flag or white spray paint.

Ambient air samples will be collected simultaneously with a soil gas sample (see Table 1 of the RI/FS Work Plan). The SUMMA sample container will be positioned at a location near the associated SGP at a height of 4 ft above grade. The ambient air sample will be obtained over an eight-hour period.

6. Investigation-Derived Waste Sampling

In general, IDW will be containerized in one of the following types of portable containers:

1. Department of Transportation-approved 55-gallon drum, as follows: bung (water/liquid IDW) or open top (soil/solid IDW).
2. Large capacity portable vessel (water/liquid IDW).

Soil/solid IDW samples will be collected from open top drums by opening the drum and collecting a grab soil sample using a hand auger or trowel and placing the sample either directly into the sample container (VOCs analysis) or into a stainless steel bowl, (other analytes). Composite samples will be collected from a representative number of drums and homogenized in the stainless steel bowl using a stainless steel trowel or spoon. Samples will be collected and will be analyzed by the laboratory for the parameters, as specified by the requirements of NGSC and the receiving facility.

Water/Liquid IDW containerized either in bung type drums or in larger capacity temporary portable vessels will be transported off the sampling site each day and disposed of without additional analysis at the Nassau County Department of Public

Works (NCDPW) sanitary sewer intake located at the former NGSC steam plant area, adjacent to the Calpine Cogeneration Facility, in accordance with the existing approval letter from the NCDPW, dated July 2004.

7. Sample Collection, Labeling, Handling, and Analysis

7.1 Soil Samples

Soil sampling to be conducted as part of the Phase 2A and 2B RI soil sampling investigation includes the collection of split-spoon soil and Shelby tube clay samples from select areas of the site (see RI/FS Work Plan for details). Split-spoon soil samples will be collected directly into the laboratory-supplied sample bottles. Shelby tube samples will be shipped in the stainless steel or polyethylene sleeve used for collection. All sample bottle caps will be secured snugly, but not over-tightened.

Samples (including QA/QC samples specified in the QAPP) will be properly labeled and identified, and the Chain-of-Custody Form will be completed. The QAPP provides additional details regarding Field Records and QA/QC samples, frequency and protocols, and sample custody. Sample containers will be checked for proper identification/labeling and compared to the Chain-of-Custody Form for accuracy prior to packaging the sample for shipment. The Chain-of-Custody Form will be placed in a sealed plastic bag and taped to the underside of the cooler lid. The sample containers will be wrapped with a cushioning material, as needed, to preclude sample container breakage during shipment and placed in a cooler. For soil samples, sufficient amounts of bagged ice or ice packs will be placed in the cooler to keep the samples at 4 degrees Celsius until arrival at the laboratory. For samples shipped for laboratory analysis, when the cooler is ready, it will be sealed with fiber (duct) tape, and custody seals will be placed in such a manner that any opening of the cooler prior to arrival at the laboratory can be visually detected.

Samples will be delivered by overnight carrier to the analytical laboratory following sample custody requirements specified in the QAPP. The laboratory will be prepared to receive the samples and perform preliminary extractions or analyses within the analytical method recommended holding times.

Soil samples will be analyzed by Mitkem (Phase 2A) or Severn Trent Laboratories, Shelton, Connecticut (Phase 2B) (see Attachment B-3 of QAPP). Shelby Tube samples will be analyzed by a geotechnical laboratory (to be determined). Analytes are specified in the QAPP and Table 1 of the RI/FS Work Plan.

7.2 Groundwater Samples

Groundwater samples will be collected directly into the laboratory-supplied sample bottles. The flow of water from the sample port will be adjusted to ensure slow laminar flow so that no entrained air bubbles result in VOC samples. Special care will be taken in filling and capping VOC vials so that headspace/air bubbles are not present in the groundwater samples. In addition, overflowing bottles will be avoided to prevent the loss of floating substances or preservatives that may have already been added to the bottle. For samples that will be analyzed for dissolved metals the sample will be filtered in the field using an in-line, 0.45-micron disposable filter prior to decanting the sample into the appropriate sample container. All sample bottle caps will be secured snugly, but not over-tightened.

Samples (including QA/QC samples specified in the QAPP) will be properly labeled and identified, and the VPB Groundwater Sampling Form or Water Sampling Log and Chain-of-Custody Form will be completed. The QAPP provides additional details regarding Field Records and QA/QC samples, frequency and protocols, sample labeling, and sample custody Sample containers will be checked for proper identification/labeling and compared to the Chain-of-Custody Form for accuracy prior to packaging any sample for shipment. The Chain-of-Custody Form will be placed in a sealed plastic bag and taped to the underside of the cooler lid. The samples will then be wrapped with a cushioning material, as needed, to preclude sample container breakage during shipment and placed in a cooler. For water samples, sufficient amounts of bagged ice or ice packs will be placed in the cooler to keep the samples at 4 degrees Celsius until arrival at the laboratory. For samples shipped for laboratory analysis, when the cooler is ready, it will be sealed with fiber (duct) tape, and custody seals will be placed in such a manner that any opening of the cooler prior to arrival at the laboratory can be visually detected.

Samples will be delivered by overnight carrier to the analytical laboratory following sample custody requirements specified in the QAPP. The laboratory will be prepared to receive the samples and perform preliminary extractions or analyses within the analytical method recommended holding times.

Groundwater samples will be analyzed by Severn Trent Laboratory of Shelton, Connecticut with selected analyses performed by Microseeps, Inc. of Pittsburgh, Pennsylvania (Attachment B-3 of QAPP) for the analytes specified in the QAPP and Table 1 of the RI/FS Work Plan.

7.3 Soil Gas Samples

Samples (including QA/QC samples specified in the QAPP) will be properly labeled and identified, and the Soil Gas Sampling Log and Chain-of-Custody Form will be completed. The QAPP provides additional details regarding Field Records and QA/QC samples, frequency and protocols, sample labeling, and sample custody. Sample containers will be checked for proper identification/labeling and compared to the Chain-of-Custody Form for accuracy prior to packaging sample for shipment. The Chain-of-Custody Form will be placed in a sealed plastic bag and taped to the underside of the shipping container lid. Samples will remain at ambient temperature throughout transport until arrival at the laboratory. When the container is ready, it will be sealed with fiber (duct) tape, and custody seals will be placed in such a manner that any opening of the container prior to arrival at the laboratory can be visually detected. Measurements will be recorded in the field notebook at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location (e.g., canister serial number, flow controller serial number, initial vacuum reading, and final pressure reading. Field sampling logs and COC records will be transmitted to the Project Manager.

Samples will be delivered by overnight carrier to the Severn Trent Laboratory, Burlington, Vermont (see Attachment B-3 of QAPP) following sample custody requirements specified in the QAPP. The laboratory will be prepared to receive the samples and perform preliminary extractions or analysis within the analytical method recommended holding times.

Soil gas/ambient air samples will be analyzed for VOCs via USEPA Method TO-15 (see QAPP).

8. Field Decontamination Procedures

Decontamination procedures for non-dedicated field equipment are presented in detail in this section and include decontamination procedures associated with non-dedicated sampling equipment and downhole drilling tools and equipment. In general, after decontamination is completed items will be stored in a manner to preserve their decontaminated condition prior to use.

Decontamination procedures associated soil sampling and well evacuation and sampling equipment (i.e., split-spoons, trowels, hand augers, bowls, flow-through cells, tracer gas shrouds, and non-dedicated pumps/appurtenances), and PPE, as applicable. Field decontamination of these items will require scrubbing with Micro-90 low-phosphate detergent (or equivalent) to remove all foreign material, followed by potable

water and/or distilled/de-ionized water rinse. The equipment will be decontaminated before and between each use and prior to de-mobilization.

VPB temporary well material and all downhole drilling tools and equipment will be free of petroleum-based oil and grease (vegetable-based lubricants are acceptable), and will be decontaminated using a high pressure steam cleaner prior to the start of drilling activities, between each borehole, and prior to leaving the Site. Decontamination fluids will be containerized, transported, and/or disposed of, as described in Section 9.

The HydroPunch®, drill rods and drive casing will be decontaminated before use, between samples and prior to de-mobilization using the following procedure:

- Disassemble the HydroPunch® unit and remove O-Rings.
- The PVC screen is disposable and must be discarded. Stainless steel screens may be decontaminated and reused.
- Scrub entire unit with a laboratory grade glassware detergent.
- Rinse entire unit with distilled/de-ionized water.
- Replace O-Rings.
- Reassemble unit.

Before and between collecting VPB temporary well groundwater samples and prior to de-mobilization, the submersible pump (with tubing attached) will be operated in a drum of potable water and detergent and then rinsed and operated in a second drum of potable water. A minimum total of 60 gallons of water will be pumped for decontamination (minimum 30 gallons of potable water and detergent and minimum of 30 gallons of potable water) until the pump and tubing are free of extraneous material and detergent. The tubing will be discarded after sampling of each VPB is complete.

Water quality probes and downhole measurement tools (i.e., sounding tape, water level indicators, etc) will be decontaminated using a distilled water rinse immediately before use.

Disposable bailers and rope from perched water sampling and tubing from groundwater sampling of permanent wells and soil gas sampling from SGPs will be discarded after each use.

9. Waste Management and Disposal

Soil and liquid IDW generated during sampling activities including, but not limited to, soil samples, drill cuttings, well purge water, and decontamination water, will be disposed as outlined in this section.

Sampling procedures involving the collection of water or gas samples obtained as direct grab samples will be performed in such a manner so to not generate waste, other than disposable PPE.

The NCDPW granted approval to utilize the Publicly Owned Treatment Works (POTW) intake, located on the NGSC site, for disposal of purge water and decontamination water. Fluids generated from decontamination activities and purge water from all temporary and permanent monitoring wells will be containerized for disposal on a daily basis via centrifugal pump to the POTW intake.

Solid IDW (i.e., soils, cuttings, PPE, and disposable sampling equipment) will be containerized in 55-gallon drums or rolloffs, characterized in accordance with the requirements of NGSC and the receiving facility, and transported off-site for disposal. Solid waste generated on-site will be staged at the designated area on NGSC property on a daily basis until such time as the waste is transported off-site for disposal. Solid waste generated off-site will be transported to the designated area on NGSC property on a daily basis and staged, until such time as the waste is transported off-site for disposal.

10. References

ARCADIS G&M, Inc. 2002. Draft Operable Unit 2 Groundwater Remedy, Operation, Maintenance and Monitoring Plan, Northrop Grumman and NWIRP Sites, Bethpage, New York. December 3, 2002.

ARCADIS Geraghty & Miller, Inc. 2000. Groundwater Feasibility Study, Grumman Aerospace-Bethpage, NY Site #130003A and Naval Weapons Industrial Reserve Plant Bethpage, NY Site #130003B.

County of Nassau Department of Public Works, 2004, Discharge of Investigation-Derived Water and Monitoring Well Purge Water to Nassau County POTW, Northrop Grumman Corp., Bethpage NY, June 2004.

Dvirka & Bartilucci, 2003. Town of Oyster Bay Bethpage Community Park Investigation Sampling Program, Bethpage, New York. December 2003.

New York State Department of Environmental Conservation (NYSDEC), 2005, Order on Consent Index # W1-0018-04-01, Site # 1-30-003A, July 4, 2005.

New York State Department of Environmental Conservation (NYSDEC) 2002. Draft DER-10 Technical Guidance for Site Investigation Remediation. December 2002.

New York State Department of Environmental Conservation (NYSDEC). 2001. Record of Decision, March 29, 2001.

New York State Department of Environmental Conservation (NYSDEC) 1998. Citizens Participation in New York Hazardous Waste Site Remediation Program: A Guidebook.

New York State Department of Health (NYSDOH) 2005. Guidance for Evaluating Soil Vapor Intrusion in the State of New York. Working Draft. New York State Department of Health, Center for Environmental Health, Bureau of Environmental Exposure Investigation. November 2005.

New York State Department of Environmental Conservation (NYSDEC), 2005, Environmental Site Remediation Database Search, July 2005.

U.S. Environmental Protection Agency (USEPA), 2004, Contract Laboratory Program National Functional Guidelines For Inorganic Data Review, Final, October

2004. U.S. Environmental Protection Agency, 2003, Index to EPA Test Methods, April 2003 revised edition.

U.S. Environmental Protection Agency, 1999, USEPA Contract Laboratory Program National Functional Guidelines For Organic Data Review, October 1999.

U.S. Environmental Protection Agency (USEPA). 1998. Groundwater Sampling Procedure, Low Stress (Low-Flow) Purging and Sampling, USEPA Region II, March 1998.

U.S. Environmental Protection Agency (USEPA). 1993. Field Methods Correspondence Oswer Directive 9285.2-11. June 1993.

ARCADIS

Attachment A-1

Phase 2 Soil RI Standard Operating Procedures

HAGER-RICHTER
GEOSCIENCE, INC.

CONSULTANTS IN GEOLOGY & GEOPHYSICS
8 INDUSTRIAL WAY-D10
SALEM, NEW HAMPSHIRE 03079-5820
TELEPHONE (603) 893-9944
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December 6, 2004
File 04SL22

Al Jaroszewski
Dvirka and Bartilucci
330 Crossways Park Drive
Woodbury, New York

tel (516) 364 - 9890
fax (516) 364 - 9045

RE: Revised Proposal
Geophysical Survey
Bethpage Community Park
Bethpage, New York

Dear Mr. Jaroszewski:

Hager-Richter Geoscience, Inc. is pleased to provide this ***revised*** proposal to conduct a geophysical survey at the Bethpage Community Park in Bethpage, New York. We have discussed the project briefly with you, but we have not seen the Site. Therefore, we are relying on the project information provided by Dvirka and Bartilucci (D&B) for the preparation of this proposal.

PROJECT UNDERSTANDING

The Site is an 18-acre community park which consists of a swimming pool, an ice skating rink, a baseball field, tennis courts, basketball courts, playgrounds, picnic areas, and a parking lot. The area of interest (AOI) is an approximately 400 ft by 500 ft area which includes the baseball field, a portion of the basketball courts, and a horseshoe pit. The baseball field and the basketball courts are surrounded by metal chain link fences. Prior to its development as a community park, the Site was used by its former owner, Grumman Aerospace (now Northrup Grumman), for sludge-drying areas and wastewater lagoons. Depths of the former lagoons reportedly range from approximately 10 ft to 25 ft below grade.

According to information provided by D&B, some of the soils at the base of the lagoons have elevated levels of Chromium^{+3}. Soils at the site are also contaminated with PCBs, metals, and local pockets of VOCs and SVOCs. The native soils reportedly consist of well sorted medium sands. Fill materials reportedly vary in composition from poorly sorted silty fine to medium sand with sporadic pieces of wood, plastic, and brick fragments.

HAGER-RICHTER
GEOSCIENCE, INC.

D&B is interested in determining whether buried drums are present, identifying potential sludge pockets, and investigating the presence of buried lagoons in the AOI. D&B has extended the scope of work to include determining the depth of a clay layer reportedly believed to be 40 ft to 50 ft below ground surface.

OBJECTIVE

The objective of the geophysical survey is: (1) to detect buried drums, potential sludge pockets, and buried lagoons within the accessible portions of the AOI, and if detected, to locate each, and (2) to determine the depth of a clay layer within the accessible portions of the AOI.

APPROACH

For Objective 1, we suggest using a combination of frequency domain electromagnetic induction (EM31) and ground penetrating radar (GPR). The EM method is especially useful for detecting buried metal waste and also has the capability of detecting areas of different apparent ground conductivity. The EM data will be acquired with data stations at approximately 1 ft intervals along survey lines spaced 10 ft apart in one direction along the survey grid, thereby providing 100% coverage. The 13.5 ft boom of the EM31 will be oriented perpendicular to the survey lines. The GPR data will be acquired along survey lines spaced 20 ft apart in the same direction as the EM31 traverse lines.

With a one-person field crew, we estimate that the EM component of the geophysical survey can be completed in two days, and we estimate that the GPR component of the geophysical survey can also be completed in two field days. With a two-person field crew operating both instruments concurrently, we estimate that the geophysical survey can be completed in two field days. We note that with either option, the cost will be based on a per person, per instrument basis. ***These estimates assume unobstructed access to the area of interest and no delay caused by others.***

For Objective 2, we suggest using either ground penetrating radar or dipole-dipole resistivity. GPR can be used to provide reasonably accurate information on the location, shape, and depths of subsurface structures where subsurface conditions are favorable (e.g., sandy, electrically resistive soil over electrically conductive clay) and where ground truth is available from borings or test pits. Where site or subsurface conditions are not favorable, it may not be possible to determine the depths or locations of subsurface structures at all.

If subsurface conditions are not favorable to the use of GPR for Objective 2, we propose a dipole-dipole resistivity survey be conducted along a minimum of four survey lines using a six

meter electrode spacing. The length of the individual lines will be approximately 400 ft to 500 ft, depending on site conditions. We estimate that under ideal conditions the resistivity profiling can be completed in two field days. Please note that actual site conditions can have a considerable impact on the electrode spacing and on the amount of resistivity profiling that can be completed in a given amount of time.

SITE PREPARATION

Our pricing does not include site preparation. ***We require that D&B set up a survey grid with 100' nodes prior to our mobilization to the Site. We also require that the fences surrounding the baseball field and basketball court be removed prior to our mobilization to the Site.*** The survey areas must be clear of surface obstructions such as vehicles, dumpsters, debris, vegetation, etc. If desired, H-R can set up a survey grid at additional time and cost.

EQUIPMENT

EM. For the EM survey we will use a Geonics Model EM31 terrain conductivity meter. The EM31 is an induction type instrument and provides measurement of both the quadrature-phase and in-phase components of terrain conductivity without ground electrodes or contact. The data for both components are recorded on a digital data logger. The EM31 is calibrated to read ground conductivity directly in millimhos per meter with a resolution of 2% of full scale and an accuracy of 1 mmho/meter. The nominal depth of earth sampled by the EM31 in the vertical dipole mode is about 18 feet.

GPR. For the GPR survey, we plan to use either our Geophysical Survey Systems Model SIR-2 digital ground penetrating radar system or our Sensors & Software Smart Cart Noggin Plus subsurface imaging radar system. Data are recorded digitally and paper printouts of the GPR data can be produced in the field. Our system includes a survey wheel that triggers the recording of the data at fixed intervals, thereby increasing the accuracy of the locations of features detected along the survey lines. We own transmit/receive antennas with the following frequencies: 120 MHZ, 250 MHZ, 300 MHZ, 500 MHZ, and 1000 MHZ. We plan to use either a 120 MHZ or 250 MHZ antenna for this project.

Resistivity. The proposed equipment consists of a "state of the art" electrical resistivity unit, the Super Sting R8 IP 8 Channel Memory Earth Resistivity and IP meter. This imaging system is a modern extension of the four electrode resistivity method. The unit consists of a power supply, transmitter, receiver, the associated electronics required to measure current and voltage, digital control programs, and an interface box. The system includes at least 28 electrodes. The electrodes are set out across the target with the inter-electrode spacing matched

to the depth of the target – deeper targets require larger electrode spacing and result in lower resolution. Two different pairs of electrodes are selected automatically by the program for current injection and voltage measurement – with many different combinations. The data can be processed in the field with a notebook PC to determine the quality of the data. After collection of the raw data, the data are transferred to a PC and are inverted using commercial software (AGI EarthImager software) that produces the best model of resistivity data.

LIMITATIONS OF THE METHODS

HAGER-RICHTER GEOSCIENCE, INC. MAKES NO GUARANTEE THAT ALL SUBSURFACE TARGETS WILL BE DETECTED IN THIS SURVEY. HAGER-RICHTER GEOSCIENCE, INC. IS NOT RESPONSIBLE FOR DETECTING TARGETS THAT CANNOT BE DETECTED BY THE METHODS USED OR BECAUSE OF SITE CONDITIONS.

EM. All electromagnetic geophysical methods, including the EM method proposed here, are affected by the presence of power lines and surface metal objects (steel sided buildings, dumpsters, vehicles, railroad tracks, reinforced concrete, etc.) Where such are present, the effects of materials in the subsurface may be masked, and firm conclusions about subsurface conditions cannot be made.

Detection and identification should be clearly differentiated. Detection is the recognition of the presence of a metal object, and the EM method is excellent for such purposes. Identification, on the other hand, is determination of the nature of the causative body (i.e., what is the body -- a drum, UST, automobile, white goods, etc.?), and EM cannot *identify* the buried metal object.

GPR. There are limitations of the GPR technique as used to detect and/or locate targets such as those of the objectives of this survey: (1) surface conditions, (2) electrical conductivity of the ground, (3) contrast of the electrical properties of the target and the surrounding soil, and (4) spacing of the traverses. Of these restrictions, only the last is controllable by us.

The condition of the ground surface can affect the quality of the GPR data and the depth of penetration of the GPR signal. Sites covered with snow piles, high grass, bushes, landscape structures, debris, obstacles, soil mounds, etc. limit the survey access and the coupling of the GPR antenna with the ground. In many cases, the GPR signal will not penetrate below concrete pavement, especially inside buildings, and a target may not be detectable. The GPR method also commonly does not provide useful data under canopies found at some facilities.

The electrical conductivity of the ground determines the attenuation of the GPR signals, and thereby limits the maximum depth of exploration. For example, the GPR signal does not penetrate clay-rich soils, and targets buried in clay might not be detected.

A definite contrast in the electrical conductivities of the surrounding ground and the target material is required to obtain a reflection of the GPR signal. If the contrast is too small, possibly due to deeply corroded metal in the target, then the reflection may be too weak to recognize and the target can be missed.

Spacing of the traverses is limited by access at many sites, but where flexibility of traverse spacing is possible, the spacing is adjusted to the size of the target.

Dipole-Dipole Resistivity. As with any of the electrical geophysical methods, resistivity data are subject to certain limitations, including site surface and subsurface conditions and structures, electrical and "geological" noise, and target depth and size. Interference from such cultural features as buildings, fencing, and underground and overhead power lines is common at many sites, and particularly at active industrial sites. Thus, for certain applications, the use of the resistivity method in urban settings might be inappropriate.

The subsurface is three dimensional in character, and although the resistivity data are acquired along a line, the data are affected by resistivity changes off-line. Therefore, unless there are parallel survey lines that are spaced appropriately, resistivity changes off-line may be interpreted as changes below the survey line where the data are acquired. This limitation is particularly significant for single survey lines.

The target depth, size, and of course, resistivity contrast may pose limitations. These three parameters, generally characterized as large or small[1], are important in the survey design, and extreme values and some combinations of values can limit the usefulness of the resistivity method. For example: A small target, say a granite boulder 2 ft in diameter, at large depth, say 20 ft or more, even with very high resistivity contrast, say 10^5 Ohm-m in a medium of 0.2 Ohm-m, cannot be detected. A target of reasonable size, say a granite boulder 2 ft in diameter, at

[1]The parameters depth and size scale to the electrode spacing. A "large depth" is any depth greater than 10 times the electrode spacing. A "small depth" is any depth less than 3 times the electrode spacing. Depths less than 10, and greater than 3, times the electrode spacing are termed "intermediate depths." A "large size" is any size greater than 2½ times the electrode spacing. A "small size" is any size less than 1 times the electrode spacing. Sizes less than 2½, and greater than 1, times the electrode spacing are termed "intermediate sizes." Resistivity contrast refers to the ratio of the resistivity of one material to that of the second material. A large resistivity contrast is any such ratio of at least 100. A small resistivity contrast is any such ratio no greater than 0.5. Ratios less than 100, and greater than 0.5, are termed " intermediate ratios."

shallow depth, say 6 ft or less, may not be detectable where the resistivity contrast is low, say 10^5 Ohm-m in a medium of 10^4 Ohm-m.

The usefulness of resistivity profiles for delineating stratigraphic changes with depth is limited theoretically by the non-uniqueness of the inversion. However, where boring information is available, the method is excellent for interpolation between borings.

A further limitation of the resistivity method arises from lack of data at the edges of a survey line where it becomes more difficult to image the subsurface and anomalies appear shallower than their true depth.

ITEMS REQUIRED FROM D&B

This proposal assumes that D&B will provide several items at no charge to H-R:

- Site plans, in CAD and hardcopy
- Site access, including legal right of entry
- Site preparation, including removal of obstacles such as vehicles, and setting up the survey grid prior to our mobilization to the site
- Site specific HASP, if required
- Available information about subsurface conditions, such as facility plans, Sanborn-type maps, utility plans, logs for borings and test pits, results of previous geophysical surveys

DELIVERABLES

Hager-Richter will provide three copies of a brief report of findings summarizing the results in terms of the objectives of the survey.

COST

The following rates assume that: (1) no Site preparation is required, (2) the level of personal protection is no higher than Level D, and (3) a day consists of no more than 8-hours on Site. Time over 8-hours on site will be billed at 1/8th the day rate per hour. Fees are firm for a period of 60 days.

HAGER-RICHTER
GEOSCIENCE, INC.

Revised Proposal
Geophysical Survey
Bethpage Community Park
Bethpage, New York
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Objective 1

Mob/Demob	1 mob @ [redacted]/ mob	$ [redacted]
Per Diem	2 people for 2 days or 1 person for 4 days	$ [redacted]
EM31/GPR Survey, as described	4 person days @ [redacted]/day	$ [redacted]

Objective 2

GPR Survey, as described	1 person @ [redacted]/day	$ [redacted]
Mob/Demob	1 mob @ [redacted]/ mob	$ [redacted]
(includes the cost of renting and shipping resistivity equipment)		
Per Diem	2 people for 2 days	$ [redacted]
Resistivity Survey	2 days @ [redacted]/ day	$ [redacted]

Estimated Total Cost [redacted]

The work will be billed at the above unit rates with the estimated total cost not to be exceeded without prior written authorization from D&B.

SCHEDULE

We can generally respond rapidly to an executed contract or notice to proceed, but we appreciate as much advance notice as possible. We own all of the equipment necessary to do the work so we are not dependent on the rental schedules of others.

ADDITIONAL INFORMATION

Hager-Richter Geoscience, Inc. is certified as a WBE or DBE by agencies in twelve states, including the six New England States, **New York** (including NYS DOT, Port Authority of NY and NJ, Empire State Development, and Metropolitan Transportation Authority), New Jersey (including NJ DOT, NJ Department of Commerce, NJ Transit Authority, and the Port Authority of NY and NJ), Ohio, Illinois, Minnesota, and Texas. With offices in Salem, New Hampshire and Orange, New Jersey, Hager-Richter is the largest geophysical specialty firm in the northeast.

Our standard terms and conditions, copy attached, are incorporated into this proposal by reference. This proposal may be accepted by an authorized person signing in the space below and returning one signed copy to us.

_____

HAGER-RICHTER
GEOSCIENCE, INC.

Revised Proposal
Geophysical Survey
Bethpage Community Park
Bethpage, New York
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We appreciate the opportunity to submit this proposal to you. If you have any questions or need additional information, please contact us at your convenience.

Sincerely yours,
HAGER-RICHTER GEOSCIENCE, INC.

Suzanne LeFrançois
Project Manager

Dorothy Richter, P.G.
President

Enc: H-R Std Terms and Conds.

Proposal Accepted by:

Authorizing Signature _____ Position _____

Firm _____ Date _____

ARCADIS

Attachment A-2

Community Air Monitoring Plan

ARCADIS

Appendix A

Attachment A-2
Community Air Monitoring Plan

Former Grumman Settling Ponds
(Operable Unit 3 – Bethpage Community Park),
Bethpage, New York.
NYSDEC Site # 1-30-003A

Revised: March 8, 2006

ARCADIS

David Stern
Task Manager

Carlo San Giovanni
Project Manager

Michael F. Wolfert
Project Director

Appendix A
Attachment A-2
Community Air Monitoring Plan
Northrop Grumman Systems Corporation
Bethpage, New York.
NYSDEC Site # 1-30-003A
Revised: March 8, 2006

Prepared for:
Northrop Grumman Systems Corporation

Prepared by:
ARCADIS G&M, Inc.
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Our Ref.:
NY001348.0706.00002

Date:
8 March 2006

Table of Contents

Former Grumman Settling Ponds (Operable Unit 3 – Bethpage Community Park), Bethpage, NY

NYSDEC Site #1-30-003A
Revised March 8, 2006

1. Introduction

In accordance with New York State Department of Health (NYSDOH) requirements, this Community Air Monitoring Plan (CAMP) has been prepared for use during certain investigative and remedial field activities associated with the Northrop Grumman Corporation (NGC), Bethpage Facility (Site). This CAMP serves to present the methods and procedures to conduct real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at each designated work area when certain activities are in progress. This CAMP is not intended for use in establishing action levels for worker respiratory protection; action levels are described in the Northrop Grumman Corporation Health and Safety Plan (HASP) (ARCADIS G&M, Inc. 2004). The intent of this CAMP is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers that are not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities that are related to the Site. The response levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, this CAMP helps to confirm that work activities do not spread contamination off-site through the air.

Depending upon the nature of the site-related contaminants of concern, chemical-specific monitoring, with appropriately-sensitive methods, may be required during field work (please refer to the HASP for details).

Reliance on this CAMP does not preclude simple, common-sense measures to keep potential VOCs, dust, and odor emissions at a minimum around work areas.

The following sections of this CAMP present the monitoring instrumentation required to comply with NYSDOH policy, the frequency of monitoring, response levels, and response actions.

2. Monitoring Instrumentation

Based on the currently available analytical data and the contaminants of concern for the NGC Site, real-time air monitoring for VOCs and particulates at the perimeter areas of the work area (i.e., the exclusion zone – see HASP for definition) will be necessary for field activities associated with investigation and remediation of the NGC Site.

VOC monitoring will be performed using real-time monitoring instrumentation that is appropriate to measure the types of VOCs known or suspected to be present at the work location (please refer to the HASP for details). The equipment will be calibrated on the frequency and using the methods described in the HASP. It is preferable to use instrumentation that is capable of calculating 15-minute running average concentrations or provide a written record of readings taken during monitoring events. If neither capability is available, then the reading obtained every 15 minutes will be used for decision making.

The particulate monitoring will be performed using real-time monitoring instrumentation that is capable of measuring particulates less than 10 micrometers in size (PM-10). It is preferable to use instrumentation that is capable of calculating 15-minute running average concentrations or provide a written record of readings taken during monitoring events. If neither capability is available, then the reading obtained every 15 minutes will be used for decision making. The particulate monitoring equipment will be equipped with an audible alarm to indicate exceedence of the response level.

3. Monitoring Frequency

This section defines the typical activities that will occur in relation to the NGC Site and relates these activities to the frequency of monitoring required.

Continuous Monitoring for VOCs and Particulates Will be Carried out for Intrusive Activities. Additionally, upwind VOC and particulate concentrations will be measured at the **start** of each work day and **periodically** (see below) thereafter to establish the background concentration. Ground intrusive activities typically include the following:

1. Soil excavation and handling.
2. Test pitting or trenching.
3. Drilling and installation of vertical profile borings, soil borings, and/or wells.
4. During the demolition of contaminated or potentially contaminated structures.
5. Construction activities involving earthwork or disturbance of earthen surfaces.

6. Other activities specified in this CAMP.

Periodic monitoring for VOCs will be carried out during non-intrusive activities. For non-intrusive activities, the upwind concentrations will be measured at the **start and finish** of the work effort to establish the background concentration. Non-intrusive activities typically include the following:

1. Site Mobilization/Demobilization of equipment and machinery.
2. Drum or container sampling.
3. Soil sampling (to the extent not coinciding with intrusive work).
4. Groundwater sampling.
5. Water-level measurements.
6. Surveying (geophysical, coordinate/elevation).
7. Well development.
8. Waste transportation.
9. Site preparation and restoration that does not involve re-grading or other disturbances to surface materials.

"Periodic" monitoring should be performed, at a minimum as follows:

1. Upon arrival at a work location to determine the ambient, or background concentrations.
2. During each phase of work that potentially may generate VOC emissions to the air.
3. Prior to leaving the work location.

As an example, "Periodic" monitoring for VOCs during sample collection activities shall include monitoring as above and during the following times:

1. When accessing wells, opening drums or containers, or overturning soil.

2. During well bailing/purging.

3. During collection of samples (soil/sediment/water).

For non-intrusive activities, particulate monitoring will not be performed.

Continuous monitoring for VOCs will be carried out during activities that occur on the Bethpage Community Park property.

3.1 VOC Monitoring Stations Locations, Response Levels, and Action

During each workday, the VOC monitoring station will be positioned at the downwind perimeter of the work area (i.e., the exclusion zone – see HASP for definition). As stated above, monitoring frequency (periodic or continuous) will be determined based on whether the activity is considered intrusive or non-intrusive (or whether the activity is occurring on Bethpage Community Park property). The direction of wind (if any) will be periodically recorded during each work day and re-positioning of upwind/downwind monitoring stations will be performed accordingly.

The VOC monitoring instrumentation output documenting 15-minute running average concentrations (or printed output of readings taken or the reading taken every 15 minutes, as available), will be compared to the following response levels:

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area exceeds 5 parts per million (ppm) **above background** for the 15-minute average, work activities will be temporarily halted and monitoring continued.

  If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm **above background** but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the work area or half the distance to the nearest potential

receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15- minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities will be shutdown.

All readings will be recorded on the appropriate air monitoring log (please refer to the HASP for details) or the electronic log will be printed out. Air monitoring results will be appended to the appropriate report.

3.2 Particulate Monitoring Stations Locations, Response Levels, and Actions

For intrusive activities, the particulate (i.e., dust) monitoring station will be positioned at the downwind perimeter of the work zone (i.e., exclusion zone – see HASP for definition). In addition, fugitive dust migration will be visually assessed during all work activities. The direction of wind (if any) will be periodically recorded during each work day and re-positioning of the downwind monitoring station will be performed accordingly. The response levels and actions for fugitive dust are as follows:

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m3) greater **than background** (upwind perimeter) for the 15-minute period or if airborne dust is visually observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m3 above the upwind level and provided that no visible dust is observed leaving the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the **background** concentration, then work will be stopped and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and/or other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m3 of the upwind level and in preventing visible dust from leaving the work area.

All readings will be recorded on the appropriate air monitoring log (please refer to the HASP for details) or the electronic log will be printed out. Air monitoring results will be appended to the appropriate report.

ARCADIS

Attachment A-3

ARCADIS Lithologic Logs Soil Classification and Terminology, New York/New Jersey Office

ARCADIS

Appendix A

Attachment A-3
ARCADIS
Lithologic Logs
Soil Classification and Terminology

New York/New Jersey Office

Introduction

During a field investigation the following soil classification system is used by ARCADIS personnel most of the time to describe unconsolidated soil material. However, there may be occasions where on a project specific basis an alternative method may have to be used due to client or regulatory requirements. The principal component (highest relative proportion) of the sample is described first, capitalizing the first letter. The principal component is then followed by other components of the sample in decreasing order of importance (i.e., relative proportion). Each description is then followed by a series of modifiers which explain other notable characteristics. The description of each component includes grain size, relative proportion, color, angularity, water content, and mineralogy/rock type. An example of a soil sample description is presented on Figure 1; please note the punctuation and case.

Stratification

Prior to preparing a descriptive lithologic log, the field geologist/hydrogeologist should examine the soil sample as to its stratification. He/she should then prepare their lithologic log keeping in mind the apparent stratification. More specifically, if the sample to be described is from a 2-foot long split spoon and alternating layers of coarse sand, fine sand, and clay exist, then the resultant description should be of the three individual lithologies and their vertical relationship and not a description lumping all 3 lithologies together.

Grain Size

The descriptive names for grain size are based on the intermediate width of the particles. For instance, particles that have an intermediate width greater than 300 millimeters (i.e., greater than 11.8 inches) are classified as boulders, whereas particles that are smaller than 0.08 millimeters are classified as silt. Table 1 (Unified Soil Classification System) presents a range of grain sizes and their descriptive category.

For gravel-sized deposits and larger the measured size is given. If all particles in gravel and larger size classes are similar then the average size is given and where the particles vary the range in size is given.

Plasticity

Unconsolidated material which passes through the No. 200 sieve (0.08) millimeters) consists principally of silt and/or clay. The plasticity of these fine-grained soils is used in classifying soil for engineering purposes. Depending on the moisture content, fine-grained soils may behave as a plastic material which may be deformed or molded into any form or shape. The plastic index indicates the range of moisture content within which a soil-water mixture is plastic. The plastic index is defined as the liquid limit minus the plastic limit. Table 2 presents the field criteria used to describe plasticity.

Roundness

Roundness (or conversely angularity) is related to the sharpness or curvature of particle edges and corners. If the grain-size of the component is coarse sand or larger, a description of the angularity is provided using the following six class terminology:

- very angular
- angular
- sub-angular
- sub-rounded
- rounded
- well-rounded

The roundness generally increases with greater distance of transport and weathering. However, particles of fine sand and silt tend to remain angular. See Appendix A for a chart displaying visual examples of sediment of varying degrees of roundness.

Color

The color is described using simple basic terminology and modifiers such as light, or dark as appropriate. Subjective terminology, such as "brick red" or "battleship gray" should be avoided.

Mineralogy

For sand size particles the mineralogy is described. For gravel and larger the mineralogy or rock type is described, as appropriate. The mineralogy/rock type is described to the best of one's ability given that the individual is in the field and not in a laboratory.

Relative Proportion

The relative proportion of each component is described using modifiers such as "trace", "little" or "some" (see Table 3. The relative proportions are estimated in the field using visual examination. The relative proportion of the principal component is not provided but can be determined by subtracting the sum of relative proportions of the non-principal components from 100 percent. See Appendix B for a chart displaying visual examples of percentage composition.

Water Content

The water content of the sample is described using the following three class terminology:

- dry
- moist
- wet

Summary

For descriptions of water content the sample in its entirety is described while all other descriptions pertain to each individual component where practical.

Unified Soil Classification System

In addition to describing the soil by this ARCADIS Soil Classification System, the sample is also described using the Unified Soil Classification System. This system is summarized on Table 4.

Table A3-1. Grain Sizes - Unified Soil Classification System (USCS).

Descriptions	Millimeters	Inches
Boulders	>300	>11.8
Cobbles	300 - 75	11.8 - 2.9
Gravel:		
Coarse	75 - 19	2.9 - .75
Fine	19 - 4.8	.75 - .19
Sand:		
Coarse	4.8 - 2.0	.19 - .08
Medium	2.0 - .43	.08 - .02
Fine	.43 - .08	.02 - .003
Fines:		
Silts	<.08	<.003
Clays	<.08	<.003

Table A3-2. Field Identification of Plasticity

Field Designation	Degree of Plasticity	Overall Plasticity Index	Feel and Smear Appearance	Ease of Rolling Threads of Soil	Smallest Diameter of Thread (inches)
Silt	Non-Plastic	0	Gritty to Rough	No Threads can be Rolled	--
Clayey Silt	Slight	1 to 5	Rough to Smooth	Difficult	1/4 O
Silt and Clay	Low	5 to 10	Rough to Smooth	Less Difficult	1/8 O
Clay and Silt	Medium	10 to 20	Smooth and Dull	Readily	1/16 o
Silty Clay	High	20 to 40	Shiny	Very Readily	1/32 o
Clay	Very High	40 and Greater	Very Shiny and Waxy	Very Readily	1/64 .

1. Pick out any fine gravel or coarse particles.
2. Moisten if necessary and press out thread between fingers to a thickness of between about 1/4-inch and 1/2-inch.
3. Roll thread on hard surface with gentle pressure of forefinger until it breaks.

Table A3-3. Modifers for Relative Proportions

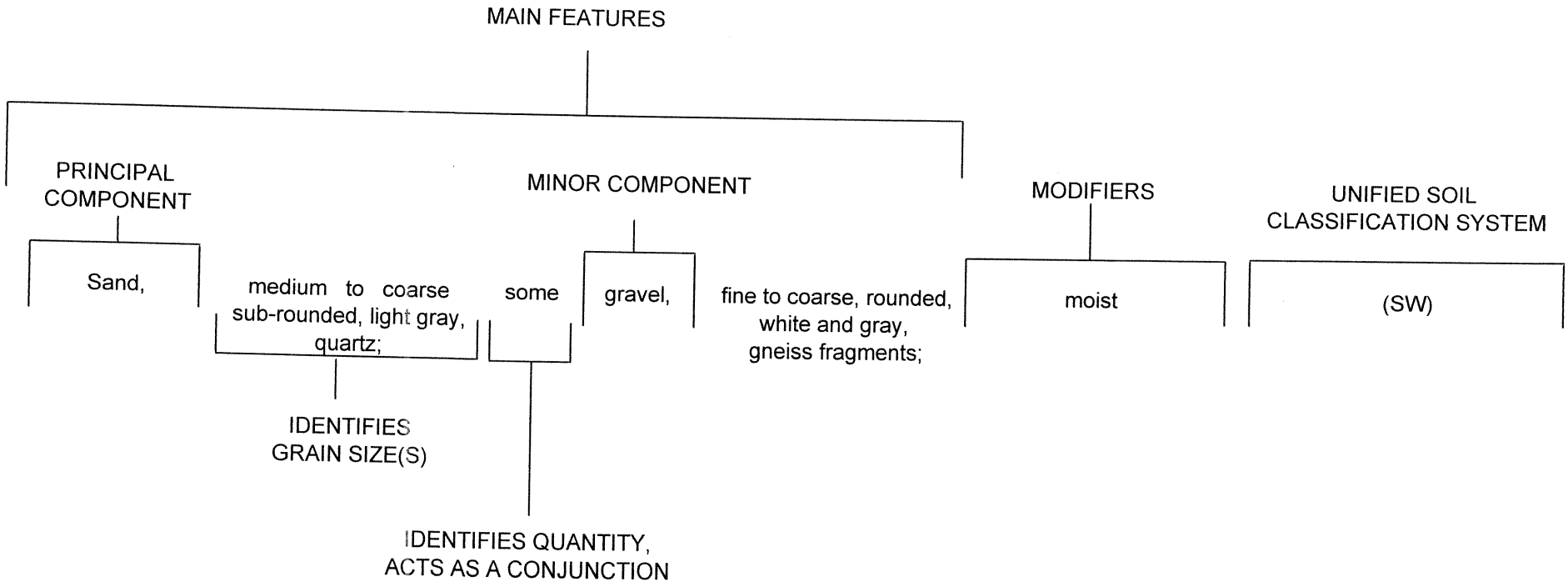
Description Term	Percent
Trace	1-10
Little	11-20
Some	21-35
And	36-50

Table A3-4. Unified Soil Classification System.

Field Identification			Group Symbols	Typical Names
Coarse-grained soils More than half of material is larger than No. 200 sieve size	Gravels More than half of coarse fraction is larger than No. 4 sieve size	Clean gravels	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		Gravel with fines	GM	Silty gravels, poorly graded gravel-sand-clay mixtures
			GC	Clayey gravels, poorly graded gravel-sand-clay mixtures
	Sand More than half of coarse fraction is smaller than No. 4 sieve size	Clean sands	SW	Well graded sands, gravelly sands little or no fines
			SP	Poorly graded sands, gravelly sands little or no fines
		Sands with fines	SM	Silty sands, poorly graded sand clay mixtures
			SC	Clayey sands, poorly graded sand clay mixtures
Fine-grained soils More than half of material is smaller than No. 200 sieve size	Silts and Clays		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silt clays of low plasticity
			MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	Inorganic clays of medium to high plasticity
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat and other highly organic soils

From Wagner, 1957 & ASTM D-2487 boundary classifications.
Soils possessing characteristics of two groups are designated by combinations of group symbols. For example: GW-GC, well graded gravel-sand mixture with clay binder. All sieve sizes on this chart are U.S. Standard

Figure A3-1. Example of ARCADIS Soil Classification System



Appendix A3-A

Comparison Chart for Estimating Roundness and Sphericity

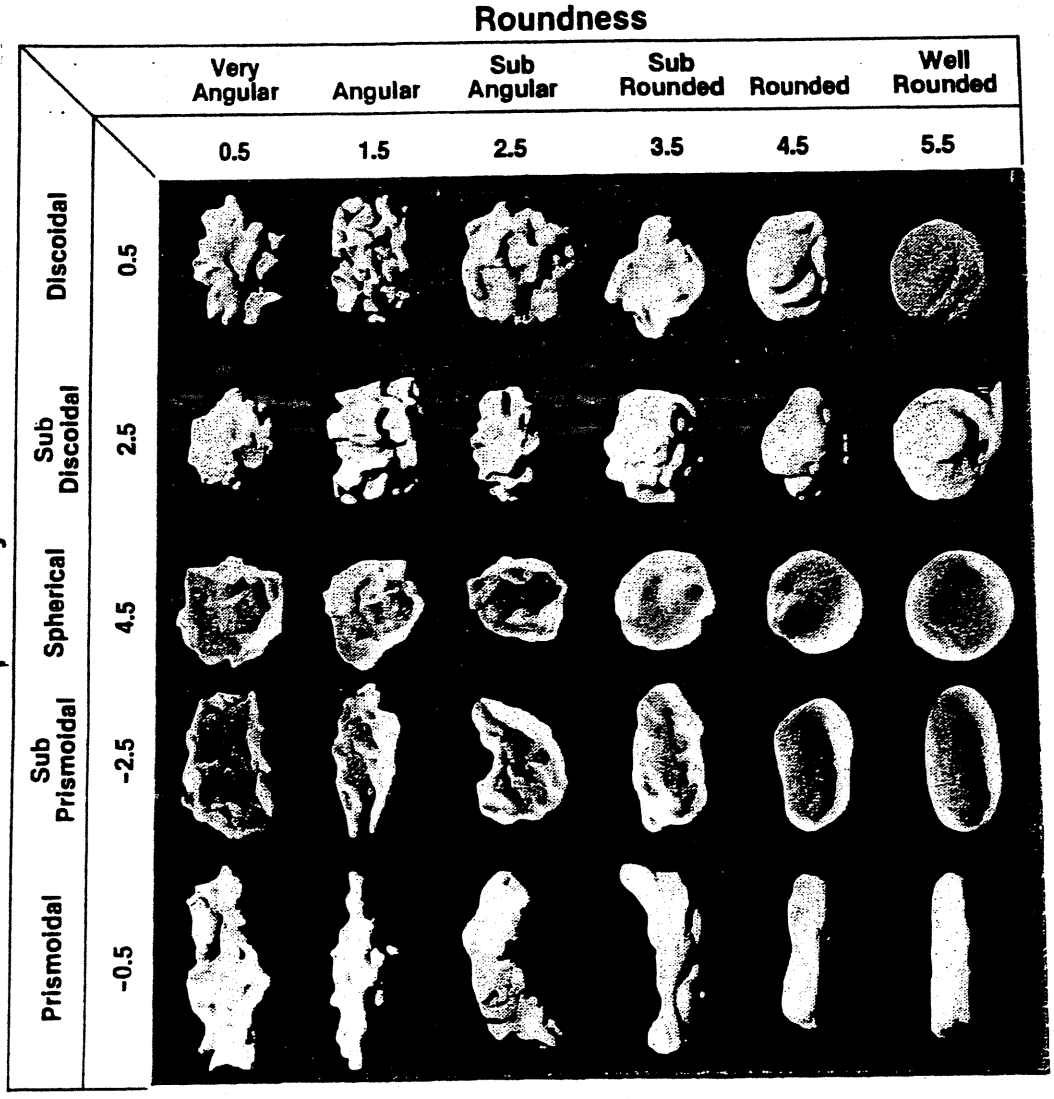
Comparison Chart for Estimating Roundness and Sphericity

by Maurice C. Powers, Elizabeth City State University

This sheet showing both sphericity and roundness suggests that particle shapes that initially break out or weather from parent rocks tend to be either discoidal, rodlike (prismatic), or spheroidal. It further suggests that as the particles are reduced in size by abrasion and/or chemical weathering they tend to assume more nearly spherical shapes. This, of course, is not invariably true, but it is the evolutionary process to be expected.

The chart below incorporates the median rho values for roundness suggested by Folk (1955) because of the ease of handling these values statistically and because they represent midpoints of each roundness class.

The same reasoning is applied here to the sphericity classes. Prismoidal shapes are identified with negative numbers whereas discoidal shapes have positive values. On this basis the median rho value obtained from a probability plot of the accumulated data will indicate quantitatively the extent to which a sample varies from a spherical shape and whether the variation is discoidal or prismoidal.



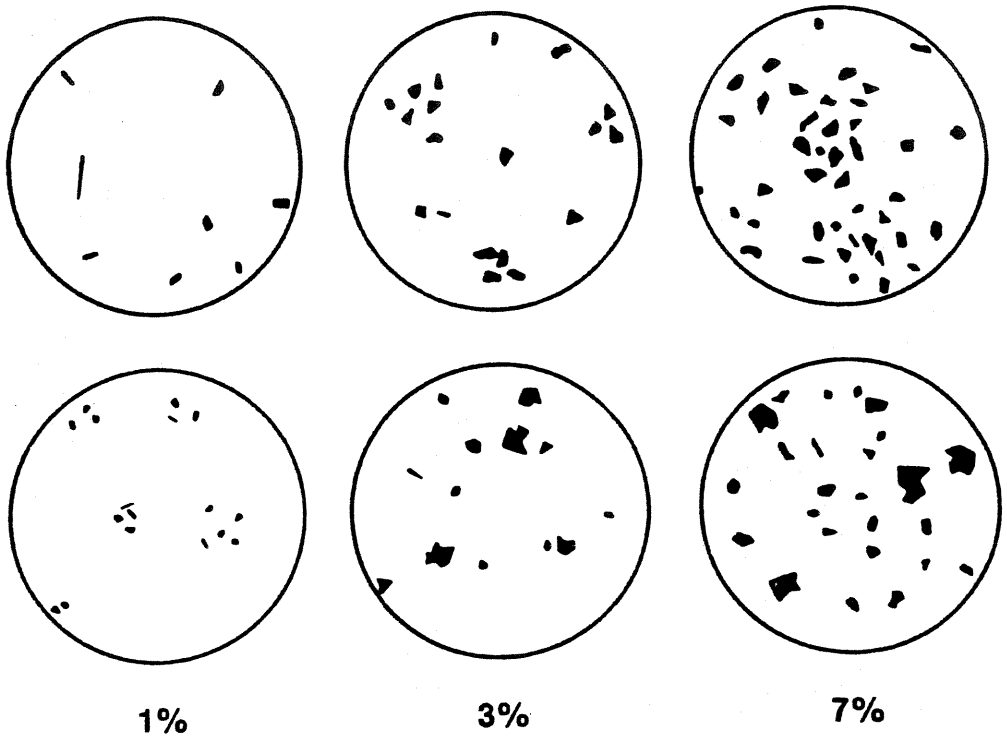
From AGI Data Sheets compiled by R.V. Dietrich, J.T. Dutro, Jr., and R.M. Foose, American Geological Institute, 1982.

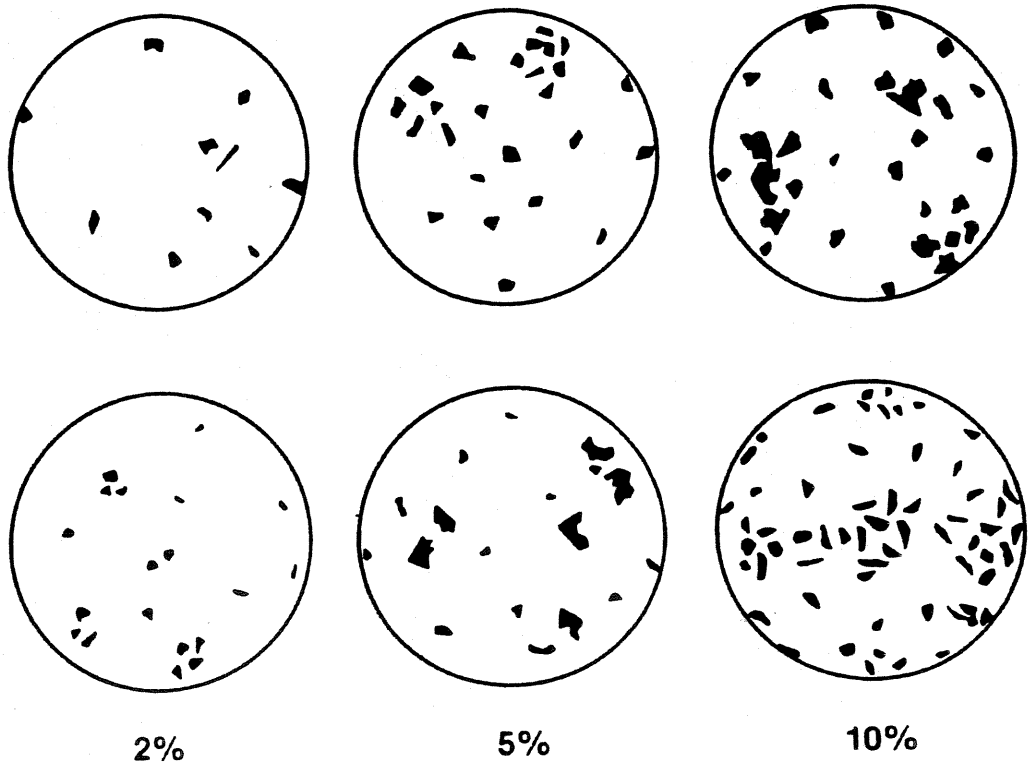
Appendix A3-B

Comparison Chart for Estimating Percentage Composition

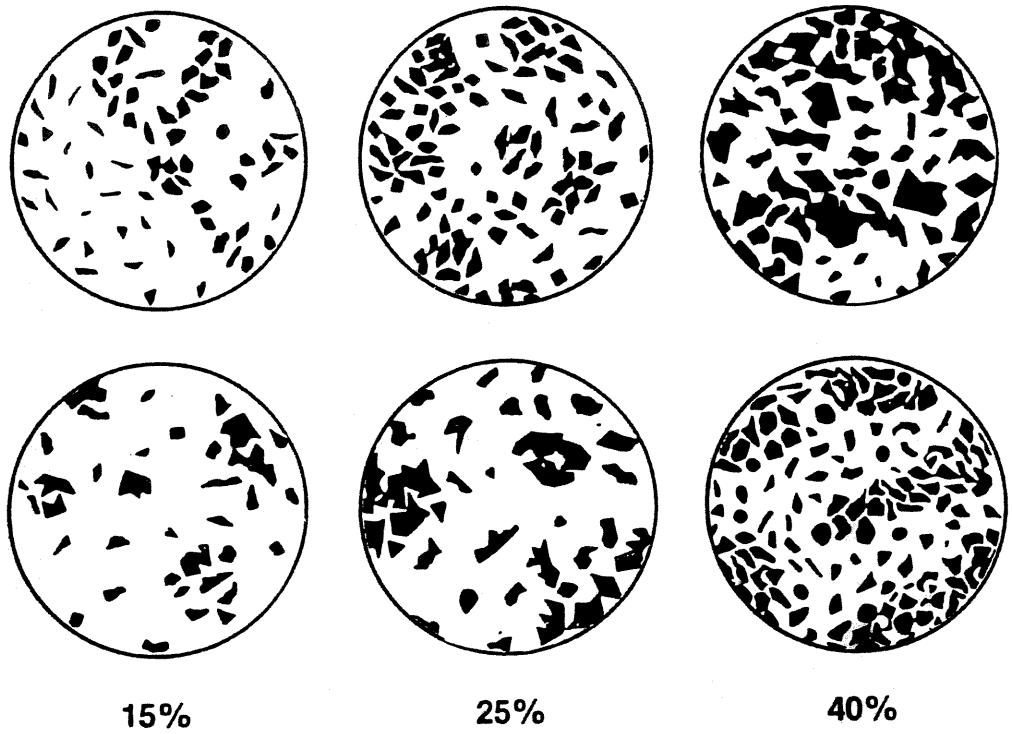
Comparison Chart for Estimating Percentage Composition

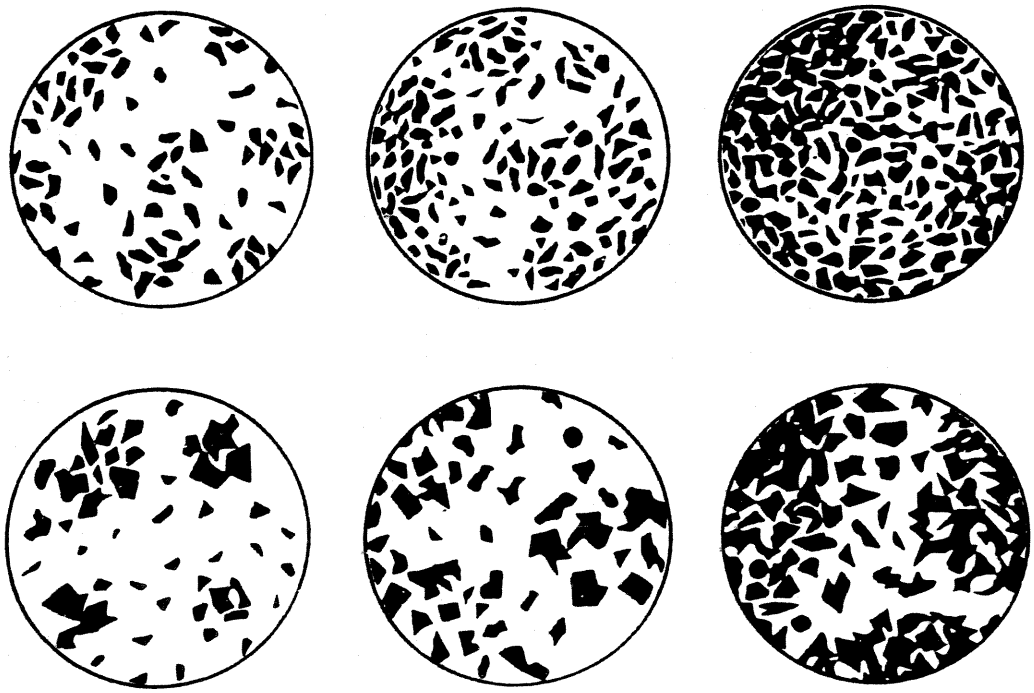
Prepared by Richard D. Terry and George V. Chilingar, Allen Hancock Foundation, Los Angeles. Reprinted from *Journal of Sedimentary Petrography*, v. 25, n. 3, p. 229-234, Sept. 1955.





From AGI Data Sheets compiled by R.V. Dietrich, J.T. ~~Dutro, Jr.,~~ and R.M. Foose, American Geological Institute, 1982.





From AGI Data Sheets compiled by R.V. Dietrich, J.T. Dutro, Jr., and R.M. Foose, American Geological Institute, 1982.

Appendix B

Quality Assurance Project Plan

ARCADIS

Appendix B

Quality Assurance Project Plan

Former Grumman Settling Ponds (Operable Unit 3 – Bethpage Community Park), Bethpage, New York.
NYSDEC Site # 1-30-003A

Revised: March 8, 2006

ARCADIS

Donna M. Brown
Project Scientist/QA Officer

Carlo San Giovanni
Project Manager

Michael F. Wolfert
Project Director

Appendix B
Quality Assurance Project Plan, Former Grumman Settling Ponds (Operable Unit 3 – Bethpage Community Park), Bethpage, New York
NYSDEC Site # 1-30-003A.
Revised: March 8, 2006

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Our Ref.:
NY001348.0706.00002

Date:
8 March 2006

Tables

Attachments

1. Introduction

This Quality Assurance Project Plan (QAPP) has been prepared by ARCADIS with input from Dvirka & Bartilucci Consulting Engineers (D&B) on behalf of Northrop Grumman Systems Corporation (NGSC), as a component of the Remedial Investigation (RI)/Feasibility Study (FS) Work Plan for the Former Grumman Settling Ponds site (Operable Unit 3 – Bethpage Community Park) in Bethpage, New York (NYSDEC Sites Number 1-30-003A) to address specific quality control (QC) checks and quality assurance (QA) auditing processes.

The overall QAPP objective is to ensure that data produced as a result of the various sampling and monitoring, including soil, groundwater, and soil gas is of the highest quality. This QAPP has been prepared in accordance with the United States Environmental Protection Agency (USEPA) guidance, "Guidance for Quality Assurance Project Plans," (USEPA 2002), The New York State Department of Environmental Conservation (NYSDEC) Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC 2002), and considering requirements of the July 4, 2005 Operable Unit 3 Order on Consent (NYSDEC 2005). This QAPP presents project organization and responsibilities, and QA/QC protocols related to field sampling and analysis activities associated with various sampling and monitoring requirements. The procedures in this QAPP will be implemented to ensure that precision, accuracy, representativeness, completeness, and comparability (PARCC parameters) of the data can be documented, as applicable.

This QAPP is part of the Sampling and Analysis Plan (SAP) which is the umbrella document that consists of Appendices A through D of the RI/FS Work Plan. The SAP includes the following required elements:

- The FSP (Appendix A) defines sampling and data gathering methods consistent with NYSDEC DER-10 and the "Field Methods Compendium," OSWER Directive 9285.2-11 (draft June 1993).

- This QAPP (Appendix B) describes the quality assurance and quality control protocols necessary to achieve the initial data quality objectives.

- The HASP (Appendix C) protects persons at and near the site during performance of the RI/FS (in accordance with 29 CFR 1910).

- The CPP (Appendix D) was developed in accordance with New York Environmental Conservation Law, hazardous waste site regulations (6 NYCRR Part 375) and Citizens Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook (NYSDEC1998).

In addition to the above, the components of the SAP are also consistent with the requirements of NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC 2002). Various cross-references to other portions of the SAP are included, as appropriate in the following Sections.

2. Site Description and Background

The Former Grumman Settling Ponds Site (Operable Unit 3 – Bethpage Community Park) is located on Stewart Avenue in Bethpage, Nassau County, New York and is situated adjacent to the northeastern portion of the NGSC Bethpage Facility site. The Park property was donated by NGSC to the Town of Oyster Bay in 1962. Soon afterwards, the current park structures were constructed by the Town, without Grumman involvement. Former activities are described in the December 2003 report prepared by Dvirka & Bartilucci (Dvirka & Bartilucci, 2003). The Park is approximately 18 acres in size and is currently owned by the Town of Oyster Bay and operated as the Bethpage Community Park (Park). The Park is bordered by the Cherry Avenue Extension and a Robert Plan Company building to the north, Stewart Avenue to the east, the NGSC Plant 24 access road to the south, and another Robert Plan Company building (former NGSC Plant 24) and the McKay Field property (owned by NGSC) to the west. The north campus of the NGSC property and the Naval Weapons Industrial Plant (NWIRP) sites are located west of the Site. The Former Occidental Chemical Corporation (OCC) RUCO Polymer Corporation (RUCO) site is located further west (RI/FS Work Plan Figure 1).

Activities planned for OU3 consist of the RI of groundwater, soil, and soil gas contaminants of potential concern (COPCs), at and near the former Grumman Settling Ponds Site, planning and preparation for evaluation of Interim Remedial Measure (IRM) remedial technologies. The following techniques will be used to collect data to determine the nature and extent of groundwater, soil, and soil gas impacts associated with former site operations, as well as to obtain preliminary information toward design of a potential IRM.

- Soil borings and soil sampling,
- Geophysical surveys,

- Test Pits and soil sampling (if needed),
- Soil gas and ambient air sampling,
- Temporary wells groundwater sampling,
- Hydropunch groundwater sampling,
- Permanent well groundwater sampling, and
- Piezometers perched water sampling.

In addition to the above, cone penetrometer testing (CPT)/membrane interface probe (MIP) methodologies may also be used, depending on field conditions.

3. Project Organization and Responsibilities

The responsibilities of the key project personnel are detailed below.

- The Project Director is responsible for overseeing the implementation of the project tasks. The Project Director will review all documents and other correspondence concerning the activities performed pursuant to the NYSDEC Superfund project (i.e., all activities associated with Operable Unit 3). The Project Director is also responsible for the overall QA including technical adequacy of the project activities and reports and conformance to the scope of work.

- The Project Manager is responsible for the following: overall project coordination; adherence to the project schedules; directing, reviewing, and assessing the adequacy of the performance of the Task Managers assigned to the project; implementing corrective action, if warranted; interacting with the Project Director; reviewing reports; and maintaining full and orderly project documentation.

- Task Manager(s) is responsible for the following: field activity QA/QC; task coordination; adherence to the project schedules; directing, reviewing, and assessing the adequacy of the performance of the technical staff and subcontractors assigned to the project; if warranted; interacting with the Project Manager; preparing reports; and maintaining full and orderly project documentation.

- The project team members include the task managers, field hydrogeologists, sampling team/field technicians, engineers, risk assessors, support staff (e.g., data

processors, secretaries, and in-house experts in engineering, etc.) who are qualified to oversee/perform the Work, as appropriate, and will be responsible for work in their respective specialty areas. Project team members will be on-site to supervise all activities specified in this Work Plan.

- The Project QA/QC Officer is responsible for performing systems auditing and for providing independent data quality review of project documents and reports.

- The Site Health and Safety Officer is responsible for implementing the site-specific health and safety directives in the Health and Safety Plan (HASP – see RI/FS Work Plan Appendix C) and for contingency response.

- The Data Validator is responsible for review of laboratory data for compliance with the QA objectives for the PARCC parameters (i.e., precision, accuracy, reproducibility, comparativeness, and completeness), and notifications to the project manager of any QC deficiencies.

4. Quality Assurance/Quality Control – Field Sampling and Analysis Activities

The overall QA objective for this aspect of the project is to develop and implement procedures for field measurements, sampling, and analytical testing that will provide data of known quality that is consistent with the intended use of the information. Generally, the specific field sampling and analysis activities to be conducted during this project which require QA/QC protocols include OU3 RI soil and groundwater sampling (i.e., soil sampling, temporary and permanent well groundwater sampling, perched water sampling, and liquid and solid waste characterization sampling), and soil gas and ambient air sampling.

Quality assurance/quality control (QA/QC) protocols will be used to ensure the PARCC parameters of data collected during these field activities meets the objectives of the overall project. Specifically, data will be gathered or developed using procedures appropriate for the intended use of the data. The field measurements and laboratory analyses will be used to support one or more steps in the monitoring described above.

The QA/QC protocols for this aspect of the project will include laboratory analysis and validation procedures, field decontamination procedures, calibration and maintenance

of field instruments, tracer gas analysis, and QA/QC sampling procedures. The following sections outline the QA/QC protocols for each of these issues.

4.1 Field QA/QC

To ensure that data collected in the field is consistent, accurate and complete, forms will be utilized for repetitive data collection, such as depth to water in wells, groundwater sampling etc. These field forms include a Soil Sample/Core Log; Vertical Profile Boring Groundwater Screening Form; Test Pit Log Form; Monitoring Well Construction Log; Daily Log; Water-Level Measurement Log; a Water Sampling Log, and Soil Gas Sampling Logs, as applicable to a specific field task. Forms are provided in Attachment B-1.

QA/QC samples will be collected to assure quality control of soil and groundwater samples. Analyses of QA/QC samples will enable data evaluation for accuracy and integrity. A QA/QC sample set includes one or more of the following: field (equipment rinsate) blank, trip blank, blind (field) duplicate, and site-specific matrix spike/matrix spike duplicate (MS/MSD), as applicable. The QA/QC sample set will vary depending on the objective of the collected sample as well as the parameter or group of parameters specified for analysis. A summary of the QA/QC samples is provided in Table B-1. In general, blanks and duplicate samples will be used to verify the quality of the sampling results. Demonstrated analyte-free water will be supplied by the laboratory for the preparation of equipment and trip blank QA/QC samples; documentation for the analysis of QA/QC blank water will be provided if contamination is detected in the blanks. A brief description of these QA/QC samples follows.

4.1.1 Field (Equipment Rinsate) Blank

A field (equipment rinsate) blank is a water sample that consists of laboratory-supplied analyte-free water that is poured through or over a decontaminated segment of sampling or other down-hole equipment to assess or document the thoroughness of the decontamination process. A rinsate blank will be collected from the decontaminated down-hole equipment by pouring analyte-free water over the equipment and into sample containers before using the equipment in sampling. Field blanks will be collected as specified in Table B-1. These QA/QC samples will only be collected in connection with the collection of aqueous-phase and soil samples and submitted for the appropriate chemical analysis (see Table B-1).

4.1.2 Trip Blank

A trip blank will contain laboratory supplied analyte-free water and will be transported to the site and returned to the laboratory without opening. This will serve as a check for contamination originating from sample transport, shipping, and from site conditions. One trip blank per day per sampling team will be utilized during groundwater sampling. The maximum number of samples per trip blank is 20. These QA/QC samples will only be collected in connection with the collection of aqueous samples (associated with groundwater sampling) for VOC analysis and submitted for the appropriate chemical analysis (see Table B-1).

4.1.3 Blind (Field) Duplicate

The relative difference in analytical results between samples and their blind duplicates will be used to determine if the data reported by the laboratory meet PARCC requirements. The blind duplicate samples will be assigned fictitious identifications; the correct sample identification number will be recorded on the water sampling log. One blind duplicate sample per 20 groundwater samples will be collected during groundwater sampling activities. These QA/QC samples will be collected in connection with the collection of aqueous and soil gas samples (associated with groundwater sampling) and submitted for the appropriate chemical analysis (see Table B-1). These QA/QC samples will also be collected in connection with the collection of and submitted for the appropriate chemical analysis (see Table B-1).

4.1.4 MS/MSD Sample

Site-specific MS and MSD samples will be collected and submitted to the laboratory as separate samples to provide site-specific matrix-interference data. Upon arrival at the laboratory, the MS/MSD samples will be spiked with appropriate analytes and analyzed by the appropriate method. The purpose of spiking and analyzing the samples is to evaluate any site-specific matrix interference on the analytical results. One MS/MSD sample set will be collected for every 20 samples collected during groundwater and soil sampling activities. These QA/QC samples will only be collected in connection with the collection of aqueous and soil samples for VOC analysis and submitted for the appropriate chemical analysis (see Table B-1).

4.1.5 Field Records

Proper documentation will consist of all field personnel maintaining records of all work accomplished including the items listed below (in addition to the information required on the forms provided in Attachment B-1):

- Date and time of work events;
- Purpose of work;
- Description of methods;
- Description of samples;
- Number and size of samples;
- Description of sampling point;
- Date and time of collection of sample;
- Sample collector's name;
- Field observations; and
- Field measurements with portable instruments.

In addition, for soil gas sampling, the following information will be collected:

- Sample depth;
- Soil gas purge volumes;
- Volume of soil gas extracted;
- Vacuum of canisters before and after samples collected; and
- Apparent moisture content of the sampling zone

All information pertinent to field sampling activities will be recorded on the logs provided in Attachment B-1. Duplicates of field notes/forms will be prepared and kept in a secure place away from the Site.

4.2 Preparation and Preservation of Sample Containers

Laboratory pre-cleaned sample containers will be provided by the laboratory. Each sample container will be provided with a label for sample identification purposes. The information on the label will include a sample identification number, time, date and initials of the sample collector. All sample containers will be accompanied by a full chain-of-custody (see Attachment B-2).

Sample containers will be thoroughly cleaned at the laboratory prior to sampling and as appropriate, sample preservatives will be added to the bottles, prior to sample bottle shipment to the client. It is laboratory practice to preserve sample containers to minimize potential contaminants in the field and to reduce unnecessary sample handling in the field (see laboratory Quality Assurance Plans in Attachment B-3 for additional information). Table B-2 provides a summary of sample analytical methods, sample containers, holding times and preservation procedures to be used.

4.3 Decontamination

Proper decontamination of all sampling equipment will help ensure that the data collected will meet the PARCC requirements. Field decontamination procedures are provided in the FSP, Section 8.

4.4 Sample Custody

To maintain and document sample possession, chain-of-custody procedures will be followed. A chain-of-custody form contains the signatures of individuals who have possession of the samples after collection in the field; the chain-of-custody form is provided in Attachment B-2.

A sample is under custody if it is:

1. In one's actual possession; or

2. In one's view, after being in your physical possession; or

3. Was in one's physical possession and then was locked up or sealed to prevent tampering; or

4. It is in a designated secure place restricted to authorized personnel.

Each person involved with the samples will know chain-of-custody procedures. A detailed discussion of the stages of possession (i.e., field collection, transfer, and laboratory custody) is presented below in the following sections.

4.4.1 Environmental Samples Chain-of-Custody

The laboratory begins the chain-of-custody procedure with the preparation of the sample bottles. The field sampler continues the chain-of-custody procedure in the field and is the first to sign the form upon collection of samples. The field sampler is personally responsible for the care and custody of the samples until they are transferred and properly dispatched. Each sample will have sample labels completed (using waterproof ink), have proper preservation, and be packaged to preclude breakage during shipment. Every sample will be assigned a unique identification number that is entered on the chain-of-custody form. Samples can be grouped for shipment using a single form.

4.4.2 Transfer of Custody and Shipments

All samples will be accompanied by a chain-of-custody record. When transferring the possession of samples, the individual(s) relinquishing and receiving will sign, date, and note the time of transfer on the chain-of-custody form. This record documents transfer of custody of samples from the sampler to another person to the analytical laboratory.

Samples will be properly packed for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in each sample cooler. All chemical analytical samples will be delivered to the laboratory within 48 hours of collection or earlier, as needed, to meet analyte holding times.

Whenever samples are split with a facility or government agency, a separate chain-of-custody record will be prepared for those samples and marked to indicate with whom the samples were split.

4.4.3 Laboratory Sample Custody

The laboratory utilized for chemical analysis will have standard operating procedures for documenting receipt and tracking of samples and compilation of sample data. Sample custody, related to sampling procedures and sample transfer, is described below:

(1) Shipping or pickup of cooler by sampling personnel.

(2) Cooler packed at the laboratory after contact with sampling personnel.

(3) Cooler wrapped with evidence tape.

4.4.4 Field Chain of Custody

(1) Chain-of-Custody form filled out by field sampling personnel.

(2) Field sampling personnel supply evidence tape and seal cooler prior to shipment back to the laboratory.

4.4.5 Laboratory Sample Custody

(1) Samplers check for any external damage (such as leaking).

(2) Samplers sign the waybill for sending cooler to the laboratory.

(3) The laboratory receives cooler and completes chain of custody.

The samples will be stored at the proper temperature prior to analysis. It is the responsibility of the laboratory to properly dispose of samples beyond the holding period.

4.5 Laboratory Analyses

All soil, soil gas/air and groundwater samples will be analyzed by a NYSDOH-approved laboratory.

Soil samples will be analyzed by a NYSDOH-approved laboratory. Soil samples will be selectively analyzed for TCL VOCs, SVOCs, cadmium (Cd)/chromium (Cr),

polychlorinated biphenyls (PCBs), and TOC using the methods specified in Table B-2. Analytes are provided in Tables B-3A to B-3C.

Groundwater samples will be analyzed for Target Compound List (TCL) VOCs (including Freon 113 under NYSDEC Analytical Services Protocol (ASP) 2000 Method OLM 4.2. The analytical laboratory will also conduct a library search of up to 10 tentatively identified compounds (TICs). Selected samples may be analyzed for semi-volatile organic compounds (SVOCs) (NYSDEC ASP Method OLM 4.2), Total Organic Carbon (TOC) (USEPA Method 9060), perchlorate (USEPA Method 314.0), Target Analyte List (TAL) Metals (NYSDEC ASP Method ILM 4.0), and biogeochemical/wet chemistry parameters (i.e., ethane, ethene, methane, alkalinity, nitrate, nitrite, sulfate, chloride, total iron, total manganese, dissolved iron, dissolved manganese, ammonia, orthophosphate, hardness, and total dissolved solids) using the methods specified in Table B-2. Analytes are provided in Tables B-3A to B-3C.

Soil gas samples will be analyzed for a selected list of site-related VOCs by a NYSDOH-approved laboratory using USEPA Method TO-15 (see Tables B-2 and B-4).

Tables B-3A, B-3B, B-3C, and B-4 summarize the list of parameters to be analyzed for in soil/solid, soil gas/air, and aqueous samples (i.e., perched water groundwater) along with the respective required quantitation limits for the following groups of analytes: VOCs, SVOCs, TOC, perchlorate, metals, and biogeochemical parameters. Geotechnical parameters will be determined during the course of RI activities and samples will be analyzed using the appropriate method under the American Society for Testing and Materials (ASTM).

The internal laboratory Standard Operating Procedures (SOPs) and QA/QC procedures are described in the individual laboratory facility Quality Assurance Plans (QAPs), independent plans provided by the analytical laboratory. Laboratory QAPs are provided in Attachment B-3.

4.6 Laboratory Reporting

The laboratory will provide a NYSDEC Category B deliverable (unless otherwise unavailable or specified) for the sampling effort within two weeks of receipt of samples. Additional documentation may be required from the laboratory based on the results of the data evaluation.

4.7 Data Validation

Data validation is the process in which analytical data generated by the laboratory are evaluated against a specific set of requirements and specifications, and determinations of data usability and limitations are made. The Data Validator examines the criteria pertaining to analytical data generated in accordance with Contract Laboratory Program (CLP) protocols from four perspectives, as follows:

- Technical requirements.
- Contractual requirements.
- Determination of compliance.
- Determination and action of how to define the usability or qualify the data.

Validation of the organic data will be performed on 5 percent of the data (20 percent of the Phase 2A soil RI data) following the QA/QC criteria set forth in the NYSDEC ASP, June 2000 and DER-10, and the USEPA CLP National Functional Guidelines for Organic Data Review, (USEPA 2001;2003). Validation of the inorganic data will be performed on 5 percent of the data (20 percent of the Phase 2A soil RI data) following the QA/QC criteria set forth in the NYSDEC ASP, June 2000 and DER-10 (NYSDEC 2002), and the USEPA CLP National Functional Guidelines for Inorganic Data Review, (USEPA 2004).

Groundwater and soil samples associated with sampling of monitoring wells and VPBs, soil samples associated with soil borings, waste characterization samples (liquid or solid-phase), and soil gas samples associated with sampling of soil gas points (SVPs) will require a NYSDEC Category B deliverable.

The NYSDEC Category B deliverable data review will include checking the following:

- Chain-of-custody forms.
- Holding times.
- GC/MS Instrument Performance checks.
- Instrument calibration.

- Trip and/or laboratory (method) blank-detected constituents.
- Surrogate spike recoveries.
- Matrix spike/spike duplicate precision and accuracy.
- Internal standards.
- Check for transcriptions between quantitation reports and Form I's.
- Blind duplicate precision.

Final validation of data obtained during the field sampling and analysis activities will be performed by the Data Validator. The laboratory deliverables will be reviewed for accuracy, precision, completeness, and overall quality of data. All laboratory data will be reviewed for adherence to method-specific QA/QC guidelines and to the data validation guidelines that are described above. If specific data quality issues arise based on the data validation and review guidelines described above, the data validation and review process may be expanded, as warranted, in order to address the specific data quality issue. Any additional validation performed will continue to be performed until the specific data quality issue is resolved.

4.8 Data Usability

The Data Validator for the project will review the analytical data for usability including determining if the data are accurate, precise, representative, complete, and comparable. The review of the analytical results will include checking chain-of-custody forms, sample holding times, blank contamination, spike recoveries, surrogate recoveries, internal standard, and precision of duplicate sample analysis, and laboratory control samples (as appropriate). This review will be used to classify the data as valid, usable, or unusable. Valid data will indicate that all QA/QC review criteria have been met and are acceptable (as per details outlined in the preceding section). Data will be characterized as usable when QA/QC parameters are marginally outside acceptable limits (example: sample holding times were slightly exceeded) where the data may be questionable, but still usable within limitation. Unusable data will be data that are observed to have gross errors or analytical interference that would render the data invalid for any purpose.

The data usability summary report (DUSR) will be prepared at the conclusion of validation.

4.9 Performance and System Audits

Performance and system audits will be performed on a periodic basis, as appropriate, to ensure that the work is implemented in accordance with the approved project SOPs and in an overall satisfactory manner. Examples of audits that will be performed during the project activities are as follows:

- The field personnel will supervise and check, on a daily basis during sampling activities, that monitoring well integrity is intact; that field measurements are made accurately; that equipment is thoroughly decontaminated; that samples are collected and handled properly; and that all field work is accurately and neatly documented.

- On a timely basis, the data packages submitted by the laboratory will be checked for the following information: that all requested analyses were performed; that sample holding times were met; that the data were generated through the approved methodology with the appropriate level of QC effort and reporting; and that the analytical results are in conformance with the prescribed acceptance criteria. The quality and limitations of the data will be evaluated based on these factors.

- The project manager will oversee the field personnel and check that the management of the acquired data proceeds in an organized and expeditious manner.

- Audits of the laboratory are performed on a regular basis by regulatory agencies. Audits are discussed in the laboratory Quality Assurance Plan. (Attachment B-3).

4.10 Preventive Maintenance

ARCADIS has established a program for the maintenance of field equipment to ensure the availability of equipment in good working order when and where it is needed, as indicated, in the following examples:

- An inventory of equipment, including model and serial number, quantity, and condition will be maintained. Each item will be tagged and signed out when in use and, its operating condition and cleanliness will be checked upon return. Routine checks will be made on the status of equipment, and spare parts will be stocked. An equipment manual library will also be maintained.

- The field personnel are responsible for making sure that the equipment is tested, cleaned, charged, and calibrated in accordance with the manufacturer's instructions before being taken to the field.

The laboratory also follows a well-defined program to prevent the failure of laboratory equipment and instrumentation. This preventive maintenance program is described in the laboratory Quality Assurance Plan. (Attachment B-3).

5. References

Dvirka & Bartilucci, 2003. Town of Oyster Bay Bethpage Community Park Investigation Sampling Program, Bethpage, New York. December 2003.

New York State Department of Environmental Conservation, 2005, Order on Consent Index # W1-0018-04-01, Site # 1-30-003A, July 4, 2005.

New York State Department of Environmental Conservation, 2002, Draft DER-10 Technical Guidance for Site Investigation and Remediation.

New York State Department of Environmental Conservation, 1998. Citizens Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook

U.S. Environmental Protection Agency (USEPA). 2004. CLP National Functional Guidelines for Inorganic Data Review, October 2004.

U.S. Environmental Protection Agency (USEPA). 2003. Index to EPA Test Methods. April 2003; revised edition.

U.S. Environmental Protection Agency (USEPA), 2002. EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, EPA/240/R-02/009.

U.S. Environmental Protection Agency (USEPA), 2001. Region II RCRA and CERCLA Data Validation Standard Operating Procedures (SOPs), CLP Organics Data Review and Preliminary Review, SOP HW-6, Revision 12, March 2001. March 2001.

U.S. Environmental Protection Agency (USEPA). 1999. CLP National Functional Guidelines for Organic Data Review, October 1999.

Table B-1. Quality Assurance/Quality Control Sample Summary, Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Former Grumman Settling Ponds, Bethpage, New York.

Matrix	Sampling Event	Sample Location/ Sample Point	Parameters [1]	Frequency	Estimated Sample Quantity per Event [4]	Estimated Field Blanks per Event (*)	Estimated Trip Blanks per Event [3]	Estimated Field Duplicates per Event (**)	Estimated MS/MSD [2] per Event
Phase 1 Remedial Investigation (completed by ARCADIS)									
Aqueous	Vertical Profile Borings	Phase 1 / VP-1 to VP-12	VOCs	Remedial Investigation	60	20	22	3	3
Aqueous	Vertical Profile Borings	Phase 1A / VP13 to VP-20	VOCs	Remedial Investigation	41	16	18	2	2
Aqueous	Vertical Profile Borings	Phase 1B / VP-21 to VP-33 (excluding VP-31)	VOCs	Remedial Investigation	59	11	12	3	3
			SVOCs		36	6	0	1	0
Soil	Vertical Profile Borings	Phase 1 / VP-2 to VP-8	TOC	Remedial Investigation	7	0	0	0	0
Soil	Vertical Profile Borings	Phase 1A / VP14 and VP-16	TOC	Remedial Investigation	6	0	0	0	0
Soil	Vertical Profile Borings	Phase 1B / VP-21 to VP-33 (excluding VP-31)	VOCs	Remedial Investigation	26	0	0	0	2
			SVOCs		16	0	0	0	0
			TOC		17	0	0	0	1
Phase 2 Remedial Investigation (Proposed - ARCADIS and Dvirka & Bartilucci)									
Soil***	Soil Borings	Phase 2A (see RI/FS Workplan Tables 3, 4, and 5)	VOCs [7]	Remedial Investigation	178	TBD	TBD	9	9
			SVOCs [7]		196	TBD	0	10	10
			Cd/Cr		3	TBD	0	0	0
			PCBs		274	TBD	0	0	0
Soil*****	Soil Borings	Phase 2B / CL-1 through CL-14 (See RI/FS Work Plan Table 1 and 5)	VOCs	Remedial Investigation	28	TBD	TBD	2	2
			TOC		28	0	0	0	0
			Physical Parameters [8]		7	0	0	0	0
Aqueous (groundwater)	Groundwater Quality Sampling of Monitoring Wells	Phase 2 CAMW-1 through CAMW-4/ B30MW-1, BCPMW-2 and BCPMW-3 (on-site); HN-40S, HN-40I, HN-42S, and HN-42I (off-site)	VOC	Remedial Investigation/IRM Pre-Design (Per Event)	11	3	TBD	1	1
			Metals		7	0	0	0	0
			ClO_4^-		11	0	0	0	0
			BioGeo [6]		7	0	0	0	0
			SVOCs		6	0	0	0	0
Aqueous (perched water)	Perched Water Quality Sampling from Piezometers	Phase 2 On-site Piezometers PZ-1 through PZ-5	VOC	Remedial Investigation (Per Event)	1	1	TBD	1	1
			Metals		1	1	0	1	0
			ClO_4^-		1	1	0	1	0
			BioGeo [6]		1	1	0	1	0
Aqueous (groundwater)	Vertical Profile Borings	Phase 2 On-site VPBs VP-3A, VP-19A, VP-27A. VP-3B, and VP-3C	VOC	Remedial Investigation****	13	TBD	TBD	1	1
			TOC		13	TBD	0	1	0
			Metals		13	TBD	0	1	0
			ClO_4^-		13	TBD	0	1	0
			BioGeo [6]		13	TBD	0	1	0
Aqueous (groundwater)	Vertical Profile Borings	Phase 2 Off-site VPBs / VP-100 through VP-108 (VP-102 to VP-104 are contingency VPBs)	VOC	Remedial Investigation****	TBD	TBD	TBD	TBD	TBD
			ClO_4^-		TBD	TBD	TBD	TBD	TBD
Soil Gas	Soil Gas/Ambient Air	Phase 2 On-site/ SVP-5 through SVP-10, Ambient Air	VOCs	Remedial Investigation	19	0	0	1	0
Soil Gas	Soil Gas/Ambient Air	Phase 2 Off-site/ SVP-100 through SVP-107, Ambient Air	VOCs	Remedial Investigation	13	0	0	1	0
Non-Aqueous Phase Liquid [9]	IF Encountered	Phase 2 Piezometers	TBD	Remedial Investigation	TBD	TBD	TBD	TBD	TBD
Solid/Aqueous (soil/water)	Waste Characterization	Grab	Varies [5]	Remedial Investigation	TBD	TBD	TBD	TBD	TBD

See next page for footnotes.

Table B-1. Quality Assurance/Quality Control Sample Summary, Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Former Grumman Settling Ponds, Bethpage, New York.

(1) Analyses will be performed in accordance with NYSDEC Analytical Services Protocol (ASP), or USEPA methods by a CLP-certified NYSDOH-approved laboratory, with the exception of physical properties, which will conform to ASTM Standards.

(2) Matrix spike/matrix spike duplicate (MS/MSD) analysis is performed on a site sample and therefore is not counted as separate samples.
For MS/MSDs, triple sample volume will be provided. MS/MSD sample sets collected at a frequency of one per 20 samples of the same matrix and will accompany the associated site sample during shipment.

(3) Trip blanks will be provided by the analytical laboratory and will accompany VOC samples as they are collected and during shipment. Trip blanks collected at a frequency of one per day. A trip blank will accompany the other samples collected the same day. The maximum number of samples per trip blank is 20.

(4) Sample count will depend on number of locations and number of samples collected per location.

(5) Waste characterization sample analysis will depend on generator knowledge and the requirements of the receiving facility.

(6) BioGeoChemical (BioGeo) sampling includes collection of field parameters (pH, specific conductance, temperature and sulfide) and the following laboratory analyses:
dissolved gases: (ethane and ethene and methane), alkalinity, nitrate, nitrite, sulfate, chloride, total iron, total managanese, dissolved iron and dissolved manganese. Selected wells will also be sampled for ammonia, hardness (as CaCO3), orthophosphate, TDS, and TOC. Samples will be submitted to Microseeps of Pittsburgh, Pennsylvania (dissolved gases only) and Severn Trent of Shelton, Connecticut.

(7) Additional samples will be taken If PID readings above background concentrations are detected. The soil sample exhibiting the highest PID reading, as well as the deepest soil sample collected from that boring, will be analyzed for VOC's and SVOC's. In addition, any soil sample exhibiting a PID reading of 50ppm or greater above background concentrations will also be analyzed for VOC's and SVOC's.

(8) Samples collected via Shelby Tube and submitted for analysis for porosity, bulk density, vertical permeability, moisture content, and fraction organic carbon by TetraTech/Woodward Clyde Consultants, Totowa, New Jersey.

(9) If non-aqueous phase liquid is encountered, a sample will be collected for fingerprinting and physical property analyses, to be determined.

* One field blank collected per day every time non-dedicated (i.e., disposable or reusable) sampling equipment (i.e., split-spoons, pumps and/or bailers) is used.

** A field (blind) duplicate will be collected at a frequency of one per 20 samples of the same matrix.

*** Soil boring Quality Assurance/Quality Control Summary obtained from Dvirka & Bartilucci.

**** Event for the purpose of sample collection - an event is considered one vertical profile boring.

***** If the CPT/MIP methodology is selected, then the actual number of borings drilled, samples collected, and analytical parameters selected will be modified, as appropriate.

MS/MSD	Matrix spike/matrix spike duplicate
VOCs	Volatile organic compounds
SVOCs	Semi volatile organic compounds
Cd/Cr	cadmium/chromium
TOC	Total Organic Carbon
TAL	Target Analyte List of Metals
USEPA	U.S. Environmental Protection Agency
NYSDEC	New York State Department of Environmental Conservation
TBD	To be determined
ASTM	American Society for Testing and Materials
CPT	Cone Penetrometer Testing
MIP	Membrane Interface Probe
IRM	Interim Remedial Measure
TDS	Total Dissolved Solids

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Table B-2. Summary of Sample Containers, Analytical Methods, Preservation, and Holding Times, Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Former Grumman Settling Ponds, Bethpage, New York.

Matrix	Monitoring Program	Parameters (1)	Analytical Laboratory Methodology	Sample Containers	Preservation	Holding Time
Aqueous (groundwater)	VPB / Groundwater Quality Samples / Perched Water Samples	VOCs	NYSDEC ASP 2000 Method OLM 4.2	Two (2) 40 mL glass with Teflon-lined septa	Cool 4 degrees C, HCl to pH<2	10 days VTSR
		SVOCs	NYSDEC ASP 2000 Method OLM 4.2	Two (2) 1-L amber	Cool 4 degrees C	5 days to extract, then 40 days VTSR to analyze
		TAL Metals	NYSDEC ASP 2000 Method ILM 4.0	One (1) 500 mL plastic	HNO_3 to pH <2	28 Days; Hg 180 days - ICAP
		Ethane and Ethene	AM20GAX	Two (2) 40 mL glass with Teflon-lined septa	None	14 days
		Methane (CH_4)	AM20GAX	Two (2) 40 mL glass with Teflon-lined septa	None	14 days
		Alkalinity	USEPA Method 310.1	(1) 500 mL, plastic	Cool 4 degrees C	14 days
		Ammonia	USEPA Method 350.1	(1) 500 mL, plastic	Cool 4 degrees C, H_2S0_4 to pH<2	28 days
		Hardness (As $CaCO_3$)	USEPA Method 130.2	(1) 500 mL, plastic	Cool 4 degrees C, HNO_3 to pH<2	6 months
		Orthophosphate	USEPA Method 365.2	(1) 500 mL, plastic	Cool 4 degrees C	48 hours
		TDS	USEPA Method 160.1	(1) 500 mL, plastic	Cool 4 degrees C	7 days
		Nitrate (NO_3)	USEPA Method 300.0	(1) 1,000 mL, plastic	Cool 4 degrees C	48 hours
		Nitrite (NO_2)	USEPA Method 300.0	(1) 1,000 mL, plastic	Cool 4 degrees C	48 hours
		Sulfate (SO_4)	USEPA Method 300.0	(1) 1,000 mL, plastic	Cool 4 degrees C	28 days
		Chloride (Cl)	USEPA Method 300.0	(1) 1,000 mL, plastic	Cool 4 degrees C	28 days
		Total Iron	NYSDEC ASP 2000 Method ILM 4.0	(1) 500 mL, plastic	HNO_3 to pH <2	28 days
		Total Manganese	NYSDEC ASP 2000 Method ILM 4.0	(1) 500 mL, plastic	HNO_3 to pH <2	28 days
		Dissolved Iron	NYSDEC ASP 2000 Method ILM 4.0	(1) 500 mL, plastic	HNO_3 to pH <2	28 days

See last page for footnotes.

Table B-2. Summary of Sample Containers, Analytical Methods, Preservation, and Holding Times, Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Former Grumman Settling Ponds, Bethpage, New York.

Matrix	Monitoring Program	Parameters (1)	Analytical Laboratory Methodology	Sample Containers	Preservation	Holding Time
		Dissolved Manganese	NYSDEC ASP 2000 Method ILM 4.0	(1) 500 mL, plastic	HNO_3 to pH <2	28 days
		TOC	USEPA Method 9060	Two (2) 40 mL glass with Teflon-lined septa	Cool 4 degrees C, H_2SO_4 to pH <2	28 days
		Perchlorate	USEPA Method 314.0	(1) 500 mL, Plastic	Cool 4 degrees C	28 days
Soil	VPB / Soil Borings*** / Shallow Soil Borings	VOCs	NYSDEC ASP 2000 Method OLM 4.2	One (1) 2 oz. glass	Cool 4 degrees C	10 days VTSR
		SVOCs	NYSDEC ASP 2000 Method OLM 4.2	One (1) 4 oz. glass	Cool 4 degrees C	10 days to extract, then 40 days VTSR to analyze
		Cd/Cr	NYSDEC ASP 2000 Method ILM 4.0	One (1) 4 oz. Glass	Cool 4 degrees C	6 months
		PCBs	NYSDEC ASP 2000 Method OLM 4.2	One (1) 4 oz. Glass	Cool 4 degrees C	10 days to extract, then 40 days VTSR to analyze
		TOC	USEPA Method 9060	One (1) 8 oz Glass	Cool 4 degrees C	28 days
Soil Gas	Soil Gas/Ambient Air	VOCs	USEPA Method TO-15	6L SUMMA, one (1) cannister	NA	28 days
Soil/Water	Waste Characterization (2)	Varies	Varies	Varies	Varies	Varies
Soil	Geotechnical	Varies	Varies	Varies	Varies	Varies

See last page for footnotes.

Table B-2. Summary of Sample Containers, Analytical Methods, Preservation, and Holding Times, Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Former Grumman Settling Ponds, Bethpage, New York.

(1)	Refer to Tables B-3 and B-4 for specific analyte lists for analyses of aqueous and soil vapor samples, respectively.
(2)	Waste characterization sample analysis will depend on generator knowledge and the requirements of the receiving facility.
USEPA	U.S. Environmental Protection Agency
NYSDEC	New York State Department of Environmental Conservation
ASP	Analytical Services Protocol
C	Celsius
L	Liter
HNO_3	Nitric Acid
mL	Milli-liter
NA	Not applicable
VOCs	Volatile organic compounds (including Freon 113)
Cd/Cr	Total cadimum/chromium
SVOCs	Semivolatile organic compounds
VTSR	Verified Time of Sample Receipt at lab.
TOC	Total Organic Carbon
***	Soil boring Quality Assurance/Quality Control Summary obtained from Dvirka & Bartilucci (2005).

Table B-3A. Analyte List for Solid and Aqueous Sample Analysis (VOCs and TOC), Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Former Grumman Settling Ponds, Bethpage, New York.

Method:	NYSDEC ASP 2000 OLM 4.2	NYSDEC ASP 2000 OLM 4.2
Matrix/Sample Type:	Aqueous/Groundwater & Water	Soil/Solid
Constituent [1]	Contract-Required Quantitation Limits (ug/L)	Contract-Required Quantitation Limits (ug/kg)
VOCs:		
Chloromethane	5	10
Bromomethane	5	10
Vinyl Chloride	2	10
Chloroethane	5	10
Methylene chloride	5	10
Acetone	50	10
Carbon disulfide	50	10
1,1-Dichloroethene	5	10
1,1-Dichloroethane	5	10
cis-1,2-Dichloroethene	5	10
trans-1,2-Dichloroethene	5	10
2-Butanone	50	10
Chloroform	7	10
1,2-Dichloroethane	5	10
1,1,1-Trichloroethane	5	10
Carbon tetrachloride	5	10
Bromodichloromethane	50	10
1,2-Dichloropropane	5	10
cis-1,3-Dichloropropene	5	10
Trichloroethene	5	10
Benzene	0.7	10
Dibromochloromethane	5	10
trans-1,3-Dichloropropene	5	10
1,1,2-Trichloroethane	5	10
Bromoform	50	10
4-Methyl-2-pentanone	50	10
2-Hexanone	50	10
Tetrachloroethene	5	10
1,1,2,2-Tetrachloroethane	5	10
Toluene	5	10
Chlorobenzene	5	10
Ethylbenzene	5	10
Styrene	5	10
Xylene (total)	5	10
Freon 113	5	10

See next page for Notes and Abbreviations.

Table B-3A. Analyte List for Solid and Aqueous Sample Analysis (VOCs and TOC), Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Former Grumman Settling Ponds, Bethpage, New York.

Method:	Groundwater Sampling USEPA 9060	Soil Sampling USEPA 9060
Matrix/Sample Type:	Aqueous/Groundwater & Water	Soil/Solid
Constituent [1]	Contract-Required Quantitation Limits (ug/L)	Contract-Required Quantitation Limits (ug/kg)
Total Organic Carbon	1	100

Notes and Abbreviations:

* CRQLs/RQLs are the same for groundwater samples (environmental monitoring) and for water samples (waste characterization sampling).

(1) Listed constituents represent Target Compound List (TCL) volatile organic compounds (VOCs), plus Freon 113 (also known as trichlorotrifluoroethane or 1,1,2-trichloro-1,2,2-trifluoroethane).

VOCs	Volatile organic compounds
TOC	Total Organic Carbon
USEPA	U.S. Environmental Protection Agency
NYSDEC	New York State Department of Environmental Conservation
ASP	Analytical Services Protocol
CRQLs	Contract-Required Quantitation Limits
RQLs	Required Quantitation Limits
ug/L	micrograms per liter
ug/kg	micrograms per kilogram

Table B-3B. Analyte List for Solid and Aqueous Sample Analysis (SVOCs), Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Former Grumman Settling Ponds, Bethpage, New York.

Method:	NYSDEC ASP 2000 OLM 4.2	NYSDEC ASP 2000 OLM 4.2
Matrix/Sample Type:	Aqueous/Groundwater	Soil/Solid
Constituent [1]	Required Quantitation Limits (ug/L)	Required Quantitation Limits (ug/kg)
SVOCs:		
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
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-Dimethylphenol	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-Methylnapthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	25	800
2-Chloronaphthalene	10	330
2-Nitroaniline	25	800
Dimethylphthalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitroaniline	25	800
Acenaphthene	10	330
2,4-Dinitrophenol	25	800
4-Nitrophenol	25	800
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphthalate	10	330
4-chlorophenyl(phenyl) ether	10	330
Fluorene	10	330
4-Nitroaniline	25	800
4,6-Dinitro-2-methylphenol	25	800
N-Nitrosodiphenylamine (1)	10	330

See next page for Notes and Abbreviations.

Table B-3B. Analyte List for Solid and Aqueous Sample Analysis (SVOCs), Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Former Grumman Settling Ponds, Bethpage, New York.

Method:	NYSDEC ASP 2000 OLM 4.2	NYSDEC ASP 2000 OLM 4.2
Matrix/Sample Type:	Aqueous/Groundwater	Soil/Solid
Constituent [1]	Required Quantitation Limits (ug/L)	Required Quantitation Limits (ug/kg)
SVOCs (continued):		
Hexachlorobenzene	10	330
Pentachlorophenol	25	800
Phenanthrene	10	330
Anthracene	10	330
Carbazole	10	330
Di-n-butylphthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butylbenzylphthalate	10	330
3,3'-Dichlorobenzidine	10	330
Benzo(a)anthracene	10	330
Chrysene	10	330
Bis(2-ethylhexyl)phthalate (BEHP)	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
Dibenz(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330
4-bromophenyl-phenylether	10	330
Benzoic acid	10	330
Benzyl alcohol	10	330
Bis(2-chloroisopropyl)ether	10	330

Notes and Abbreviations:

SVOCs	Semivolatile organic compounds
USEPA	U.S. Environmental Protection Agency
RQLs	Required Quantitation Limits
ug/L	micrograms per liter
ug/kg	micrograms per kilogram

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Table B-3C. Analyte List for Analysis of Aqueous Samples (Metals Perchlorate, Biogeochemical/Wet Chemistry Parameters), Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Former Grumman Settling Ponds, Bethpage, New York.

Matrix/Sample Type:	Aqueous/Groundwater	Aqueous/Groundwater	Soil/Solid	Soil/Solid
Constituent	Method	Contract Required Detection Limits (ug/L)	Method	Contract Required Detection Limits (mg/kg)
Inorganics (Metals):				
Aluminum	NYSDEC ILM4.0	200**	Same	258
Antimony	NYSDEC ILM4.0	60	Same	11.7
Arsenic	NYSDEC ILM4.0	10**	Same	8
Barium	NYSDEC ILM4.0	200	Same	2
Beryllium	NYSDEC ILM4.0	5	Same	2
Cadmium	NYSDEC ILM4.0	5**	Same	3
Calcium	NYSDEC ILM4.0	5000	Same	85
Chromium	NYSDEC ILM4.0	10	Same	3
Cobalt	NYSDEC ILM4.0	50	Same	2
Copper	NYSDEC ILM4.0	25	Same	5
Iron	NYSDEC ILM4.0	100	Same	145
Lead	NYSDEC ILM4.0	3**	Same	9
Magnesium	NYSDEC ILM4.0	5000	Same	35
Manganese	NYSDEC ILM4.0	15	Same	2.5
Mercury	NYSDEC ILM4.0	0.2**	Same	0.05
Nickel	NYSDEC ILM4.0	40	Same	5
Potassium	NYSDEC ILM4.0	5000	Same	200
Selenium	NYSDEC ILM4.0	5**	Same	16
Silver	NYSDEC ILM4.0	10	Same	3
Sodium	NYSDEC ILM4.0	5000	Same	94
Thallium	NYSDEC ILM4.0	10**	Same	20
Vanadium	NYSDEC ILM4.0	50	Same	4
Zinc	NYSDEC ILM4.0	20**	Same	20
BioGeochemical/Wet Chemistry:				
Ethane	AM20GAX	5 ng/L*	--	--
Ethene	AM20GAX	5 ng/L*	--	--
Methane (CH_4)	AM20GAX	15 ng/L*	--	--
Alkalinity	USEPA 310.1	0.594 mg/L	--	--
Nitrate (NO_3)	USEPA 300.0	0.002 mg/L	--	--
Nitrite (NO_2)	USEPA 300.0	0.003 mg/L	--	--
Sulfate (SO_4)	USEPA 300.0	0.012 mg/L	--	--
Chloride (Cl)	USEPA 300.0	0.147 mg/L	--	--
Total Iron	USEPA 6010	0.1 mg/L	--	--
Total Manganese	USEPA 6010	0.1 mg/L	--	--
Dissolved Iron	USEPA 6010	0.1 mg/L	--	--
Dissolved Manganese	USEPA 6010	0.1 mg/L	--	--
Ammonia	USEPA 350.1	40	--	--
Hardness (as $CaCo_3$)	USEPA 130.2	1000	--	--
Orthophosphate	USEPA 365.2	100	--	--
TDS	USEPA 160.1	10,000	--	--
Perchlorate:				
Perchlorate	USEPA 314.0	4	--	--

Notes and Abbreviations:

USEPA	U.S. Environmental Protection Agency
RQLs	Required Quantitation Limits
ug/L	micrograms per liter
mg/L	Milligrams per liter
ng/L	Nanograms per liter
ug/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
*	Method quantitation limits reported by Microseeps, Inc., Pittsburgh, PA.
**	MDL Reported in this instance.
--	Not Applicable

Table B-4. Analyte List for Analysis of Soil Gas and Air Samples (VOCs), Quality Assurance Project Plan (QAPP), RI/FS Work Plan, Former Grumman Settling Ponds, Bethpage, New York.

	Method:	USEPA Method TO-15
	Matrix:	Gas/Air
Constituent [1]		Contract-Required Detection Limits ($\mu g/m^3$)
VOCs:		
1,1,1-Trichloroethane		1
1,1,2,2-Tetrachloroethane		1
1,1,2-Trichloroethane		1
1,1-Dichloroethane		1
1,1-Dichloroethene		1
1,2-Dichloroethane		1
1,2-Dichloropropane		1
1,3-Butadiene		1
Acetone		1
Benzene		1
Bromodichloromethane		1
Bromoform		1
Bromomethane		1
Carbon Disulfide		1
Carbon Tetrachloride		1
Chlorobenzene		1
Chloroethane		1
Chloroform		1
Chloromethane		1
cis-1,2-Dichloroethene		1
cis-1,3-Dichloropropene		1
Dibromochloromethane		1
Dichlorodifluoromethane (Freon 112)		1
Ethylbenzene		1
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)		1
Methyl Butyl Ketone (2-hexanone)		1
2-Butanone (MEK)		1
Methyl Isobutyl Ketone (4-Methyl-2-pentanone)		1
Methylene Chloride		1
Styrene		1
Tetrachloroethene		1
Toluene		1
trans-1,2-Dichloroethene		1
trans-1,3-Dichloropropene		1
Trichloroethene		1
Vinyl Chloride		1
Xylene (m,p) [a]		1
Xylene (o)		1

Notes and Abbreviations:

(1) Listed constituents based on Target Compound List (TCL) volatile organic compounds (VOCs), plus Freon 113 (also known as trichlorotrifluoroethane or 1,1,2-trichloro-1,2,2-trifluoroethane), except for acetone, 2-butanone, 4-methyl-2-pentanone, and 2-hexanone.

USEPA U.S. Environmental Protection Agency

$\mu g/m^3$ Milligrams per cubic meter

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Attachment B-1

Field Forms

ARCADIS GERAGHTY & MILLER

Sample/Core Log

Boring/Well _____ Project/No. _____ Page ____ of ____

Site Location _____ Drilling Started _____ Drilling Completed _____

Total Depth Drilled _____ Feet Hole Diameter _____ inches Type of Sample/ Coring Device _____

Length and Diameter of Coring Device _____ Sampling Interval _____ feet

Land-Surface Elev. _____ feet ☐ Surveyed ☐ Estimated Datum _____

Drilling Fluid Used _____ Drilling Method _____

Drilling Contractor _____ Driller _____ Helper _____

Prepared By _____ Hammer Weight _____ Hammer Drop _____ ins.

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description

VERTICAL PROFILE BORING GROUNDWATER SCREENING
OPERABLE UNIT 3 REMEDIAL INVESTIGATION
NORTHROP GRUMMAN CORPORATION
BETHPAGE, NEW YORK

VPB DESIGNATION: _____ **DATE(S):** _____ **SAMPLER:** _____ **Page** _____ **of** _____

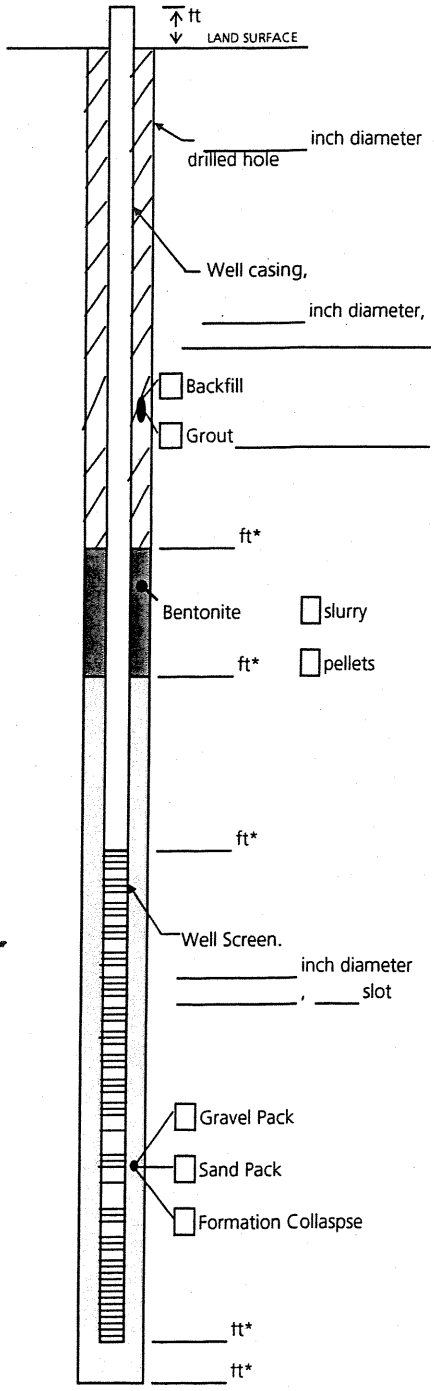
Date	Start Time	Pump Decon Prior to Sampling	Stainless-Steel Screen Depth (ft bls)	Depth to Water (ft bls)	Gallons in Well	Purge Volume (gallons) (3 well volumes)	Total Volume Purged	Initial Sample Appearance	Temperature (C) Purge Volume 1	2	3	pH Purge Volume 1	2	3	Conductivity (umhos/cm) Purge Volume 1	2	3	Final Sample Appearance	Coded Replicate	Time Sampling Completed

ft bls feet below land surface.

ARCADIS G&M, Inc.

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project _____ Well _____

Town/City _____

County _____ State _____

Permit No. _____

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) _____

Drilling Method _____

Drilling Contractor _____

Drilling Fluid _____

_____

Development Technique(s) and Date(s)

_____

_____

_____

Fluid Loss During Drilling _____ gallons

Water Removed During Development _____ gallons

Static Depth to Water _____ feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose _____

_____

_____

Remarks _____

_____

_____

_____

_____

Prepared by _____

ARCADIS GERAGHTY & MILLER

DAILY LOG

Well(s)_____ Project/No._____Page _____of_____

Site Location_____

Prepared By _____

Date/Time	Description of Activities

ARCADIS G&M

Page ______ of ______

Water Level Record

Project ____________________________

Date ____________

Well (s)	Depth to Water (ft)	Time	Remarks

G:\TECHNICL\FIELD LOGS\Water Level Round.XLS- Sheet1

ARCADIS GERAGHTY & MILLER

Water Sampling Log

Project _____ Project No. _____ Page 1 of _____

Site Location _____ Date _____

Site/Well No. _____ Replicate No. _____ Code No. _____

Weather _____ Sampling Time: Begin _____ End _____

Evacuation Data

Measuring Point _____

MP Elevation (ft) _____

Land Surface Elevation (ft) _____

Sounded Well Depth (ft bmp) _____

Depth to Water (ft bmp) _____

Water-Level Elevation (ft) _____

Water Column in Well (ft) _____

Casing Diameter/Type _____

Gallons in Well _____

Gallons Pumped/Bailed Prior to Sampling _____

Sample Pump Intake Setting (ft bmp) _____

Purge Time begin _____ end _____

Pumping Rate (gpm) _____

Evacuation Method _____

Field Parameters

Color _____

Odor _____

Appearance _____

pH (s.u.) _____

Conductivity (mS/cm) _____

(µmhos/cm) _____

Turbidity (NTU) _____

Temperature (°C) _____

Dissolved Oxygen (mg/L) _____

Salinity (%) _____

Sampling Method _____

Remarks _____

Constituents Sampled	Container Description	Number	Preservative

Sampling Personnel _____

Well Casing Volumes

Gal./Ft.				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride
ft	feet	msl	mean sea-level	s.u.	Standard units
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter
mg/L	Miligrams per liter	NR	Not Recorded	VOC	Volatile Organic Compounds

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Soil Gas Sample Log

Sample ID _____ Project/No. _____

Date _____ Sampling Personnel _____

Time _____

Weather _____

Atmos. Pressure _____ Wind Speed: _____

Precipitation?: _____

DESCRIPTION OF SAMPLE LOCATION:

_____ Outdoor

Location _____

Est. depth to water (ft): _____

Soil type: _____

_____

Odor: _____

Color: _____

_____ Indoor

Location _____

Basement: yes / no

Room size ft x ft: _____

Floor material: cement / wood / dirt

Slab Thickness (ft): _____

Visible cracks?: yes / no

Sub-slab material: dirt / gravel

PROBE INSTALLATION:

Date: _____

Method: _____

Diameter: _____

Depth: _____

Packing material: _____

Location Sketch:

PURGE:

Date: _____

Time: _____

Rate: _____

Volume: _____

SAMPLE COLLECTION:

Sample Time: _____

Sample Rate: _____

Sample Volume: _____

Sample Start Time: _____

Sample End Time: _____

CONTAINER VACUUM:

Initial Canister Vacuum: _____

Final Canister Vacuum: _____

CONTAINER DESCRIPTION:

Canister: 6-L Summa

Canister Serial Number: _____

ANALYTICAL METHOD:

_____

Dvirka and Bartilucci CONSULTING ENGINEERS A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.	Project No.: Project Name:	Boring No.: Sheet ___ of ___ . By:
Drilling Contractor: . Driller: Drill Rig: Date Started:	Geologist: Drilling Method: Drive Hammer Weight: Date Completed:	Boring Completion Depth: " Ground Surface Elevation: Boring Diameter:

Depth (ft.)	Soil Sample				Headspace Analysis			Sample Description	USCS
	No.	Type	Blows Per 6"	Rec	FID ppm	PID ppm	CH4 ppm		
-0-									
-1.5'-									
-2-									
-3-									
-4-									
-5-									
-6-									
-7-									
-8-									
-9-									
-10-									

Sample Types:
SS =
ST =
D&M =
UC = Undisturbed Core (Dennison Type)

NOTES:

D&B_BLOG

Dvirka and Bartilucci CONSULTING ENGINEERS A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.	Project No.: Project Name:	Test Pit No.: Sheet of By:
Contractor: Operator: Equipment:	Geologist: Test Pit Method: Date Started: Date Completed:	Test Pit Completion Depth: Ground Surface Elevation: Test Pit Dimension(s):

Weather Conditions:

Depth *(ft.)*	OVA *(ppm)*	PID *(ppm)*	Description of Materials	Remarks
-0-				
-1-				
-2-				
-3-				
-4-				
-5-				
-6-				
-7-				
-8-				
-9-				
-10-				

NOTES:

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Attachment B-2

Chain-of-Custody Form

ARCADIS

Laboratory Task Order No./P.O. No. _____

CHAIN-OF-CUSTODY RECORD

Page ____ of ____

Project Number/Name _____

Project Location _____

Laboratory _____

Project Manager _____

Sampler(s)/Affiliation _____

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	ANALYSIS / METHOD / SIZE						Remarks	Total

Sample Matrix: L = Liquid; S = Solid; A = Air

Total No. of Bottles/ Containers

Relinquished by: _____	Organization: _____	Date ___/___/___	Time _____	Seal Intact?
Received by: _____	Organization: _____	Date ___/___/___	Time _____	Yes No N/A
Relinquished by: _____	Organization: _____	Date ___/___/___	Time _____	Seal Intact?
Received by: _____	Organization: _____	Date ___/___/___	Time _____	Yes No N/A

Special Instructions/Remarks: _____

Delivery Method: ☐ In Person ☐ Common Carrier _____ SPECIFY ☐ Lab Courier ☐ Other _____ SPECIFY

AG 05-12/01

MITKEM CORPORATION
175 Metro Center Boulevard
Warwick, Rhode Island 02886-1755
(401) 732-3400 • Fax (401) 732-3499
email: mitkem@mitkem.com

CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY	PHONE	COMPANY	PHONE	LAB PROJECT #:
NAME	FAX	NAME	FAX	
ADDRESS		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP		CITY/ST/ZIP		
CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:		

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	REQUESTED ANALYSES	COMMENTS
	/									
	/									
	/									
	/									
	/									
	/									
	/									
	/									
	/									
	/									
	/									
	/									

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
		/		/		
		/		/		
		/		/		

WHITE: LABORATORY COPY YELLOW: REPORT COPY PINK: CLIENT'S COPY

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Attachment B-3

Laboratory Quality Assurance Plans (QAP)

SEVERN TRENT LABORATORIES - CONNECTICUT
LABORATORY QUALITY MANUAL
Revision: 6

128 Long Hill Cross Road
Shelton, Connecticut 06484
Phone: (203) 929-8140
Fax: (203) 929-8142

Approved by:

Peter Frick, Laboratory Director — Date: March 22, 2005

Marsha K. Culik, Quality Assurance Manager — Date: March 22, 2005

Table of Contents

Tables

Figures

1. Introduction, Purpose, and Scope

1.1. Severn Trent Laboratories (STL) Overview

Severn Trent Plc is a leading environmental services group providing water, waste and utility services. The businesses include Severn Trent Water, Biffa, Severn Trent Laboratories (STL) and Severn Trent Services.

The corporate vision is to be at the forefront of the environmental services industry. The corporate values of environmental leadership, service and quality define the business culture and strategic direction.

STL offers a broad range of environmental testing services provided by over two thousand professionals in the US. STL's testing capabilities include chemical, physical, and biological analyses of a variety of matrices, including aqueous, solid, drinking water, waste, tissue, air and saline/estuarine samples. Specialty capabilities include air toxics, radiological testing, tissue preparation and analysis, aquatic toxicology, microbiology, Mycology, asbestos, microscopy services, and on-site technologies including mobile laboratory services.

This plan is intended to describe the quality assurance program of the STL-Connecticut facility located at 128 Long Hill Cross Roads, Shelton, Connecticut. STL operates a corporate wide quality assurance program and this facility QA program complies with the requirements set forth in the corporate program.

1.2. Quality Assurance Policy

It is STL's policy to:

- Provide high quality, consistent, and objective environmental testing services that meet all federal, state, and municipal regulatory requirements.
- Generate data that are scientifically sound, legally defensible, meet project objective, and are appropriate for their intended use.
- Provide STL clients with the highest level of professionalism and the best service practices in the industry.
- Build continuous improvement mechanisms into all laboratory, administrative and managerial activities.
- Maintain a working environment that fosters open communication with both clients and staff and ensures data integrity.

1.3. Management Commitment to Quality Assurance

STL management is committed to providing the highest quality data and the best overall service in the environmental testing industry. To ensure that the data produced and reported by STL meet the requirements of its clients and comply with the letter and spirit of municipal, state and federal regulations, STL maintains a Quality System that is clear, effective, well communicated, and supported at all levels in the company.

STL Vision and Mission Statement

Vision

STL will be the recognized industry leader for environmental analysis.

Mission

Through the innovation and dedication of our people, together with the quality of our systems, we will deliver levels of performance that delight our clients, retain the confidence of our stakeholders and enable the profitable growth of our business.

1.4. Purpose

The purpose of this Laboratory Quality Manual (LQM) is to describe the STL-Connecticut Quality System and to outline how that system enables all employees of STL-Connecticut to meet the Quality Assurance (QA) policy. The LQM also describes specific QA activities and requirements and prescribes their frequencies. Roles and responsibilities of management and laboratory staff in support of the Quality System are also defined in the LQM. In some cases, the requirements in the facility QA program may be more stringent than the corporate program, but in no case can they be less stringent.

1.5. Scope

The requirements set forth in this document are applicable to the STL-Connecticut quality systems and laboratory operations.

STL operates under the regulations and guidelines of the following federal programs:

US Army Corp of Engineers, Hazardous, Toxic and Radioactive Waste (USACE HTRW)
Clean Air Act (CAA)
Clean Water Act (CWA)

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
New York State Department of Environmental Conservation (NYSDEC)
National Pollution, Discharge, and Elimination System (NPDES, NJPDES)
Resource Conservation and Recovery Act (RCRA)
Safe Drinking Water Act (SDWA)
US Army Corps of Engineers, Hazardous, Toxic and Radioactive Waste (USACE HTRW)

STL also provides services under various state and local municipal guidelines. A current list of Analytical Services and certifications can be provided by the laboratory or viewed on the MySTL webpage at www.MySTL-inc.com.

This QMP was written to comply with the National Environmental Laboratory Accreditation Conference (NELAC) standards and the STL corporate Quality Management Plan, M-Q-001.

1.6 **Servicing**

Project Managers are the direct client contact and they ensure resources are available to meet project requirements. Although Project Managers do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project Managers provide a link between the client and laboratory resources.

The laboratory has established procedures for performing and verifying that client servicing meets requirements. Typical services provided are:

- Sample Containers/Supplies – *Container Management: Process Operation* (VCM-001)
- Project QAP preparation – *Project Planning Process* (VPM-002)
- Regulatory advisory functions – *Project Planning Process* (VPM-002)
- Consulting -- *Project Planning Process* (VPM-002)

Regulatory and advisory functions are addressed under the same procedures used for project planning.

2. References

The following references were used in preparation of this document and as the basis of the STL Quality System:

EPA Requirements For Quality Management Plans, EPA QA/R-2, United States Environmental Protection Agency Management Staff, Washington, DC, Draft Interim Final, March 2001.

EPA Quality Manual for Environmental Programs, 5360, US EPA Office of Research and Development, National Center for Environmental Research and Quality Assurance, Quality Assurance Division, July 1998.

Good Automated Laboratory Practices, EPA 2185, 1995.

National Environmental Laboratory Accreditation Conference, Constitution, Bylaws, and Standards, EPA600/R-98/151, US EPA Office of Research and Development, July 2000.

Shell for Analytical Chemistry Requirements, US Army Corps of Engineers, 2001.

DOD Quality Systems manual (QSM) for Environmental Laboratories, Version 2

3. *Terms and Definitions*

Accuracy: the degree of agreement between an observed value and an accepted reference value.

Audit: a systematic evaluation to determine the conformance to specifications of an operational function or activity.

Batch: environmental samples, which are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria. Where no preparation method exists (example, volatile organics, water) the batch is defined as environmental samples that are analyzed together with the same process and personnel, using the same lots of reagents, not to exceed 20 environmental samples. An analytical batch is composed of prepared environmental samples, extracts, digestates or concentrates that are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Chain of Custody (COC): an unbroken trail of accountability that ensures the physical security of samples, data and records.

Clean Air Act: legislation in 42 U.S.C. 7401 et seq., Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/Superfund): legislation (42 U.S.C. 9601-9675 et seq., as amended by the Superfund Amendments and reauthorization Act of 1986 (SARA), 42 U.S.C. 9601et seq.

Compromised Sample: a sample received in a condition that jeopardizes the integrity of the results. See Section 4.7.1 for a description of these conditions.

Confidential Business Information (CBI): information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products.

Confirmation: verification of the presence of a component using an additional analytical technique. These may include second column confirmation, alternate wavelength, derivatization, mass spectral interpretation, alternative detectors, or additional cleanup procedures.

Corrective Action: action taken to eliminate the causes of an existing non-conformance, defect or other undesirable situation in order to prevent recurrence.

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Equipment Blank: a portion of the final rinse water used after decontamination of field equipment; also referred to as Rinsate Blank and Equipment Rinsate.

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

Federal Water Pollution Control Act (Clean Water Act, CWA): legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat. 816.

Field Blank: a blank matrix brought to the field and exposed to field environmental conditions.

Field of Testing (FOT): a field of testing is based on NELAC's categorization of accreditation based on program, matrix, analyte.

Good Laboratory Practices (GLP): formal regulations for performing basic laboratory operations outlined in 40 CFR Part 160 and 40 CFR Part 729 and required for activities performed under FIFRA and TSCA.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis and still be considered valid as promulgated in the method.

Initial Demonstration of Capability (IDC): procedure to establish the ability to generate acceptable accuracy and precision. Also referred to as Initial Demonstration of Proficiency.

Internal Chain of Custody: an unbroken trail of accountability that ensures the physical security of samples, data and records. Internal Chain of Custody refers to additional documentation procedures implemented within the laboratory that includes special sample storage requirements, and documentation of all signatures and/or initials, dates, and times of personnel handling specific samples or sample aliquots.

Instrument Detection Limit (IDL): the minimum amount of a substance that can be measured on specific instrument, with a specified degree of confidence that the amount is greater than zero. The IDL is associated with the instrumental portion of a specific method only, and specific sample preparation steps are not considered in its derivation.

A calculated IDL, by definition, has an uncertainty of +100% with 99% confidence, and is the point at which the possibility of detection of false negatives is 50 % and false positives is 1%. The IDL thus represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Instrument Blank: a blank matrix that is the same reagents as the processed sample matrix (i.e. extract, digestate, condensate) and introduced onto the instrument for analysis.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s), processed simultaneously with, and under the same conditions as, samples through all steps of the analytical procedure.

Laboratory Quality Manual (LQM): a document stating the quality policy, quality system and quality practices of the laboratory. The LQM may include by reference other documentation relating to the laboratory's quality system.

Limit of Detection (LOD): the minimum amount of a substance that an analytical process can reliably detect. (see MDL)

Matrix: The substrate of a test sample. For purposes of batch and QC requirements determination, the matrix descriptions in Table 1 are used.

Table 1 Matrix Descriptions

Matrix	Description
Air	Air samples as analyzed directly or as adsorbed into a solution or absorption matrix and desorbed.
Aqueous	Aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine source. Includes surface water, groundwater and effluents.
Drinking Water	Aqueous sample that has been designated a potable water source.
Saline	Aqueous sample from an ocean or estuary, or other salt-water source such as the Great Salt Lake.
Liquid	Liquid with <15% settleable solids.
Solid	Soil, sediment, sludge or other matrices with ≥15% settleable solids.
Waste	A product or by-product of an industrial process that results in a matrix not previously defined.
Tissue	Sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Matrix Duplicate (MD): duplicate aliquot of a sample processed and analyzed independently; under the same laboratory conditions; also referred to as Sample Duplicate.

Matrix Spike (MS): field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a replicate matrix spike.

Method Blank: a blank matrix processed simultaneously with, and under the same conditions as, samples through all steps of the analytical procedure.

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific method. An MDL, by definition, has an uncertainty of +100% with 99% confidence, and is the point as which the possibly of detection of false negative is 50% and false positive is 1%. The MDL thus represents a range where qualitative detection occurs using a specific method. Quantitative results are not produced in this range. Also referred to as Limit of Detection.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Precision: the degree to which a set of observations or measurements of the same property, usually obtained under similar conditions, conform to themselves; a data quality indicator.

Preservation: refrigeration and or reagents added at the time of sample collection to maintain the chemical and or biological integrity of the sample.

Proficiency Testing: determination of the laboratory calibration or testing performance by means of inter-laboratory comparisons.

Proficiency Test (PT) Sample: a sample, the composition of which is unknown to the analyst, that is provided to test whether the analyst/laboratory can produce analytical results within specified performance limits. Also referred to as Performance Evaluation (PE) sample.

Proprietary: belonging to a private person or company.

Quality Assurance (QA): an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

Quality Assurance (Project) Plan (QAPP): a formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.

Quality Control (QC): the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users.

Quality Control Sample: an uncontaminated sample matrix spiked with a known amount(s) of an analyte(s) from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

Quality Management Plan (QMP): a formal document describing the management policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an agency, organization or laboratory to ensure the quality of its product and the utility of the product to its users.

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA/QC.

Quantitation Limit (QL): the lowest point at which a substance can be quantitatively measured with a specified degree of confidence using a specific method. The QL can be based on the MDL, and is generally calculated as 3-5 times the MDL, however, there are analytical techniques and methods where this relationship is not applicable. Also referred to a Practical Quantitation Level (PQL), Estimated Quantitation Level (EQL), or Limit of Quantitation (LOQ).

Raw Data: any original information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof and that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. Reports specifying inclusion of "raw data" do not need all of the above included, but sufficient information to create the report data.

Record Retention: the systematic collection, indexing and storing of documented information under secure conditions.

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.

Reporting Limit (RL): The level to which data is reported for a specific test method and /or sample. The RL is generally related to the QL. The RL must be minimally at or above the MDL.

Resource Conservation and Recovery Act (RCRA): legislation under 42 USC 321 et seq. (1976).

Safe Drinking Water Act (SDWA): legislation under 42 USC 300f et seq. (1974), (Public Law 93-523).

Sampling and Analysis Plan (SAP): A formal document describing the detailed sampling and analysis procedures for a specific project.

Selectivity: The capability of a method or instrument to respond to a target substance or constituent in the presence of non-target substances.

Sensitivity: the capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.

Spike: a known amount of an analyte added to a blank, sample or sub-sample.

Standard Operating Procedure (SOP): a written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.

Systems Audit: a thorough, systematic, on-site, qualitative review of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system.

Storage Blank: a blank matrix stored with field samples of a similar matrix.

Trip Blank: a blank matrix placed in a sealed container at the laboratory that is shipped and held unopened in the field and returned to the laboratory in the shipping container with the field samples.

Test Method: defined technical procedure for performing a test.

Toxic Substances Control Act (TSCA): legislation under 15 USC 2601 et seq., (1976).

Traceability: the property of a result of a measurement that can be related to appropriate international or national standards through an unbroken chain of comparisons.

Verification: confirmation by examination and provision of evidence that specified requirements have been met.

4. *Management Requirements*

4.1. Organization and Management

4.1.1. Organization

The STL-Connecticut organizational structure is presented on the organizational chart as outlined in the appendix. A QA Manager is designated at the STL facility and reports to the Laboratory Director. The facility QA Manager has an indirect reporting relationship to the Corporate QA Director.

4.1.2. Roles and Responsibilities

President

The President of STL, Inc. has overall management responsibility and authority for Severn Trent's laboratory division, including responsibility for budgeting, resource allocation, long term planning, sales, marketing, and final approval on all management and administrative policies and management plans. The President authorizes the STL Corporate LQM and as such, sets the standards for the Quality System.

Chief Operating Officer (COO)
The COO is responsible for daily management of all STL facilities. The COO's responsibilities include allocation of personnel and resources, long term planning, and development of technical policies and management plans. The COO authorizes the STL Corporate LQM and is responsible for ensuring that business operations are conducted in accordance with its requirements.

Vice President Client and Operations Services (VP COS)
The VP of Operations Services is responsible for all essential elements of offerings to clients, including risk management, legal compliance and contract administration, quality assurance, information technology, and environmental health and safety. The VP COS authorizes the QMP and responsibilities include authorization of Manuals, Policies and Procedures, providing support and direction to the Managers of these areas, and supporting the COO in decisions regarding long term planning, resource allocation, and capital expenditures.

QA Director
The QA Director is responsible for establishing, implementing and communicating STL's quality system. The QA Director monitors compliance with the QMP, provides regulatory and technical updates to the STL facilities, assists in development of management plans and technical policies to be approved by the COO, and coordinates training within STL. The QA Director is available to any employee in STL to resolve data quality or ethical issues. The QA Director is independent of operational functions.

Director of Technical Services
The Director of Technical Services is responsible for establishing, implementing and communicating STL's Technical Policies, Standard Operating Procedures, and Manuals. Other responsibilities include conducting technical assessments as required, acting as a technical resource in national contracts review, coordinating new technologies, establishing best practices throughout STL, advising STL staff on technology advances, innovations, and applications, and organizing and running STL's technical committee.

Chief Information Officer (CIO)
The CIO is responsible for establishing, implementing and communicating STL's IT Policies, Standard Operating Procedures, and Manuals. Other responsibilities include coordinating new technologies, development of electronic communication tools such as STL's intranet and internet sites, ensuring data security and documentation of software, ensuring compliance with Good Automated Laboratory Practices (GALP), and assistance in establishing, updating, and maintaining Laboratory Information Management Systems (LIMS) at the various STL facilities.

Environmental Health and Safety (EH&S) Director
The Health and Safety Coordinator is responsible for the safety and well-being of all employees while at the laboratory. This includes, but is not limited to, administering the Corporate Safety Manual that complies with federal regulations, MSDS training and review, conducting laboratory safety orientation and tours for all new employees, providing instructions on safety equipment, cleaning up laboratory spills, and instructing personnel of laboratory procedures for emergency situations. The Health and Safety Coordinator is on-call 24-hours a day, 7-days a week for all laboratory situations.

The Health and Safety Coordinator responsibilities additionally include waste management of laboratory generated hazardous waste in accordance with appropriate regulations. This includes maintenance of required documentation, such as waste manifests, segregation of waste in accordance with requirements, and training of personnel in proper segregation of waste and preparation of Safety related SOPs.

General Manager (GM)
The GM is directly responsible for the daily operations of one or more operating facilities within STL. The GM's responsibilities include allocation of personnel and resources, long term planning, setting goals, and achieving the financial, business, and quality objectives of STL. The GM ensures timely compliance with corporate management directives, policies, and management systems reviews.

Laboratory Director
The Laboratory Director oversees the daily operations of the laboratory. The Laboratory Director's responsibilities include supervision of staff, setting goals for the employees, and achieving the financial, business, and quality objectives of the facility. The Laboratory Director is to maintain technical understanding of analytical methodology for

the laboratory operations, development of procedural improvements and investigation of non-conformances.

QA Manager

The Quality Assurance Manager (QAM) has the full-time responsibility to evaluate the adherence to policies and to assure that systems are in place to produce the level of quality defined in this LQM. The QAM is responsible for:

- Ensures IDL/MDL studies are completed and documented
- Ensures method validation studies are completed and documented
- Periodically performs data package inspections
- Performs data authenticity audits on 100% of analysts and instruments
- Assist in the preparation, compilation, and submittal of quality assurance project plans
- Reviews program plans for consistency with organizational and contractual requirements and advises appropriate personnel of deficiencies
- Maintains QA records
- Maintains certifications and accreditations
- Initiates and oversees both internal and external audits; documents root cause investigations for all noted deficiencies; and ensures timely audit closure
- Maintains a corrective action process for internally identified issues and ensures timely closure
- Manages the laboratory's PT Program and performs/documents root cause investigations for all failures
- Monitors to ensure the documentation of training and method demonstration are current
- Facilitates SOP development and document control

The QA Manager shall have the final authority to accept or reject data, and to stop work in progress in the event that procedures or practices compromise the validity and integrity of analytical data. The QAM is available to any employee at the facility to resolve data quality or ethical issues. The QA Manager shall be independent of laboratory operations and has an indirect reporting relationship to the QA Director.

Project Managers

The laboratory recognizes the importance of efficient project management. The laboratory Project Managers (PM) are responsible for preparing the project technical profile which summarizes QA/QC requirements for the project, maintaining the laboratory schedule, communicating technical requirements to the laboratory, and advising the Laboratory, QA and Technical Managers of all variances. The laboratory Project Manager will provide technical guidance and the necessary laboratory-related information to the preparer of project-specific QAPPs and provide peer review of the final document to ensure accuracy of the laboratory information.

Technical Managers (Laboratory Departmental Group Leader/Supervisor)

The Laboratory Supervisor oversees the daily operations of their particular laboratory department. The supervisor's responsibilities include supervision of staff, setting goals and objectives for their employees, and achieving the business and quality objectives of the facility.

4.2. Quality System

4.2.1. Objectives of STL-Connecticut Quality System

The goal of the STL-Connecticut Quality System is to ensure that business operations are conducted with the highest standards of professionalism in the industry.

To achieve this goal, it is necessary to provide our clients with scientifically sound, well documented, regulatory compliant data, and to ensure that we provide the highest quality service available in the industry with uncompromising data integrity. A well-structured, organized and communicated quality system is essential in meeting this goal. The laboratory's quality system is designed to minimize systematic error, encourage constructive, documented problem solving, and provides a framework for continuous improvement.

This LQM, Work Instructions and the SOPs are the basis and outline for our quality and data integrity system and contain requirements and general guidelines under which the laboratory conducts operations. In addition, other documents may be used by the laboratory to clarify compliance with quality system or other client requirements. Within the LQM, SOP or Work Instruction numbers are noted in parenthetic text. These numbers refer to the laboratory procedure(s) associated with the subject item. A table listing these quality system policies and procedures is appended to this document.

The QA Manager is responsible for implementing and monitoring the Quality System. The QA Manager reports to the Laboratory Director on the performance of the quality system for review and continuous improvement. The QA Manager has sufficient authority, access to work areas, and organizational freedom (including sufficient independence from cost and schedule considerations) to:

- Initiate action to prevent the occurrence of any nonconformities related to product, process and quality system,
- Identify and record any problems affecting the product, process and quality system,
- Initiate, recommend, or provide solutions to problems through designated channels,
- Verify implementation of solutions, and
- Assure that further work is stopped or controlled until proper resolution of a non-conformance, deficiency, or unsatisfactory condition has occurred and the deficiency or unsatisfactory condition has been corrected.

The QA Manager identifies opportunities for continual improvement. When a situation arises where acceptable resolution of identified issues cannot be agreed upon at the laboratory, direct access to STL's Corporate Quality Director is available. This provides laboratory QA personnel independence, where needed, to ensure that QA policies and procedures are enforced.

The Laboratory Quality Manual is the basis and outline for the STL-Connecticut Quality System and contains guidelines under which the STL-Connecticut facility conducts operations in accordance with the STL Corporate Quality Management Plan (QMP).

4.2.2. Laboratory Quality Manual (LQM)

The following elements are addressed in the STL-Connecticut facility's LQM:

1. Table of Contents, lists of references and glossaries, and appendices.
2. Quality policy statement, including objectives and commitments, by facility management.
3. Organization and management structure of the laboratory, its place in the STL organization and relevant organizational charts.
4. Relationship between management, technical operations, support services and the quality system.
5. Record retention procedure.
6. Document control procedure.
7. Job descriptions of essential staff and reference to job descriptions of other staff.
8. Identification of the laboratory's approved signatories.
9. Procedure for achieving traceability of measurements.
10. List of test methods under which the laboratory performs its testing.
11. Procedure for reviewing new work.
12. Reference to the calibration and/or verification test procedures used.
13. Sample handling procedure.
14. Reference to the major equipment, reference standards, facilities and services used by the laboratory in conducting tests.
15. Reference to procedures for calibration, verification and maintenance of equipment.
16. Reference to verification practices including inter-laboratory comparisons, proficiency testing programs, use of reference materials and internal QC practices.
17. Procedures for feedback and corrective action when testing discrepancies are detected, or departures from policies and procedures occur.
18. Procedure for exceptionally permitting departures from documented policies and procedures or from standard specifications.
19. Procedure for dealing with client complaints.
20. Procedure for protecting client confidentiality and proprietary rights.
21. Procedure for audits and data review.

22. Procedure for establishing that personnel are adequately experienced and trained.
23. Reference to procedures for reporting analytical results.

4.3. Document Control

A system of document control is essential to provide the framework necessary to ensure that methods and procedures are followed in a consistent manner.

The STL-Connecticut laboratory has developed a centralized document control system and is administered by the QA department. The document control system provides for the following:

- A unique document control number for each document
- A central location for all documents
- A systematic method for distribution of approved documents
- A tracking system for existing documents
- Identification of document revisions
- A mechanism for periodic review of documents
- Archival of outdated material
- A focal point for information exchange
- Facilitates the establishment of standardized methods and procedures

4.3.1. Document Control Procedure

Security and control of documents is necessary to ensure that confidential information is not distributed and that all current copies of a given document are from the latest applicable revision. Unambiguous identification of a controlled document is maintained by identification of the following items in the document header: Document Name, Document Number, Effective Date, Number of Pages. Controlled documents are authorized by Management and/or the QA Department. Controlled documents are marked as such and records of their distribution are kept by the QA Department. Controlled documents, such as SOPs will be stamped in red with "Controlled Document #". If this writing is not in red, then that copy will not be considered a controlled document.

4.3.2. Document Revision

Changes to documents occur when a procedural change warrants a revision of the document. When an approved revision of a controlled document is ready for distribution, obsolete copies of the document are replaced with the current version of the document. The previous revision of the controlled document is archived by the QA Department. Laboratory SOPs and quality documents are required to be reviewed annually and updated as needed.

A detailed description of the document control system is contained in STL-Connecticut SOP for Document Control. This document is available for inspection and review during a site visit. The Quality Assurance Manager is responsible for ensuring that the document control system is properly managed. Any new or revised document must be submitted to the QA Manager for review and distribution.

4.4. Request, Tender, and Contract Review

4.4.1. Contract Review

For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is STL's intent to provide both standard and customized environmental laboratory services to our clients. To ensure project success, technical staff perform a thorough review of technical and QC requirements contained in contracts. Contracts are reviewed for adequately defined requirements and STL's capability to meet those requirements.

Contract review shall include a review of the client's requirements in terms of compound lists, test methodology requested, sensitivity, accuracy, and precision requirements. The STL representative ensures that the laboratory's test methods are suitable to achieve these requirements and must ensure that the laboratory holds the appropriate certifications and approvals to perform the work. The review also includes the laboratory's capabilities in terms of turnaround time, capacity, and resources to provide the services requested, as well the laboratory's ability to provide the documentation, whether hardcopy or electronic. If the laboratory cannot provide all services but intends to subcontract such services, whether to another STL facility or to an outside firm, this must be documented and discussed with the client prior to contract approval.

All contracts entered into by STL are reviewed and approved by the appropriate personnel at the facility or facilities performing the work. Any contract requirement or amendment to a contract communicated to STL verbally is documented and confirmed with the client in writing. Any discrepancy between the client's requirements and STL's capability to meet those requirements is resolved in writing before acceptance of the contract. Contract amendments, initiated by the client and/or STL, are documented in writing for the benefit of both the client and STL.

All contracts, Quality Assurance Project Plans (LQMPs), Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the permanent project record as defined in Section 4.12.1.

4.4.2. Project Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, STL assigns a Project Manager (PM) to each client. The PM is the first point of contact for the client. It is the PM's responsibility to ensure that project specific technical and QC requirements are effectively communicated to the laboratory personnel before and during the project. The labnet LIMS system used at STL-CT requires that project information be entered prior to samples being logged into the laboratory.

The STL - Connecticut facility has established many procedures in order to ensure that communication is inclusive and effective. These include project memos, designation and meetings of project teams, and meetings between the laboratory staff and the client. STL has found it very effective to invite the client into this process. STL strongly encourages our clients to visit the laboratories and hold formal or informal sessions with employees in order to effectively communicate client needs on an ongoing basis, as well as project specific details for customized testing programs.

4.4.3. Data Quality Objectives

Data Quality Objectives (DQO) are qualitative and quantitative statements used to ensure the generation of the type, quantity, and quality of environmental data that will be appropriate for the intended application. Typically, DQOs are identified before project initiation, during the development of QAPPs and SAPs. The analytical DQOs addressed in this section are precision, accuracy, representativeness, completeness, and comparability.

The components of analytical variability (uncertainty) can be estimated when QC samples of the right types and at the appropriate frequency are incorporated into measurement process at the analytical laboratory. STL incorporates numerous QC samples to obtain data for comparison with the analytical DQOs and to ensure that the measurement system is functioning properly. The QC samples and their applications, described in Section 5.8.2, are selected based on regulatory, method- or client-specific requirements. Analytical laboratory QC samples for inorganic, and organic analyses may include calibration blanks, instrument blanks, method blanks, LCS, calibration standards, MS, MSD, and surrogate spikes.

The DQOs discussed below ensure that data are gathered and presented in accordance with procedures appropriate for its intended use, that the data is of known and documented quality, and are able to withstand scientific and legal scrutiny.

Precision is an estimate of variability. It is an estimate of agreement among individual measurements of the same physical or chemical property, under prescribed similar conditions. Precision is expressed either as Relative Standard Deviation (RSD) for greater than two measurements or as Relative Percent Difference (RPD) for two

measurements. Precision is determined, in part, by analyzing data from aggregate LCS results, MS, MSD, and MD.

Precision also refers to the measurement of the variability associated with the entire process, from sampling to analysis. Total precision of the process can be determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations.

Accuracy is the degree of agreement between a measurement and the true or expected value, or between the average of a number of measurements and the true or expected value. It reflects the total error associated with a measurement.

Both random and systematic errors can affect accuracy. For chemical properties, accuracy is expressed either as a percent recovery (R) or as a percent bias (R - 100). Accuracy is determined, in part, by analyzing data from LCS, MS, and MSD.

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, a variation in a physical or chemical property at a sampling point, or an environmental condition. Data representativeness is primarily a function of sampling strategy; therefore, the sampling scheme must be designed to maximize representativeness. Representativeness also relates to ensuring that, through sample homogeneity, the sample analysis result is representative of the constituent concentration in the sample matrix. STL makes every effort to analyze an aliquot that is representative of the original sample, and to ensure the homogeneity of the sample before sub-sampling.

Completeness is defined as the percentage of measurements that are judged valid or useable. Factors negatively affecting completeness include the following: sample leakage or breakage in transit or during handling, loss of sample during laboratory analysis through accident or improper handling, improper documentation such that traceability is compromised, or sample result is rejected due to failure to conform to QC specifications. A completeness objective of 95% of the data specified by the statement of work is the goal established for most projects.

Comparability is a measure of the confidence with which one data set can be compared to another. Only data of known quality such as precision and bias be readily compared. To ensure comparability, all laboratory analysts are required to use uniform procedures (e.g., SOPs) and a uniform set of units and calculations for analyzing and reporting environmental data.

4.5. Subcontracting

STL Connecticut may find the need to send selected analyses to a subcontract laboratory either within the STL network or outside of the STL organization. The most common reason for utilization of a subcontract facility is that the procedure is not routinely

performed by the STL Connecticut laboratory and the subcontractor has greater experience in day-to-day execution of the method. All subcontract laboratories utilized by STL on a continuing basis require approval of the QA department prior to use, either on a corporate level or locally.

Subcontracting is arranged with the documented consent of the client, in a timely response which shall not be unreasonably refused. All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Proof of required certifications from the subcontract facility are maintained in STL project records. Where applicable, specific QC guidelines, LQMPs, and/or SAPs are transmitted to the subcontract laboratory. Samples are subcontracted under formal Chain of Custody (COC).

Subcontract laboratories may receive an on-site audit by a representative of the STL network's QA staff if it is deemed appropriate by the QA Manager. The audit involves a measure of compliance with the required test method, QC requirements, as well as any special client requirements.

Project reports from external subcontract laboratories are not altered and are included in original form in the final project report provided by STL.

Subcontracting may also occur between STL facilities. Subcontracting within STL is subject to the same requirements as detailed above.

4.6. Purchasing Services and Supplies

Evaluation and selection of suppliers and vendors is done, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by a member of the supervisory or management staff. A list of current vendors used by the lab is on file with the QA dept along with any documented quality issues.

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Purchasing guidelines for equipment and reagents meet with the requirements of the specific method and testing procedures for which they are being purchased. Solvents and Acids are pretested in accordance with the SOP, S-T-001, Testing Solvents and Acids, at a predefined STL laboratory. Documentation of lot certification is communicated to the QAMs and posted on the STL intranet.

4.6.1 Solvent and Acid Lot Verification

Pre-purchase approval is performed for solvents and acids purchased in large quantities unless a certificate of conformance has been furnished. These may include acetone, ethyl ether, hexane, methylene chloride, nitric acid, hydrochloric acid, sulfuric acid, and hydrogen peroxide. Each lot of incoming supplies requiring pre-approval is checked against the previously approved lot number. If the lot number is not approved, the lot is refused. If the lot number is an approved lot number, it is accepted and documented. Solvents and acids are pre-tested in accordance with STLs Corporate *Testing Solvents and Acids* procedure (S-T-001) for all of the STL laboratories. A Certificate of Analysis is requested for all standards and reagents as applicable and kept on file at the laboratory.

4.7. Service to the Client

Each client is assigned a Project Manager . The PM is the focal point for setting up projects, placing bottle orders, reviewing sample receipts, monitoring jobs within the lab, communicating any analytical issues and reviewing the final report.

4.7.1. Sample Acceptance Policy

Samples are considered "compromised" if the following conditions are observed upon sample receipt:

- Cooler and/or samples are received outside of temperature specification.
- Samples are received broken or leaking.
- Samples are received beyond holding time.
- Samples are received without appropriate preservative.
- Samples are received in inappropriate containers.
- COC does not match samples received.
- COC is not properly completed or not received.
- Breakage of any Custody Seal.
- Apparent tampering with cooler and/or samples.
- Headspace in volatiles samples.
- Seepage of extraneous water or materials into samples.
- Inadequate sample volume.
- Illegible, impermanent, or non-unique sample labeling.

When "compromised" samples are received, it is documented in the project records and the client is contacted for instructions. If the client decides to proceed with analysis, the project report will clearly indicate any of the above conditions and the resolution.

4.7.2. Client Confidentiality and Proprietary Rights

Data and sample materials provided by the client or at the client's request, and the results obtained by STL, shall be held in confidence (unless such information is generally available to the public or is in the public domain or client has failed to pay STL for all services rendered or is otherwise in breach of the terms and conditions set forth in the STL and client contract) subject to any disclosure required by law or legal process. STL's reports, and the data and information provided therein, are for the exclusive use and benefit of client, and are not released to a third party without written consent from the client.

4.8. Complaints

STL believes that effective client complaint handling processes have important business and strategic value. Listening to and documenting client's concerns captures 'client knowledge' that helps to continually improve processes and outpace the competition. Implementing a client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

Client complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly. Client complaints are documented by the employee receiving the complaint. The documentation can take the form of a corrective action report (as described in Section 4.10) or in a format specifically designed for that purpose. The Laboratory Director, PM, Customer Service Manager, and QA Manager are informed of all client complaints, and assist in resolving the complaint.

The nature of the complaint is identified, documented, and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA department is required to conduct a special audit to assist in resolving the issue. A written confirmation, or letter to the client, outlining the issue and response taken is strongly recommended as part of the overall action taken.

The number and nature of client complaints is reported to the Corporate QA Manager in the QA Monthly report submitted by each facility. The overall number of complaints received per facility is tracked and the appropriateness of the response to client complaints is assessed. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Management Systems Review.

4.9. Control of Non-conformances

Non-conformances include any out of control occurrence. Non-conformances may relate to client specific requirements, procedural requirements, or equipment issues. All non-conformances in the laboratory are documented at the time of their occurrence.

All non-conformances that affect a sample and/or sample data become part of the affected project's permanent record. When appropriate, reanalysis is performed where QC data falls outside of specifications, or where data appears anomalous. If the reanalysis comes back within established tolerances, the results are approved. If the reanalysis is still outside tolerances, further reanalysis or consultation with the Supervisor, Manager, PM, Laboratory Director, or QA Manager for direction may be required. All records of reanalysis are kept with the project files.

Where non-conformances specifically affect a client's sample and/or data, the client is informed and action must be taken. Action can take the form of reporting and flagging the data, and including the non-conformance in the project narrative or cover letter.

4.10. Corrective Action

4.10.1. General

The STL-Connecticut facility has an established, documented corrective action process. Each corrective action is thoroughly investigated, and the investigation, outcome of the investigation, action taken, and follow-up is documented. Corrective action reports are reviewed, approved, and maintained by the QA department.

All corrective actions, whether immediate or long-term, will comprise the following steps to ensure a closed-loop corrective action process:

- Define the problem.
- Assign responsibility for investigating the problem.
- Determine a corrective action to eliminate the problem.
- Assign, and obtain commitment to, responsibility for implementing the corrective action.
- Implement the correction.
- Assess the effectiveness of the corrective action and verify that the corrective action has eliminated the problem.

4.10.1.1 Immediate Corrective Action

Immediate corrective actions to correct or repair non-conforming equipment and systems are generally initiated in response to adverse conditions identified through QC procedures. The analyst has relatively quick feedback that a problem exists, e.g., calibration does not meet or QC check samples exceed allowable criteria, and can take immediate action to repair the system.

The initial responsibility to monitor the quality of a function or analytical system lies with the individual performing the task or procedure. DQOs are evaluated against laboratory-established or against method or client specified QA/QC requirements. If the assessment reveals that any of the QC acceptance criteria are not met, the analyst must immediately assess the analytical system to correct the problem. When the appropriate corrective action

measures have been defined and the analytical system is determined to be "in-control" or the measures required to put the system "in-control" have been identified and scheduled, the problem and resolution or planned action is documented in the appropriate logbook or NCM. Data generated by an analytical system that is determined to be out-of-control must never be released without approval of the Section Manager, QA Manager, Laboratory Director and client notification.

4.10.1.2 Long-term Corrective Action

Long-term corrective action is generally initiated due to QA issues, which are most often identified during internal and external audits. Typically, a deeper investigation into the root cause of the nonconformance is warranted, and the problem may take much longer to identify and resolve. Staff training, method revision, replacement of equipment, and LIMS reprogramming are examples of long-term corrective action.

4.10.2. Initiation

Any employee in STL is authorized to initiate a corrective action. The initial source of corrective action can also be external to STL (i.e. corrective action because of client complaint, regulatory audit, or proficiency test). When a problem that requires corrective action is identified, the following items are identified by the initiator on the corrective action report: the nature of the problem, the name of the initiator, and the date. If the problem affects a specific client project, the name of the client and laboratory project number is recorded, and the PM is informed immediately.

4.10.3. Cause analysis

The corrective action process must be embarked upon as a joint, problem solving and constructive effort. Identification of systematic errors, or errors that are likely to occur repetitively due to a defect or weakness in a system, is particularly valuable in maintaining an environment of continuous improvement in laboratory operations.

When a corrective action report is initiated, the initiator works with the affected employee(s) and/or department(s) to identify the root cause of the problem. An essential part of the corrective action process is to identify whether the problem occurred due to a systematic or isolated error.

If the initiator of the corrective action report is uncertain as to what would constitute appropriate corrective action or is unable to resolve the situation, the problem is identified to the Supervisor, Manager, Laboratory Director or the QA Manager who provides assistance in the corrective action process.

The root cause of the problem and associated cause analysis is documented on the corrective action form.

4.10.4. Corrective Action

Once the root cause of a problem is identified, the initiator and affected employee(s) and/or department(s) examine potential actions that will rectify the present problem to the extent possible, and prevent recurrence of future, similar occurrences. An appropriate corrective action is then recommended. The corrective action must be appropriate for the size, and nature of the issue.

Implementation of the corrective action and the date of implementation are documented on the corrective action report.

Copies of the corrective action form are given to the appropriate department(s) and, if related to a specific project report, included in the project file. An essential part of the corrective action process is communication and awareness of the problem, the cause, and the action taken to prevent future occurrences and/or rectify the immediate problem.

4.10.5. Monitoring Corrective Action

All corrective action reports are forwarded to the QA Department. The QA department reviews all corrective actions and selects one or more of the more significant corrective actions for inclusion in the annual systems audit. The QA Department also may implement a special audit. The purpose of inclusion of the corrective action process in both routine and special audits is to monitor the implementation of the corrective action and to determine whether the action taken has been effective in overcoming the issue identified.

4.11. Preventative Action

Preventative action is defined as noting and correcting a problem before it happens, because of a weakness in a system, method, or procedure. Preventative action includes analysis of the Quality System to detect, analyze, and eliminate potential causes of non-conformances. When potential problems are identified, preventative action is initiated to effectively address the problem to eliminate or reduce the risk identified. The preventative action process takes the same format as the corrective action process.

4.12. Records

It is the responsibility of all members of the laboratory to maintain complete records of all operations performed. All records shall be neat and organized. All laboratory records are the property of the laboratory and shall not be removed from the premises without permission from supervisors. All records are considered confidential and must be safeguarded. Unauthorized changes, loss or destruction of records can be grounds for dismissal from the laboratory. Consult the Severn Trent Laboratories Ethics Policy regarding integrity of data and employee conduct.

Measurement records must be recorded in pre-printed electronic record logs or pre-printed measurement logs. This policy will facilitate the organization and archival of all laboratory data for future reference. In some departments records maybe kept electronically using the labnet LIMS system. This may include standard prep, reagent prep or sample prep. Electronic records are backed up and safeguarded as per STL's IT policies.

All injection forms, instrumentation forms, sample prep forms, QC forms, etc. which are used to process samples and measurement results are described and attached to each analytical SOP. The SOP specifies where these records and forms are cataloged and stored.

All measurement data is recorded in pre-numbered, bound, logbooks in permanent ink. Transcriptions will be avoided whenever possible. The record will reflect the measurement performed and all appropriate details for conclusions related to the measurement. The record must be initialed and dated by the individual performing the measurement on the day the measurement is performed. Corrections shall be made by drawing a single line through the error, initialing and dating the error. All forms will be reviewed by the QA Manager annually. If it is found that the document does not meet the requirements of the SOP, the discrepancy is forwarded to the group/section leader through the corrective action process (reference SOP on Corrective Action Reports). Further detail on laboratory document control is found in the SOP on Document Control.

4.12.1. Record Types

Record types are described in Table 2.

Table 2 STL Record Types

Raw Data	Controlled Documents	QC Records	Project Records	Administrative Records
Calibration	LQM	Audits/ Responses	COC Documentation	Accounting
Computer Tapes/Disks	LQM	Certifications	Contracts and Amendments	EH&S, Manual, Permits, Disposal Records
QC Samples	SOPs	Corrective Action	Correspondence	Employee Handbook
Sample data		Logbooks*	QAPP	OSHA 29 CFR Part 1910
Software (Version control)		Method & Software Validation, Verification	SAP	Personnel files, Employee Signature & Initials, Training Records
		Standards Certificates	Telephone Logbooks	Technical and Administrative Policies

*Examples of Logbooks: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature,

4.12.2. Record Retention

Table 3 outlines STL's standard record retention time. For raw data and project records, record retention is calculated from the date the project report is issued. For other records, such as Controlled Documents, QC, or Administrative Records, the retention time is calculated from the date the document is formally retired. Drinking Water records are required to be stored for 10 years.

Table 3 STL Record Retention

Record Type	Department	Archival Requirement
Raw Data	All	5 Years from project completion
Controlled Documents	All	5 Years from document retirement date
QC	All	5 Years from archival
Project	All	5 Years from project completion
Administrative	Personnel/Training	7 years
	Accounting	See Accounting and Control Procedures Manual

4.12.3. Programs with Longer Retention Requirements

Specific client projects and regulatory programs have longer record retention requirements than the STL standard record retention length. In these cases, the longer retention requirement is noted in the archive. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

4.12.4. Archives and Record Transfer

Archives are indexed such that records are accessible on either a project or temporal basis. Archives are protected against fire, theft, loss, deterioration, and vermin. Electronic records are protected from deterioration caused by magnetic fields and/or electronic deterioration. Access to archives is controlled and documented.

STL ensures that all records are maintained as required by the regulatory guidelines and per the LQM upon facility location change or ownership transfer.

Stored information may consist of hardcopy or electronic data stored on a magnetic media.

All hardcopy information is stored at the laboratory that generated the data or off-site at a commercial document storage facility equipped with a professional security system.

All electronic data is stored on-site at the laboratory that generated the data or off-site at a commercial document storage facility equipped with a professional security system and a controlled environment suitable for storage of magnetic media.

Access to archived information is controlled by the appropriate data management custodian or facility manager.

At STL-Connecticut, reports for the current year are filed by the data management department. The report files along with any data package are then stored in numbered boxes. The number of the box is recorded into the cross reference logs and then stored in the designated storage area. The previous year's data is stored off-site at a secure storage facility. All jobs must be signed out in a logbook if being removed from the data management area.

STL ensures that all records are maintained as required by the regulatory guidelines and per the LQM upon facility location change or ownership transfer. Upon STL facility location change, all archives are retained by STL in accordance with the LQM. Upon ownership transfer, record retention requirements are addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established without disclosing client confidentiality. Clients shall be notified in the case of ownership transfer.

In the event that the laboratory is closed, all final test reports generated by the laboratory will be submitted to the clients if not previously provided. All records will then be transferred to STL's corporate record storage location. All boxes and contents will be appropriately labeled with the dates of destruction (Refer to Tables 5 and 6) and managed in accordance their policies.

4.13. Internal Audits

4.13.1. Audit Types and Frequency

A number of types of audits are performed at STL. Audit type and frequency are categorized in Table 4.

Table 4. Audit Types and Frequency

Audit Type	Performed by	Frequency
Systems	QA Department or Designee	Annual

Audit Type	Performed by	Frequency
Data	QA Department or Designee	**Data Report Review:** As necessary to ensure an effective secondary review process
		Analyst Data Audits: 100% of all analysts annually
		Electronic Data Audits: 100% of all organic instruments
Special	QA Department or Designee	As Needed

4.13.2. Systems Audits

Facility systems audits are technical in nature and are conducted on an ongoing basis by the QA Manager or his/her designee at each facility. Systems audits cover all departments of the facility, both operational and support.

The audit report is issued by the Internal Auditor of the facility within 30 calendar days of the audit. The audit report includes the following elements: Introduction, Scope of Audit, Type of Audit, Improvements and Innovations, Deficiencies, and a timeframe within which the audit must be addressed. The audit report is addressed to the Laboratory Director and copied to the General Manger. If the internal audit is performed by someone other than the facility QA Manager, the report must also be addressed to that QA Manger.

Written audit responses are required within 30 calendar days of audit report issue. The audit response follows the format of the audit report, and corrective actions and time frames for their implementation are included for each deficiency. The audit response is directed to all individuals copied on the audit report. Where a corrective action requires longer than 30 days to complete, the target date for the corrective action implementation is stated and evidence of the corrective action is submitted to the QA Department in the agreed upon time frame.

4.13.3. Data Audits

Data audits are focused to assess the level of customer service, method compliance, regulatory compliance, accuracy and completeness of test results and reports, documentation, and adherence to established QC criteria, laboratory SOPs, technical policy, and project specific QC criteria. Data audits may be accomplished through electronic instrument data audits, analyst data authenticity audits or final project report review.

A data auditing frequency target of 5% has been established. The QA Department provides feedback and/or corrections and revisions to project reports where necessary.

Data audits include spot-checking of manual integrations by QA personnel in order to determine that the manual integration is appropriate and documented according to Section 5.3.6.

Records of the data audits are kept, and the frequency of data audits is included in the monthly QA report. In performing data audits, it is essential that data be assessed in terms of differentiating between systematic and isolated errors. Upon noting anomalous data or occurrences in the data audits, the QA Department is responsible for seeking clarification from the appropriate personnel, ascertaining whether the error is systematic or an isolated error, and overseeing correction and/or revision of the project report if necessary. Errors found in client project reports are revised and the revision sent to the client. The QA Department is also responsible for assisting in the corrective action process where a data audit leads to identification of the need for process evaluation and change.

Where specific clients and regulatory programs require more frequent data auditing, the individual facility meets the data auditing frequency for that program. For projects falling under the DOD QSM, a 10% data audit frequency shall be followed.

4.13.3.1 Data Authenticity Audits

Data authenticity audits shall be performed on 100% of all analysts by the QA department or a designee independent from the operations. Performing data authenticity checks will typically include verifying raw data, evaluating calculation tools and independently reproducing the final results and comparing it to the hardcopy on randomly selected batches of data. The QA manager will report the percentage of analysts reviewed (for the year) in the monthly QA report and should average about 8% per month.

4.13.3.2 Electronic Data Audits

Electronic data audits are performed on 100% of all organic instruments by the QA department or a designee independent from the operations. This may include Mint Miner® scanning of randomly selected batches of electronic data followed by a chromatography system review. The QA manager will report the percentage of instruments reviewed (for the year) in the monthly QA report and should average about 8% of instruments per month. Electronic data audits include spot-checking of manual integrations by QA personnel in order to determine that the manual integration is appropriate and documented.

4.13.3.3 Final Reports Reviews

The frequency of auditing final reports depends on the effectiveness of the laboratory's secondary review process. If the laboratory infrequently finds report errors or there is a low percentage of revised reports due to analytical error, audits may be less frequent.

4.13.4. Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, proficiency testing results, data audits, systems audits, validation comments, or regulatory audits. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

4.13.5. External Audits

STL facilities are routinely audited by clients and external regulatory authorities. STL is available for these audits and makes every effort to provide the auditors with the personnel, documentation, and assistance required by the auditors. STL recommends that the audits be scheduled with the QA Department so that all necessary personnel are available on the day of the audit.

4.14. Management Reviews

4.14.1. QA Reports to Management

A monthly QA report is prepared by QA Manager and forwarded to the Laboratory Director, the GM, and the Corporate QA Manager. The reports include statistical results that are used to assess the effectiveness of the Quality System. The format of the monthly report is shown in Figure 1.

4.14.2. Management Systems Review

A Quality Management Systems review of the facility is performed at least annually by either the Laboratory Director, QAM or his/her designee. The management systems review ensures that the laboratory's quality system is adequate to satisfy the laboratory's policies and practices, government requirements, certification, accreditation, approval requirements, and client expectations. Management systems reviews are accomplished through monthly quality assurance reporting, goal setting and an annual LQM review and revision.

4.14.3 Monthly QA Report and Metrics

By the 3rd day of the month, the QA manager prepares a monthly QA report. The report is sent to the Laboratory Director, General Manager and Corporate Quality Director. The report contains a narrative summary and metrics spreadsheet . At a minimum, the report content contains the items listed below (Figure 1). During the course of the year, the Laboratory Director, General Manager or Corporate Quality Director may request that additional information be added to the report.

Figure 1. Monthly QA Report Format

1	Audits
	Internal System Audits External System Audits
2	Revised Reports / Client Feedback
	Revised Reports Client Complaints Client Compliments
3	Certification Changes
	Changes Losses / Revocations
4	Proficiency Testing
	Study participation and scores Combined PT scores Repeat failures
5	SOP Status
	Report the percentage of SOPs that have been revised or reviewed within the last 24 months.
6	Miscellaneous QA and Operational Issues
	Narrative outlining improvements, regulatory compliance issues and general concerns.
Appended	Metrics Spreadsheet
	Summarize metrics in template provided by the Corporate Quality Director

5. *Technical Requirements*

5.1. Personnel

5.1.1. General

The STL-Connecticut management believes that its highly qualified and professional staff is the single most important aspect in assuring the highest level of data quality service in the industry.

STL-Connecticut staff consists of over forty professionals and support personnel that include:

- Laboratory Director
- Senior Management
- Quality Assurance Manager
- Information Systems Analyst
- Analytical Chemists
- Laboratory Technicians
- Sample Custodian
- Health and Safety/Waste Management Coordinators
- Customer Service Staff
- Account Executives

In order to ensure that employees have sufficient education and experience to perform a particular task, job descriptions are defined for each laboratory position. Job descriptions are located on the STL Intranet HR web page.

The personnel who are responsible for operations of sample analyses and data validation are outlined in Section 5 of the Appendix. Section 1 of the appendix presents professional profiles of key personnel within the STL-Connecticut organization. Profiles of additional STL staff members are available for review during a facility visit or are available upon special request.

5.1.2. Training

STL is committed to furthering the professional and technical development of employees at all levels. The QA Manager and the Laboratory Management may periodically review the training needs of the staff and make recommendations for any additional training. Each department within the laboratory is responsible for personnel training. Each training session, whether it be individual or group training must be documented utilizing the forms attached to the SOP for Employee Training. The completed forms must be submitted to the Human Resource department for placement into the employee training files.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. The QA section, in conjunction with the Human Resources section are responsible for maintaining documentation of these activities.

Project specific training may also take place. Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project by the Project Manager. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. Group Leader will then hold departmental meeting to discuss upcoming projects. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality.

The following evidence items are maintained in the employees technical training file for each technical employee:

- Initial Demonstration of Capability (IDOC)
- The employee has read and understood the latest version of the laboratory's quality documentation.
- The employee has read and understood the latest, approved version of all test methods and/or SOPs for which the employee is responsible.
- Annual evidence of continued DOC that may include successful analysis of a blind sample on the specific test method; a similar test method; an annual DOC; or four successive and acceptable LCSs.
- An ethic Agreement signed by each staff member (renewed each year)
- A confidentiality agreement signed by each staff member (renewed each year)
- Documentation of external training courses attended
- All training regarding QA policies and procedures

Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics). This information is maintained in the employee's secured personnel file. This includes:

- An Ethics Agreement signed by each staff member (renewed each year).
- A Confidentiality Agreement signed by each staff member (renewed each year).

Minimum training requirements for STL-Connecticut employees are outlined in Table 5.

Table 5 STL Employee Minimum Training Requirements

Required Training	Time Frame [1]	Employee Type
Environmental Health & Safety	Month 1	All
Ethics	Two Weeks	All
Data Integrity	Two Weeks	Technical and PMs
Ethics Refresher	Annually	All
Quality Assurance	Quarter 1	All
Initial Demonstration of Capability (IDOC)	Prior to unsupervised method Performance	Technical

[1] From the date of initial employment unless otherwise indicated.

Technical training is accomplished within each laboratory by management to ensure method comprehension. All new personnel are required to demonstrate competency in performing a particular method by successfully completing an Demonstration of Capability (DoC) before conducting analysis independently on client samples.

DoCs are performed by analysis of four replicate QC check samples. Results of successive LCS analyses can be used to fulfill the DoC requirement. The accuracy and precision, measured as average recovery and standard deviation (using n-1 as the population), of the 4 replicate results are calculated and compared to those in the test method (where available). If the test method does not include accuracy and precision requirements, the results are compared to target criteria set by the laboratory. The laboratory sets the target criteria such that they reflect the data quality objectives of the specific test method or project data quality objectives. An DoC Certification Statement is recorded and maintained in the employee's training or personnel file. Figure 2 shows an example of a DoC Certification Statement.

Continuing DoCs certification is required annually and must be documented in the same manner as the DoC.

Figure 2 Demonstration of Capability Certification Statement

Demonstration of Capability
Certification Statement

Laboratory Name: Date:
Laboratory Address:

Method:_____
Matrix: _____

Analyst Name:

We the undersigned certify that:

1. The analyst identified above, using the cited test method, which is in use at this facility for the analysis of samples under the National Environmental Laboratory Accreditation Program, have met the Initial Demonstration of Capability.
2. The test method was performed by the analyst identified on this certification.
3. Copies of the test method and SOP are available for all personnel on site.
4. The data associated with the DoC are true, complete and representative.
5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is available for review by authorized inspectors.

Laboratory Manager/Supervisor	Signature	Date
Quality Assurance Manager	Signature	Date

5.1.3. Ethics Policy

Establishing and maintaining a high ethical standard is an important element of a quality system. In order to ensure that all personnel understand the importance the company places on maintaining high ethical standards at all times, STL has established an Ethics Policy P-L-006 and an Ethics Agreement (Figure 4). Each employee shall sign the Ethics Agreement, signifying agreed compliance with its stated purpose.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize the Company's ability to do work on Government contracts, and for that reason, the Company has a Zero Tolerance approach to such violations.

Ethics is also a major component of the STL training program. Each employee must be trained in ethics within three months of hire in a training program that includes an overview of regulatory programs and program goals, a review of the ethics statement, and group discussions about data integrity and data misrepresentation. Employees must be trained as to the legal and environmental repercussions that result from data misrepresentation. A data integrity hotline is maintained by STL and administered by the QA Director. An annual refresher in ethics will be held for each employee.

Figure 3 STL Ethics Agreement

Severn Trent Laboratories, Inc.

I understand that STL is committed to ensuring the highest standard of quality and integrity of the data and services provided to our clients. I have read the Ethics Policy of the Company.

With regard to the duties I perform and the data I report in connection with my employment at the Company, I agree that:

- I will not intentionally report data values that are not the actual values obtained;
- I will not intentionally report the dates, times, sample or QC identifications, or method citations of data analyses that are not the actual dates, times, sample or QC identifications, or method citations;
- I will not intentionally misrepresent another individual's work;
- I will not intentionally misrepresent any data where data does not meet Method or QC requirements. If it is to be reported, I will report it with all appropriate notes and/or qualifiers;
- I agree to inform my Supervisor of any accidental reporting of non-authentic data by me in a timely manner; and I agree to inform my Supervisor of any accidental or intentional reporting of non-authentic data by other employees; and
- If a supervisor or a member of STL management requests me to engage in or perform an activity that I feel is compromising data validity or quality, I will not comply with the request and report this action immediately to a member of senior management, up to and including the President of STL.

As a STL employee, I understand that I have the responsibility to conduct myself with integrity in accordance with the ethical standards described in the Ethics Policy. I will also report any information relating to possible kickbacks or violations of the Procurement Integrity Act, or other questionable conduct in the course of sales or purchasing activities. I will not knowingly participate in any such activity and will report any actual or suspected violation of this policy to management.

The Ethics Policy has been explained to me by my supervisor or at a training session, and I have had the opportunity to ask questions if I did not understand any part of it. I understand that any violation of this policy subjects me to disciplinary action, which can include termination. In addition, I understand that any violation of this policy which relates to work under a government contract or subcontract could also subject me to the potential for prosecution under federal law.

EMPLOYEE SIGNATURE _____ Date _____

Supervisor/Trainer: _____ Date _____

5.2. Facilities

The laboratory is a secured facility with controlled and documented access. Access is controlled by various measures including locked doors (key access), and a staffed reception area. All visitors sign in and are escorted by STL Connecticut personnel while at the facility. The laboratory is locked at all times, unless a receptionist is present to monitor building access (e.g., between the hours of 8:30 a.m. and 5:00 p.m. Monday through Friday).

The laboratory currently maintains a staff of approximately 40 environmental professionals and occupies a facility of approximately 14,000 sq. ft. Separate laboratory areas are dedicated to GC instrumentation, GC/MS instrumentation, extractions for organic parameters, sample preparation for metals analysis, metals analysis and wet chemistries. The floor plan of the analytical laboratory is included in Section 4 of the Appendix.

The volatiles analysis laboratory containing GC/MS instrumentation has a separate air handling system which is maintained at a positive pressure at all times. The organic sample preparation laboratory has a separate HVAC system that creates negative pressure in the area. This design results in a contaminant-free environment for trace-level volatiles analysis.

Critical instrumentation such as GC/MS units, ICP's, AA's, data systems, gas chromatographs and LIMS are tied into an uninterruptible power supply system (UPS) to minimize instrument downtime and damage for short duration power interruptions.

The sample receipt and storage area is under the responsibility of the sample custodian. A locked walk-in refrigeration unit and 10 locked commercial refrigerator units are used to house samples waiting for analysis. Samples for volatile analysis are stored in separate units. Locked laboratory refrigerators, located throughout the laboratory, are used to maintain sample extracts or laboratory reagents. Each laboratory refrigerator is dedicated to sample, sample extract, or reagent storage.

All STL facilities are equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. STL also provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, respirators, etc.

5.3. Test Methods

5.3.1. Method Selection

Most of the test methods performed at STL-Connecticut originate from test methods published by a regulatory agency such as the US EPA and other state and federal

regulatory agencies. These include, but are not limited to, the following published compendiums of test methods:

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January, 1996.

Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water.

Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.

Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.

Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991.

Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992.

Statement of Work for Inorganics Analysis, ILM04.1, USEPA Contract Laboratory Program Multi-media, Multi-concentration.

Statement of Work for Organics Analysis, OLM03.2, USEPA Contract Laboratory Program, Multi-media, Multi-concentration.

Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, OLM04.2/OLM04.3, USEPA Contract Laboratory Program, September 1998.

Standard Methods for the Examination of Water and Wastewater, $18^{th}/19^{th}$ edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.

Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996.

Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.

5.3.2. SOPs

Each STL facility maintains an SOP Index for all standard, non-standard, and laboratory developed methods. SOPs are also maintained for describing processes that are not related to a specific method. Method SOPs are maintained to describe a specific test method. Process SOPs are maintained to describe function and processes not related to a specific test method.

Method SOPs contain the following information:

Title Page with Document Name, Document Number, Revision Number, Effective Date, Page Numbers and Total # of Pages, Authorized Signatures, Dates and Proprietary Information Statement (Figure 4).

1. Identification of Test Method
2. Applicable Matrix
3. Reporting Limit
4. Scope and Application, including test analytes
5. Summary of the Test Method
6. Definitions
7. Interferences
8. Safety
9. Equipment and Supplies
10. Reagents and Standards
11. Sample Collection, Preservation, Shipment and Storage
12. Quality control
13. Calibration and Standardization
14. Procedure
15. Calculations
16. Method Performance
17. Pollution Prevention
18. Data Assessment and Acceptance Criteria for Quality Control Measures
19. Corrective Actions for Out-of-Control Data
20. Contingencies for Handling Out-of-Control or Unacceptable Data
21. Waste Management
22. References
23. Tables, Diagrams, Flowcharts and Validation Data

Process SOPs contain the following information:

Title Page with Document Name, Document Number, Revision Number, Effective Date, Page Numbers and Total # of Pages, Authorized Signatures, Dates and Proprietary Information Statement (Figure 4).

1. Scope
2. Summary
3. Definitions
4. Responsibilities
5. Safety
6. Procedure
7. References
8. Tables, Diagrams, and Flowcharts

Reference the STL-Connecticut SOP on SOPs for the exact format.

The QA Department is responsible for maintenance of SOPs, archival of SOP historical revisions, and maintenance of an SOP index. SOPs, at a minimum, undergo annual review. Where an SOP is based on a published method, the laboratory maintains a copy of the reference method.

Figure 4 Proprietary Information Statement

SOP Appendix
In some cases, a standard laboratory procedure is modified slightly for a specific client or project at the client or regulatory agency's request. In these cases, an Appendix to the SOP may be attached that indicates the modifications to the SOP which are specific to that project. SOP appendices shall not be used to alter test methods required by regulation such that the modifications would results in non-compliances.

5.3.3. Method Validation

Laboratory developed methods are validated and documented according to the procedure described in Section 5.3.5.

5.3.4. Method Verification

Method verification is required when a validated standard test method or a method modification is implemented. The level of activity required for method verification is dependent on the type of method being implemented, or on the level of method modification and its affect on a method's robustness. Method modification often takes advantage of a method's robustness, or the ability to make minor changes in a method without affecting the method's outcome. Method verification commonly will minimally require Determination of Method Sensitivity and Determination of Accuracy and Precision as described in Section 5.3.5. When implementing new, but previously validated methodologies, method verification may require additional activities such as Determination of Range.

5.3.5. Method Validation and Verification Activities

Before analyzing samples by a particular method, method validation and/or method verification must occur. A complete validation of the method is required for laboratory developed methods. While method validation can take various courses, the following activities are generally required as part of method validation. Method validation records are designated QC records and are archived accordingly.

Determination of Method Selectivity
Method selectivity is demonstrated for the analyte(s) in the specific matrix or matrices. In some cases, to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

Determination of Method Sensitivity
Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed. The laboratory determines MDLs are described in Section 4.4.3.6 and the corporate procedure S-Q-003.

Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)
An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum level at which both the presence of an analyte and its concentration can be reliably determined. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it is done so with a qualification that denotes the semi-quantitative nature of the result.

Determination of Interferences
A determination that the method is free from interferences in a blank matrix is performed.

Determination of Range
Where appropriate, a determination of the applicable range of the method is performed. In most cases, range is determined and demonstrated by comparison of the response of an analyte in a curve to established or targeted criteria. The curve is used to establish the range of quantitation and the lower and upper values of the curve represent upper and lower quantitation limits. Curves are not limited to linear relationships.

Demonstration of Capability
DoCs are performed prior to method performance.

Determination of Accuracy and Precision
Accuracy and precision studies may be required as a separate determination from the IDC. Accuracy and precision studies are generally performed using four replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

Documentation of Method
The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Appendix describing the specific differences in the new method is acceptable in place of a separate SOP.

Continued Demonstration of Method Performance
Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as Laboratory Control Samples and Method Blanks.

5.3.6 Data Reduction and Review

Analytical data are entered/downloaded directly into LIMS or recorded on pre-formatted bench sheets that are paginated and bound into laboratory logbooks. These logbooks are issued and controlled by the laboratory's QA Section. A unique document control code is assigned to each book to assure that chronological record keeping is maintained.

Analytical data is referenced to a unique sample identification number for internal tracking and reporting. Both LIMS entries and logbook pages contain the following information, as applicable: analytical method, analyst, date, sequential page number, associated sample numbers, standard concentrations, and raw data. Entries are in chronological order and maintained so as to enable reconstruction of the analytical sequence.

The analyst is responsible for entering / recording all appropriate information, and for signing and dating all logbook entries daily. All entries and logbook pages are reviewed for completeness by a supervisor, peer reviewer. Data review checklists document the analytical review of the LIMS entries, logbook and associated QC indicators. Copies of instrument outputs (chromatograms, mass spectra, etc..) are maintained on file or electronically with the analyst's signature/initials and date.

5.6.3.1 Data review

All data, regardless of regulatory program or level of reporting, are subject to a thorough review process. All levels of the review are documented.

Initial Review

The initial review is often referred to as a "bench-level" review. In most cases, the analyst who generates the data (i.e. logs in, prepares and/or runs the samples) is the initial reviewer. In some cases, an analyst may be reducing data for samples run by an auto-sampler set up by a different analyst. In this case, the identity of both the analyst and the initial reviewer is identified in the raw data.

One of the most important aspects of primary review is to make sure that the test instructions are clear, and that all project specific requirements have been understood and followed. If directions to the analyst are not clear, the analyst must go to the Supervisor, Manager, or PM, who must clarify the instructions.

Once an analysis is complete, the initial reviewer ensures that:

- Sample preparation information is complete, accurate, and documented.
- Calculations have been performed correctly.
- Quantitation has been performed accurately.
- Qualitative identifications are accurate.
- Manual integrations are appropriate.

- Data flags to indicate manual integrations are recorded.
- Manual integrations are authorized by a date and signature or initials of primary analyst.
- Client specific requirements have been followed.
- Method and process SOPs have been followed.
- Method QC criteria have been met.
- QC samples are within established limits.
- Dilution factors are correctly recorded and applied.
- Non-conformances and/or anomalous data have been documented and communicated.
- COC procedures have been followed.
- Initial review is documented by date and initials/signature of primary analyst.

Any anomalous results and/or non-conformances noted during the Initial Review are communicated to the Supervisor and the PM for resolution. Resolution can require sample reanalysis, or it may require that data be reported with a qualification. Non-conformances are documented per Section 4.9.

The laboratory employs a system of QA sign-off sheets called QC Batch Approval Forms and Quality Control Approval Reports (QCAR's), where each analyst must sign off that their respective part of the analysis is complete and meets the QA/QC requirements of the governing SOP. Both the Volatile and semi-volatile computer systems produce batch-specific QC summary reports to check various analytical parameters. Analysis QCAR's are filed with the analysis batches while the final deliverable QCAR's are signed and placed in each job folder along with any Corrective Action Forms (CAF) which details any problems which were encountered in the measurement of samples. Any deviations from SOPs are noted on CAF's and explained in the SDG narrative which is incorporated into the final report. The group leader has final sign-off responsibility on the QCAR and is responsible for assuring the overall quality of the data.

Secondary Review

The secondary review is a complete technical review of a data set and is performed by the Group/Section or designee. The secondary review is documented and the secondary reviewer is identified. The following items are reviewed:

- Qualitative Identification
- Quantitative Accuracy
- Calibration
- QC Samples
- Method QC Criteria
- Adherence to method and process SOPs
- Accuracy of Final Client Reporting Forms
- Manual Integrations – 100% as verified by signature of secondary data reviewer
- Completeness
- Special Requirements/Instructions

If problems are found during the secondary review, the reviewer must work with the appropriate personnel to resolve them. If changes are made to the data, such as alternate qualitative identifications, identifications of additional target analytes, re-quantitation, or re-integration, the secondary reviewer must contact the laboratory analyst and/or primary reviewer of the data so that the primary analyst and/or reviewer is aware of the appropriate reporting procedures. It is at this time the case narrative is written for the report.

Completeness Review

The completeness review performed by the Project Manager, the includes the review of a project narrative and/or cover letter which outlines anomalous data and non-compliances using project narrative notes and non-compliance reports generated during the primary and secondary review. The completeness review addresses the following items:

- Is the project report complete with all samples present?
- Does the data meet with the client's expectations?
- If available, were the data quality objectives of the project met?
- Are QC outages and/or non-conformances approved and appropriately explained in the narrative notes?

5.3.6.1 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the section manager or alternate analyst prior to updating the data in LIMS. The spreadsheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the STL Corporate SOP entitled *Acceptable Manual Integration Practices* (S-Q-004).

Copies of all raw data and the calculations used to generate the final results, such as bound logbooks, are retained on file for a minimum of 5 years or as otherwise requested by the client/project.

Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

The following sections will describe the general procedures which are employed at the STL-Connecticut laboratory. More specific detail can be found in the standard operating procedures.

- Gas Chromatography

Data from the Gas Chromatographs is acquired through interfaces with a computer system utilizing Perkin Elmer Turbo Chrom chromatography software. After acquisition, the data is automatically copied to the Thermo analytical systems Target software package for data processing and quantitation. Data is reviewed at the bench level by the analyst. The data is reviewed for chromatographic scaling and dilutions. Necessary reintegrations and rescalings are done using Target. On column result data is then transferred to the labnet LIMS system. Prep data is manually entered and then linked to the analyses for final result calculation. If the data meets QC requirements, final reports are printed.

- GC/Mass Spectrometry

GC/MS data is acquired utilizing Hewlett Packard Chemstation computer systems with Environquant software. After acquisition, the data is automatically copied to the Thermo analytical systems Target software package for data processing and quantitation. This software allows for the comparison of sample non-target spectrum against reference library spectra. The most recent NIST/EPA mass spectral library supported by the system must be used. On column result data is then transferred to the labnet LIMS system. Prep data is manually enter and then linked to the analyses for final result calculation. Data is reviewed by the analyst. If the data meets QC requirements, final reports are printed.

- Atomic Spectroscopy

ICAP metals are analyzed by a Thermo-Jarrel Ash 61E or 61E Purge. The raw data collected is transferred via a network system to the labnet LIMS system. Mercury data is analyzed on the mercury analyzer and is transferred via a network system to the labnet LIMS system. Prep data is manually entered and then linked to the analysis for finally result calculation.

- Classical Chemistry

Routine wet chemistry analyses have pre-printed logbooks, such as distillation logs and digestion logs. The less frequent analyses are recorded in analysts' notebooks. Raw data is then entered into the LIMS for data calculation. This includes the calibration curve data which may have been previously entered. Semi-automated analyses performed on the Lachat produce results. These results are then electronically transferred to the LIMS system. Any associated prep data is manually entered and then linked to the analysis for final result calculation. Any raw data produced is stored in a central file.

5.3.7 Data Integrity and Security

This section details those procedures that are relevant to computer systems that collect, analyze, and process raw instrumental data, and those that manage and report data. STL Connecticut uses Labnet, STL's propriety LIMS, for Quotes, Project setup, sample login, standard and reagent traceability, data and report generation.

Security and Traceability

Access to computer systems that collect, analyze, and process raw instrumental data, and those that manage and report data is both controlled and recorded. There are various systems at STL to which this applies, which include the Laboratory Information Management System (LIMS), as well as specific systems such as a chromatography data system.

Control of the system is accomplished through limitation of access to the system by users with the education, training and experience to perform the task knowledgeably and accurately. System users are granted privileges that are commensurate with their experience and responsibilities.

Computer access is tracked by using unique login names and passwords for all employees that have access to the computer system. Entries and changes are documented with the identity of the individual making the entry, and the time and date. Where a computer system is processing raw instrumental data, the instrument identification number as described in Section 5.4.1 is recorded. Many of these systems, such as the Target Data System, have the capability of maintaining audit trails to track entries and changes to the data. This function is activated on any computer system that has that capability.

Outputs from all instruments are monitored for readability and consistency. If clarity is less than desired, corrective actions are undertaken to rectify the output based on instrument manufacturers' recommendations.

Verification

All commercially obtained software is verified prior to use and after version upgrade. Verification involves assessing whether the computer system accurately performs its intended function. Verification generally is accomplished by comparing the output of the program with the output of the raw data manually processed, or processed by the software being replaced. The records of the verification are required to contain the following information: software vendor, name of product, version, comparison of program output and manual output, raw data used to verify the program, date, and name of the individual performing the verification. Records of verification are retained as QC records.

Validation

Software validation involves documentation of specifications and coding as well as verification of results. Software validation is performed on all in house programs. Records of verification include original specifications, identity of code, printout of code, software name, software version, name of individual writing the code, comparison of program output with specifications, and verification records as specified above. Records of validation are retained as QC records.

Auditing

The QA Department systems audit includes review of the control, security, and tracking of Information Technology (IT) systems and software.

STLs LIMS System Managers continually review the control, security, and tracking of IT systems and software.

Version Control
The laboratory maintains copies of outdated versions of software and associated manuals for all software in use at the laboratory for a period of 5 years from its retirement date. The associated hardware, required to operate the software, is also retained for the same time period.

5.4. Equipment

5.4.1. Equipment Operation

STL facilities maintain state of the art instrumentation to perform the analyses within the QC specifications of the test methods. Each STL facility maintains an equipment list that includes the following information:

- Identity
- Date Installed
- Manufacturer's Name, Model Number, Serial Number
- Current Location
- Preventative Maintenance Schedule

All equipment is subject to rigorous checks upon its receipt, upgrade, or modification to establish that the equipment meets with the selectivity, accuracy, and precision required by the test method for which it is to be used. All manufacturer's operations and maintenance manuals are kept up to date and accessible for the use of the equipment operator. Documentation of equipment usage is maintained using analytical run and maintenance logbooks. Table 6 lists STL's major equipment.

Table 6 Major Equipment List

Instrument Type	Number
Gas Chromatograph (GC)	6
Gas Chromatograph/Mass Spectrometer (GC/MS)	8
Air Desorber	1
Inductively Coupled Argon Plasma Emission Spectrophotometer (ICP)	2
Mercury Cold Vapor Analyzer	1
Infrared Spectrophotometer (IR)	1
Wet Chemistry Autoanalyzer	2
Ion Chromatograph	1
UV-Visible Spectrophotometer	2
TOC Analyzer	2

5.4.2. Equipment Maintenance

STL employs a system of preventative maintenance in order to ensure system up time, minimize corrective maintenance costs and ensure data validity. All routine maintenance is performed as recommended by the manufacturer and may be performed by an analyst, instrument specialist or outside technician. Maintenance logbooks are kept on all major pieces of equipment in which both routine and non-routine maintenance is recorded. Notation of the date and maintenance activity is recorded each time service procedures are performed. The return to analytical control following instrument repair is documented in the maintenance logbook. Maintenance logbooks are retained as QC records. Section 5 of the Appendix outlines the Preventive Maintenance performed at STL Connecticut.

Where it is desirable, the STL-Connecticut laboratory has service contracts for major instruments. These contracts provide routine preventive maintenance according to the manufacturer's requirements. Additionally the laboratory maintains an inventory of expendable parts and supplies to minimize downtime and to allow laboratory personnel to make minor repairs if necessary.

5.4.3. Equipment Verification and Calibration

All equipment is tested upon receipt to establish its ability to meet the QC guidelines contained in the test method for which the instrumentation is to be used. This testing is documented in instrument run and maintenance logbooks. Once an instrument is placed in routine service, ongoing instrument calibration is demonstrated at the appropriate frequency as defined in the test method. The calibration data, which includes instrument conditions and standard concentrations, is documented in pre-formatted instrument runlogs or within LIMS itself. The preparation of all reference materials used for calibration is documented via LIMS. Refer to Corporate SOP P-T-001, Selection of Calibration Points for Proper handling of Calibration data. Any instrument that is deemed to be malfunctioning is clearly marked and taken out of service. When the instrument is brought back into control, this is documented in the instrument maintenance log.

5.5. Measurement Traceability

5.5.1. General

Traceability of measurements is assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration are not necessarily documented in a test method analysis or by analysis of a reference standard is subject to ongoing certifications of accuracy.

These include procedures for checking specifications ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. With the exception of Class A Glassware (including glass microliter syringes that have a certificate of accuracy), quarterly accuracy checks are performed for all mechanical volumetric devices. Eppendorf pipets shall be verified monthly and checked prior to use. Wherever possible, subsidiary or peripheral equipment is

checked against standard equipment or standards that are traceable to national or international standards.

The accuracy of any non standard lab ware, such as plastic digestion cups or sample vials, used to measure initial sample volumes or final sample extract volumes must be verified one per lot. Class A glassware such as flasks, pipets, graduated cylinders and volumetrics shall be verified one per lot prior to being put into service within the lab. Accuracy must be verified to within 3 percent in accordance with ASTM procedures.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balances are calibrated on each day of use. All thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

Laboratory SOPs specify the required level of accuracy in volumetric glassware. In all cases, volumetric glassware meets the requirements specified in the published test method.

5.5.2. Reference Standards

The receipt of all reference standards is documented in labnet. References standards are purchased from commercial vendors and labeled with a unique Standard Identification Number, date received, and the expiration date. The expiration dates for ampulated solutions shall not exceed the manufacturer's expiration date. Expiration dates for laboratory-prepared stock and diluted standards shall be no later than the expiration date of the stock solution or material first. Expiration dates for pure chemicals shall be established by the laboratory and be based on chemical stability, possibility of contamination, and environmental and storage conditions. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

The preparation of all daughter solutions, whether a single or multiple-component stock, intermediate, or working standard solution, is documented in a standard solution preparation logbook, in a designated section of the analytical logbook or in the LIMS systems reagent program. This documentation references the Standard ID of the respective parent solution(s) used in its preparation, providing a solid trail back to the solution or chemical received from the vendor. These records include the standard name, final volume, matrix, final concentration, analyst initials, prep date and expiration date. A daughter solution should not have an expiration date which post-dates any of the parent solutions used in its preparation.

Where possible standards are purchased with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The documentation of standard purity is archived, and references the Standard Identification Number.

All efforts are made to purchase standards that are $\geq$ 97.0% purity. If this is not possible, the purity is used in performing standards calculations.

The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a different lot is acceptable for use as a second source. The appropriate QC criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an ICV or LCS is used as the second source confirmation.

Storage conditions, such as shelf life, ambient or chilled, controlled or restricted access, wet or desiccated, etc.., are in conformance with the specifications set in the associated method, the program requirements, or the manufacturer's recommendation, as appropriate.

Analytical Calibration Standards

The calibration standards used for instruments and equipment are described in the specific analytical methods, or instrument manufacturers' operational guides. All standard preparations are recorded in a bound "Standards Preparation Log Book" or entered into labnet, with the lot number, method of preparation, date and analyst's initials. The labnet system and or log provides the internal documentation which traces the internal working standards to primary and secondary (purchased) stocks.

Samples shall not be stored in the same areas as the standards.

Records on the traceability of the standards are maintained within each department. These records include sources, dates of receipt, lot numbers (if applicable) and expiration dates (if applicable). All purchased standards shall be traceable to NIST Standards including EPA/A2LA standards.

Table 7 provides an overview of the standard sources, types and preparation by instrument group.

- Metals Calibration Standards

Commercially available at 1000 ppm levels from Inorganic Ventures and prepared from primary standard material traceable to NIST Standards including EPA/A2LA standards. Stock standards solutions are prepared every six months or when needed as multi-element stocks.

- Inorganic Calibration Standards

Calibration standards described in the methodology use ACS Reagent Grade materials. Some reference materials are available from NIST to standardize titrating solutions. Stock solutions are prepared every three months while diluted working standards are prepared daily at the time of analysis

- Organic Calibration Standards

Pure compounds, Calibration mixes and Spike solutions for organic compounds are available through, Protocol, Supelco, Inc., Restek, Inc. and Accustandard, Inc. Volatile organic stocks are

prepared every six months and diluted working standards are prepared weekly. Stock non-volatile solutions can be prepared every six months and diluted working standards are prepared as needed.

- pH Calibration Standards

Calibration materials which are certified by the manufacturer to be standardized against NIST Standards are commercially available and are used by the laboratory. Three standards - 4,7, and 10 are used daily to calibrate the pH meters.

- Weighing Calibration Standards

Analytical balances are certified annually. Calibration is performed on a weekly or daily basis using class "S" weights (0.50, 5.00, and 50g). All Class S weights shall be calibrated within 5 years and traceable to NIST.

- Oven Calibration Standards

Daily calibration by monitoring oven temperature with a thermometer calibrated annually with a NIST Certified Thermometer. Digital thermometers shall be calibrated on a quarterly basis.

- Conductivity Calibration Standard

Conductivity solutions are described in Standard Methods, 18th edition, Section 502.

- Turbidity Standards

Formazin solution prepared from CMS neat standard according to EPA Method 180.1-2. Four standards are used to prepare a calibration curve and are made fresh daily. The stock formazin standard is prepared every three months and kept under refrigeration.

- Photometer Calibration Standard

Spectronic Standards - Catalog #331-31-50 (wavelength calibration).

TABLE 7 .STANDARD SOURCES AND PREPARATION

Inst. Group	Source	Form Received	Storage	Preparation from Source	Laboratory Storage	Preparation Frequency
GC/MS-Volatiles	Restek, Inc. EPA Supelco Accustandard Protocol	Neat Solutions> 1000 ppm	Frozen	Primary stocks are prepared from source stocks Intermediate stocks are prepared from primary or source stocks Working stocks are prepared from intermediates	Freezer Refrigerator N/A	Semi-annual Weekly Weekly
GC/MS GC - SV	Restek, Inc. EPA RTP Supelco Accustandard	Neat Solutions >1000 ppm	Frozen	Primary stocks are prepared from source stocks Intermediate stocks are prepared from primary or source stocks Working stocks are prepared from intermediates	Freezer Refrigerator Refrigerator Certain Pesticies stored at room temperature	Semi-annual Semi-annually Semi-annually
ICP	Inorganic Ventures	Solutions of 1000ppm	Room temp.	Primary stocks (1 - 10 ppm) are prepared from source Intermediate stocks (1ppb - 1 ppm) Working stocks	O.15% HNO_3 at room temperature 0.15% HNO_3 at room temperature 0.15% HNO_3 at room temperature	Annually Semi-annually or as needed Daily

The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a different lot is acceptable for use as a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or Laboratory Control Sample (LCS) is used as the second source confirmation.

5.5.3. Reagents

Reagents are, in general, required to be analytical reagent grade unless otherwise specific in method SOPs. Reagents must be at a minimum the purity required in the test method.

With the exception of the cycletainers, all solvents are pretested at an alternate STL facility. Documentation of approval is submitted to QA and posted on the STL intranet. All reagents are entered into the labnet lims system for tracking. The date of reagent receipt or preparation, and the date the reagent was opened are documented on the preprinted labnet label.

Cycletainers

STL-CT utilizes cycletainers for the organic Extractions solvents such as Hexane and Methylene Chloride. To access certification of these containers the distributor will fax a certificate of analysis from the manufacturer for the lots to be used to the QA Manager. These are kept on file. Cycletainers that do not come with a Certificate of Analysis must be pre-tested at the lab prior to being put into use. A sample of the solvent shall be concentrated and analyzed by the appropriate method. Solvents are tested and accepted in accordance with STLs Corporate *Testing Solvents and Acids* procedure (S-T-001). Documentation of lot verification must be in the extraction log and data kept on file with QA.

5.6. Sampling

Sample representativeness and integrity are the foundations upon which meaningful analytical results rely. Where documented and approved SAPs and/or LQMPs are in place, they must be made available to the laboratory before sample receipt, and approved by laboratory management before sample receipt.

5.7. Sample Handling, Transport, and Storage

5.7.1. General

Chain of Custody (COC) can be established either when bottles are sent to the field, or at the time of sampling. STL can provide all of the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory.

Samples are received at the laboratory by a designated sample custodian and a unique Laboratory Project Identification Number is assigned thru the labnet system. The following information is recorded for each sample shipment: Client/Project Name, Date and Time of Laboratory Receipt, Laboratory Project Number, and Signature or initials of the personnel receiving the cooler and making the entries.

Upon inspection of the cooler and custody seals, the sample custodian opens and inspects the contents of the cooler, and records the cooler temperature. All documents are immediately inspected to assure agreement between the test samples received and the COC.

Any non-conformance, irregularity, or compromised sample receipt as described in Section 4.7.1 is documented on the labnet checklist and brought to the immediate attention of the PM for resolution with the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the permanent project record. The sample data is then logged into the LIMS system by the Sample Management department.

Samples that are being tested at another STL facility or by an external subcontractor are repackaged, iced, and sent out under COC.

Following sample labeling as described in Section 5.7.1, the sample is placed in storage. Sample storage is required to be access controlled. All samples are stored according to the requirements outlined in the test method, and in a manner such that they are not subject to cross contamination or contamination from their environment. Unless specified by method or state regulation, a tolerance range of $\pm$ 2°C is used. The walk-in storage unit is monitored daily, all others are monitored each business day.

The National Enforcement Investigations Center (NEIC) of EPA defines custody of evidence in the following ways:

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

At STL-Connecticut, chain of custody begins with shipment of the sample bottles and coolers. STL-Connecticut has a printed external chain-of-custody form that accompanies each sample shipment. An example of this form is found in Section 3 of the appendix.

Upon receipt of the samples in the laboratory the sample custodian and the sample control group are responsible for obtaining all necessary shipping documentation and verification of all data entered into the laboratory sample custody records. The internal laboratory custody form is generated at this point.

All samples and projects entering the laboratory are identified with a job/project number. Individual sample bottles are then identified using the job number and sample counter. The samples are then stored according to the requirements of the analytical protocols (refrigeration) and preservative type.

Preliminary sample receipt notifications are distributed to each department to notify department of sample arrival and facilitate the analysis of parameters with short holding times. Each department has a system of tracking sample analysis throughout their respective departments to ensure protocol holding times are met.

All documentation received with samples is reviewed by the sample custodian at the time of receipt. The project manager then reviews the paperwork and checks off the login review in labnet. If there are any discrepancies noted by the sample custodian, the client is then contacted for resolution.

The specific procedures and requirements for receiving samples are specified in the SOP for sample control - "Sample Processing Methods Performed at Sample Arrival". STL's chain-of-custody record is designed to meet the legal requirements of federal, state and local government agencies and the courts of law. The record covers:

- Labeling of sample bottles, packing the shipping container and transferring the shipping container under seal to the custody of a shipper;
- Outgoing shipping manifests;
- The chain-of-custody form completed by the person(s) breaking the shipping container seal, taking the sample, resealing the shipping container and transferring custody to a shipper;
- Incoming shipping manifests;
- Breaking the shipping container's reseal;
- Storing each labeled sample bottle in a secured area;
- Disposition of each sample to an analyst or technician; and
- The use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

For each link in this process the records indicate the following:

- The person with custody; and
- The time and date each person accepted or relinquished custody.

STL has implemented the following standard operating procedures with regard to laboratory chain-of-custody:

- Samples are stored in a secure area;
- Non-employee access to the laboratories are controlled through the use of limited access points at each facility. Outside personnel can access the facility either through the front receptionist or the sample receipt area. Other access doors to the laboratory are maintained in a secure manner at all times;

- All visitors to each facility are required to sign-in at the reception area and must be escorted by an STL representative at all times while in the laboratory;

- The designated sample custodian and authorized personnel control access to the sample storage units; and

- Samples remain in secured sample storage until removed for sample preparation or analysis; and

All samples are stored in either the walk-in refrigerator or in a separate locked refrigerator. Samples must be stored at 4 ± 2° C. All unused portions of samples, including empty sample containers, are returned to the secure sample control area.

5.7.2. Sample Identification and Traceability

Each sample container is assigned a unique Sample Identification Number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a sample identification label. Access to samples is controlled and documented, identifying the identity of the sample handler, and date and time of sample access. All unused portions of th sample are returned to the Sample control area.

5.7.3 Subsampling

Taking a representative sub-sample from a container containing a soil or solid matrix is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation.

After thoroughly mixing the sample within the sample container or transfer to a wip bag (or other suitable plastic bag), a sub-sample from various quadrants and depths of the sample are taken to acquire the required sample weight. Any non-homogenous looking material is avoided and noted as such within the sample preparation record.

The procedure used for subsampling with the laboratory is outlined in the SOP for Compositing, Homogenization and splitting Environmental Samples.

5.7.4 Sample Preparation

Sample preparation procedures are documented in the laboratory's analytical SOPs.

5.7.5 Sample Disposal

Samples are retained in the STL-Connecticut storage facilities for 30 days after the project report is sent unless prior arrangements have been made with the client. Samples may be held longer or returned to the client per written request. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work. All radioactive or dioxin containing samples will be returned to the client.

The STL-Connecticut laboratory has a designated hazardous waste storage area with bermed floors and separate ventilation. This area and satellite accumulation areas are the direct responsibility of the Hazardous Waste Manager (HWM). The HWM routinely inspections each area to ensure regulatory adherence.

Samples designated for disposal are removed from sample control and brought to the hazardous waste storage area. Samples designated for disposal may be returned to clients for disposal, on a case-by-case basis.

The laboratory sample waste to be disposed of is segregated by waste streams. Waste profiles have been generated for the following streams: acid liquid waste, NaOH liquid waste, vials (GC, GC/MS), waste organic solvent and waste pyridine. Other laboratory waste is disposed of through the established compatible waste streams. If no compatible waste stream is available the waste is sent out via lab pack procedure.

A Hazard Waste Minimization Plan has been prepared for the STL-Connecticut facility and is designed to minimize the volume and toxicity of all waste streams being generated whenever possible. This Hazard Waste Minimization Plan is designed to meet or exceed the requirements set forth in 54 FR 25056, June 12, 1989.

Each process that generates waste will be assessed to determine if there are ways to either reduce the volume or toxicity of waste being generated. It is unlikely that most processes will be changed due to the stringent EPA standard operating procedures which must be followed. Strong emphasis will, however, be placed on efficient use of products used to prevent excessive amounts from becoming waste.

5.8. Assuring the Quality of Test Results

5.8.1. Proficiency Testing

STL analyzes Proficiency Test (PT) samples as required for certification and as outlined in the National Environmental Laboratory Accreditation Conference (NELAC). Each STL facility participates in the PT program semi-annually for each area of testing and matrix (e.g. organics, inorganics, microscopy, radiological, microbiological; aqueous and drinking water) for which it is accredited. In addition to the PT program required for NELAC accreditation, STL participates in a number of additional PT programs, as appropriate for the specific facility, such as the Army Corps of Engineers Laboratory Assessment program.

PT samples are handled and tested in the same manner (procedural, equipment, staff) as environmental samples. PT test sample data is archived using the requirements for project and raw data record retention.

Double Blind Performance Evaluation

STL CT also participates in a double blind performance. An external vendor is contracted by the corporate QA Director to submit double blind samples to the STL facility. Both the level of customer service and the accuracy of the test results are assessed objectively by the external contractor, who provides a detailed report to the QA Director and to each of the STL facilities. This is administered as a double blind program in order to assess all facets of STL operations.

5.8.2. Control Samples

Control samples are analyzed with each batch of samples to monitor laboratory performance in terms of accuracy, precision, sensitivity, selectivity, and interferences. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch. There are also a number of QC sample types that monitor field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed Note that frequency and criteria of control samples vary with specific regulatory, methodology and project specific criteria.

5.8.2.1 Method Performance Control Samples: Preparation Batch

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment.

Control samples are added to each prep batch to monitor method performance (Table 8) and are processed through the entire analytical procedure with investigative/field samples.

Table 8. Preparation Batch Control Samples

Control Sample Type	Details	
Method Blank (MB)	Use	Monitors for potential contamination introduced during the sample preparation and analytical processes.
	Typical Frequency [1]	1 per batch of ≤ 20 samples per matrix type per sample extraction or preparation method.

Table 8. Preparation Batch Control Samples

Control Sample Type	Details	
	Description	Organics: Laboratory pure water for water samples or a purified solid matrix for soil or solid samples (when available or when requested); solid matrices commonly include sodium sulfate, vendor or agency supplied soil or solid, or purchased sand; these solids may require purification at the laboratory prior to use. Inorganics: Laboratory pure water for both water and soil or sediment samples. ***Volume/weights are selected to approximately equal the typical sample volume/weight used in sample preparation; and final results in a soil/solid batch may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison to actual field samples.***
Laboratory Control Sample (LCS)	Use	Measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects.
	Typical Frequency [1]	1 per batch of ≤ 20 samples per matrix type per sample extraction or preparation method. For multi-analyte methods, the LCS may consist of surrogates in the blank matrix, and or a representative selection of target analytes/internal standards.
	Description	Prepared from a reference source of known concentration and processed through the preparation and analysis steps concurrently with the field samples. Aqueous LCS's may be processed for solid matrices unless a solid LCS is requested; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the actual field samples.
Known QC Sample	Use	Comply with regulatory requirements; check the accuracy of an analytical procedure; troubleshoot method performance problems; verify an analyst in training's ability to accurately perform a method; to verify the return-to-control after method performance problems; and may also be used as an LCS.
	Typical Frequency [1]	As defined by the client or QAPP.
	Description	Obtained from outside suppliers or agencies; generally require preparation from concentrated materials by dilution into a standard matrix; contain known analytes or compounds; acceptance limits are provided by the vendor.

[1] Denotes an STL required frequency.

Field blanks, equipment blank and trip blanks, when received, are analyzed in the same manner as other field samples. However, a field blank should not be selected for matrix QC,

as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB".

5.8.2.2 Method Performance Control Samples: Matrix

Matrix control samples include sample duplicates (MD), sample matrix spikes (MS), and sample surrogate spikes. These control samples help monitor for potential physical and chemical effects which may interfere with the precision and/or accuracy of the selected analytical method. Since interferences can enhance or mask the presence of target analytes, matrix control samples measure the degree of interference and are used to assist in the interpretation of the analytical results. The laboratory avoids performing matrix QC on known field blank samples, such as trip blanks and rinsates, since these samples are not indicative of the sample matrix.

Table 9. Matrix Control Samples

Control Sample Type	Details	
Matrix Duplicate (MD)	Use	Monitors the effect of site matrix on the precision of the method; and of the reproducibility of laboratory preparation and measurement techniques. **Note:** Precision may also be affected by the degree of homogeneity of the sample, particularly in the case of non-aqueous samples or aqueous samples with particulates. Sample homogeneity and matrix effect should be considered when field samples are used to assess reproducibility. **Note:** A field duplicate, when received, measures Representativeness of sampling and the effect of the site matrix upon precision.
	Typical Frequency [1]	1 per 20 samples per matrix or per SAP/QAPP [2].
	Description	***Performed by analyzing two aliquots of the same field sample independently; analyzed for each associated sample matrix (e.g., when requested by the client or the analytical method).***
Matrix Spike (MS)	Use	Measures the effect of site sample matrix on the accuracy of the method.
	Typical Frequency [1]	1 per 20 samples per matrix or per SAP/QAPP.

Table 9. Matrix Control Samples

Control Sample Type	Details	
	Description	Aliquot of a field sample which is spiked with the analytes or compounds of interest; analyzed for each associated sample matrix (when requested by the client or analytical method). The determination of MS percent recovery (% R) requires an analysis of a fortified sample and a non-fortified sample under the same procedural conditions (e.g., sample volumes, dilutions, procedural conditions, etc..). The concentration determined in the non-fortified sample is subtracted from the fortified sample concentration before determining the %R. The degree of homogeneity of the sample, particularly in the case on non-aqueous samples or samples with particulates, may affect the ability to obtain representative recoveries.
Matrix Spike Duplicate (MSD)	Use	Measures effect of site sample matrix on precision of method.
	Typical Frequency [1]	1 per 20 samples per matrix, when requested by the client or the analytical method, or per SAP/QAPP [2].
	Description	Alternative to sample duplicate. Generally, inorganic protocols specify an MD/MS and organic protocols specify an MS/MSD.
Surrogate Spike	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Every QC and analytical sample.
	Description	Compounds similar to the target analytes in structure, composition and chromatography, but not typically found in the environment, are added to each QC and analytical sample, prior to preparation (e.g., extraction). If the surrogates in an analytical batch do not all conform to established control limits, the pattern of conformance in investigative and control samples is examined to determine the presence of matrix interference or the need for corrective action.
Internal Standards	Use	Monitor the qualitative aspect of organic and inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP/MS methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] Denotes an STL required frequency.
[2] Either an MSD or an MD is required per 20 samples per matrix or per SAP/QAPP.

5.8.3 Statistical Control Limits and Charts

Statistical control limits and control charts are used to establish method performance of a given analysis and to monitor trends of QC results graphically over time. Once a data base

of the laboratory results for a method/matrix/QC analyte combination is established, the acceptability of a given analysis of that QC parameter (and of the analytical batch to which it belongs) can be evaluated in light of the laboratory's normal performance. This is intended to help identify problems before they might affect data. Often, patterns of response that are not at all evident in sets of numbers are very distinct when the same values are viewed as a chronological graph.

Establishment of Limits

The purpose of using statistical control limits is to define, for each analyte in a given method/matrix/QC type combination, a range of expected values. This range encompasses the random variation that occurs normally in the laboratory and allows one to evaluate control samples in that context, rather than according to an arbitrary or external set of values. Limits for accuracy and precision are defined below:

Accuracy

As recoveries of a QC analyte in a given matrix are tabulated over time, a mean value for recovery is established, as is the standard deviation (s) of those recoveries. If the analysis is in statistical control (e.g., if the set of QC recoveries over time show random variation about the mean) approximately 99.7% of all recoveries for that QC will fall within three standard deviations (3s) of the mean. Thus, assuming that the mean itself is an acceptable level of recovery, the values corresponding to 3s above and 3s below the mean are defined as the Control Limits. Any single recovery outside these values is assumed to have resulted from some circumstance other than normal variation and shall be investigated.

Roughly 95% of points should fall within 2s of the mean. The values +2s and -2s are the Warning Limits. Any normal result has approximately a 1/20 chance of being between 2s and 3s from the mean, so a result in this region doesn't necessarily warrant corrective action, but attention should be paid to such points.

Precision

Precision is used to indicate matrix variability so that appropriate decisions can be made by the client when repeated analyses vary significantly. The coefficient of variation, expressed as a percentage (e.g., the %RSD) for the data set used to calculate accuracy control limits defines the control limit for precision. Duplicate analyses of the QC samples, such as duplicates or MS/MSD, should have an RPD less than or equal to this established precision control limit to be considered free of matrix interferences.

The laboratory calculates statistical control limits on an annual basis, or more frequently if change have been made to the analytical process which affects the chemistry of the method. Such limits are available on a project or QAPP-specific basis.

In the case where laboratory generated limits do not meet the requirements of a specific project or regulation then the project and regulatory limits shall supersede the laboratory defined limits.

5.8.4 Calibration

Calibration protocols are method specific and defined in STL facility method SOPs.

- Instrument Calibration Procedures

The proper calibration of instrumentation and equipment is a key element in the quality of the analysis done by the laboratory. Each type of instrumentation and each EPA approved method has specific requirements for the calibration procedures, depending on the analytes of interest and the medium of the sample.

Table 10 lists in tabular form the general procedures which are followed by STL Connecticut. The calibration protocols meet or exceed the minimum method criteria requirements. Exact details regarding calibration for each method are outlined in the analytical SOPs. If a method calibration requirement, outlined in a project specific QA Plan, is more stringent than those listed in the Quality Assurance Plan, the more stringent will be followed in each case.

Documentation and records on calibrations are maintained in instrument logs and also with the data sets of the samples which are analyzed and related to them. In addition, laboratory department managers monitor the results of the calibration program to ensure the proper implementation at the analyst level.

TABLE 10 INSTRUMENT CALIBRATION SUMMARY

Analysis	Cal. Type	# Standards	Type of curve	Acceptance/rejection criteria	Frequency
GC Pesticides Herbicides OP pesticides GRO/DRO	Initial Continuing	5 concentration levels 1 standard (mid)	Linear	≤ 20% RSD $r^2 \leq 0.99$ +/- 15% Difference	continuing calibration fails every 12 hrs or 20 samples
GC/MS quadrupole	Initial Continuing	5 concentration levels; tuning with BFB/DFTPP 1 standard; tuning with BFB/DFTPP	Linear; tuned to manufacturer's specifications	≤ 30% RSD $r^2 \leq 0.99$ +/- 20% Diff	continuing calibration failure Every 12 hours
ICP	Initially Daily Continuing	5 concentration levels 2 levels 1 standard	Linear	According to instrument manufacture's instructions	Quarterly Every 10 samples
Lachat Analysis	Initially, Daily Continuing	5 concentration levels 1 standard	Linear	<.995 coefficient of variation $r^2 \leq 0.99$	continuing calibration failure Every 10 samples
pH Meters	Initially and daily Continuing	3 standards 1 standard	Linear	+/- 95% of value $r^2 \leq 0.99$	Daily Every 10 samples
Spectrophoto-meter	Initially and daily Continuing	5 concentration levels plus set %T with no cuvette in holder 1 standard	Linear	<.995 coefficient of variation $r^2 \leq 0.99$ +/- 95% of value	Daily Every 10 samples
Infrared Spectrophoto-meter	Initially and monthly Continuing	5 concentration levels 1 level	Linear	<.995 coefficient of variation $r^2 \leq 0.99$ +/- 95% of value	Daily Every 10 samples
Conductivity meter	Daily Continuing	3 concentration levels 3 concentration levels	Linear	<.995 coefficient of variation $r^2 \leq 0.99$ +/- 95% of value	Daily Every 10 samples

TABLE 10 INSTRUMENT CALIBRATION SUMMARY

Turbidimeter	Daily Continuing	3 concentration levels 3 concentration levels	Linear	<.995 coefficient of variation $r^2 \leq 0.99$ +/- 95% of value	Daily Every 10 samples
Balance	Daily	3 levels Class "S" weights	Point		Check single weight upon use

5.8.5 Glassware cleaning

STL Connecticut employs rigorous cleaning procedures for all glassware used within the laboratory. Glassware washing procedures are to be posted at all relevant stations. Detailed procedures are outlined in SOP for Glassware Washing.

5.8.6 Procedure for Permitting Departures from Documented Procedure

Where a departure from a documented SOP, test method, or policy is determined to be or perceived to be necessary, or is unavoidable, the departure is documented on a non-conformance summary or in a format specifically designed for that purpose. The departure from procedure must be authorized by the QA Manager, the Laboratory Director or the department Manager. Where a departure affects a specific client project, the PM must be informed of the deviation. In some instances, it is appropriate to inform the client before permitting a departure. Any such occurrence is documented in the cover letter and/or project narrative.

5.8.7 Development of QC Criteria, Non-Specified in Method/Regulation

Where a method or regulation does not specify acceptance and/or rejection criteria, the laboratory must examine the data user's needs and the demonstrated sensitivity, accuracy and precision of the available test methods in determining appropriate QC criteria.

Data users often need the laboratory's best possible sensitivity, accuracy, and precision using a routinely offered test method, or are unsure of their objectives for the data. For routine test methods that are offered as part of STL's standard services, the laboratory bases the QC criteria on statistical information such as determination of sensitivity, historical accuracy and precision data, and method verification data. The method SOP includes QC criteria for ongoing demonstration that the established criteria are met (e.g., acceptable LCS accuracy ranges, precision requirements, method blank requirements, initial and continuing calibration criteria, etc..).

In some cases, a routine test method may be far more stringent than a specific data user's needs for a project. The laboratory may either use the routinely offered test method, or may opt to develop an alternate test method based on the data user's objectives for sensitivity, accuracy, and precision. In this case, it can be appropriate to base the QC criteria on the data user's objectives, and demonstrate through method verification and ongoing QC samples that these objectives are met.

For example, a client may require that the laboratory to test for a single analyte with specific DQOs for sensitivity, accuracy, and precision as follows: Reporting Limit of 10 ppm, Accuracy ±25%, and RSD of <30%. The laboratory may opt to develop a method that meets these criteria and document through the Method Blank results, MDL study, and LCS results that the method satisfies those objectives. In this case, both the method and the embedded QC criteria have been based on the client's DQOs.

In some cases, the data user needs more stringent sensitivity, accuracy, and/or precision than the laboratory can provide using a routine test method. In this case, it is appropriate that the laboratory provide documentation of the sensitivity, accuracy, and precision obtainable to the data user and let the data user determine whether to use the best available method offered by the laboratory, or determine whether method development or further research is required.

5.9. Project Reports

5.9.1. General

Laboratory customers have a wide variety of analytical needs. In order to meet these varied requirements, the laboratory offer several levels of data reporting options ranging from very simple format to an extreme level of documentation. Table 11 presents the contents of various levels of reports offered by the laboratory. Custom reporting beyond those listed is usually available but may require additional cost. The information provided in Table 11 is a summary only. In some cases, individual methods may not include the indicated items. For example, in metals graphite furnace analysis an ICP interference check would not be included since it is inappropriate for that method.

The criteria described in Section 5.9.2 apply to all Project Reports that are generated under NELAC requirements. The criteria described in Section 5.9.3 and 5.9.4 apply to all Project Reports.

5.9.2. Project Report Content

- Title
- Laboratory name, address, telephone number, contact person
- Unique Laboratory Project Number
- Total Number of Pages (report must be paginated)

- Name and address of Client
- Client Project Name (if applicable)
- Laboratory Sample Identification
- Client Sample Identification
- Matrix and/or Description of Sample
- Dates: Sample Receipt, Collection, Preparation and/or Analysis Date
- Definition of Data Qualifiers
- Reporting Units
- Test Method

The following are required where applicable to the specific test method or matrix:

- Solid Samples: Indicate Dry or Wet Weight
- Whole Effluent Toxicity: Statistical package used
- If holding time $\leq$ 48 hours, Sample Collection, Preparation and/or Analysis Time
- Indication by flagging where results are reported below the quantitation limit.

5.9.3. Project Narrative

A Project Narrative and/or Cover Letter is included with each project report and at a minimum includes an explanation of any and all of the following occurrences:

- Non-conformances
- "Compromised" sample receipt (see Section 4.7.1)
- Method Deviations
- QC criteria failures

Project Release

The Project Manager or his/her designee authorizes the release of the project report with a signature. The Laboratory Director or his/her designee authorizes the release of the project report narrative with a signature as required by the data reporting deliverables.

Where amendments to project reports are required after issue, these shall be in the form of a separate document and/or electronic data deliverable. The revised report is clearly identified as revised with the date of revision and the initials of the person making the revision. Specific pages of a project report may be revised using the above procedure with an accompanying cover letter indicating the page numbers of the project revised. The original version of the project report must be kept intact and the revisions and cover letter included in the project files.

5.9.4. Subcontractor Test Results

Project reports from external subcontract shall not be altered, and shall be included in original form in the final project report provided by STL. Data from subcontractors' reports may be added to an STL electronic deliverable.

Subcontracted data shall be clearly identified as such, and the name, address, and telephone number for the laboratory performing the test is included in the project report. If the report is being generated under NELAC requirements, all information outlined in Section 5.9.2 are required for both the originating laboratory and the subcontracting laboratory.

Data subcontracted within STL may be reported on the originating laboratory's report forms provided the following mandatory requirements are met:

- The name, address, and telephone number of the facility are provided.
- Analytical results produced by the STL intra-company subcontractor are clearly identified as being produced by the subcontractor facility.
- The intra-company subcontractor's original report, including the chain of custody is retained by the originating laboratory.
- Proof of certification is retained by the originating laboratory.
- All information as outlined in Section 5.9.2 is included in the final report where the report is required to be compliant with NELAC, for both the originating and subcontracting laboratory.

5.9.5. Electronic Data Deliverables

Electronic Data Deliverables (EDD) are routinely offered as part of STL's services. STL offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), New Agency Standard (NAS), Format A, Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process in Section 4.4.1. Once the facility has committed to providing diskettes in a specific format, the coding of the format is performed. This coding is documented and validated. The validation of the code is retained as a QC record.

EDDs are subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory demonstrates that it can routinely generate that EDD without errors. Any revisions to the EDD format are reviewed until it is demonstrated that it can routinely be generated without errors.

5.9.6. Project Report Format

STL offers a wide range of project reporting formats, including EDDs, short report formats, and complete data deliverable packages modeled on the Contract Laboratory Protocol (CLP) guidelines. Regardless of the level of reporting, all projects undergo the same levels of review as described in Section 5.3.6.

Table 11 Report Content Options

	Data reporting Options			
Wet Chemistry	Level 1	Level 2	Level 3 *	Level 4 (CLP)
Case narrative	Yes	Yes	Yes	Yes
Sample Results	Result forms	Result forms	Result forms	Result forms
Method Blank	Yes	Yes	Yes	Yes
External Chain of Custody	Yes	Yes	Yes	Yes
Internal Chain of Custody	Yes	Yes	Yes	Yes
Duplicate	-	Yes	Yes	Yes
Matrix Spike	-	Yes	Yes	Yes
Initial Calibration Verification (ICV)	-	-	Yes	Yes
Continuing Calibration Verification (CCV)	-	-	Yes	Yes
Laboratory Control Sample (LCS)	-	-	Yes	Yes
EPA Forms 1-14	-	-	Yes	Yes
Metals	Level 1	Level 2	Level 3 *	Level 4 (CLP)
Case Narrative	Yes	Yes	Yes	Yes
Sample Results	Result forms	Result forms	Result forms	Result forms
Method Blank	Yes	Yes	Yes	Yes
External Chain of Custody	Yes	Yes	Yes	Yes
Internal Chain of Custody	Yes	Yes	Yes	Yes
Duplicate	-	Yes	Yes	Yes
Matrix Spike	-	Yes	Yes	Yes
Initial Calibration Verification (ICV)	-	-	Yes	Yes
Continuing Calibration Verification (CCV)	-	-	Yes	Yes
Laboratory Control Sample (LCS)	-	-	Yes	Yes
ICP Interference Check	-	-	Yes	Yes
ICP Linear Range	-	-	Yes	Yes
ICP Post Spike	-	-	Yes	Yes
EPA Forms 1-14	-	-	Yes	Yes
Organics	Level 1	Level 2	Level 3*	Level 4 (CLP)
Case Narrative	Yes	Yes	Yes	Yes
Sample Results	Result forms	Result forms	Result forms	Result forms
Method Blank	Yes	Yes	Yes	Yes
External Chain of Custody	Yes	Yes	Yes	Yes
Internal Chain of Custody	Yes	Yes	Yes	Yes
Matrix Spike	-	Yes	Yes	Yes
Matrix Spike Duplicate	-	Yes	Yes	Yes
Laboratory Control Sample (LCS)	-	-	Yes	Yes
Surrogate Recovery Information	-	Yes	Yes	Yes
Tuning Data (GC/MS only)	-	-	Yes	Yes
Initial Calibration Information	-	-	Yes	Yes
Continuing Calibration Information	-	-	Yes	Yes
Run Sequence Logs	-	-	Client Specific	Client Specific
Sample Preparation Logs	-	-	Yes	Yes
Chromatograms and Mass Spectra	-	-	-	Yes
EPA Forms 1-8	-	-	Yes	Yes

* Raw backup data not provided

Table 12 Correlation of QMP Sections with NELAC Quality Manual Requirements

NELAC Chapter 5.5.2 Quality Manual	Quality Management Plan Section
a. Quality policy statement, including objectives and commitments	1.2 Quality Assurance Policy 4.2.1 Objectives of the Quality System
b. Organization and management structure	4.1 Organization and Management
c. Relationship between management, technical operations, support services and the quality systems	4.1.2 Roles and Responsibilities 4.2 Quality System
d. Records retention procedures; document control procedures	4.3 Document Control 4.12.2 Record Retention
e. Job descriptions of key staff and references to job descriptions of other staff	4.1.2 Roles and Responsibilities
f. Identification of laboratory approved signatories	4.1 Organization and Management
g. Procedures for achieving traceability of measurements	5.5 Measurement Traceability
h. List of all test methods under which the laboratory performs its accredited testing	5.3.1 Method Selection
i. Mechanisms for assuring the laboratory reviews all new work to ensure that it has the appropriate facilities and resources before commencing such work	4.4.2 Project-Specific Quality Planning
j. Reference to the calibration and/or verification test procedures used	5.4.3 Equipment Verification and Calibration
k. Procedures for handling submitted samples	4.7.1 Sample Acceptance Policy 5.7 Sample Handling, Transport and Storage
l. Reference to the major equipment and reference measurement standards used as well as the facilities and services used in conducting tests	5.2 Laboratory Facilities 5.4.2 Equipment Maintenance 5.4.3 Equipment Verification and Calibration
m. Reference to procedures for calibration, verification and maintenance of equipment	5.4.2 Equipment Maintenance 5.4.3 Equipment Verification and Calibration
n. Reference to verification practices including interlaboratory comparisons, proficiency testing programs, use of reference materials and internal QC schemes	5.8.1 Proficiency Testing 5.8.2 Control Samples
o. Procedures for feedback and corrective action whenever testing discrepancies are detected, or departures from documented procedures occur	4.9 Control of Non-Conformances 4.10 Corrective Action 4.11 Preventive Action 5.8.6 Permitting Departures from Documented Procedures

Table 12 Correlation of QMP Sections with NELAC Quality Manual Requirements

NELAC Chapter 5.5.2 Quality Manual	Quality Management Plan Section
p. Laboratory management arrangements for exceptionally permitting departures from documented policies and procedures	4.4.2 Project-Specific Quality Planning 5.8.6 Permitting Departures from Documented Procedures
q. Procedures for dealing with complaints	4.8 Complaints
r. Procedures for protecting confidentiality and proprietary rights	4.7.2 Client Confidentiality and Proprietary Rights
s. Procedures for audits and data review	4.13 Internal Audits 5.3.6 Data Reduction and Review
t. Process/procedures for establishing that personnel are adequately experienced in duties they are expected to carry out and are receiving any needed training	5.1.2 Training
u. Ethics policy statement developed by the laboratory and training personnel in their ethical & legal responsibilities	5.1.3 Ethics Policy
v. Reference to procedures for reporting analytical results	5.3.6 Data Reduction & Review 5.9 Project Reports
w. Table of contents, listing reference, glossaries and appendices	TOC Table of Contents Appendix I: List of Cited SOPs and Misc. Laboratory Information

APPENDIX, Section 1

PROFESSIONAL PROFILES OF KEY PERSONNEL

The following professional profiles are presented alphabetically and represent the key quality assurance and laboratory management personnel for the network organization. Additional professional profiles are available for review during a site visit to any of our laboratory facilities.

Qualifications Summary

Mr. Frick has 20 years of experience in environmental and analytical chemistry that includes broad management and leadership experience. He is responsible for the overall direction of the laboratory and has extensive knowledge in environmental analytical chemistry and business management.

Professional Experience

Laboratory Director – 2004 to present

STL Connecticut—Shelton, CT
Mr. Frick directs the growth and development of the laboratory, including strategic plan development and implementation. He is responsible for all phases of operation within the Shelton, Connecticut facility, including; the technical and administrative management of the laboratory. The functional groups of the facility include Sample Control, Sample Preparation, Organic Chemistry, Metals, Wet Chemistry, Project Management, QA/QC and Information Technology, Report Generation, Data Management, and Human Resources. His other responsibilities include adherence to budget, staff development and control, quality assurance and quality control, scheduling, client support/liaison, as well as profit and loss responsibility for the facility. In addition, he is responsible for oversight of the Environmental Health and Safety Program, and was instrumental in the set up of the mixed waste license for the Connecticut laboratory.

Chromatography Product Manager
Supelco Incorporated—Bellefonte, PA—1998 to 2004

Laboratory Director
American Environmental Network—Schaumburg, IL—1996 to 1998

Laboratory Manager
Industrial Environmental Analysts—Schaumburg, IL—1995 to 1996

Group Leader
Industrial Environmental Analysts—Monroe, CT—1988 to 1995

Chemist
Environmental Analysis Corporation—Norwalk, CT—1984 to 1988

Education

- BS in Chemistry – University of Connecticut—Storrs, CT—1984
- MBA in Finance – University of Bridgeport—Bridgeport, CT—1993

Professional Training

- Environmental Laboratory Management —John H. Taylor, ACS Course
- Performance Management Workshop—Cynthia. Barnet, HR Consultant
- Interview Skills Workshop—Cynthia. Barnet, HR Consultant
- Frontline Leadership Development —William Frackler, Ingoldsby, Inc.
- 40 Hour OSHA Training —Lynn Sherman, YWC Midwest
- Radiation Safety Program Training —Radiation Safety Associates, Inc.
- Theory of Constraint Training—Sigma-Aldrich, Inc.
- Strategic Sales Management —Sigma-Aldrich, Inc.
- Corporate Finance Workshops—Sigma-Aldrich, Inc.

Professional Affiliations

- American Chemical Society

Qualifications Summary

Mr. Hobart has 14 years of experience in the environmental laboratory industry that includes management of the client services and sample control departments, project management responsibilities, and experience performing analyses. He possesses excellent presentation skills, communication skills, and writing proficiency. Paul is adept at motivating his team to achieve goals and objectives.

Professional Experience

Client Services Manager – 1999 to present

STL Connecticut -- Shelton, CT
Mr. Hobart's responsibilities include the administrative management of the project management, sample control and courier staff of the facility. He coordinates the project management staff with laboratory operations to ensure that projects are executed properly and effectively. He is responsible for generating and tracking price quotations, and for providing detailed forecasting and project schedules to the laboratory director. Additionally, Paul is responsible for the management of key client accounts.

Project Manager – 1996 - 1999
STL Connecticut – Whippany NJ and Shelton, CT

Project Manager – 1993 -1996
Quanterra, Inc. – Edison, NJ and Pittsburgh, PA

Analyst/Project Manager – 1990 - 1993
Analytica, Inc. – Golden, CO

Analyst – 1980 - 1990
Ledoux & Co. – Teaneck, NJ

Education

- BA in Literature – Ramapo College of NJ--Mahwah, NJ--1986

Professional Training

- Seminar- Conference on Customer Service, 2000
- Principles of Mass Spectrometry , 1991

Qualifications Summary

Ms. Culik has over 22 years experience in the environmental laboratory field. Experience includes analysis of drinking water utilizing a variety of organic and inorganic methods and Gas chromatography chemist on environmental samples. Experience also includes supervisor of the Gas Chromatography department responsible for analysis of environmental samples for pesticides/PCB's according to EPA/NYSDEC CLP Protocols, SW846 Methods and EPA "600" Series Methods.

Professional Experience

Quality Assurance Manager – 1991 to present

STL Connecticut (formerly IEA Incorporated)--Shelton, CT--1991 to Present

Ms Culik is responsible for developing and implementing the laboratory's quality system and laboratory quality manual to ensure compliance with STL policies for quality assurance and control (QA/QC). She administrates the laboratory certification and accreditation programs and responds to external audits. She is responsible for the assessment of operations through internal audits, management review and proficiency testing and for the oversight of preventative and corrective actions. Additional responsibilities include document control and archival of laboratory records. In addition, she prepares and submits monthly reports to corporate management, assists in reviewing project QA plans and serves as a laboratory/client support liaison.

Ms. Culik's responsibilities also include maintaining the laboratory's LIMS reporting system.

Gas Chromatography Group Leader

IEA Incorporated –Monroe, CT – 1986 to 1991

Chemist

York Laboratories – Monroe, CT – 1984 to 1986

Laboratory Analyst

American Waterworks Service Company – 1981 to 1984

Lab Technician

Suffolk County Water Authority 1978 to 1981

Lab Technician

Hooker Chemicals & Plastics – 1976 to 1978

Education

- AAS – Medical Technology, S.U.N.Y. at Alfred - Alfred, New York, 1976

Professional Training

- Two day seminar on Environmental Laboratory Management
  John H. Taylor, Analytical Technology.

- Performance Management Workshop
  One day seminar
  Cynthia Barnet, Human Resources Consultant

- Interview Skills Workshop
  One day seminar
  Cynthia Barnet, Human Resources Consultant

- Leadership Development Workshop
  Four day workshop
  William Frackler, Ingoldsby, Inc.

- Mass Spectral Data Interpretation
  One day seminar
  Dr. Frank Rutecek, Cornell University

- Introduction to Analytical Separations
  Four day seminar
  Dr. Dhea Habboush, Sacred Heart University

- ASQC Course
  Auditing of Quality Systems

- ASQC Course
  Introduction to SPC

- Six Sigma Green belt training

Professional Affiliations

Qualifications Summary

Mr. Helfrich has 15 years of experience in the environmental laboratory industry that includes extensive management/leadership experience with full profit and loss responsibility. He has functioned in numerous analytical roles including: Sample prep, furnace analysis, ICP analysis and hazardous waste coordinator. Experienced in data review, and familiar with EPA and NYSDEC protocols. He possesses excellent communication skills. Mr. Helfrich has an exceptional ability to effectively handle multiple projects and tasks. He is action-oriented, with a can-do attitude, a fast learner who has the capacity to adapt quickly to new situations.

Professional Experience

Inorganic Manager – 1998 to present

STL Connecticut - 1998 to Present
Mr. Helfrichs' responsibilities include the technical management of the inorganic analytical laboratory including approximately 10 chemists. The functional groups of the facility include Sample Preparation, Metals, General Inorganic Chemistry, and Report Generation. His other responsibilities include staff development and control, quality assurance and quality control of the inorganic departments, scheduling, as well as profit and loss responsibility for the Inorganic department. In addition, he is responsible for oversight of Waste Management and is part of the Environmental Health and Safety Program team.

Metals Manager
IEA INC – Monroe CT, 1992 to 1998

Metals Chemist
IEA INC – Monroe CT, 1989-1992

Education

- BS in Biology - St. Anselm College, Manchester NH, 1982
- MS in Chemistry - Quinnipiac College, Hamden CT, 1986
- MBA in Finance – Sacred Heart University, Fairfield CT, 1990

Qualifications Summary

Mrs. Maturo has over 19 years of experience in the environmental laboratory industry that includes extensive management/leadership experience.

She started in the Organic Extractions department as a lab technician and worked her way up to supervisor. From there, she transferred to the Gas Chromatography Department in order to expand her knowledge by learning more about the analysis of environmental samples. She is now Group Leader of the GC Department and is experienced in Pesticide and PCB residue analysis as well as a variety of other GC parameters.

Professional Experience

Gas Chromatography Group Leader-1991 to present

STL Connecticut (formery IEA, Inc.)-1991 to present
Mrs. Maturo is Supervisor of the Gas Chromatography Department. She is responsible for the analysis of environmental samples for Organochlorine and Organophosphorous pesticides, PCB's, Diesel Range Organics, and CT. Extractable Petroleum Hydrocarbons according to EPA/NYSDEC CLP Protocols, SW846 Methods and EPA "600" Series Methods.

Other duties include hiring personnel, ordering supplies, tracking samples thru the department, updating SOP's and final data package review.

GC- Senior Lab Technician

STL Connecticut (formerly IEA, formerly AEN)-1988 to 1991
Ms. Maturo's primary duties were the operation of gas chromatographs for a variety of analyses. She has experience in pesticide/PCB determinations as well as other miscellaneous analytes.

Other duties included sample tracking, data entry, report generation, and preparation of standards used for instrument calibration.

Extractions Technician/Extractions Group Leader

STL Connecticut (formerly YWC)-1988 to 1991
Over this time period Ms. Maturo was a member of the extractions group and supervised the operations and staff for the last year. Her duties were primarily extraction of environmental samples for semi-volatile organics, pesticides/PCB's and herbicides.
Other duties included preparation of standard reagents used in the extraction procedures, writing SOP's, and screening of sample extracts by gas chromatography.

Education

- BS in Biology – Southern Connecticut State University—New Haven, CT--1985

Professional Training

- Six Sigma Yellow Belt Management Training, 2003
- HAZWOPER Refresher-Field Safety Corp., 2000
- Perkin Elmer TurboChrom C/S Fundamentals Training Course, 1999
- Gas Chromatography Open Forum-Hewlett Packard, 1999
- "Dealing with Unacceptable Employee Behavior"- SkillPath Seminar, 1999
- Frontline Leadership-Zenger Miller, date Unknown
- 24 Hour Technician Course for Hazardous Waste Operations and Emergency Response-Field Safety Corp., 1999
- RCRA Compliant Hazardous Waste Handler Program-Field Safety Corp., 1999
- "Coaching and Teambuilding Skills for Managers and Supevisors"-SkillPath Seminar, date unknown
- Gas Chromatography Workshop-Env. Research Institute, UCONN., 1995
- "Basic Supervision"-SkillPath Seminar, 1988

Professional Affiliations

Lawrence H. Decker

Qualifications Summary

Mr. Decker has 18 years of experience in the environmental laboratory industry that includes supervisory and leadership experience. He possesses extensive knowledge in volatile organic analyses and is a resource to the laboratory, project management and customers. He is an action-oriented manager with a can-do attitude; who has the capacity to adapt quickly to new situations.

Professional Experience

GC/MS Manager – 1992 to present

Mr. Decker's responsibilities include the management and overall production of the volatile organics laboratory including 3 employees and 7 analytical systems. Methodologies include SW-846, CLP, EPA 500 and 600 series methods. Other responsibilities include work scheduling, data review, method development and compliance and employee training. He is also proficient in the maintenance and troubleshooting of all analytical systems in his laboratory. In addition, he ensures conformance to STL Environmental Health and Safety and manages costs and expenditures incurred by his laboratory.

GC/MS Section Leader
Industrial Environmental Analysts—Monroe, CT—1991 to 1992

GC/MS Analyst
Industrial Environmental Analysts—Monroe, CT—1986 to 1991

Education

- BA in Biology – Franklin Pierce College—Rindge, NH --1982

Professional Training

- Mass Spectroscopy Data Interpretation – Dr. Frank Turecek
- GC/MS Software Training – Mark Hartwick
- HP User I Course – Hewlett-Packard
-

Professional Affiliations

American Chemical Society

Qualifications Summary

Mrs. May has 14 years of experience in the environmental laboratory industry that includes extensive experience in all phases of laboratory operations in the organic departments. She began as an analyst for GC volatile organics and quickly became responsible for the analysis of GC/MS volatiles, GC Pesticide/PCB and Herbicides, as well as GC/MS semi-volatiles. She also learned the extractions of all these analyses. She then changed companies to work in GC Pesticide/PCB/Herbicide/DRO analysis and reporting for SW-846 and CLP protocols. She became the Senior analyst in the department and was responsible for any troubleshooting issues with the instruments as well as system manager for the acquisition/analysis software system. She was then promoted to GC/MS Semivolatile Group leader and is now responsible for the day to day operation of the GC/MS Semi-Volatiles group.

Professional Experience

GC/MS Semi-volatile Group Leader – June 1, 2004 to present

STL Connecticut--Shelton, CT—June 1, 2004 to Present
Mrs. May's responsibilities include the supervision of 2 analyst's, sample tracking through the department, the analysis of semi-volatile extracts, target and non-target compound identification, instrument troubleshooting and maintenance, the reporting of data, and the final review of data packages. She provides guidance to staff to ensure that project specific data quality objectives are met. She ensures that the SOP's are updated and that the department is meeting protocol requirements.

GC Analyst II to IV/Reporting

STL Connecticut--Shelton, CT—April 1996 to June 2004

Responsiblities included data reporting as well as analysis of Pesticides, PCB's, Herbicides, CTETPH, DRO's, and Fingerprint Analysis. Responsible for troubleshooting and maintenance of all instrumentation as well as method development. She was the system manager for the Perkin Elmer Turbochrom software system. She perfomed data review of data packages.

GC/MS Semivolatile and Volatile analyst

Averill Environmental Laboratory—Plainville, CT--1993 to 1996

Responsible for the analysis and reporting of volatile and semi-volatile samples using SW-846 and drinking water methodologies. Responsible for the extraction of pesticides, PCB's, semi-volatile and TPH extracts.

GC Analyst

Averill Environmental Laboratory—Plainville, CT--1990 to 1996

Responsible for the analysis and reporting of Volatile, Pesticide, PCB, and Herbicide samples using SW-846 and drinking water methodologies.

Education

- BS in Renewable Natural Resources-Cum laude – University of Connecticut—Storrs, CT--1990

Professional Training

- Capillary Chromatography Training - 1996
- Turbochrom Client/Server System Manager – 2001
- Comprehensive Environmental GC Training - 2001
- RCRA Compliant Hazardous Waste Handler Program – 1999

Qualifications Summary

Ms. Haas has 7 years of experience in the environmental laboratory industry that includes management/leadership experience. Ms. Haas is responsible for the overall operations of the classical chemistry department. These responsibilities include but are not limited to meeting client satisfaction goals, managing the human resources within the department, and ensuring health and safety and quality assurance plan compliance. Ms. Haas serves as a technical resource to department employees, as well as project managers, sales personnel, and clients. She makes recommendations to laboratory management in regard to process improvements.

Professional Experience

Department Manager – Classical Chemistry – 2001 to present

STL Connecticut, Shelton, CT--2001 to Present
Ms. Haas' responsibilities include:

- Coordinating work projects with project managers to appropriately schedule laboratory workload to meet client requirements.
- Prioritizing samples for analysis to ensure that OTD and TAT requirements are met.
- Determining client-specific requirements and testing methodology; communicating requirements to analysts.
- Scheduling employees in regard to workload and backlog to improve efficiency.
- Supervising supervisors to maximize productivity and ensure appropriate testing procedures are used n compliance with QA and SOP requirements.
- Preparing and analyzing samples for analysis based on method requirements.
- Uploading data files to reporting system.
- Reviewing data produced in assigned department and authorizes its release.
- Communicating department issues and providing status reports to Laboratory Director and Projects Managers.
- Recommending process improvements to improve efficiency.
- Partnering with laboratory management to evaluate new work opportunities and plan implementation.

Classical Chemistry Laboratory Analyst/Data Manager

STL Connecticut, Shelton, CT--1997 to 2001

- Analyzed water and soil matrices using Standard Operation Procedures specific to the classical chemistry department.
- Performed tests such as total suspended and dissolved solids, pH, alkalinity, oil and grease, and hexavalent chromium using colorimetric, gravimetric, instrumental, and titrametric methods.
- Oversaw quality control of department.
- Prepared and reviewed client reports using raw data.
- Supervised data management staff.

Veterinary Technician
Mobile Veterinary Clinic, Trumbull, CT--1994-1997

- Performed diagnostic tests and procedures, such as radiographs and blood collection.
- Administered medical treatments.
- Provided surgical assistance and nursing care.
- Supervised kennel workers.
- Educated clients.

Campus Organizer
NJ Public Interest Research Group (NJPIRG), New Brunswick, NJ--1990-1993

- Organized student activities in NJPIRG chapter at Rutgers University.
- Created and implemented environmental programs, such as educating grade-school children about recycling.
- Lobbied for environmental legislation.
- Managed 100 student interns and volunteers.
- Developed relations with administration and faculty.

Education

➢ BS in Biology – Rutgers University—New Brunswick, NJ --1990

Personnel Resume

Johanna L. Dubauskas

Qualifications Summary

Ms. Dubauskas has 24 years of experience in the environmental industry that includes extensive knowledge of laboratory, hazardous waste treatment and project management skills. She possesses excellent organizational and communication ability. Her enthusiasm for the highest achievable level of quality and customer service is apparent. Johanna has an exceptional capability to effectively handle multiple projects and tasks.

Professional Experience

Senior Project Manager – 1991 to present

STL Connecticut – Shelton, CT
Ms. Dubauskas' responsibilities include assisting clients in solving problems, answering client inquiries, discussing technical issues and managing clients through sampling programs with guidance on proper protocols. She is also responsible for scheduling sample pickups, coordinating incoming work within the laboratory, preparing written price quotations and invoicing. In addition, she assists Account Executives on sales calls and in project kick-off meetings.

Client Service Representative – 1987 to 1991
York Labs – Monroe, CT

Inside Sales Representative – 1986 to 1987
The Rockbestos Company – New Haven, CT

Chemical Buyer – 1985 to 1986
Pfaltz & Bauer – Waterbury, CT

Lab Technician – 1984 to 1985
Cecos Treatment Corporation – Bristol, CT

Research and Development Chemist –1983 to 1985
American Chemical and Refining, Inc. – Waterbury, CT

Chemist – 1980 to 1983
Environmental Waste Removal, Inc. – Waterbury, CT

Education

- BA in Biology – Western Connecticut State University – Danbury, CT - 1979

Professional Training

- Certificate Program of Environmental Science – 1985
- Customer Service Seminar - 2000

Qualifications Summary

Mrs. Duhancik has 6 years of experience in the environmental laboratory industry that includes project management and volatile organic compound GC/MS analysis experience. She possesses excellent communication and organizational skills. Jill has a passion for the highest achievable level of quality and customer service. She has an exceptional ability to effectively handle multiple projects and tasks. She is an action-oriented individual with a can-do attitude; a fast learner who has the capacity to adapt quickly to new situations. Jill is also adept at motivating a team to achieve goals and objectives.

Professional Experience

Project Manager – 2002 to present

STL Connecticut -Shelton, CT
Mrs. Duhancik's responsibilities include the coordination and management of customer's projects through all phases of laboratory operations, ensuring fulfillment of Severn Trent Laboratories commitments to client requirements, error-free work, and on-time delivery. She maintains communications with clients and Account Executives and serves as a liaison between clients and laboratory operations to meet client's needs. Mrs. Duhancik works closely with business unit personnel to manage quotations and change orders for existing scopes of work. She monitors compliance with industry regulations, contractual agreements, program management processes, and program specifications. She works towards achieving goals for revenue, profit, and KRI's through the effective utilization of laboratory capacity and definition of customer requirements.

VOA Analyst – 1998-2002
STL Connecticut – Shelton, CT

Waitress – 1996-1998
Olive Garden – Orange, CT

Education

- BS in Environmental Science – Saint Joseph College – West Hartford, CT -1998
- BS in Biology - Saint Joseph College – West Hartford, CT -1998

Personnel Resume

William D. Goodman

Qualifications Summary

Mr. Goodman has 3 years of experience in the environmental laboratory industry that includes Semivolatiles extractions and GC/MS analysis and management positions. He possesses excellent communication and writing skills. He has a passion for the highest achievable level of quality and customer service and the ability to effectively handle multiple projects and tasks. He is an action-oriented member of STL-CT with a can-do attitude; a fast learner who has the capacity to adapt quickly to new situations. He is also adept at motivating a team to achieve goals and objectives.

Professional Experience

Project Manager – 2004 to present

STL Connecticut – Shelton, CT--2004 to Present
Mr. Goodman's responsibilities include coordination and management of customers' projects through all phases of laboratory operations, ensuring fulfillment of Severn Trent Laboratories' commitments to client requirements, error-free work, and on-time delivery. Maintains communications with clients and Account Executives and serves as a liaison between clients and laboratory operations to meet client needs. Works closely with business unit personnel to manage quotations and change orders for existing scopes of work. Monitors compliance with industry regulations, contractual agreements, program management processes, and program specifications. Works toward achieving goals for revenue, profit, and customer service through the effective utilization of laboratory capacity and definition of customer requirements.

Extractions Manager
STL-Connecticut—Shelton, CT—02/2004 to 05/2004

Semivolatiles Analyst
STL-Connecticut—Shelton, CT—01/2002 to 02/2004

Extractions Analyst
STL-Connecticut—Shelton, CT—09/2001 to 02/2002

Education

- B.S. Environmental Science, St. Michael's College, Winooski Park, Colchester, VT May 2001.

APPENDIX, Section 2

ETHICS POLICY and QUALITY STATEMENT

SEVERN TRENT STL

Severn Trent Laboratories, Inc.
EMPLOYEE ETHICS STATEMENT

I understand that STL is committed to ensuring the highest standard of quality and integrity of the data and services provided to our clients. I have read the Ethics Policy of the Company.

With regard to the duties I perform and the data I report in connection with my employment at the Company, I agree that:

- I will not intentionally report data values that are not the actual values obtained;
- I will not intentionally report the dates, times, sample or QC identifications, or method citations of data analyses that are not the actual dates, times, sample or QC identifications, or method citations;
- I will not intentionally misrepresent another individual's work;
- I will not intentionally misrepresent any data where data does not meet Method or QC requirements. If it is to be reported, I will report it with all appropriate notes and/or qualifiers;
- I agree to inform my Supervisor of any accidental reporting of non-authentic data by me in a timely manner; and I agree to inform my Supervisor of any accidental or intentional reporting of non-authentic data by other employees;
- If a supervisor or a member of STL management requests me to engage in or perform an activity that I feel is compromising data validity or quality, I will not comply with the request and will report this action immediately to a member of senior management, up to and including the President of STL; and
- I will not share the pricing or cost data of Vendors or Suppliers with anyone outside of the Severn Trent family of companies.

As a STL employee, I understand that I have the responsibility to conduct myself with integrity in accordance with the ethical standards described in the Ethics Policy. I will also report any information relating to possible kickbacks or violations of the Procurement Integrity Act, or other questionable conduct in the course of sales or purchasing activities. I will not knowingly participate in any such activity and will report any actual or suspected violation of this policy to management.

The Ethics Policy has been explained to me by my supervisor or at a training session, and I have had the opportunity to ask questions if I did not understand any part of it. I understand that any violation of this policy subjects me to disciplinary action, which can include termination. In addition, I understand that any violation of this policy which relates to work under a government contract or subcontract could also subject me to the potential for prosecution under federal law.

EMPLOYEE SIGNATURE _____ Date _____

Supervisor/Trainer: _____ Date _____

Reference: STL Ethics Policy, P-L-006, Rev. 5.

SEVERN TRENT STL

Severn Trent Laboratories, Inc.

CONFIDENTIALITY AND PROPRIETARY INFORMATION AGREEMENT

Severn Trent Laboratories, Inc. and its predecessors, in their businesses, have developed and use commercially valuable technical and non-technical information and to guard the legitimate interests of STL and its clients, it is necessary to protect certain information as confidential and proprietary.

I, _____ , understand and acknowledge that during the term of my employment by STL, I will be privy to and entrusted with certain confidential information and trade secrets of STL and its clients.

Confidential information and trade secrets include, but are not limited to: customer and client lists; price lists; marketing and sales strategies and procedures; operational and equipment techniques; business plans and systems; quality control procedures and systems; special projects and technological research, including projects, research and reports for any government entity or client; client's plans and processes; client's manner of operation; the trade secrets of clients; client's data; vendor or supplier pricing; and any other records, data, files, drawings, inventions, discoveries, applications, or processes which are not in the public domain.

I agree as follows:

1. I will not in any way, during the term of my employment, or at any time thereafter, except as authorized in writing by the Legal Department of STL or the client where client data is involved, disclose to others, use for my own benefit, remove from STL's premises, copy or make notes of any confidential information and/or trade secrets of STL or its clients, excepting only that information which may be public knowledge. Technical and business information of any previous employer or other third party which I may disclose to STL shall be limited to that which was acquired legitimately and disclosed to me without restriction as to secrecy.

2. I agree that all inventions (whether or not patentable) conceived or made by me during the period of my employment by STL shall belong to STL, provided such inventions grow out of my work for STL and are related to the business of STL. I agree to disclose and assign such inventions to STL. In California, this provision shall not apply to any invention which qualifies fully under Section 2870 of the California Labor Code.

3. On termination of my employment from STL, I will deliver to STL all documents, records, notes, data, memoranda, files, manuals, equipment and things of any nature which relate in any way to confidential information and/or trade secrets of STL or its clients and which are in my possession or under my control.

4. I acknowledge that if I were to breach any provision of this Confidentiality Agreement, money damages will be inadequate, and I hereby agree that STL shall be entitled, where appropriate, to specific performance and/or injunctive relief (i.e. to require me to comply with this Agreement). I further acknowledge that the willingness of STL to hire me or to continue my employment constitutes full and adequate consideration for the agreements, and obligations to which I have agreed as set forth in this document.

I have executed this Agreement, intending to be legally bound.

_____	_____	_____
Printed Name	*Signature*	*Date*

Reference: STL Ethics Policy, P-L-006, Rev. 5.

APPENDIX, Section 3

CHAIN-OF-CUSTODY FORM

Chain of Custody Record

STL Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Tel: 203-929-8140

SEVERN TRENT STL
Severn Trent Laboratories, Inc.

STL-4124 (0901)

Client	Project Manager	Date	Chain of Custody Number 00019
Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page _____ of _____
City / State / Zip Code	Site Contact	Lab Contact	Analysis (Attach list if more space is needed)
Project Name and Location (State)	Carrier/Waybill Number		Special Instructions/ Conditions of Receipt
Contract/Purchase Order/Quote No.	Matrix	Containers & Preservatives	

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Air	Aqueous	Sed.	Soil	Other	Unpres.	H_2SO_4	HNO_3	HCl	NaOH	ZnAc/ NaOH	Other	Analysis	Special Instructions/ Conditions of Receipt

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other_____

QC Requirements (Specify)

1. Relinquished By	Date	Time	1. Received By	Date / Time
2. Relinquished By	Date	Time	2. Received By	Date / Time
3. Relinquished By	Date	Time	3. Received By	Date / Time

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

APPENDIX, Section 4

STL SAMPLE PRESERVATION AND HOLDING TIME REQUIREMENTS

Parameter[1]	Methods	Matrix	Holding Time*	Container	Preservation
Inorganics-Metals					
Metals, excluding Hg	200 Series 7000 Series 6010	Water	6 months	500 ml P,G	HNO3 to PH <2
Mercury	200 Series 7000 Series	Water	28 Days	500 ml P,G	HNO3 to PH <2
Metals, excluding Hg	200 Series 7000 Series 6010	Soil	6 months	100 g P,G	Cool 4°C
Mercury	200 Series 7000 Series	Soil	28 Days	100 g P,G	Cool 4°C
Inorganics-Wet Chemistries					
Acidity	EPA 600	Water	14 Days	100 ml P,G	Cool 4°C
Alkalinity	EPA 600	Water	14 Days	100 ml P,G	Cool 4°C
BOD	EPA 600	Water	48 Hours	1000 ml P,G	Cool 4°C
Bromide	EPA 600	Water	28 Days	50 ml P,G	None Req.
COD	EPA 600	Water	28 Days	50 ml P,G	Cool 4°C, H2SO4 to pH <2
Chloride	EPA 600	Water	28 Days	50 ml P,G	None Req.
Chromium, CR+6	EPA 600	Water	24 Hours	50 ml P,G	Cool 4°C
Cyanide	EPA 600	Water	14 Days[2]	500 ml P,G	Cool 4°C, NaOH to pH>12 Ascorbic Acid[3]
Fluoride	EPA 600	Water	28 Days	500 ml P,G	None Req.
Hardness	EPA 600	Water	6 Months	100 ml P,G	HNO3 to pH <2
MBAS	EPA 600	Water	48 Hours	500 ml P,G	Cool 4°C
Nitrogen-Ammonia	EPA 600	Water	28 Days	500 ml P,G	Cool 4°C, H2SO4 to pH <2
Nitrogen-TKN	EPA 600	Water	28 Days	500 ml P,G	Cool 4°C, H2SO4 to pH <2
Nitrate	EPA 600	Water	48 Hours	100 ml P,G	Cool 4°C
Nitrate-Nitrite	EPA 600	Water	28 Days	100 ml P,G	Cool 4°C, H2SO4 to pH <2

Parameter	Methods	Matrix	Holding Time*	Container	Preservation
Inorganics-Wet Chemistries-cont.					
Oil and Grease	EPA 600	Water	28 Days	1000 ml P,G	Cool 4°C, HCL or H2SO4 to pH <2
Petroleum Hydrocarbons	EPA 600-418.1	Water	28 Days	1000 ml P,G	Cool 4°C, HCL to pH <2
pH	EPA 600	Water	Immed.	50 ml P,G	NA
Phenols	EPA 600	Water	28 Days	500 ml P,G	Cool 4°C, H2SO4 to pH<2
Phosphorus, Ortho	EPA 600	Water	48 Hours	50 ml P,G	Filter Immed., Cool 4°C
Phosphorus,Total	EPA 600	Water	28 Days	50 ml P,G	Cool 4°C, H2SO4 to pH <2
Residue, TDS	EPA 600	Water	7 Days	100 ml P,G	Cool 4°C
Residue, TSS	EPA 600	Water	7 Days	250 ml P,G	Cool 4°C
Residue, TS	EPA 600	Water	7 Days	250 ml P,G	Cool 4°C
Residue, Volatile	EPA 600	Water	7 Days	250 ml P,G	Cool 4°C
Residue, Settleable	EPA 600	Water	48 Hours	250 ml P,G	Cool 4°C
Specific Conductance	EPA 600	Water	28 Days	100 ml P,G	Cool 4°C
Sulfate	EPA 600	Water	28 Days	250 ml P,G	Cool 4°C
Sulfide	EPA 600	Water	7 days	500 ml P,G	Cool 4°C, ZnAc/NaOH to pH >9
TOC	EPA 600	Water	28 Days	50 ml P,G	Cool 4°C, HCL or H2SO4 to pH <2
TOX	EPA 600	Water	28 Days	40 ml G	Cool 4°C, H2SO4 to pH <2, Sodium Sulfite
Turbidity	EPA 600	Water	48 Hours	100 ml P,G	Cool 4°C
Cyanide	SW846	Soil	14 Days	100 g G	Cool 4°C
Sulfide	SW846	Soil	7 Days	100 g G	Cool 4°C

Parameter	Methods	Matrix	Holding Time*	Container	Preservation
Organics-Parameters by Gas Chromatography					
Volatiles; Halogenated	600 series SW846	Water	7/14 Days[5]	3 x 40 ml vial	Cool 4°C, Thiosulfate[4]
Volatiles; Aromatics	600 series SW846	Water	7/14 Days[5]	3 x 40 ml vial	Cool 4°C, HCL to pH <2 Thiosulfate[4]
Volatiles; Non-Halogenated	SW846 - 8015	Water	7/14 Days[5]	3 x 40 ml vial	Cool 4°C, Thiosulfate[4]
Semi-volatiles	600 series SW846	Water	ext.- 7 Days anal.-40 Days	1L, amber G	Cool 4°C, Thiosulfate[4]
Organochlorine Pesticides/PCBs	600 series SW846	Water	ext.- 7 Days anal.-40 Days	1L, amber G	Cool 4°C, Thiosulfate[4]
Organophosphorus Pesticides	600 series SW846	Water	ext.- 7 Days anal.-40 Days	1L, amber G	Cool 4°C, Thiosulfate[4]
Herbicides	SW846	Water	ext.- 7 Days anal.-40 Days	1L, amber G	Cool 4°C, Thiosulfate[4]
Volatiles; Halogenated	SW846	Soil	14 Days	50 g, G	Cool 4°C
Volatiles; Aromatics	SW846	Soil	14 Days	50 g, G	Cool 4°C
Volatiles; Non-Halogenated	SW846 - 8015	Soil	14 Days	50 g, G	Cool 4°C
Semi-volatiles	SW846	Soil	ext.- 14 Days anal.-40 Days	100 g, G	Cool 4°C
Organochlorine Pesticides/PCBs	SW846	Soil	ext.- 14 Days anal.-40 Days	100 g, G	Cool 4°C
Organophosphorus Pesticides	SW846	Soil	ext.- 14 Days anal.-40 Days	100 g, G	Cool 4°C
Herbicides	SW846	Soil	ext.- 14 Days anal.-40 Days	100 g, G	Cool 4°C

Parameter	Methods	Matrix	Holding Time*	Container	Preservation
Organics-GC/MS Parameters					
Volatiles; Halogenated	600 series SW846	Water	7/14 Days[5]	3 x 40 ml vial	Cool 4°C, Thiosulfate[4]
Volatiles; Aromatics	600 series SW846	Water	7/14 Days[5]	3 x 40 ml vial	Cool 4°C, HCL to pH <2 Thiosulfate[4]
Volatiles; Halogenated	500 series	Water	7/14 Days[5]	3 x 40 ml vial	Cool 4°C, HCL to pH <2 Thiosulfate[4]
Volatiles; Aromatics	500 series	Water	7/14 Days[5]	3 x 40 ml vial	Cool 4°C, HCL to pH <2 Thiosulfate[4]
Semi-volatiles	600 series SW846	Water	ext.- 7 Days anal.-40 Days	1L, amber G	Cool 4°C, Thiosulfate[4]
Volatiles; Halogenated	SW846	Soil	14 Days	50 g, G	Cool 4°C
Volatiles; Aromatics	SW846	Soil	14 Days	50 g, G	Cool 4°C
Semi-volatiles	SW846	Soil	ext.- 14 Days anal.-40 Days	100 g, G	Cool 4°C

* From Collection

1. The following information is based upon WPA requirements outlines in Part 136, title 40 of the Code of Federal Regulations. Various state agencies have differing requirements for both holding times and preservation from those listed above. In such cases, the local requirements supersede the EPA information.

2. Maximum holding time is 24 hours when sulfide is present. Sample must be tested with lead acetate paper be fore pH adjustment in order to determine is sulfide is present.

3. If residual chlorine is present in the sample 0.6 g of ascorbic acid is utilized.

4. If samples contain residual chlorine sodium thiosulfate must be added at the time of sampling.

5. If samples do not received pH adjustment, the holding time is 7 days.

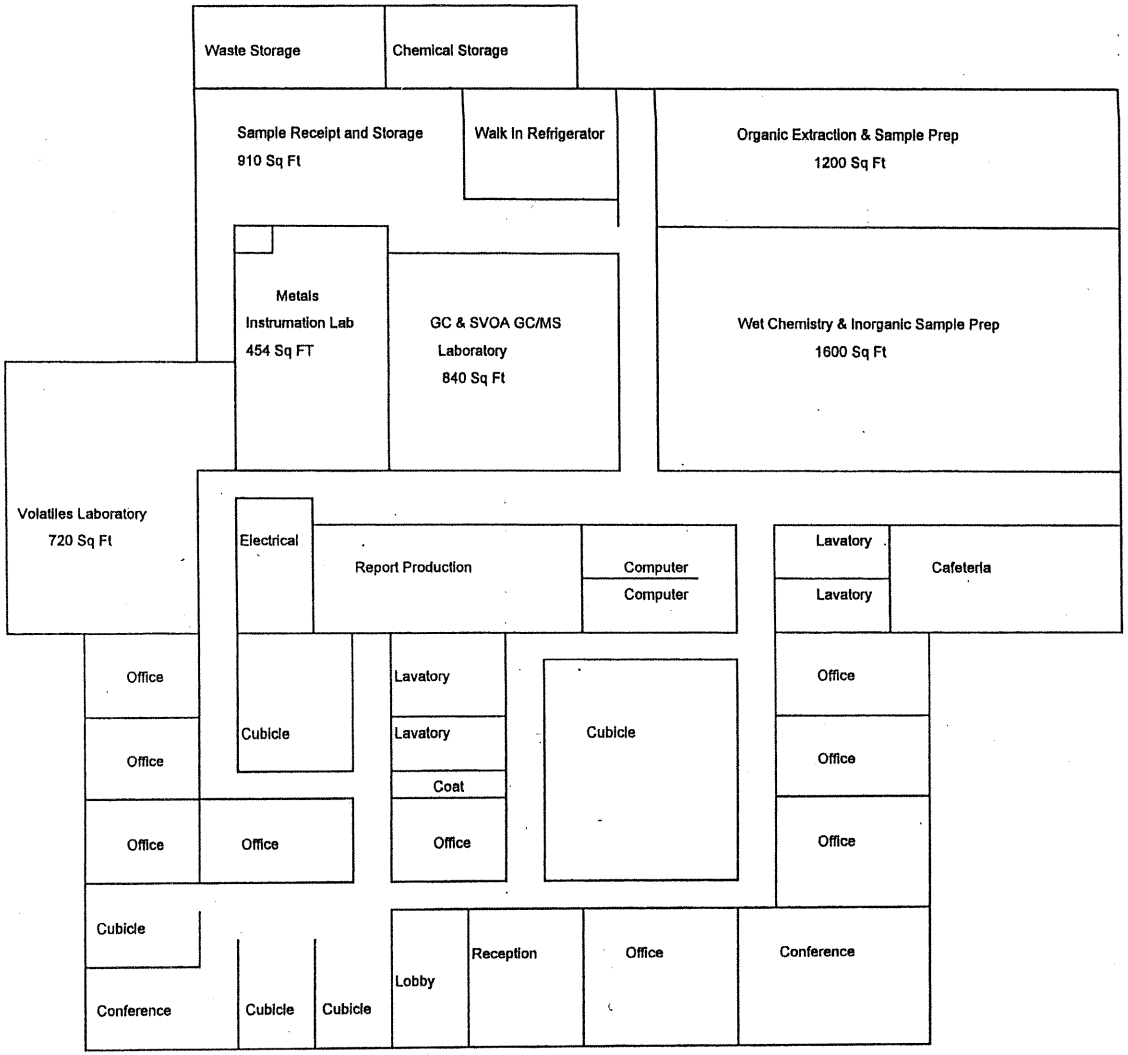
APPENDIX, Section 5

LABORATORY FLOOR PLAN

EQUIPMENT LIST

PREVENTIVE MAINTENANCE

Severn Trent Laboratories
Shelton, CT



STL CONNECTICUT LABORATORY
Instrument List

Instrument Type	Manufacturer	Model	Purchase Date	Autosampler	Method Performed
ICP	Thermo Jarrell Ash (61E) S/N 349490	61E ICAP	1994	Yes	6010B, 200.7
	Thermo Jarrell Ash (61P) S/N 464790	61E Trace	1997	Yes	6010B, 200.7
Mercury Analyzer	Perkin Elmer S/N 1398	FIMS	1999	Yes	7471A, 7470, 245.1
GC/MS Semivolatiles	Hewlett-Packard (U) S/N US33210086	5973/6890	2004	Yes	8270C, 625, SIM
	Hewlett-Packard (Q) S/N US00007319	5890/5971	1992	Yes	8270C, 625, SIM
	Hewlett-Packard (R) S/N US00036181	5890/5971	1992	Yes	8270C, 625, SIM
	Hewlett-Packard (P) S/N US00007291	5890/5971	1992	Yes	8270C, 625, SIM
GC/MS Volatiles	Hewlett-Packard (L) S/N 3240A18492	5890/5971	1992	Yes	8260B, 624
	Hewlett-Packard (K) S/N 3029A30026	5890/5970	1990	Yes	8260B, 624 – waters
	Hewlett-Packard (O) S/N 3203A41807	5890/5971	1991	Yes	8260B, 624 – waters
	Hewlett-Packard (N) S/N 3133A37851	5890/5971	1991	Yes	8260B, 624
	Hewlett-Packard (M) S/N 33033A33746	5890/5970	1991	Yes	8260B, 624 – soils
	Hewlett-Packard (T) S/N 3336A51317	5890/5972	1996	Yes	T0 17 – air
	Hewlett-Packard (v) S/N	6890/5973	2004	Yes	8260B, 624
GC Semivolatiles	Hewlett-Packard (GC1C/D) S/N	5890II - Dual ECD	1994	Yes	8081, 8082, 608
	Hewlett-Packard (GC4C/D) S/N 3033A33529	5890II - Dual ECD	1992	Yes	8082
	Hewlett-Packard (GC5C/D) S/N	5890II - Dual ECD	1989	Yes	8081, 8082, 608
	Hewlett-Packard (GC7C/D) S/N	5890II - Dual ECD	2004	Yes	8081, 8082, 608
	Hewlett-Packard (GC2C/D) S/N 3033A32099	5890II – FID/NPD	1991	Yes	WSO, 8141
	Hewlett-Packard (GC3) S/N 3033A32563	5890 - FID	1991	Yes	8015B (DRO), ETPH
Ion Chromatograph	Lachat S/N A83000-1476	Quickchem 8000	1999	Yes	300.0, 9056 350.1, 351.2 9012, 335.4, 353.2, 420.2
TOC	Dohrmann	Phoenix 8000	2004	No	415.2, 9060

Updated 5/14/04

STL CONNECTICUT LABORATORY
Instrument List

Instrument Type	Manufacturer	Model	Purchase Date	Autosampler	Method Performed
	Dohrmann	DC-190	1998	Yes	415.2, 9060
TKN Digestion System	Scientific Instruments	AD-4020	1994	No	351.2, 351.3
UV/VIS	Barnstead Turner	SP 830	2003	No	7196A, 376.2
UV/VIS	Buck Scientific	HC 404	2000	No	418.1
PH Meter	Orion Research	SA 720	1998	No	9040B, 9045C, 150.1
PH Meter	Beckman	12	1995	No	9040B, 9045C, 150.1
Autotitrator (pH, Alkalinity, Conductance)	Man-Tech (ATZ)	PC 1300	2003	Yes	9040B, 9045C, 150.1, 2320B, 310.1, 310.2, 2510B, 9050A, 120.1
Dissolved Oxygen Meter	YSI	51A	1994	No	405.1
Turbidimeter	HACH	2100 N	1990	No	180.1
Conductivity	Cole-Parmer	1484-20	1996	No	120.1
Automated Distillation Apparatus	Westco S/N 1028	1075 Easy Dist	2003	No	350.1, 420.2, 9066
COD	HACH	45600	1991	No	410.4
Flash Point Apparatus	Precision Scientific	Pensky-Martin	1990	No	1020
Midi Distillation Setups	Andrews Galss	110-10-R	1995	No	9012A, 335.1, 335.3
TCLP Spinners	Dayton	3M137B/5K939B	1990	No	1311, 1312
GPC	ABC	Autoprep 1000	1999	Yes	8270, 8081, 8082

STL- Connecticut LABORATORY PREVENTIVE MAINTENANCE

GC/MS SYSTEMS		
EQUIPMENT	ACTION PERFORMED	FREQUENCY
Hewlett-Packard 5970 MSD / 5971 MSD/5972 MSD	Check oil level in mechanical pumps	Weekly
	Change the oil in the mechanical pumps	Every 6 months
	Inspect the pump hoses and replace if required	Every 6 months
	Change oil in the turbo pump	Every 6 months
	Change exhaust trap absorbent	Every 6 months
	Inspect and refill the calibration sample vial with PFTBA	Every 6 months
	Vacuum fan grills and filters	Every 6 months
	Ion source cleaning and filament replacement	As needed
	Manual tuning	As needed
	Replace electron multiplier	As needed
	Clean out transfer line to GC	After every column removal
Hewlett-Packard 5890 GC	Check helium gas supply	Daily
	Change split vent trap	Every 3 months
	Column replacement and conditioning	As needed
	Column cutting and reinstallation	Daily or as needed
	Change helium gas cylinder	As needed
	Change liner and septum	Daily or as needed
	Clean injection port	As needed
EQUIPMENT	ACTION PERFORMED	FREQUENCY
Hewlett-Packard 7672A Autosampler	Inspect and correct injector alignment	After reseating
	Inspect syringe	Daily
	Check compressed air gas supply	Daily
	Inspect and adjust tension on sample tray	Daily
	Change rinse vials	Daily
	Change waste vials	Weekly
	Replace syringe	As needed
	Sand injector post	As needed
	Realign autosampler on brackets	As needed

	Change compressed air cylinder	As needed
Hewlett-Packard 7673A Autosampler	Inspect syringe	Daily
	Inspect seating of injector	Daily
	Change rinse vials	Daily
	Change waste vials	Weekly
	Replace syringe	As needed
	Reset control box	As needed
Tekmar Purge and Trap Sample Concentrators and Autosamplers	Inspect spargers and fittings	Daily
	Check purge flow	Daily
	Inspect line and valve temperatures	Daily
	Change and condition trap	As needed
	Adjust purge flow	As needed
	Rinse or clean sparging vessels	As needed
	Rinse sample lines	As needed
	Bake out trap	After each analysis, extend as needed
	Replace lines and fittings	As needed
	Adjust line and valve temperatures	As needed
EQUIPMENT	ACTION PERFORMED	FREQUENCY
Envirochem Air Sample Concentrator and AS	Inspect fittings	Daily
	Check flows	Daily
	Inspect line and valve temperatures	Daily
	Change and condition internal traps	As needed
	Adjust flow	As needed
	Bake out trap	After each analysis, extend as needed
	Replace lines and fittings	As needed
	Adjust line and valve temperatures	As needed
Archon	Check Syringe	Daily
	Check reagent water and waste bottles	Daily
	Autocalibrate robotic arm	As needed
	Replace inline filter	As needed

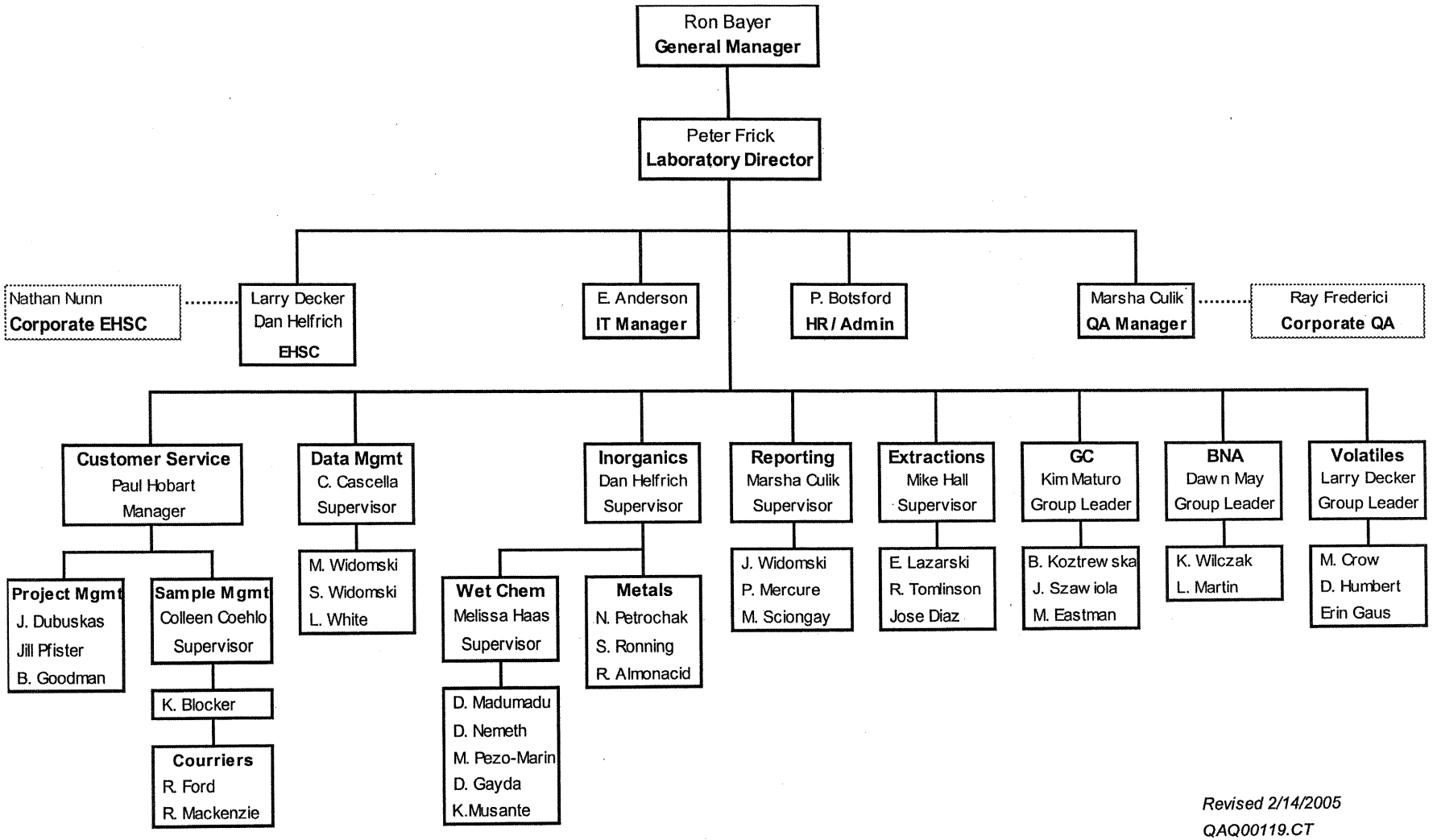
GC SYSTEMS		
EQUIPMENT	ACTION PERFORMED	FREQUENCY
Hewlett-Packard 5890A GC (GC-1,4,5 Dual ECD)	Check gas supply	Daily
	Check breakdown criteria	As required by run sequence
	Vacuum filters and grills	Quarterly
	Column replacement and conditioning	As needed
	Column cutting and reinstallation	As needed
	Change gas cylinders	As needed
	Change liner and septum	As needed
	Replace guard column	As needed
	Clean injection port	As needed
	Recondition ECD	As needed
	Change ECD vent absorbent traps	Quarterly
EQUIPMENT	ACTION PERFORMED	FREQUENCY
Hewlett-Packard 5890A GC (GC-3 FID/NPD)	Check gas supply	Daily
	Vacuum filters and grills	Quarterly
	Column replacement and conditioning	As needed
	Column cutting and reinstallation	As needed
	Change gas cylinders	As needed
	Change liner and septum	As needed
	Clean injection port	As needed
	Replace or reactivate the NPD collector	As needed
Hewlett-Packard 7673A Autosampler	Inspect syringe	Daily
	Inspect seating of injector	Daily
	Inspect rinse and waste vials	Daily
	Vacuum filters and grills	Quarterly
	Replace syringe	As needed
	Change rinse and waste vials	As needed

EQUIPMENT	ACTION PERFORMED	FREQUENCY
METALS SYSTEMS		
Inductively Coupled Plasma	Change capillary and pump tubing	Twice weekly
	Replace liquid argon tank	As required
	Reprofile via slit micrometer	Per manual
	Replace and realign plasma torch	As needed
	Clean nebulizer and spray chamber	As needed
	Check primary imaging mirror	Weekly
Mercury Analyzer	Clean sample cell and tubing	Monthly
	Check sparger condition	Daily
	Check level of mercury scrubber solution	Daily
	Replace lamps	As required
WET CHEMISTRY SYSTEMS		
EQUIPMENT	ACTION PERFORMED	FREQUENCY
pH Meters	Clean electrode if calibration has deteriorated	As needed
	Store pH electrodes in pH 7.0 buffer	Daily
	Check ISE electrodes and meter	Per manual
Analytical Balances	Surfaces cleaned and covered	Daily
	Calibrated and cleaned by manufacturer	Semi-annually
	Accuracy checked by class "S" weights	Prior to use
Conductivity Meters	Instrument surfaces inspected and cleaned	Daily
	Calibrated using 0.01M potassium chloride	Daily
	Spare cells on inventory	As needed
Spectrophotometers	Instrument cleaned	Daily use
Autoanalyzer Systems	Clean all components and flush system	Daily use
	Inspect all pump tubes and sample lines	Daily use
	Inspect line coils, heating baths and filters	Weekly
	Inspect all colorimeter filters	Weekly
	Inspect and clean chemical manifolds	Monthly

APPENDIX, Section 6

ORGANIZATIONAL CHART

STL Connecticut Organization



Revised 2/14/2005
QAQ00119.CT

SEVERN TRENT STL

Leaders in Environmental Testing

APPENDIX, Section 7

CORRECTIVE ACTION FORM

STL

CORRECTIVE ACTION FORM

A. Originator Information **Client Inquiry**

Client:_____ Job/Case:_____

Date/time:_____ Sample Number(s):_____

Client/Lab Contact: _____ Date/Time Response Due:_____

Detailed Description of Potential Problem:

_____

_____

_____

_____

_____

_____

_____

B. Quality Assurance Information **Corrective Action ID#** _____

Recommended Corrective Action:

_____

_____

_____

_____

Groups Involved:

__Sample Control __ Wet Chemistry __ Metals __Organic Extraction

__Gas Chromatography __ MS- VOA __ Report Generation __Lab Director

__Client Service __ MS -SV __EDD ___ Subcontractor

C. Final Resolution

Describe What Happened and Corrective Action Taken:

_____

_____

_____

_____

Supervisor Signature: _____ Date_____ Date/Time Client Notified:_____

D. Quality Assurance Final Approval (QA Manager or designee use only)

Corrective Action Approved:_____

APPENDIX, Section 8

LISTING OF LABORATORY

STANDARD OPERATING PROCEDURES (SOPs)

Standard Operating Procedures Listing

Dept	Document Number	Revison	Active Date	SOP Title	Document Type
Sample Receipt	SMS00106.CT	6	09/05/04	Bottle Order Preparation	SOP
Sample Receipt	SMS00408.CT	8	09/06/04	Sample Processing and Sample Arrival	SOP
Sample Receipt	SMS00609.CT	9	09/06/04	Storing Water and Soil Samples	SOP
Sample Receipt	SMS00808.CT	8	09/06/04	Documenting Sample and Removal from the Laboratory	SOP
Sample Receipt	SMS00908.CT	8	09/06/04	Securing the Laboraotory and Samples	SOP
Sample Receipt	SMS01006.CT	6	09/06/04	Temperature Control Requirements	SOP
Sample Receipt	SMS01106.CT	6	09/06/04	Compositing, Homogenization and Splitting Environmental Samples	SOP
Sample Receipt	SMS01304.CT	4	09/06/04	Log-in for CLP (OLM04.2) Samples	SOP
Sample Receipt	SMS01402.CT	2	09/06/04	Sample Disposal	SOP
Sample Receipt	SMS01500.CT	0	09/04/04	Handling Samples under a Foreign Soil Permit	SOP
Organic Prep	SPS02804.CT	2	03/06/03	Preparation of Chlorinated Herbicides (W) - 8151A	SOP
Organic Prep	SPS01306.CT	6	05/15/02	Aqueous BNA Methods 3510/3520	SOP
Organic Prep	SPS01205.CT	5	04/25/02	Aqueous Pest/PCB Methods 3510C/3520C	SOP
Organic Prep	SPS01405.CT	5	09/01/02	Soil BNA Method 3550	SOP
Organic Prep	SPS01605.CT	5	06/20/02	Soil Pest/PCB Method 3550	SOP
Organic Prep	SPS01703.CT	3	05/15/02	Aqueous OP Pesticides Methods 3510/3520	SOP
Organic Prep	SPS01805.CT	5	04/03/02	SW846 GPC of BNA extracts	SOP
Organic Prep	SPS01902.CT	2	04/03/02	GPC of Pesticide/PCB extracts method 3640	SOP
Organic Prep	SPS02703.CT	3	09/05/02	Soil OP Pesticides Method 3550	SOP
Organic Prep	SPS03005.CT	5	04/02/02	Waste dilution - BNA	SOP
Organic Prep	SPS03103.CT	3	09/13/02	Waste dilution - Pesticides/PCB (3580)	SOP
Organic Prep	SPS03205.CT	5	05/15/02	Pesticide/PCB extraction method 608	SOP
Organic Prep	SPS03302.CT	2	09/05/02	Prep Soil/Sediment samples for CLP P/P OLM03.2	SOP
Organic Prep	SPS03401.CT	1	04/03/02	GPC of Pesticide extracts OLM03.2	SOP
Organic Prep	SPS03503.CT	3	02/21/03	Prep Soil/Sed samples for CLP BNA's OLM03.2	SOP
Organic Prep	SPS03601.CT	1	04/03/02	GPC of Semivolatile extracts OLM03.2	SOP
Organic Prep	SPS03701.CT	1	02/20/03	Prep of Aqueous samples for CLP BNA's OLM03.2	SOP
Organic Prep	SPS03802.CT	2	05/22/02	Prep of Aqueous samples for CLP P/P OLM03.2	SOP
Organic Prep	SPS03901.CT	1	06/18/97	CLP Extraction Standard Prep	SOP
Organic Prep	SPS02901.CT	1	07/26/96	Alumina Column C/U Method 3611A	SOP
Organic Prep	SPS04001.CT	1	06/05/02	Prep of Aqueous SV OLC10/92	SOP
Organic Prep	SPS04201.CT	1	09/18/02	Prep of Semivolatiles in Tissue samples	SOP
Organic Prep	SPS04305.CT	5	06/20/02	Prep of Pesticides/PCBs in Tissue samples	SOP
Organic Prep	SPS04403.CT	3	02/16/00	Prep of Chlorinated Herbicides -Method 8151 (S)	SOP

Standard Operating Procedures Listing

Dept	Document Number	Revison	Active Date	SOP Title	Document Type
Organic Prep	**SPS04502.CT**	2	09/18/02	Prep of PUF Samples for Pesticides/PCB T04	SOP
Organic Prep	**SPS04602.CT**	2	09/09/02	Prep of PUF Samples for Semi-volatiles T013	SOP
Organic Prep	**SPS04703.CT**	3	05/22/02	Prep of SV Method 625 (Water)	SOP
Organic Prep	**SPS04801.CT**	1	09/18/02	Prep of Wipe Samples Pesticides/PCBs	SOP
Organic Prep	**SPS04903.CT**	3	09/18/02	Florisil Cartridge clean-up P/P extracts	SOP
Organic Prep	**SPS05002.CT**	2	06/05/02	Prep of Low Level PCBs - Method 608	SOP
Organic Prep	**SPS05101.CT**	1	03/06/03	Prep of Low level PCBs - 3510C	SOP
Organic Prep	**SPS05304.CT**	4	06/05/02	Prep of Aqueous samples for DRO analysis - 8015B	SOP
Organic Prep	**SPS05203.CT**	3	06/20/02	Prep of Solid samples for DRO analysis - 8015B	SOP
Organic Prep	**SPS05602.CT**	2	02/13/03	Prep of Aqueous samples for CLP P/P OLM04.3	SOP
Organic Prep	**SPS05702.CT**	2	02/20/03	Prep of Soil/Sediment samples for CLP P/P OLM04.3	SOP
Organic Prep	**SPS05802.CT**	2	02/20/03	GPC CLP P/P Extracts OLM04.3	SOP
Organic Prep	**SPS05902.CT**	2	02/13/03	Standards Prep for CLP P/P OLM04.3	SOP
Organic Prep	**SPS06002.CT**	2	02/13/03	Prep of Aqueous samples for CLP BNA's OLM04.3	SOP
Organic Prep	**SPS06102.CT**	2	02/20/03	Prep of Solid samples for CLP BNA's OLM04.3	SOP
Organic Prep	**SPS06202.CT**	2	02/20/03	GPC of Semivolatile extracts OLM04.3	SOP
Organic Prep	**SPS06301.CT**	1	02/20/03	Standards Prep for CLP BNA OLM04.3	SOP
Organic Prep	**SPS06400.CT**	0	03/17/00	Standards Prep for CLP Pest/PCB OLM03.2	SOP
Organic Prep	**SPS06500.CT**	0	04/02/02	Prep of BNA Soils - Method 3541	SOP
Organic Prep	**SPS06600.CT**	0	09/10/02	Prep of Soil Samples for GC Method 3541	SOP
GCMS Semi VOA	**MSS01604.CT**	4	10/04/04	GC/MS Semivolatiles OLM03.2	SOP
GCMS Semi VOA	**MSS02009.CT**	9	10/10/04	GC/MS Analysis Method 625	SOP
GCMS Semi VOA	**MSS02200.CT**	0	10/05/04	GC/MS Semivolatile OLC2.1	SOP
GCMS Semi VOA	**MSS02706.CT**	6	08/19/04	GC/MS Semivolatile analysis - Method 8270C	SOP
GCMS Semi VOA	**MSS03501.CT**	1	09/14/04	GC/MS Semi-volatiles OLM04.3	SOP
GCMS Semi VOA	**MSS03601.CT**	1	10/08/04	GC/MS Semi-volatile screening OLM04.3	SOP
GCMS Semi VOA	**MSS03701.CT**	1	10/07/04	Semi-volatile Std Prep	SOP
GCMS Semi VOA	**MSS03400.CT**	0	01/21/03	Semi-volatile by Method T0 13A	SOP
GCMS VOA	**MSS00100.CT**	0	04/30/93	Volatile Std Prep CLP	SOP
GCMS VOA	**MSS01500.CT**	0	dft	GC/MS Volatile 524.2 Rev. 3	SOP
GCMS VOA	**MSS01801.CT**	1	06/27/97	GC/MS Volatiles OLM03.2	SOP
GCMS VOA	**MSS02102.CT**	2	02/15/00	GC/MS Analysis Method 624	SOP
GCMS VOA	**MSS02803.CT**	3	09/23/03	GC/MS Volatile analysis - Method 8260B	SOP
GCMS VOA	**MSS02900.CT**	0	dft	GC/MS Volatiles - OLC02.1	SOP
GCMS VOA	**MSS03001.CT**	1	03/27/03	GC/MS VOA OLM04.3	SOP

Standard Operating Procedures Listing

Dept	Document Number	Revison	Active Date	SOP Title	Document Type
GCMS VOA	**MSS03300.CT**	0	01/27/00	GC/MS Volatile Standards Prep OLM04.2	SOP
GCMS VOA	**MSS03802.CT**	2	01/24/05	Volatile by Method T0 17	SOP
GC Semivoa	**GCS00302.CT**	2	01/13/04	Sulfur Removal	SOP
GC Semivoa	**GCS00504.CT**	4	01/13/04	Analysis of OP Pesticides Method 8141A	SOP
GC Semivoa	**GCS00703.CT**	3	02/18/04	Misc. Volatiles Method 8015 (DAI)	SOP
GC Semivoa	**GCS01302.CT**	2	01/13/04	Analysis of Hydrocarbon Fingerprinting	SOP
GC Semivoa	**GCS01104.CT**	4	01/20/04	Pesticides/PCB Method 608	SOP
GC Semivoa	**GCS01503.CT**	3	01/13/04	GC/ECD Pesticides/PCB analysis OLM03.2	SOP
GC Semivoa	**GCS01804.CT**	4	01/13/04	Diesel Range Organics - Method 8015B	SOP
GC Semivoa	**GCS02003.CT**	3	01/19/04	Pesticide/PCB analysis - Method T04	SOP
GC Semivoa	**GCS02104.CT**	4	01/13/04	Water soluble Organics - DAI/NPD	SOP
GC Semivoa	**GCS02205.CT**	5	01/14/04	Analysis of Pesticides - Method 8081A	SOP
GC Semivoa	**GCS02306.CT**	6	01/14/04	Analysis of PCBs - Method 8082	SOP
GC Semivoa	**GCS02403.CT**	3	01/20/04	Analysis of Herbicides - Method 8151A	SOP
GC Semivoa	**GCS02503.CT**	3	01/20/04	GC/ECD Pesticides/PCB CLP OLM04.3	SOP
GC Semivoa	**GCS02603.CT**	3	01/20/04	Pesticide/PCB Standard Prep OLM04.3	SOP
GC Semivoa	**GCS02702.CT**	2	01/13/04	CT ETPH - DRO	SOP
Metals	**MES00906.CT**	6	04/01/04	SW846 Method 3010A	SOP
Metals	**MES01006.CT**	6	04/01/04	SW846 Method 3050B	SOP
Metals	**MES02001.CT**	1	01/20/03	Method 6010B - TJA61 Trace ICP	SOP
Metals	**MES02201.CT**	1	02/12/00	Metals Digestion ILM04.1 (Water)	SOP
Metals	**MES02301.CT**	1	02/12/00	Metals Digestion ILM04.1 (Soil)	SOP
Metals	**MES02401.CT**	1	02/12/00	Determination of Mercury in Water ILM04.1	SOP
Metals	**MES02501.CT**	1	02/12/00	Determination of Mercury in Soil ILM04.1	SOP
Metals	**MES02601.CT**	1	03/22/00	Determination of Metals - ILM04.1 TJA-61E Trace	SOP
Metals	**MES02700.CT**	0	08/01/96	Determination of Metals - 200.7 TJA 61E Trace	SOP
Metals	**MES02800.CT**	0	08/01/96	Determination of Mercury in Water Method 245.1	SOP
Metals	**MES02900.CT**	0	dft	Metals Digestion of Wipe Samples	SOP
Metals	**MES03103.CT**	3	03/27/03	Mercury 7470A (Hot Block)	SOP
Metals	**MES03202.CT**	2	01/20/03	Mercury 7471A (Hot Block)	SOP
Metals	**MES03301.CT**	1	07/12/02	Metals Digestion 200.7 (Water)	SOP
Wet Chemistry	**CVS01004.CT**	4	01/28/04	Analysis of Oil & Grease (Gravimetric)- 413.1	SOP
Wet Chemistry	**WC:070891:0**	0	07/08/91	Analysis of Salinity in Water	SOP
Wet Chemistry	**CVS04301.CT**	1	02/26/99	Measurement of Conductivity	SOP
Wet Chemistry	**WC:071691:0**	0	07/16/91	Analysis of Dissolved Oxygen in Water	SOP

Standard Operating Procedures Listing

Dept	Document Number	Revison	Active Date	SOP Title	Document Type
Wet Chemistry	CVS00706.CT	6	10/14/04	Analysis of Alkalinity in Water - 310.1	SOP
Wet Chemistry	CVS02603.CT	3	10/14/04	Analysis of Ammonia (method 350.2) in Water	SOP
Wet Chemistry	CVS00900.CT	0	03/31/94	Measurement of pH	SOP
Wet Chemistry	CVS01705.CT	5	10/14/04	Analysis of Sulfide	SOP
Wet Chemistry	CVS00506.CT	6	01/23/04	Analysis of Biochemical Oxygen Demand	SOP
Wet Chemistry	CVS01205.CT	5	02/17/04	Analysis of COD (Method 410.4)	SOP
Wet Chemistry	CVS01101.CT	1	02/04/00	Analysis of Samples for Total Cyanide CLP Protocol	SOP
Wet Chemistry	CVS01502.CT	2	10/8/1999	SOP for Toxicity Characteristic Leaching Procedure - 1311	SOP
Wet Chemistry	CVS04003.CT	3	4/10/2000	Measurement of Turbidity in Water Samples	SOP
Wet Chemistry	CVS00103.CT	3	10/26/1999	Analysis of Total Dissolved Solids in Water	SOP
Wet Chemistry	CVS03403.CT	3	10/19/2004	Analysis of TOC Soil Samples	SOP
Wet Chemistry	CVS03902.CT	2	10/8/1999	Analysis of Chloride (325.2) in Water	SOP
Wet Chemistry	CVS01901.CT	1	10/9/1999	Standard Operating Procedure for Reactivity	SOP
Wet Chemistry	CVS04603.CT	3	6/8/2004	Standard Operating Procedure for Corrosivity	SOP
Wet Chemistry	CVS02303.CT	3	10/19/2004	Standard Operating Procedure for Ignitability (1030)	SOP
Wet Chemistry	CVS00204.CT	4	1/21/2004	Analysis of Total Suspended Solids in Water	SOP
Wet Chemistry	CVS02502.CT	2	10/8/1999	Analysis of Nitrate and Nitrite for Water Samples (Method 353.2)	SOP
Wet Chemistry	CVS02002.CT	2	10/20/2004	SOP for Total Cyanide - Method 335.4	SOP
Wet Chemistry	CVS02102.CT	2	10/4/2004	SOP for Amenable Cyanide - Method 335.1	SOP
Wet Chemistry	CVS00300.CT	0	08/21/93	SOP for Total Solids	SOP
Wet Chemistry	CVS02900.CT	0	3/20/1995	SOP for CEC Method 9081	SOP
Wet Chemistry	CVS03000.CT	0	3/20/1995	SOP for Soil Homogenization	SOP
Wet Chemistry	CVS03303.CT	3	10/19/2004	SOP for Oxidation -Reduction Potential	SOP
Wet Chemistry	CVS03700.CT	0	10/10/1996	SOP for The Determination of Ferrous Iron	SOP
Wet Chemistry	CVS02403.CT	3	10/20/2004	SOP for Phenols method 420.1/420.2	SOP
Wet Chemistry	CVS04100.CT	0	1/6/1997	SOP for Determination of Percent Solids	SOP
Wet Chemistry	CVS04504.CT	4	6/8/2004	SOP for Oil and Grease - Method 1664A	SOP
Wet Chemistry	CVS04703.CT	3	10/20/2004	SOP for Total Petroleum Hydrocarbons - Method 418.1	SOP
Wet Chemistry	CVS04804.CT	4	10/27/2004	SOP for Analysis of Total Phosphorus	SOP
Wet Chemistry	CVS04902.CT	2	11/1/1999	SOP for Sample Screening for Chorine Residual	SOP
Wet Chemistry	CVS05203.CT	3	10/28/2004	SOP for Chlorine Residual	SOP
Wet Chemistry	CVS05102.CT	2	10/28/2004	SOP for Reagent Water Monitoring	SOP
Wet Chemistry	CVS05303.CT	3	11/2/2004	SOP for Ferrous Iron (SM4500)	SOP

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Dept	Document Number	Revison	Active Date	SOP Title	Document Type
Wet Chemistry	CVS05005.CT	5	11/2/2004	SOP for Hexavalent Chromium – 7196A	SOP
Wet Chemistry	CVS05401.CT	1	5/16/2002	SOP for Total Cyanide – 9012A	SOP
Wet Chemistry	CVS05500.CT	0	9/10/1999	SOP for CC Labeling /Coding of Standards	SOP
Wet Chemistry	CVS05601.CT	1	05/16/02	Total Sulfide (W/S) 9030B	SOP
Wet Chemistry	CVS05701.CT	1	10/07/02	Paint Filter	SOP
Wet Chemistry	CVS05802.CT	2	01/29/04	SOP for pH of Soil	SOP
Wet Chemistry	CVS06000.CT	0	04/25/00	SOP for TKN (351.2)	SOP
Wet Chemistry	CVS06100.CT	0	04/25/00	SOP for Ion Chromatography –9065/300	SOP
Wet Chemistry	CVS06200.CT	0	05/21/01	SOP for SPLP Preparation (SW846 1312)	SOP
Wet Chemistry	CVS06400.CT	0	03/12/03	SOP for Flashpoint 1020	SOP
Wet Chemistry	CVS06301.CT	1	02/12/03	SOP for Cyanide – ILM05.2	SOP
Wet Chemistry	CVS06500.CT	0	05/23/03	SOP for Color	SOP
Wet Chemistry	CVS06600.CT	0	08/20/03	SOP for Hardness	SOP
Wet Chemistry	CVS06700.CT	0	02/12/04	SOP for TPH-IR Soils – Soxtherm	SOP
Wet Chemistry	CVS07000.CT	0	01/26/04	SOP for Autotitrator	SOP
Wet Chemistry	CVS07100.CT	0	11/02/04	SOP for TOC -water Phoenix 8000	SOP
Information Systems	SYS01900.CT	0	04/23/97	SOP for GC/MS Chemserver Archive	SOP
Information Systems	SYS02000.CT	0	01/20/98	SOP for Generating Standard E-mail Result Files	SOP
Information Systems	SYS02300.CT	0	04/08/02	SOP for GC Target Deliverables	SOP
Information Systems	SYS02400.CT	0	07/22/02	SOP for GC Labnet Deliverables	SOP
Information Systems	SYS02500.CT	0	DFT	SOP for GC/MS VOA Target Deliverables	SOP
Information Systems	SYS02600.CT	0	DFT	SOP for GC/MS VOA Labnet Deliverables	SOP
Project Management	MKS00101.CT	1	03/06/99	SOP for Taking Client Orders	SOP
Project Management	MKS00201.CT	1	03/06/99	SOP for LIMS Log-in	SOP
Project Management	MKS00400.CT	0	06/22/94	SOP for Telephone Logs	SOP
Quality Assurance	QAS00305.CT	5	02/12/03	SOP for Document Control	SOP
Quality Assurance	QAS00504.CT	4	02/10/03	SOP for Corrective Action Reports	SOP
Quality Assurance	QAS00803CT	3	2/10/2003	SOP for Generating SOPs	SOP
Quality Assurance	QAS00901.CT	1	1/27/2001	SOP for Balance Calibraton	SOP
Quality Assurance	QAS01003.CT	1	10/1/2004	SOP for Document coding, Approval and Revisions	SOP
Quality Assurance	QAS01101.CT	1	2/23/1999	SOP for Thermometer Calibration	SOP
Quality Assurance	QAS01301CT	1	1/10/2003	SOP for Corrections to Lab Documents	SOP
Quality Assurance	QAS01201.CT	1	4/10/2000	SOP for Temperature Monitoring of Lab Equipment	SOP
Quality Assurance	QAS01501.CT	1	3/15/2001	SOP for Glassware Cleaning	SOP
Quality Assurance	QAS01601.CT	1	6/1/2003	SOP for Employee Training	SOP

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Dept	Document Number	Revison	Active Date	SOP Title	Document Type
Quality Assurance	**QAS01700.CT**	0	02/22/99	SOP for Conducting MDL Studies	SOP
Quality Assurance	**QAS01800.CT**	0	03/01/99	SOP for Reagent Control and Coding	SOP
Quality Assurance	**QAS01900.CT**	0	09/01/99	SOP for Terms and Definitions	SOP
Quality Assurance	**QAS02001.CT**	1	02/12/03	SOP for PT Testing	SOP
Quality Assurance	**QAS02102.CT**	2	02/24/03	SOP for Maintenance logs	SOP
Quality Assurance	**QAS02200.CT**	0	04/10/00	SOP for Sample Prep for MEOH preserved Volatiles	SOP
Quality Assurance	**QAS02400.CT**	0	05/01/04	SOP for Independent QA Review	SOP
Report Preparation	**RPS00304.CT**	4	04/25/00	Preparation and Review of Laboratory Reports	SOP
Report Preparation	**RPS00400.CT**	0	03/21/95	Report Retrieval	SOP
Report Preparation	**RPS00600.CT**	0	10/07/04	EDD Generation	SOP
Health and Safety	**SFS00202.CT**	2	06/03/02	Operating and Maintaining Fume Hoods	SOP
Health and Safety	**SFS00101.CT**	1	01/14/05	Tracking and Collection of Hazardous Waste	SOP
Radiological	**RAS00102.CT**	2	06/03/02	Tracking and Collection of Mixed Waste	SOP
Radiological	**RAS00202.CT**	2	06/03/02	Radioactivity Swipe Tests	SOP
Radiological	**RAS00302.CT**	2	06/03/02	Radiation Screening	SOP
Radiological	**RAS00400.CT**	0	08/24/94	Management/Disposal of Mixed Waste	SOP

APPENDIX, Section 9

LISTING OF ANALYTICAL CAPABLITIES

STL Analytical Capabilities List

STL Connecticut

Program	Technique	Analyte Group	Method ▲	Source	Description
Solid & Hazardous Waste	Waste Characterization	Waste Characterization	1020A	SW-846	Flashpoint (Setaflash)
Solid & Hazardous Waste	Waste Characterization	Waste Characterization	1030	SW-846	Ignitability of Solids
Solid & Hazardous Waste	Waste Characterization	Waste Characterization	1030	SW-846	Flashpoint of Solids
Non-potable Water	Colorimetric	General Chemistry	110.2	EPA	Color
Non-potable Water	Electrometric	General Chemistry	120.1	EPA	Conductance, Specific
Solid & Hazardous Waste	TCLP	Leach	1311	SW-846	Toxicity Characteristic Leachate Procedure
Solid & Hazardous Waste	SPLP	Leach	1312	SW-846	Synthetic Precipitate Leachate Procedure
Non-potable Water	General Chemistry	General Chemistry	140.1	EPA	Odor
Drinking Water	Electrometric	General Chemistry	150.1	EPA	pH
Non-potable Water	Electrometric	General Chemistry	150.1	EPA	pH
Non-potable Water	Gravimetric	Residue Testing, solids	160.1	EPA	Solids, Total Dissolved
Non-potable Water	Gravimetric	Residue Testing, solids	160.2	EPA	Solids, Total Suspended
Non-potable Water	Gravimetric	Residue Testing, solids	160.3	EPA	Solids, Total
Non-potable Water	Gravimetric	Residue Testing, solids	160.3	EPA	Moisture, Percent (%)
Non-potable Water	Gravimetric	Residue Testing, solids	160.4	EPA	Solids, Total Volatile
Non-potable Water	Gravimetric	Residue Testing, solids	160.4	EPA	Solids, Volatile Suspended
Non-potable Water	Gravimetric	General Chemistry	160.5	EPA	Solids, Settleable
Non-potable Water	Gravimetric	Residue Testing, solids	160.5	EPA	Solids, Settleable
Non-potable Water	Gravimetric	Hydrocarbons	1664A	EPA	Oil & Grease
Non-potable Water	Turbidimetric	General Chemistry	180.1	EPA	Turbidity
Drinking Water	Turbidimetric	General Chemistry	180.1	EPA	Turbidity
Drinking Water	ICP	Metals	200.7	EPA	ICP Metals
Non-potable Water	ICP	Metals	200.7	EPA	ICP Metals
Non-potable Water	Calculation	General Chemistry	200.7	EPA	Hardness (calculation from ICP results)
CLP	ICP	Metals	200.7 CLP-M	CLP ILM04.0	ICP Metals
Non-potable Water	General Chemistry	General Chemistry	2120B	SM	Color
Drinking Water	General Chemistry	General Chemistry	2120B	SM	Color
Non-potable Water	Turbidimetric	General Chemistry	2130 B	SM	Turbidity

Drinking Water	Turbidimetric	General Chemistry	2130 B	SM	Turbidity
Non-potable Water	Titrimetric	General Chemistry	2320 B	SM	Alkalinity, Hydroxide
Non-potable Water	Titrimetric	General Chemistry	2320 B	SM	Alkalinity, Bicarbonate
Non-potable Water	Titrimetric	General Chemistry	2320 B	SM	Alkalinity, Total
Non-potable Water	Titrimetric	General Chemistry	2320 B	SM	Alkalinity, Carbonate
Drinking Water	Titrimetric	General Chemistry	2320B	SM	Alkalinity, Bicarbonate
Drinking Water	Titrimetric	General Chemistry	2320B	SM	Alkalinity, Total
Drinking Water	Titrimetric	General Chemistry	2320B	SM	Alkalinity, Carbonate
Non-potable Water	Calculation	General Chemistry	2340B	SM	Hardness
Drinking Water	Calculation	General Chemistry	2340B	SM	Hardness (by calculation)
Non-potable Water	CVAA	Metals	245.1	EPA	Mercury-Hg (cold vapor)
Drinking Water	CVAA	Metals	245.1	EPA	Mercury-Hg (cold vapor)
CLP	CVAA	Metals	245.1 CLP-M	CLP ILM04.0	Mercury-Hg (water by manual cold vapor)
CLP	CVAA	Metals	245.5 CLP-M	CLP ILM04.0	Mercury-Hg (soil by manual cold vapor)
Drinking Water	Electrometric	General Chemistry	2510B	SM	Conductance, Specific
Non-potable Water	Electrometric	General Chemistry	2510B	SM	Conductance, Specific
Non-potable Water	Gravimetric	General Chemistry	2520B	SM	Salinity
Non-potable Water	Gravimetric	Residue Testing, Solids	2540 B	SM	Solids, Total
Drinking Water	Gravimetric	Residue Testing, Solids	2540 C	SM	Solids, Total Dissolved
Non-potable Water	Gravimetric	Residue Testing, Solids	2540 C	SM	Solids, Total Dissolved
Non-potable Water	Gravimetric	Residue Testing, Solids	2540 D	SM	Solids, Total Suspended
Non-potable Water	General Chemistry	General Chemistry	2710D	SM	Sludge Volume Index
Non-potable Water	Ion Chromatography	Anions	300	EPA	Phosphate (Ortho)
Non-potable Water	Ion Chromatography	Anions	300	EPA	Sulfate, as SO4
Non-potable Water	Ion Chromatography	Anions	300	EPA	Nitrite-Nitrogen
Non-potable Water	Ion Chromatography	Anions	300	EPA	Nitrate-Nitrogen
Non-potable Water	Ion Chromatography	Anions	300	EPA	Anions, by IC (Br, PO4, SO4, NO3, NO2,Cl, F)
Non-potable Water	Ion Chromatography	Anions	300	EPA	Fluoride
Non-potable Water	Ion Chromatography	Anions	300	EPA	Nitrate/Nitrite
Non-potable Water	Ion Chromatography	Anions	300	EPA	Chloride
Non-potable Water	Ion Chromatography	Anions	300	EPA	Bromide
Drinking Water	Ion Chromatography	Anions	300.0	EPA	Phosphate (Ortho)
Drinking Water	Ion Chromatography	Anions	300.0	EPA	Anions, by IC (Br, PO4, SO4, NO3, NO2,Cl, F)
Drinking Water	Ion Chromatography	Anions	300.0	EPA	Nitrite-Nitrogen
Drinking Water	Ion Chromatography	Anions	300.0	EPA	Nitrate/Nitrite
Drinking Water	Ion Chromatography	Anions	300.0	EPA	Fl Fluoride (IC)

Drinking Water	Ion Chromatography	Anions	300.0	EPA	Sulfate, as SO4
Drinking Water	Ion Chromatography	Anions	300.0	EPA	Nitrate-Nitrogen
Drinking Water	Ion Chromatography	Anions	300.0	EPA	Chloride
Solid & Hazardous Waste	Digestion	Metals	3010A	SW-846	Acid Digest of Aqueous Samples for Total Metals FLAA& ICP
Solid & Hazardous Waste	Digestion	Metals	3050B	SW-846	Acid Digest of Sediments, Sludges & Soils
Non-potable Water	Titrimetric	General Chemistry	310.1	EPA	Alkalinity, Bicarbonate
Non-potable Water	Titrimetric	General Chemistry	310.1	EPA	Alkalinity, Hydroxide
Drinking Water	Titrimetric	General Chemistry	310.1	EPA	Alkalinity, Carbonate
Drinking Water	Titrimetric	General Chemistry	310.1	EPA	Alkalinity, Hydroxide
Non-potable Water	Titrimetric	General Chemistry	310.1	EPA	Alkalinity, Total
Drinking Water	Titrimetric	General Chemistry	310.1	EPA	Alkalinity, Total
Non-potable Water	Titrimetric	General Chemistry	310.1	EPA	Alkalinity, Carbonate
Drinking Water	Titrimetric	General Chemistry	310.1	EPA	Alkalinity, Bicarbonate
Non-potable Water		Hydrocarbons	310.13	NY	Petroleum Hydrocarbons (TPHC)
Drinking Water	Spectrophotometric	General Chemistry	330.5	EPA	Chlorine Residual
Non-potable Water	Spectrophotometric	General Chemistry	330.5	EPA	Chlorine Residual, DPD
Non-potable Water	Spectrophotometric	Cyanides	335.1	EPA	Cyanide, Amenable to Chlorination
CLP	Spectrophotometric	Cyanides	335.2 CLP-M	CLP ILM04.0	Cyanide, Total
Drinking Water	Spectrophotometric	Cyanides	335.4	EPA	Cyanide, Total
Non-potable Water	Spectrophotometric	Cyanides	335.4	EPA	Cyanide, Total (Semi-automated)
Drinking Water	Colorimetric	Nitrogen Series	350.1	EPA	Ammonia, Nitrogen (w. distillation)
Non-potable Water	Spectrophotometric	Nitrogen Series	350.1	EPA	Ammonia, Nitrogen (w. distillation)
Non-potable Water	Spectrophotometric	Nitrogen Series	350.1	EPA	Ammonia, Nitrogen (Automated phenate)
Non-potable Water	Spectrophotometric	Nitrogen Series	350.1	EPA	Nitrogen, Total Organic (TON), automated phenate
Drinking Water	Colorimetric	Nitrogen Series	350.1	EPA	Ammonia, Nitrogen (Automated phenate)
Non-potable Water	Spectrophotometric	Nitrogen Series	350.2	EPA	Ammonia, Nitrogen (w. distillation)
Non-potable Water	Spectrophotometric	General Chemistry	3500-CR D	SM	Chromium (Hexavalent)
Non-potable Water	Spectrophotometric	Metals	3500-FE D	SM	Ferrous Iron
Non-potable Water	Spectrophotometric	Nitrogen Series	351.2	EPA	Nitrogen, Total Kjeldahl (TKN)
Non-potable Water	Spectrophotometric	Nitrogen Series	351.2	EPA	Nitrogen, Total Organic (TON), automated
Non-potable Water	General Chemistry	Nitrogen series	351.2-350.1	EPA	Organic Nitrogen (calculation)
Solid & Hazardous Waste	Extraction	Organics	3510C	SW-846	Separatory Funnel Liquid-Liquid
Solid & Hazardous Waste	Extraction	Organics	3520C	SW-846	Continuous Liquid-Liquid
Non-potable Water	Spectrophotometric	Nitrogen Series	353.2	EPA	Nitrate/Nitrite, Automated Cd Reduction

Non-potable Water	Spectrophotometric	Nitrogen Series	353.2	EPA	Nitrite-Nitrogen, Automated Cd Reduction
Non-potable Water	Spectrophotometric	Nutrients	353.2	EPA	Nitrate-Nitrogen, Automated Cd Reduction
Drinking Water	Spectrophotometric	Nutrients	353.2	EPA	Nitrate-Nitrogen
Drinking Water	Spectrophotometric	Nitrogen Series	353.2	EPA	Nitrite-Nitrogen
Drinking Water	Spectrophotometric	Nitrogen Series	353.2	EPA	Nitrate/Nitrite
Non-potable Water	Spectrophotometric	Nitrogen Series	354.1	EPA	Nitrite-Nitrogen
Solid & Hazardous Waste	Extraction	Organics	3541	SW-846	Soxhlet (Automated)
Solid & Hazardous Waste	Extraction	Organics	3550B	SW-846	Ultrasonic Extraction
Solid & Hazardous Waste	Extraction	Organics	3580A	SW-846	Waste Dilution
Non-potable Water	Potentiometric	General Chemistry	360.1	EPA	Oxygen, Dissolved
Solid & Hazardous Waste	Clean-Up	Organics	3610B	SW-846	Alumina Cleanup
Solid & Hazardous Waste	Clean-Up	Organics	3620B	SW-846	Florisil Cleanup
Solid & Hazardous Waste	Clean-Up	Organics	3640A	SW-846	Gel-Permeation Cleanup
Non-potable Water	Spectrophotometric	Nutrients	365.2	EPA	Phosphate (Ortho)
Non-potable Water	Spectrophotometric	Nutrients	365.2	EPA	Phosphorus (Total), Persulfate digestion
Solid & Hazardous Waste	Clean-Up	Organics	3660B	SW-846	Sulfur Cleanup
Solid & Hazardous Waste	Clean-Up	Organics	3665A	SW-846	Sulfuric Acid/Permanganate Cleanup
Non-potable Water	Titrimetric	Sulfide Species	376.1	EPA	Sulfide, as S
Non-potable Water	Potentiometric	Demand Series	405.1	EPA	BOD5
Non-potable Water	Spectrophotometric	Demand Series	410.4	EPA	COD, Automated
Non-potable Water	Gravimetric	Hydrocarbons	413.1	EPA	Oil & Grease
Non-potable Water	Infrared Spectrophotometric	Carbon	415.1	EPA	Total Organic Carbon (TOC)
Non-potable Water	Infrared Spectrophotometric	Carbon	415.1	EPA	Dissolved Organic Carbon
Non-potable Water	Gravimetric	Hydrocarbons	418.1	EPA	Petroleum Hydrocarbons-IR (TPHC)
Non-potable Water	Spectrophotometric	Phenols	420.2	EPA	Phenols, Total (Automated)
Drinking Water	General Chemistry	General Chemistry	4500-Cl D, E, F, G, I	SM	Chlorine, Total
Drinking Water	General Chemistry	General Chemistry	4500-Cl G	SM	Chlorine Residual
Non-potable Water	General Chemistry	General Chemistry	4500-Cl G	SM	Chlorine Residual
Drinking Water	Spectrophotometric	Cyanides	4500-CN C E	SM	Cyanide, Total
Drinking Water	Colorimetric	General Chemistry	4500-CN E	SM	Cyanide, Total
Non-potable	Spectrophotometric	Cyanides	4500-CN G	SM	Cyanide, Amenable to Chlorination

Water					
Drinking Water	Spectrophotometric	Cyanides	4500-CN G	SM	Cyanide, Amenable to Chlorination
Non-potable Water	Spectrophotometric	Cyanides	4500-CN I	SM	Cyanide, Weak & Dissociable
Non-potable Water	Spectrophotometric	Cyanides	4500-CN I	SM	Cyanide, Free (Weak Acid Dissociable)
Non-potable Water	Electrometric	General Chemistry	4500-H+B	SM	pH
Drinking Water	Electrometric	General Chemistry	4500-H+B	SM	pH
Non-potable Water	Potentiometric	General Chemistry	4500-O G	SM	Oxygen, Dissolved
Solid & Hazardous Waste	Purge and Trap	Volatile Organics	5030B	SW-846	Purge and Trap for Aqueous Samples
Solid & Hazardous Waste	Purge and Trap	Volatile Organics	5035	SW-846	Closed System Purge and Trap for Soils and Waste
Drinking Water	GC/MS	Volatile Organics	524.2	EPA	Volatiles, Drinking Water
Drinking Water	GC/MS	Volatile Organics	524.2	EPA	Tentatively Identified Compounds (TICs)
Solid & Hazardous Waste	ICP	Metals	6010B	SW-846	Metals
Non-potable Water	GC/ECD	Pesticides	608	EPA	Organochlorine Pesticides
Non-potable Water	GC/ECD	Pesticides	608.1	EPA	Organochlorine Pesticides
Non-potable Water	GC/ECD	Pesticides	614	EPA	OP Pesticides
Non-potable Water	GC/MS	Volatile Organics	624	EPA	Volatiles
Non-potable Water	GC/MS	Semivolatile Organics	625	EPA	Polynuclear Aromatic Hydrocarbons (PAHs)
Non-potable Water	GC/MS	Semivolatile Organics	625	EPA	Semivolatiles
Solid & Hazardous Waste	Colorimetric	Metals	7196A	SW-846	Chromium (Hexavalent)
Solid & Hazardous Waste	CVAA	Metals	7470A	SW-846	Mercury in Liquid Waste
Solid & Hazardous Waste	CVAA	Metals	7471A	SW-846	Mercury in Solid or Semisolid Waste
Solid & Hazardous Waste	GC/FID	Hydrocarbons	8015B	SW-846	Diesel Range Organics
Solid & Hazardous Waste	GC/FID Direct Aqueous Injection	Volatile Organics	8015B	SW-846	VOC-DAI-Direct Aqueous Injection
Solid & Hazardous Waste	GC/ECD	Pesticides	8081A	SW-846	Organochlorine Pesticides
Solid & Hazardous Waste	GC/ECD	PCBs	8082	SW-846	PCBs
Solid & Hazardous Waste	GC/NPD	Pesticides	8141A	SW-846	Organophosphorous Pesticides
Solid & Hazardous Waste	GC/MS	Volatile Organics	8260B	SW-846	Volatile Organic Compounds
Solid & Hazardous	GC/MS	Semivolatile Organics	8270C	SW-846	PAHs GC/MS Scan Low Level

Waste					
Solid & Hazardous Waste	GC/MS	Semivolatile Organics	8270C	SW-846	Semivolatiles
Solid & Hazardous Waste	GC/MS	Semivolatile Organics	8270C SIM	SW-846	PAHs GC/MS SIM Low Level
Solid & Hazardous Waste	Spectrophotometric	Cyanides	9012A	SW-846	Cyanide, Amenable to Chlorination
Solid & Hazardous Waste	Spectrophotometric	Cyanides	9012A	SW-846	Cyanide, Total
Solid & Hazardous Waste	Titrimetric	Sulfide Species	9034	SW-846	Sulfide, Acid Insoluble
Solid & Hazardous Waste	Electrometric	General Chemistry	9040B	SW-846	Corrosivity, as pH
Solid & Hazardous Waste	Electrometric	General Chemistry	9045C	SW-846	pH, Solid & Waste
Solid & Hazardous Waste	Ion Chromatography	Nutrients	9056	SW-846	Nitrate-Nitrogen
Solid & Hazardous Waste	Ion Chromatography	Anions	9056	SW-846	Nitrite-Nitrogen
Solid & Hazardous Waste	Ion Chromatography	Anions	9056	SW-846	Chloride
Solid & Hazardous Waste	Ion Chromatography	Anions	9056	SW-846	Phosphate [Ortho]
Solid & Hazardous Waste	Ion Chromatography	Nutrients	9056	SW-846	Nitrate/Nitrite
Solid & Hazardous Waste	Ion Chromatography	Anions	9056	SW-846	Bromide
Solid & Hazardous Waste	Ion Chromatography	Anions	9056	SW-846	Fl Fluoride (IC)
Solid & Hazardous Waste	Ion Chromatography	Anions	9056	SW-846	Anions
Solid & Hazardous Waste	Ion Chromatography	Anions	9056	SW-846	Sulfate, as SO4
Solid & Hazardous Waste	Infrared Spectrophotometric	Carbon	9060	SW-846	Total Organic Carbon (TOC)
Solid & Hazardous Waste	Colorimetric	Phenols	9066	SW-846	Phenols, Total
Solid & Hazardous Waste	General Chemistry	Physical Properties	9095A	SW-846	Paint Filter Test
Solid & Hazardous Waste	Waste Characterization	Waste Characterization	Chapter 7, Ignitability	SW-846	Ignitability
CLP	Digestion	Metals	CLP Metals Digestion	ILM04.0	CLP Metals Digestion
Other	General Chemistry	Leach	D-3987	ASTM	ASTM Leaching Procedure
Non-potable Water	Titrimetric	Carbon	Lloyd Kahn	Region II	Total Organic Carbon (TOC)

Clean Air	GC/MS	Semivolatile Organics	Mod TO-13A	EPA	Polynuclear Aromatic Hydrocarbons (PAHs)
CLP	GC/ECD	Pesticides/PCBs	Pesticides / Aroclors	CLP OLM03.2	Organochlorine Pesticides / PCBs
CLP	GC/ECD	Pesticides/PCBs	Pesticides / Aroclors	CLP OLM04.1	Organochlorine Pesticides / PCBs
CLP	GC/ECD	Pesticides/PCBs	Pesticides / Aroclors	CLP OLM04.2	Organochlorine Pesticides / PCBs
CLP	GC/MS	Semivolatile Organics	Semivolatile Organics	CLP OLC02.1	Semivolatiles, Low Level
CLP	GC/MS	Semivolatile Organics	Semivolatile Organics	CLP OLM04.1	Semivolatiles
CLP	GC/MS	Semivolatile Organics	Semivolatile Organics	CLP OLM04.2	Semivolatiles
CLP	GC/MS	Semivolatile Organics	Semivolatile Organics	CLP OLM03.2	Semivolatiles
Solid & Hazardous Waste	Waste Characterization	Waste Characterization	SW846,Chapter7	SW-846	Sulfide (Reactive)
Solid & Hazardous Waste	Waste Characterization	Waste Characterization	SW846,Chapter7	SW-846	Cyanide (Reactive)
Clean Air	GC/MS	Semivolatile Organics	TO-13	EPA	Polyaromatic Hydrocarbons by GC/MS
Clean Air	GC/ECD	Pesticides	TO-4	EPA	Pesticide by GC
Non-potable Water	Calculation	General Chemistry	Total Cr - Cr+6	SM	Chromium, Trivalent by Difference
CLP	GC/MS	Volatile Organics	Volatile Organics	CLP OLM03.2	Volatiles
CLP	GC/MS	Volatile Organics	Volatile Organics	CLP OLM04.1	Volatiles
CLP	GC/MS	Volatile Organics	Volatile Organics	CLP OLM04.2	Volatiles
CLP	GC/MS	Volatile Organics	Volatile Organics	CLP OLC02.1	Volatiles, Low Level

Submit Query

Mitkem Corporation

QUALITY ASSURANCE PLAN

Date Revised: 11/22/04

Revision 6

Approved By:

Karen M. Gavitt
QA/QC Director/Technical Director-Inorganics

11/23/04
Date

Edward A. Lawler
Operations Manager/Technical Director-Organics

11/23/04
Date

MITKEM Corporation 175 Metro Center Boulevard, Warwick, RI 02886
Phone Number: (401) 732-3400, Fax Number: (401) 732-3499

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2.0 Table of Contents (Cont.)

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3.0 INTRODUCTION

MITKEM Corporation is a minority-owned small business environmental services company, incorporated in the State of Rhode Island.

Offices and laboratories are located in Warwick, Rhode Island. The laboratory occupies approximately 11,000 square feet of laboratory space.

This Quality Assurance Plan (QAP) describes the policies, organization, objectives, quality control activities. It also specifies quality assurance functions employed at MITKEM and demonstrates MITKEM's dedication to the production of accurate, consistent data of known quality. This QAP is developed by following the guidelines discussed in the EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA/R-5, Interim Final, Jan., 1994 and the National Environmental Laboratory Accreditation Conference (NELAC) standards, July 12, 2002.

4.0 QUALITY ASSURANCE POLICY STATEMENT

MITKEM is firmly committed to the production of valid data of known quality through the use of analytical measurements that are accurate, reproducible and complete. To ensure the production of such data, MITKEM has developed a comprehensive Quality Assurance/Quality Control Program that operates throughout the entire organization.

MITKEM Management considers Quality Assurance/Quality Control to be of the highest importance in the success of its Analytical Testing Laboratory and therefore fully supports the staff in the implementation and maintenance of a sound and thorough Quality Assurance Program.

MITKEM's corporate success is based on its participation in the most rigorous and quality-focused environmental testing programs, such as the EPA Contract Laboratory Program, US Department of Defense programs, NELAC, and other nationwide and state-specific certification and approval programs. These programs require consistent application of the QA/QC procedures described in this document. MITKEM's ability to demonstrate and document that analyses were performed in this manner is one of the foundations of its business. The other foundation of its business is to provide superior levels of customer service, above and beyond the norm for laboratories performing at this level of quality.

MITKEM's approach to customer service is to aggressively meet or exceed customer expectations, particularly in terms of turnaround time for results. While the production of rapid turnaround time data may require MITKEM employees to "go the extra mile" for the customer, without quality, the data are useless. MITKEM constantly strives to manages its business to rapidly provide data to meet all the requirements of its quality program.

- MITKEM management works to insure: that employees understand the primary importance of quality in its day to day operations,
- that employees will not be subjected to pressure to sacrifice quality for turnaround, financial or other considerations,
- that employees understand the importance of their ethical responsibilities in terms of data manipulation, falsification or other illegal or improper actions,
- that the company has policies to avoid involvement in activities that diminishes its competence, impartiality, judgment or operational integrity.
- that employees maintain all client information in a confidential manner, and
- that employees understand that any short-term gain realized by disregarding the QA/QC program will be more than wasted by the serious penalties for these actions.
- That the laboratory has the technical personnel to identify occurrences of departure from the quality system and to initiate actions to prevent or minimize such departures.

All employees receive training in these issues as part of the initial orientation process, and are required to acknowledge that they understand their responsibilities in these areas.

These issues are also discussed among all laboratory staff at company meetings and re-training sessions. The QA Officer, Technical Director and other senior company management are readily available to all staff through their daily presence, "open door" policy and approachable manner. This allows any employee to readily discuss any questions, concerns or issues that may occur.

Quality Control is defined as an organized system of activities whose purpose is to demonstrate that quality data are being produced through documentation. Quality Assurance is more broadly defined as a system of activities designed to ensure that the quality control program is actually effective in producing data of the desired quality.

Quality Control is included as part of Quality Assurance. In supporting government regulatory and enforcement proceedings, a high degree of attention to quality is essential. Thorough application of quality control principles and routine quality assurance audits is required.

The basic components of the MITKEM QA/QC Program are control, evaluation and correction.

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

Evaluation involves the assessment of data generated during the control process. For example, precision and accuracy are determined from the results of duplicates and spikes, and other check samples. Long-term evaluation measures include performance and systems audit conducted by regulatory agencies, as well as the MITKEM quality assurance group.

Correction includes the investigation, diagnosis and resolution of any problems detected in an analytical system. Proper functioning of the system may be restored through method re-evaluation, analysis of additional check samples, trouble-shooting and repair of instrumentation or examination and comparison with historical data. Corrective actions are documented and reviewed to make sure they are implemented.

Certain situations may occur when there are occasional departures or exceptions from documented policies and procedures or standard specifications due to client or project specific protocols, unusual sample matrix, or special non-target analyte or non-routine analyses. MITKEM's policy is to fully document all such procedures and their associated QC, and notify the client or regulatory agency. If the situation is to continue, a Standard Operating Procedure will be written and implemented.

5.0 QUALITY ASSURANCE MANAGEMENT, ORGANIZATION AND RESPONSIBILITY

Quality Assurance at MITKEM is a company-wide function that depend on:

(1) cooperative working relationships at all levels within the laboratory and

(2) multi-level review through all working levels of responsibility.

Responsibilities for QA/QC functions begin with the bench scientist and extend to the chief executive officer.

The primary level of quality assurance resides with the bench scientist. After completion of the documented training program, his/her responsibilities include:

- complying with all aspects of formally approved analytical methods and SOPs,
- carefully documenting each step of the analytical process,
- conscientiously obtaining peer review as required,
- promptly alerting laboratory supervisors and/or QA staff members to problems or anomalies that may adversely impact data quality, and
- participation in corrective actions as directed by the laboratory supervisor or QA Director.

The supervisor of each laboratory is responsible for ensuring thorough oversight of the quality of the data generated by the bench scientists. The laboratory supervisor implements and monitors the specific QC protocols and QA programs with the laboratory to ensure a continuous flow of data meeting all control protocols and Mitkem QA requirements. The laboratory supervisor's responsibilities include providing the bench chemist with adequate resources to achieve the desired quality of performance.

The MITKEM organizational structure is shown in the Organization Chart. Resumes of the CEO/Technical Director, President, Quality Assurance Director, Operations Manager, Chief Financial Officer, MIS Director, Project Managers, Laboratory Supervisors, and other key personnel are included.

Mitkem's lines of communication flow upward on the Organizational Chart. If an employee lacks professional confidence in his or her supervisor, he or she may, at any time, speak with someone in management higher up in the Organizational Chart.

Implementation of the entire Quality Assurance Program is the responsibility of the QA Director. While interacting on a daily basis with laboratory staff members, the QA Director remains independent of the laboratories and reports directly to the Chief Executive Officer/Technical Director. The QA Director evaluates laboratory compliance with respect to the QA program through informal and formal systems and performance audits as described in Section 13.0. Remedial action, to alleviate any detected problems,

is suggested and/or discussed with the appropriate parties and implemented when necessary.

With input from the appropriate staff members, the QA Director writes, edits and archives QA Plans, QC protocols, safety procedures, and Standard Operating Procedures (SOPs) in accordance with US EPA approved methodologies, and GLP procedures. If sitespecific or projectspecific QA Plans and/or QC protocols are needed, these will be generated as needed.

An essential element of the QA program is record keeping and archiving all information pertaining to quality assurance including QA/QC data, pre-award check sample results, scores and followup; performance test sample results,scores, and followup; state certifications of the laboratory; external and internal audits with resolution of EPA and other audit team comments, recommendations and reports. The QA Director also plays an important role in the corrective action mechanism described in Section 16.

In addition, the QA Director works with scientists and management to continuously upgrade procedures and systems to improve the laboratory's efficiency and data quality.

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

Laboratory management will ensure the competence of all who operate equipment, perform tests and calibrations, evaluate data and sign reports. When employees are I training, appropriate supervision will be provided until the employee has demonstrated the appropriate level of understanding, training, and skill.

Mitkem Corporation's personnel job descriptions:

Responsibilities of each staff area in the laboratory include:

Bench Scientist / Preparation Laboratory Areas:

- Analysis of samples through compliance with all aspects of formally approved analytical methods and laboratory SOPs.
- Carefully documenting each step of the analytical process.
- Noting in the appropriate logbook area any unusual occurrences or sample matrix problems.
- Conscientiously obtaining peer review as required.
- Promptly alerting laboratory supervisors and/or QA staff members to problems or anomalies. that may adversely impact data quality.
- Routine housekeeping duties for their laboratory area.

Bench Scientist / Instrument Laboratory Areas:

- Analysis of samples through compliance with all aspects of formally approved analytical methods and laboratory SOPs.
- Routine maintenance of instrumentation.
- Preparation of analytical standards and spiking solutions which are documented and traceable to their original source.
- Carefully documenting each step of the analytical process.
- Noting in the appropriate logbook area any unusual occurrences or sample matrix problems.
- Conscientiously obtaining peer and supervisor review as required.
- Promptly alerting laboratory supervisors and/or QA staff members to problems or anomalies that may adversely impact data quality.
- Documenting the initial review of analysis data to determine compliance with established company QA/QC protocols and any project-specific QA criteria, and noting any unusual occurrences or discrepancies on the data review checklist.
- Routine housekeeping duties for their laboratory area.

Data Reporting Staff:

- Assemble CLP-format data reports by organizing data report forms and raw data in proper order to allow for technical data review.
- Enter data into LIMS or other data reporting computer programs.
- Provide non-technical typographical review of data entered into computer systems by other individuals.
- Deliver data reports to customers by FAX or electronic mail.
- Paginate, photocopy, scan, archive Mitkem's copies of customer reports or other documentation to be retained by the laboratory.
- Ship, or organize for courier delivery, final data reports to customers.
- Assist the QA Director in management of the document control system.

Supervisor:

- Oversight of bench scientists in their laboratory areas.
- Monitors the status of all work in their laboratory area to insure compliance with holding time and turnaround time requirements.
- Training new scientists in the appropriate procedures and methods in the laboratory.
- Works with laboratory managers and the QA staff to review, revise and implement SOPs.
- Insures adequate resources to perform the needed tasks by working with administrative personnel to order needed supplies.
- Insures all supplies and reagents meet the QC requirements of their intended task prior to their use in the laboratory.
- Insures all staff are using proper safety protocols.
- Works with laboratory managers on the annual review of personnel performance.

- Interviews prospective new employees to insure they have the minimal level of qualifications, experience, education and skills necessary to perform their tasks, as well as the appropriate work ethic and social skills necessary for proper teamwork and productivity.
- Review of analytical data to insure compliance with method/SOP requirements prior to release to the client.
- Documents any non-compliance or other unusual occurrences noted during sample analysis and data review such that these can be included in the report narrative and explained to the client.

Senior Scientists:

- Review of analytical data to insure compliance with method/SOP requirements prior to release to the client.
- Documents any non-compliance or other unusual occurrences noted during sample analysis and data review such that these can be included in the report narrative and explained to the client.
- Assist laboratory Managers and Supervisors in other tasks as required.

Operations Manager:

- Prioritizes work in the laboratory areas to insure projects are completed on a timely basis.
- Works with laboratory Managers and Supervisors to coordinate laboratory areas in the completion of analytical projects.
- Review of analytical data to insure compliance with method/SOP requirements prior to release to the client.
- Writes project report narratives to document any unusual occurrences noted during sample analysis.
- Works with management and supervisory staff to continuously improve the quality and efficiency of all company procedures.
- Works with clients to insure all questions and concerns are addressed and answered.
- Assists laboratory Managers and Supervisors in the annual review of personnel performance.
- Supervises laboratory Managers and Supervisors to insure compliance with company QA policies and other company procedures.

Project Manager:

- Works with the client to completely understand the requirements of all incoming work.
- To evaluate the client's requirements as compared to the abilities of the laboratory as stated in Mitkem's Standard Operating Procedure (SOP); Project Management, SOP 110.0023.
- To communicate the customer's requirements to all laboratory staff working on the project.
- Works with the customer to determine the number and type of sample containers required for the project.
- Works with the Sample Custodian to resolve and communicate to the client any problem or discrepancies with incoming samples.

- Maintains open, responsive and continuous communication with the customer.
- Follows up with the client to assess level of satisfaction, and insure all project goals have been accomplished.

QA Director:

- Implements the entire QA program.
- Interact on a daily basis with laboratory staff.
- Evaluates compliance with the QA program through formal and informal reviews of data and processes.
- Implements the corrective action system.
- Works with laboratory Managers and Supervisors to implement new SOPs and to annually review and revise existing SOPs.
- Interfaces with certification authorities and agencies to maintain existing certifications and obtain new certifications.
- Maintains records of employee training and certification.
- Instructs laboratory personnel annually on ethics in the workplace.
- Oversees analytical trends that need to be evaluated and corrected.
- Oversees the implementation of annual MDLs and control limit studies.
- Directs both the internal and external audit program.

CEO/Technical Director:

- Review of analytical data to insure compliance with method/SOP requirements prior to release to the client.
- Supervises all Management, QA and Supervisory staff to insure compliance with company QA policies and other company procedures.
- Provides technical assistance to all areas of the laboratory staff.
- Works with clients to insure their understanding of complex technical issues.
- Performs final review of select analytical data to ensure compliance with method/SOP requirements prior to release to the client.
- Acts as technical consultant for chemistry related issues that arise in the lab.
- Provides assistance with instrument optimization or performance issues as needed.
- Offers input on the purchase and operation of new instrumentation.
- Trains other analysts in procedures and methodologies.

In Mitkem's organizational structure, the CEO/Technical Director is one of the principal owners of the company. He is the ultimate authority for all chemistry-related aspects of the company. Mitkem's President is a non-chemist who possesses extensive experience in business management and development. His responsibilities are to directly supervise the daily management of the company, with particular focus on sales, marketing, customer service and financial management. The QA Director is a Vice President of the company, who reports directly to the President, but also has direct access to the CEO/Technical Director. She has the

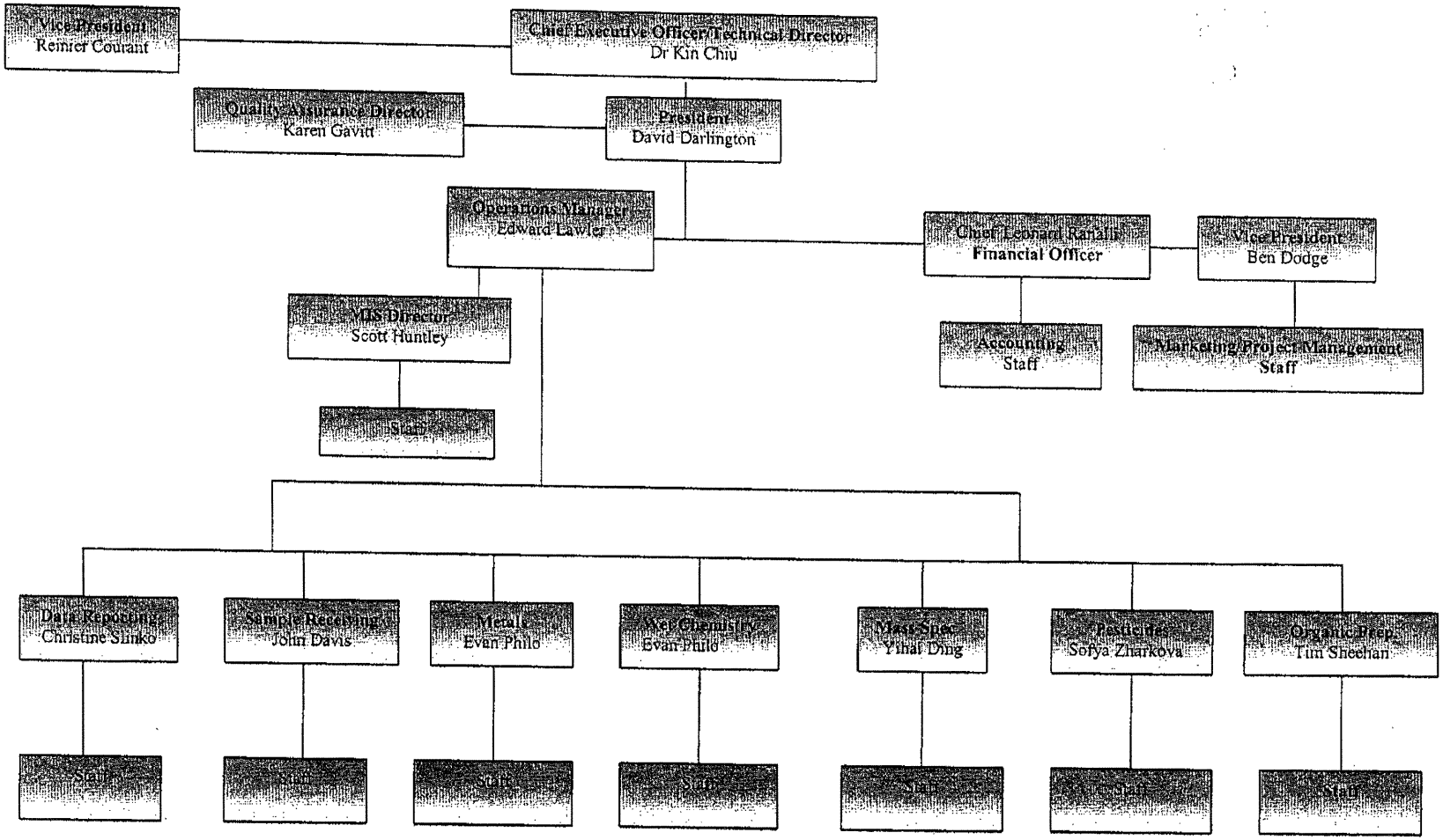
authority within the management system to bring any issue to the highest levels of the company management and ownership, as well as to halt the release of data she believes to be questionable or suspend the performance of an analysis she believes to be unreliable. The Operations Manager is a Vice President of the company, and works with the project management and marketing staff and with the laboratory Supervisors to prioritize and coordinate work within the laboratories.

The personnel training records are located in the QA department. All individual training is documented including new employee training, individual training, annual retraining procedures, and Health and Safety training.

Figure 5-1
MITKEM Corporation's Organizational Chart

MITKEM CORPORATION

Organizational Chart



KIN S. CHIU
Chief Executive Officer/Head Chemist

Dr. Chiu is a MIT trained mass spectroscopist with extensive experience in the trace level analyses of organic and hazardous waste compounds in environmental samples. He has over twenty years of experience in using GC/MS, HPLC and GC with various detectors. He has been involved with research and development on non-routine analytical approaches to environmental chemistry problems. Dr Chiu has been the lead chemist responsible for analytical laboratory operations at several of the most respected laboratory facilities in the northeast.

Dr. Chiu has extensive program management experience through positions of high responsibility in Contract Laboratory Program (CLP) laboratories. He also has significant experience with the management of programs involving Army Corps of Engineers, Navy and Air Force analytical requirements.

Dr. Chiu also has extensive experience with the financial and business management responsibilities of small and medium size corporations, as well as the public sector. MITKEM is his second environmental laboratory start-up. The first, CEIMIC Corporation was also highly successful. He was an active partner in both the technical and business aspects of both companies.

EDUCATION

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Cambridge, Massachusetts
Chemistry, PhD

RUTGERS UNIVERSITY
New Brunswick, New Jersey
Environmental Sciences, MS

UNIVERSITY OF MARYLAND
College Park, Maryland
Chemistry, BS

RELATED EXPERIENCE

1994-Present **MITKEM CORPORATION**
Warwick, Rhode Island
- Chief Executive Officer
- Technical Director

1993	**COAST TO COAST ANALYTICAL** Westbrook, Maine - Director of Laboratory Operations
1991-1993	**MASSACHUSETTS WATER RESOURCES AUTHORITY** Boston, Massachusetts - Laboratory Superintendent
1988-1992	**CEIMIC CORPORATION** Narragansett, Rhode Island - Vice President Organic Laboratory Operations and Technical Director
1983-1988	**ENSCO/ERCO DIVISION** Cambridge, Massachusetts - Head of Research and Development

REINIER A. COURANT

Vice President

Mr. Courant has over twenty five years of experience in environmental chemistry. He has managed a number of large scale multi-disciplinary and international environmental baseline studies. These studies involved the collection and analysis of samples for a wide variety of parameters, evaluation and interpretation of the generated data, and writing of the final report. Mr. Courant has authored 25 scientific papers, taught chemistry at the university level and held senior scientist and project manager positions as well as upper management and partner positions in several environmental firms.

Mr. Courant has extensive experience in many phases of environmental chemistry, with particular concentration in laboratory design and automation, specifically in electronic transfer of data and set-up of information management systems. Mr. Courant also has considerable experience in sample analysis, data review and data package preparation for EPA Contract Laboratory Program inorganic sample analyses. Mr. Courant's experience with chemical analysis instrumentation is wide-ranging, with a primary focus on elemental and trace metals analyses.

In the past ten years he has been involved in the start-up and senior management of several environmental testing laboratories.

EDUCATION

UNIVERSITY OF RHODE ISLAND
Graduate School of Oceanography
Kingston, Rhode Island
Chemical Oceanography, MS

NORTHEASTERN UNIVERSITY
Boston, Massachusetts
Mathematics, MS

DELFT INSTITUTE OF TECHNOLOGY
Delft, Netherlands
Chemistry

RELATED EXPERIENCE

1994-Present

MITKEM CORPORATION
Warwick, Rhode Island
- Vice President

1991-1994	**CC CORPORATION** Lexington, Massachusetts - President
1987-1991	**CEIMIC CORPORATION** Narragansett, Rhode Island - Vice President
1985-1987 1980-1983	**ENERGY AND ENVIRONMENTAL ENGINEERING, INC.** Cambridge, Massachusetts - Vice President
1983-1985	**RESEARCH PLANNING INSTITUTE** Columbia, South Carolina - Senior Chemist Niger Delta Baseline Studies
1978-1980	**INTERSTATE ELECTRONICS CORPORATION** Anaheim, California - Senior Oceanographer US EPA Studies of US Offshore Dumpsites
1976-1978	**ENERGY RESOURCES COMPANY - ERCO** Cambridge, Massachusetts - Field Operation Manager and Senior Oceanographer Georges Bank Region Environmental Baseline Studies
1972-1976	**UNIVERSITY OF RHODE ISLAND** Kingston, Rhode Island - Research Specialist/Graduate Student
1969-1972	**WOODS HOLE OCEANOGRAPHIC INSTITUTE** Woods Hole, Massachusetts - Research Assistant/Graduate Student

DAVID DARLINGTON

President

Mr. Darlington has over eighteen years of business experience, including twelve in senior management position. He is responsible for overall management of the company, focusing on building and maintenance of client relationships, establishment and review if operating budgets and financial performance, and the negotiation of contracts for government, engineering and consulting customers.

Previously, Mr. Darlington held top management positions at 3M Companies Traffic Control Material Division, Special Assistant to the Governor of Rhode Island and as a partner in the Securities firm of American Securities and Research Corporation. He was responsible for supervision of technical sales, budget and financial review and addition, prior to entering the environmental business. Mr. Darlington held senior positions with fortune 500 companies including 3M, AT&T, Verizon and Merrill Lynch.

EDUCATION

Marquette University
Milwaukee, Wisconsin
- Political Science, BA

RELATED EXPERIENCE

2002-Present	**Mitkem Corporation** Warwick, Rhode Island President
2000-2002	**3M Corporation** St. Paul, Minnesota
1994-2000	**Office of the Governor** Providence, RI
1989-1994	**Verizon Communications** Boston, Massachusetts

EDWARD A. LAWLER

Operations Manager/Technical Director-Organics

Mr. Lawler has over twenty years of experience in environmental laboratory operations. He has extensive experience in managing laboratory workflow and in establishing and maintaining customer relationships. He also has considerable experience in a wide range of environmental chemical analyses, with a concentration in trace level volatile organics analysis.

Mr. Lawler's responsibilities include coordination and prioritization of all analytical chemistry testing at Mitkem. This includes daily meetings with the organic and inorganic laboratory supervisors and managers to insure all technical and schedule requirements are met. Mr. Lawler also reviews laboratory data to insure QA/QC criteria have been achieved, and provides final review of data reports prior to delivery to clients. Mr. Lawler also manages certain significant analytical testing programs, acting as principal technical liaison with the client.

Mr. Lawler's previous experience includes various staff, management and senior management positions at several environmental testing laboratories. Direct project experience includes EPA CLP, Army MRD, Navy NEESA and NFESC, DOD HAZWRAP and New York DEC ASP programs. Mr. Lawler has also provided expert testimony at several Superfund trials including pre-trial consulting and trial witness services.

EDUCATION:

UNIVERSITY OF MASSACHUSETTS
Amherst, Massachusetts
Environmental Sciences, BS

RELATED EXPERIENCE:

1997-Present

MITKEM CORPORATION
Warwick, Rhode Island
-Operations Manager

1989-1997

NATIONAL ENVIRONMENTAL TESTING, CAMBRIDGE DIVISION
Bedford, Massachusetts
-Division Manager
-Proposal/Contract Manager
-Director of Project Management

1983-1989	**CAMBRIDGE ANALYTICAL ASSOCIATES, INC.** Boston, Massachusetts -Project Manager -Volatile Organic Laboratory Manager
1978-1983	**ENERGY RESOURCES COMPANY, INC. - ERCO** Cambridge, Massachusetts -Volatile Organics (GC) Manager -Analytical Chemist-Volatile Organics Lab -Analytical Chemist-Organic Preparation Lab
1978	**LAPUCK LABORATORIES, INC.** Watertown, Massachusetts -Analytical Chemist-Wet Chemistry & Metals -Microbiologist

KAREN M. GAVITT

QA/QC Director-Technical Director, Inorganics

Ms. Gavitt has nearly fourteen years of experience in the analysis of environmental and hazardous waste samples for both organic and inorganic analytes. A large portion of this experience has involved the use of axial ICP, radial ICP, cold vapor AA and graphite furnace AA for trace metals analysis and wet chemistry analyses.

Ms. Gavitt's responsibilities at Mitkem include management of the inorganic chemistry laboratories including metals and conventional wet chemical analyses. Her duties include the day-to-day scheduling of all analytical work in her department to meet program turnaround and method holding time requirements. Ms. Gavitt is also responsible for the technical and QC performance of a wide variety of methods, as well as development and implementation of Standard Operating Procedures, method and instrument performance measures, daily review of sample and QC data, training of laboratory staff and discussion of program requirements and project status with Mitkem's project managers and clients.

She was a GC/MS analyst during her most recent employment before joining Mitkem. Ms. Gavitt also has experience in the analysis of samples for inorganic and organic analyses by US EPA CLP protocols, New York State ASP protocols and various DOD analytical programs.

EDUCATION

DUQUESNE UNIVERSITY
Pittsburgh, Pennsylvania
Chemistry, BS

RELATED EXPERIENCE

1994-Present — **MITKEM CORPORATION**
Warwick, Rhode Island
- QA/QC Director/Technical Director
- Lab Manager
- Inorganic Laboratory Manager

1994 — **ENVIRONMENTAL SCIENCES SERVICES**
Providence, Rhode Island
- GC/MS Analyst

1990-1994 — **CEIMIC CORPORATION**
Narragansett, Rhode Island
- Trace Metals Laboratory Supervisor
- Organic Prep Lab Technician

YIHAI DING

GCMS Laboratory Supervisor

Mr. Ding has experience in a wide variety of analytical chemistry techniques, including GC, GC/MS, HPLC and FTIR. His expertise includes the operation, calibration and maintenance of sophisticated, computer controlled instrumentation.

Mr. Ding's responsibilities at Mitkem involve the coordination of volatile organics analyses using GC/MS and GC instrumentation. His duties in this role include supervising analysts in the daily calibration, maintenance and troubleshooting of analytical instruments, monitoring schedules and holding times, analysis of samples, review of sample and QC data. He also is involved with the implementation of Standard Operating Procedures, documentation of instrument and method QC criteria and development of new methods and implementation of new analytical technology. Mr. Ding also insures the production of volatile organic data is coordinated with other laboratory sections.

Mr. Ding's prior experience includes research into the mechanisms and kinetics of various biochemical processes. A large portion of this research has required the analysis of reactants and products using state-of-the-art chemical instrumentation. Mr. Ding has also taught chemistry and biochemistry laboratory courses at the university level.

EDUCATION

MIDDLE TENNESSEE STATE UNIVERSITY
Murfreesbro, Tennessee
- Chemistry, MS

JILIN UNIVERSITY
Changchun, China
- Biochemistry, BS

RELATED EXPERIENCE

1998-Present

MITKEM CORPORATION
Warwick, Rhode Island
- GCMS Supervisor for both Volatile Organics Laboratory and Semi-Volatile Organics
- GC/MS Analyst

1994-1998

MIDDLE TENNESSEE STATE UNIVERSITY
Murfreesbro, Tennessee
- Researcher
- Laboratory Instructor, chemistry and biochemistry

1993-1994

NATIONAL ENZYME ENGINEERING LAB
Changchun, China
- Researcher

SOFYA ZHARKOVA

Pesticides/ PCB/SVOA Supervisor

Sofya Zharkova has had an impressive background in the organic chemistry field, which has spanned over twenty years. She has had nearly seven years of laboratory management experience. Her daily duties include the daily calibration, maintenance, and troubleshooting for various sophisticated computer controlled analytical instrumentation. Ms. Zharkova moniters schedules and holding times for samples. She reviews the analysis of samples and Quality Control data. She is involved in the implementation of Standard Operating Produces, she documents new analytical techniques and ensures that Pesticide/ PCB information is coordinated with other laboratory sections.

Ms. Zharkova has had extensive experience and knowledge in procedures such as multi-step synthesis; isolation, purification and analysis of organic compounds that make her ideally qualified for her current position.

EDUCATION

Institute of Chemical Technology
Russia
Major-Organic Chemistry, BS

RELATED EXPERIENCE

2004 — **Mitkem Corporation**
Warwick, Rhode Island
SVOA Laboratory Supervisor in Training

2000-Present — **Mitkem Corporation**
Warwick, Rhode Island
Pesticides/PCB Laboratory Supervisor

1997-1999 — **Ceimic Corporation**
Narragansett, Rhode Island
GC Laboratory Supervisor

1993-1996 — **Rubezhnoye Chemical Co.**
Ukraine
Senior Chemist

1984-1993 — **Rubezhnoye Chemical Co.**
Ukraine
Chemist

1981-1984 — **Rubezhnoye Chemical Co.**
Ukraine
Laboratory Technician

EVAN PHILO

Metals And Wet Chemistry Supervisor

Evan Philo has had two years experience as a metals supervisor. He has had over three years experience working in the metals laboratory. Mr. Philo is responsible for the daily overseeing of the calibration, maintenance, troubleshooting and monitoring of the analytical instruments. He manages the analysis of samples, the review of the sample analysis and Quality Control Data. The daily sample preparation schedule is also one of his responsibilities. Mr. Philo also performs and delegates the implementing and writing of new Standard Operating Procedures. He ensures that the information obtained is coordinated with the other laboratory sections.

EDUCATION

Cornell University
Ithaca, New York
Major-Biology, BS

RELATED EXPERIENCE

2000- Present

Mitkem Corporation
Warwick, Rhode Island
Chemist
Metals and Wet Chemistry Supervisor

2000

United States Census Bureau
Boston, MA
Census Enumerator

1998-1999

Albert R. Mann Library
Ithica, New York
Computer Laboratory Service Operator

1997

Cornell University
Laboratory of Ornithology
Ithica, New York
Data Assistant

JOHN DAVIS

Receiving Supervisor

John Davis's responsibilities include the receipt, handling, documentation and log-in of incoming samples. In this role, he receives samples from clients, couriers and commercial carriers, documents the condition of samples upon arrival, checks for proper preservation, compares sample identifications on containers, sample tags and chain of custody forms and notes any discrepancies, assigns internal sample numbers and insures the proper laboratory sample labels are attached to sample bottles. Following the receipt process he insures that samples are logged-in to Mikem's internal tracking computer system and properly stored awaiting analysis. He is also responsible for maintenance of internal chain of custody documentation and identifying samples eligible for final disposal. Additionally, he oversees the hazardous waste disposal and pickups for the company.

Mr. Davis maintains ongoing communication with CLP Project Managers and laboratory staff involving any problems or other issues in sample receipt and analysis assignment. He also holds the part-time position of courier at Mitkem Corporation in which he is responsible for sample pick-up and delivery services throughout the New England Region. Particular emphasis is placed on the maintenance of legal chain of custody and exceptional customer service.

RELATED EXPERIENCE

2004 — **Mitkem Corporation**
Warwick, Rhode Island
Receiving Supervisor

2001- 2003 — **Mitkem Corporation**
Warwick, Rhode Island
Sample Custodian
Courier

TIMOTHY M. SHEEHAN

Organic Preparation Laboratory Supervisor

As a newly-appointed supervisor Mr. Sheehan is responsible for the daily workflow management and supervision of the organic sample preparation laboratory. In this role he evaluates incoming sample analysis requests, schedules sample and QC analyses, reviews data, interfaces with the supervisors of the GC and GC/MS laboratories to insure all technical and schedule requirements are met. He also provides training to laboratory staff, develops and reviews Standard Operating Procedures, implements new methods, performs and evaluates method performance documentation.

Mr. Sheehan is familiar with U.S. EPA and SW846 methodologies and sample extraction and cleanup protocols.

EDUCATION

Johnson & Wales University
Providence, RI
- A.S. Web Site Development
- B. S. Information Science-Networking

RELATED EXPERIENCE

2003 – Present

Mitkem Corporation
Warwick, RI
- Preparation Laboratory Supervisor

2001-2003

Mitkem Corporation
Warwick, RI
- Organic Laboratory Chemist

SCOTT HUNTLEY

LIMS Manager

Mr. Huntley has over 18 years experience in the environmental testing field. He has considerable experience in computer sciences and had been involved, throughout his career, in the setup and implementation of several Laboratory Information Management Systems (LIMS) and automated data reduction systems. Mr. Huntley's responsibilities include the set-up and validation of automated data transfer, reduction, storage, evaluation and reporting programs within Mitkem's LIMS. He also is responsible for set-up of the electronic data delivery capabilities as well as the control charting capabilities of this system.

Previously Mr. Huntley has held several supervisory positions in environmental laboratories focusing on CLP and other DOD analytical programs. He has a wide range of experience in routine and state of the art analytical programs and methods. Mr. Huntley is experienced in the use of automated data transfer and reduction systems and laboratory automation techniques.

EDUCATION:

RHODE ISLAND COLLEGE
Providence, Rhode Island
Chemistry, BS
Computer Science, BS

RELATED EXPERIENCE:

1999-Present

MITKEM CORPORATION
Warwick, RI
- MIS Senior Systems Analyst

1996-1999

MITKEM CORPORATION
Warwick, RI
- Senior Chemist
- Organic Lab Manager

1991-1996

EA LABORATORIES
Sparks, MD
- Supervisor of Organic Chemists

1989-1991

CEIMIC CORPORATION
Narragansett, RI
- Night shift supervisor

1986-1989

RI ANALYTICAL LABORATORIES
Providence, RI
- GC Chemist

LEONARD A. RANALLI

Chief Financial Officer

Mr. Ranalli has an extensive financial and business background. He brings to the Mitkem Corporation 18 years of banking experience. His expertise is in operations and financial management.

EDUCATION:

BROWN UNIVERSITY
Providence, Rhode Island
Sociology, BA

RELATED EXPERIENCE:

1994-Present

MITKEM CORPORATION
Warwick, Rhode Island
- Chief Financial Officer

1992-1994

OLD STONE BANK
Providence, Rhode Island
- Assistant Vice President/
Commercial Real Estate Officer

1990-1992

EASTLAND BANK
Woonsocket, Rhode Island
- Assistant Vice President/
Commercial Loan Officer

1981-1990

RHODE ISLAND HOSPITAL TRUST NATIONAL BANK
Providence, Rhode Island
- Loan Officer
- Credit Analyst
- Operations Manager, Wire Transfer Department
- Operations Manager, Purchasing Department

BENJAMIN F. DODGE

Marketing Director

Mr. Dodge oversees day-to-day program management of in-house projects and serves as technical liaison to clients. In this role Mr. Dodge is responsible for defining project scope through discussion with the client, determination of proper analytical methodology, development of price quotations, discussion of technical and schedule issues with laboratory personnel, reviewing client requests on chain of custody and sample transmittal documentation, resolution of any problems in sample delivery or documentation, review of project log-in information, monitoring project status and communication of status information to the client, discussion of results and communication of questions or technical interpretation with the client, and follow-up on completed projects.

Mr. Dodge has managed a wide variety of analytical services projects at Mitkem, including site investigation, remedial support, long-term landfill monitoring, industrial wastewater and hazardous waste programs. A number of these programs have involved the production of EPA Contract Laboratory Program (CLP) data deliverables, or New York State Analytical Services Protocol (ASP) deliverables and methodology. Significant portions of the programs managed by Mr. Dodge have involved rapid turnaround analytical services, requiring a high level of program management.

EDUCATION

EASTERN CONNECTICUT COLLEGE
Willimantic, Connecticut
Environmental Science, BS

RELATED WORK EXPERIENCE

1996-Present

MITKEM CORPORATION
Warwick, Rhode Island
- Marketing Director
- Project Coordinator
- Sample Custodian

6.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, REPRESENTATION, COMPLETENESS AND COMPARABILITY AND QA REPORTING

As part of the evaluation component of the overall QA Program, laboratory results are compared with the data quality indicators defined as follows:

- Precision: the agreement of reproducibility among individual measurements of the same property usually made under identical conditions.
- Accuracy: the degree of agreement of a measurement with the true or accepted value.
- Representation: the degree to which data accurately and precisely represent a characteristic of a population, parameter variations of a sample of a finite process condition, or of a finite environmental condition.
- Completeness: a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions.
- Comparability: an expression of the confidence with which one laboratory data set can be compared with another laboratory data set in regard to the same property and laboratory sample population.

Quality Assurance objectives may vary by project and requested parameters. The accuracy, precision, and representation of data will be functions of the origins of the sample material, the procedures used to analyze sample and generate data, and the specific sample matrices involved in each project. Quality control practices utilized in the evaluation of these data quality indicators include blanks, replicates, spikes, standards, check samples, calibrations and surrogates. The process for quantifying or assessing the above indicators for data quality is addressed in Section 15.

6.1 Precision and Accuracy:

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

- Published historical data;
- Method validation studies;
- MITKEM experience with similar samples and/or;
- Project-specific requirements, such as those stipulated by the USEPA in the CLP protocols and control documents.

6.2 Representation:

Analytical data should represent the sample analyzed regardless of the heterogeneity of the original sample matrix. In most cases, representation is achieved by mixing the laboratory sample well before removing a portion for analysis. On occasion, multi-phase laboratory samples may require that each phase be analyzed individually and reported in relation to its proportion in the whole sample.

6.3 Completeness:

The completeness goal is 100% in all cases and includes:

- Analysis of all samples;
- Generation and analysis of all required QC samples;
- Sufficient documentation of associated calibration, tuning and standardization;
- Records of data reduction processes, including manual calculations.

While the laboratory staff is responsible for achieving the completeness objective stated above, assigning each project a specific project manager whose functions include sample management and tracking ensures completeness.

6.4 Comparability:

To assure comparability, MITKEM employs established and approved analytical methods (e.g. USEPA protocols), consistent analytical bases (dry weight, volume, etc.) and consistent reporting units (mg/Kg, µg/L, etc.). Where data from different samples must be comparable, the same sample preparation and analysis protocols are used for all of the samples of interest.

6.5 QA Reporting

General QA procedures require that an MS/MSD or DUPLICATE/MS be reported with each sample batch up to 20 samples. In addition, each batch requires a method blank (MB) and laboratory control sample (LCS).

An acceptance criterion for the MB depends upon the method criteria. In-house control limits dictate the acceptability of the LCS. A high bias LCS is considered acceptable if the analyte is not present in the samples above the reporting limit. A low bias LCS will require re-extraction (if sample volume allows) and re-analysis.

DUP, MS, and MSD recoveries and calculated RSD's are specified in the methods of analyses. Recoveries outside the limits require some form of corrective action, whether that includes a post-digestion/distillation/extraction

spike, re-extraction, re-analysis and/or notification to the client in the project narrative.

Omega LIMS will flag any QA samples outside method criteria on the reporting forms. Formal written corrective action reports are required for any incident that does not meet method criteria and cannot be remedied at the laboratory. The QA Officer signs off on any corrective actions and can also track QA trends in this manner.

7.0 SAMPLING PROCEDURES

For most projects, outside sampling teams deliver or send samples to the MITKEM laboratory. When sampling by MITKEM personnel is required, the sampling team follows the sampling procedures outlined in the EPA/SOW *Test Methods for Evaluating Solid Wastes*, SW-846, 3rd Edition, or procedures found in the EPA "Handbook for Sampling and Sample Preservation of Water and Wastewater".

Appropriately prepared sample containers are supplied by MITKEM at clients' request. When required, preservatives are added to the sample containers. Tables 7-1 through 7-3 provide the MITKEM Recommended Container, Preservation Techniques and Holding Times. Additional sample volumes may be required if additional QC functions are to be performed.

Holding times for SW846, CLP Methods, Standard Methods and certain USEPA methods are different and are presented in Tables 7-1 to 7-3. Holding times for most methods are calculated from the date of sample collection. Holding times for CLP methods are calculated from the Validated Time of Sample Receipt (VTSR). It should be noted that the CLP analysis program combines chemical analyses and contract compliance procedures in one document. For laboratory analysis and contract compliance purposes, holding times are calculated from VTSR, while post-analysis data usability and validation (generally performed by the client or a third party) compares holding times to the SW-846 method holding times calculated from date of sample collection.

Representative portions of samples are taken for analysis by following Mitkem SOP 110.0039, Standard Operating Procedure for Sub-Sampling.

Table 7-1
Recommended Container, Preservation Techniques and Holding Times for SW-846 Analyses

Analytes	Method	Containers	Required* Volume	Preservation	Holding Times
Volatile Organics					
Solid	8260B, 5030B	Amber glass jar with Teflon lining	Minimal head-space in jar	4°C	14 days
Solid [a]	8260B, 5035	40mL vial or Encore with Teflon lining	5.0gram ± 0.5	4°C, unpreserved	48 hours
				DI Water -10 to - 20°C	14 days
				Sodium bisulfate -10 to –20°C, 4°C	14 days
				Methanol 4°C	14days
Aqueous	8260B, 5030B	40mL VOA Vials with Teflon septum	40mL	4°C HCl, pH<2	14 days
Semivolatile Organics					
Solid	3540C, 3550B 8270C	Amber glass jar with Teflon lining	30gram	4°C	Extraction within 14 days Analysis within 40 days
Aqueous	3510C, 3520C 8270C	Amber glass bottles with Teflon lining	1L	4°C	Extraction within 7 days Analysis within 40 days
Polychlorinated Biphenyls					
Solid	3540C, 3550B 8082	Amber glass jar with Teflon lining	30gram	4°C	Extraction within 14 days Analysis within 40 days
Aqueous	3510C, 3520C 8082	Amber glass bottle with Teflon lining	1L	4°C	Extraction within 7 days Analysis within 40 days
Organochlorine Pesticides					
Solid	3540C, 3550B 8081A	Amber glass jar with Teflon lining	30gram	4°C	Extraction within 14 days Analysis within 40 days
Aqueous	3510C, 3520C 8081A	Amber glass bottle with Teflon lining	1L	4°C	Extraction within 7 days Analysis within 40 days
Chlorinated Herbicides					
Solid	8151A 8151A	Amber glass jar with Teflon lining	30gram	4°C	Extraction within 14 days Analysis within 40 days
Aqueous	8151A 8151A	Amber glass bottle with Teflon lining	1L	4°C	Extraction within 7 days Analysis within 40 days

Table 7-1 (cont'd)

Recommended Containers, Preservation Techniques and Holding Times
for
SW846 Analyses

Analytes	Method	Containers	Required* Volume	Preservation	Holding Times
Total Petroleum Hydrocarbons					
Gasoline Range Organics					
Solid	8015M, 5030B	Amber glass jar With Teflon lining	Minimal head-space in jar	4°C	14 days
Solid [a]	8015M, 5035	40mL vial or Encore with Teflon lining	5.0gram ± 0.5	4°C, unpreserved	48 hours
				DI Water -10 to -20^0C	14 days
				Sodium bisulfate -10 to -20^0C, 4^0C	14 days
				Methanol 4^0C	14days
Aqueous	8015M, 5030B	40mL VOA vials With Teflon septum	40mL	4°C HCl, pH<2	14 days
Diesel Range Organics					
Solid	3540C, 3550B 8015M	Amber glass jar with Teflon lining	30gram	4°C	Extraction within 14 days Analysis within 40 days
Aqueous	3510C, 3520C 8015M	Amber glass bottle with Teflon lining	1L	4°C H_2SO_4, pH<2	Extraction within 7 days Analysis within 40 days
Total Metals except Mercury and Chromium (VI)					
Solid	3050B 6010B	Amber glass jar with Teflon lining	10g	4°C	180 days
Aqueous	3005A, 3010A	Polyethylene bottle	100mL	HNO_3, pH<2	180 days
Chromium (VI)					
Solid	7196A	Amber glass jar with Teflon lining	10g	4°C	Digestion within 30 days Analysis within 96 hours
Aqueous	7196A	Polyethylene bottle	25mL	4°C	24 hours
Mercury					
Solid	7471A	Amber glass jar	10g	4°C	28 days
Aqueous	7470A	Polyethylene bottle	100mL	4°C HNO_3, pH<2	28 days

Cyanide						
	Solid	9012	Amber glass jar with Teflon lining	10g	4°C	14 days
	Aqueous	9012	Polyethylene bottle	50mL	4°C NaOH, pH≥12	14 days
Flashpoint						
	Aqueous	1010	Amber glass bottle	30mL	4°C	28 days

Table 7-2

Recommended Container, Preservation Techniques and Holding Times
For
CLP/ASP Analyses

Analytes	Method	Containers	Required* Volume	Preservation	Holding Times
Volatile Organics					
Solid	CLP/ASP	Amber glass jar with Teflon lining	Minimal head-space in jar	4°C	10 days from VTSR
Aqueous	CLP/ASP	40mL VOA vials with Teflon septum	40mL	4°C HCl, pH<2	10 days from VTSR
	CLP Low	40mL VOA vials with Teflon septum	40mL	4°C HCl, pH<2	10 days from VTSR
Semivolatile Organics					
Solid	CLP/ASP	Amber glass jar with Teflon lining	30gram	4°C	10 days from VTSR Analysis within 40 days
Aqueous	CLP/ASP	Amber glass bottle with Teflon lining	1L	4°C	5 days from VTSR Analysis within 40 days
	CLP Low	Amber glass bottle with Teflon lining	1L	4°C	5 days from VTSR Analysis within 40 days
Organochlorine Pesticide/PCB					
Solid	CLP/ASP	Amber glass jar with Teflon lining	30gram	4°C	10 days from VTSR Analysis with 40 days
Aqueous	CLP/ASP	Amber glass bottle with Teflon lining	1L	4°C	5 days from VTSR Analysis within 40 days
	CLP Low	Amber glass bottle with Teflon lining	1L	4°C	5 days from VTSR Analysis within 40 days
Cyanide					
Solid	CLP/ASP	Amber glass jar	10gram	4°C	12 days from VTSR
Aqueous	CLP/ASP	Polyethylene bottle	50mL	4°C NaOH, pH>12	12 days from VTSR
Total Metals except Mercury					
Solid	CLP/ASP	Amber glass jar	10gram	4°C	180 days from VTSR
Aqueous	CLP/ASP	Polyethylene bottle	100mL	HNO_3, pH<2	180 days from VTSR

Table 7-2 (con't)

Recommended Container, Preservation Techniques and Holding Times
For
CLP/ASP Analyses

Analytes	Method	Containers	Required* Volume	Preservation	Holding Times
Mercury					
Solid	CLP/ASP	Amber glass jar	10gram	4°C	26 days from VTSR
Aqueous	CLP/ASP	Polyethylene bottle	100mL	4°C HNO_3, pH<2	26 days from VTSR

Table 7-3

Recommended Containers, Preservation Techniques and Holding Times
for
Other Analyses

Analytes	Method	Containers	Required* Volume	Preservation	Holding Times
Volatile Organics					
Aqueous	624	40mL VOA vials with Teflon septum	40mL	4°C HCl, pH<2	14 days
	524.2	40mL VOA vials with Teflon lining	40mL	4°C HCl, pH<2	14 days
Semivolatile Organics					
Aqueous	3510C, 3520C 625	Amber glass bottle with Teflon lining	1L	4°C	Extraction within 7 days Analysis within 40 days
Organochlorine Pesticide/PCB					
Aqueous	3510C, 3520C 608	Amber glass bottle with Teflon lining	1L	4°C	Extraction within 7 days Analysis within 40 days
EDB/DBCP					
Aqueous	504.1	40mL VOA vials with Teflon septum	35mL	4°C HCl, pH<2	28 days
MA Extractable Petroleum Hydrocarbons (EPH)					
Solid	3540C, 3550B MADEP	Amber glass jar with Teflon lining	30gram	4°C	Extraction within 7 days Analysis within 40 days
Aqueous	3510C, 3520C MADEP	Amber glass bottle with Teflon lining	1L	4°C HCl, pH<2	Extraction within 14 days Analysis withing 40 days
MA Volatile Petroleum Hydrocarbons (VPH)					
Solid	MADEP	Amber glass jar with Teflon lining	30gram	4°C 15mL Methanol	14 days
Aqueous	MADEP	40mL VOA vial with Teflon lining	40mL	4°C HCl, pH<2	14 days
Oil & Grease					
Aqueous	1664	Amber glass bottle with Teflon lining	1L	4°C HCl, pH<2	28 days
Alkalinity					
Aqueous	SM2320	Polyethylene bottle	100mL	4°C	14 days
Ammonia					
Aqueous	SM4500NH3B	Polyethylene bottle	100mL	4°C H_2SO_4, pH<2	28 days
Chloride					
Aqueous	EPA 325.2	Polyethylene bottle	100mL	4°C	28 days

Table 7-3 (cont'd)

Recommended Containers, Preservation Techniques and Holding Times for Other Analyses

Analytes	Method	Containers	Required Volume	Preservation	Holding Times
Chloride	E300.0	Polyethylene bottle	50mL	4°C	28 days
COD					
Aqueous	SM5220D	Amber VOA vial	40mL	4°C H2SO4, pH<2	28 days
Color					
Aqueous	E110.2Modified	Polyethylene bottle	50mL	4°C	Immediate
Nitrate/Nitrite					
Aqueous	E353.2	Polyethylene bottle	50mL	4°C H_2SO_4, pH<2	28 days
Nitrate/Nitrite					
Aqueous	E300.0	Polyethylene bottle	50mL	4°C	48 hours
Nitrite					
Aqueous	SM4500NO2B E300.0	Polyethylene bottle	50mL	4C	48 hours
Orthophosphate					
Aqueous	SM4500-P, E E300.0	Polyethylene bottle	50mL	4°C	48 hours
Total phosphate					
Aqueous	SM4500-P B,E	Polyethylene bottle	50mL 50mL	4°C H_2SO_4, pH<2	28 days
Phenols					
Aqueous	SM5530B E420.1	Polyethylene bottle	250mL	4°C H_2SO_4, pH<2	28 days
Sulfates					
Aqueous	SM4500SO4 E E300.0	Polyethylene bottle	50mL	4°C	28 days
Sulfide Total					
Aqueous	SM4500-S D	Polyethylene bottle	50mL	4°C NaOH, pH>12 ZnAc	28 days
Reactivity					
Solid	Chapter 7 SW846	Amber glass jar	10gram	4°C	28 days
Aqueous		Polyethylene bottle	250mL	4°C	28 days
Total Organic Carbon (TOC)					
Solid	Lloyd Kahn	Amber glass jar	10g	4°C	14 days

Table 7-3 (cont'd)

Recommended Containers, Preservation Techniques and Holding Times
For
Other Analyses

Analytes	Method	Containers	Required* Volume	Preservation	Holding Times
Total Organic Carbon					
Aqueous	E415.1	40mL VOA vials	40mL	4°C HCl, pH<2	28 days
TKN					
Aqueous	SM4500Norg C	Polyethylene bottle or Amber glass bottle	50mL	4°C H_2SO_4, pH<2	28 days
Total Solids (TS)					
Aqueous	SM2540B	Polyethylene bottle	200mL	4°C	7 days
Total Dissolved Solids (TDS)					
Aqueous	SM2540C	Polyethylene bottle	200mL	4°C	7 days
Total Suspended Solids (TSS)					
Aqueous	SM2540D	Polyethylene bottle	200mL	4°C	7 days
Settleable Solids					
Aqueous	SM2540F	Polyethylene bottle	200mL	4°C	48 hours

* These represent minimum required volume. Additional sample volumes should be collected to minimize headspace loss for volatile analysis. Additional sample aliquot are also required to perform QA/QC functions (e.g. spikes, duplicates), % moisture for solid samples and sample re-analysis (if needed).

[a] For Massachusetts analyses, the volatile soil samples are to be preserved in methanol in the field.

8.0 SAMPLE CUSTODY

8.1 Chain of Custody:

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

A sample is considered to be in the custody under the following conditions:

- It is in an authorized person's actual possession, or
- It is in an authorized person's view, after being in that person's physical possession, or
- It was in an authorized person's possession and then was locked or sealed to prevent tampering, or
- It is in a secure area.

Chain-of-custody originates as samples are collected. Chain-of-custody documentation accompanies the samples as they are moved from the field to the laboratory with shipping information and appropriate signatures indicating custody changes along the way.

Laboratory chain-of-custody is initiated as samples are received and signed for by the Sample Custodian or by a Sample Receiving Assistant at MITKEM. Documentation of sample location continues as samples are signed in and out of the central storage facility for analysis in the several MITKEM departments using the Sample Tracking Forms (Fig 8.4-1). After analysis, any remaining sample is held in the central storage area to await disposal. Mitkem's policy is to hold spent samples for a period of at least thirty days from submittal of final report, unless other arrangements are agreed upon with the client.

8.2 Laboratory Security:

Samples at MITKEM are kept within the secure areas during all stages of residence, including the periods of time spent in preparation for analysis, while undergoing analysis and while in storage.

The entire laboratory is designated as a secure area. The doors to these areas are under continuous surveillance or are kept locked after regular business hours and may only be accessed by key. Only authorized personnel are allowed to enter the secure areas. A MITKEM staff member must accompany visitors to the laboratory.

8.3 Duties and Responsibilities of Sample Custodian:

Duties and responsibilities of the Sample Custodian include but are not limited to:

8.3.1 Receiving samples.

8.3.2 Inspecting and documenting sample shipping containers for presence/absence and condition of:

8.3.2.1 Custody seals, locks, "evidence tape", etc.;

8.3.2.2 Container breakage and/or container integrity to include air space in samples for Volatiles analysis.

8.3.3 Recording condition of both shipping containers and sample containers (cooler temperature, bottles, jars, cans, etc.).

8.3.4 Signing Documents shipped with samples (i.e. air bills, chain-of-custody record(s), Sample Management Office (SMO) Traffic Reports, etc.)

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

8.3.6 Initiating the paper work for sample analyses on laboratory documents (including establishing sample workorder files) as required for analysis or according to laboratory standard operating procedures.

8.3.7 Label samples with laboratory sample identification numbers and cross-referencing laboratory numbers to client numbers and sample tag numbers.

8.3.8 Placing samples and spent samples into appropriate storage and/or secure areas.

8.3.9 Where applicable, making sure that sample tags are removed from the sample containers and included in the workorder file.

8.3.10 Where applicable, accounting for missing tags in a memo to the file or documenting that the sample tags are actually labels attached to sample containers or were disposed of, due to suspected contamination.

8.3.11 Monitoring storage conditions for proper sample preservation such as refrigeration temperature and prevention of cross-contamination.

8.3.12 Sending shipping containers prepared sample bottles and sample instructions to clients who request them.

8.3.13 Recording temperatures of freezers and refrigerators in the laboratories.

8.4 Sample Receipt:

The Sample Custodian or his/her designated representative receives sample shipments at MITKEM. Unless the shipment is a continuation of a previous workorder, a new workorder file is started for the sample. The information is logged into the Sample Receipt Logbook (Figure 8.4-1).

The cooler is inspected for the following (if applicable) and documented on the Sample Login Form (Figure 8.4-2) for USEPA CLP samples and on the Sample Condition Form (Figure 8.4-3) for the other samples:

- Custody seal (conditions and custody number)
- Air bill (courier and air bill #)

The cooler is then opened and the following checked (in order). Make sure the hood is turned on when the cooler is opened.

- Chain of custody records (or traffic report). These are usually taped to the inside of the cover.
- Radioactivity using the Geiger counter.
- Cooler temperature using the temperature gun. Record the temperature of a temperature blank if available with a calibrated thermometer. Record each temperature on the COC. For EPA samples, record which temperature is actually included with the appropriate paperwork.

The Sample Custodian will perform the following:

- Remove the sample containers and arrange them in the same order as documented in the chain of custody report.
- Inspect condition of the sample containers.
- Assign laboratory sample ID and cross-reference the laboratory ID to the client ID.
- Remove tags and place in the workorder file.
- Check preservative and document in the Sample Condition Form (Figure 8.4-3) if needed. If additional preservative is needed, it is added at this time.
- Check for air bubbles in aqueous samples and for proper preservation for soil samples designated for volatile organic analysis.

- Ensure peer review occurs for proper cross-referencing and labeling of sample containers.

Any discrepancies or problems are noted in the Sample Condition Notification Form (Figure 8.4-4).

Depending on the workorder, the sample custodian may directly inform the client of the discrepancies or conveys the information to the project manager who will in turn inform the client.

Samples can be rejected at Mitkem for any of the following reasons:

1. Complete and proper documentation was not sent with the samples.
2. Sample labels cannot be identified because indelible ink was not used during the sampling procedure.
3. Hold times had already been exceeded when samples arrived at the laboratory.
4. Inadequate sample volume.
5. Potential cross-contamination has occurred among samples.
6. Samples are inadequately preserved.
7. The samples or shipping container is badly destroyed during shipping.
8. The samples are potentially radioactive.
9. The samples represent untreated fecal waste for which Mitkem employees are currently not inoculated against.

In all instances, the client is contacted initially before any action is taken at Mitkem.

The Sample Custodian signs the Sample Receipt Form and originates a file for the set of samples. The following forms are included in the file: the Sample Receipt Form, chain of custody records, shipping information, and an orange Sample Condition Notification Form if any problems or discrepancies need to be addressed.

When the Sample Custodian is not available to receive samples another MITKEM staff member signs for the sample container. The time, date and name of the person receiving the container are recorded on the custody records. In addition, the cooler temperature and radiation count are measured and recorded on the Sample Condition Form. The samples are then stored in the centralized walk-in refrigerator in the sample receipt area. The sample receipt area is located in the secure area of the laboratory. For EPA samples, VOA samples are immediately removed from the cooler and stored in the VOA analysis laboratory. The samples are officially received and documented by the Sample Custodian or designee before the next business day.

At times, samples will be sent to another lab for analysis not performed at MITKEM. These subcontracted analyses are performed by laboratories certified to perform the analyses. Mitkem, to the best of its ability, monitors the performance of these outside laboratories to ensure that any analyses occurring off-site is method compliant.

These samples are placed in bubble bags to prevent breakage and stored in a cooler in the walk-in or stored in the small refrigerator in Sample Receiving. The samples are either hand delivered to a local sub-contract lab or sent by air courier with MITKEM's chain-of-custody (Figure 8.4-5).

8.5 Sample Log-in Identification:

8.5.1 Sample Identification;

To maintain sample identity, each sample received at MITKEM is assigned a unique sample identification (Sample ID) number. Samples are logged into MITKEM via the Omega Laboratory Information Management System (LIMS).

After inspecting the samples, the Sample Custodian logs each sample into the Omega LIMS, which assigns a MITKEM Sample ID Number. These Numbers are assigned sequentially in chronological order. MITKEM Sample Identification Numbers appear in the following format: YXXXX-NNF

In which: Y – represents the current year with A for 2002, B for 2003, C for 2004, etc.

XXXX – represents a four-digit work order number that is assigned sequentially to each submittal of samples

NN – represents the sample number within the group or workorder.

F – represents the fraction. All sample portions that are received in identical bottles with identical preservatives are grouped into one fraction.

For example, the first fraction of the fifth sample of the 20th workorder of 2003 would have the number: B0020-05A

The MITKEM Sample ID Numbers are recorded on the Sample Login Form (Figure 8.4-2) for USEPA CLP samples and on the Sample Condition Form (Figure 8.4-3) for the other samples. Information on these forms cross-reference the Sample ID Numbers with SDG numbers, sample tag numbers and/or other client identifiers. Each sample is clearly labeled with its MITKEM Sample ID Number by the Sample Custodian.

The same sample ID Number appears on the LIMS status report, on each sample preparation container and extract vial associated with the sample.

8.5.1.1 Sample Extract Identification:

As described in Section 8.5.1, a sample extract is identified with the same unique sample identification number as the sample from which it derives. In addition, it bears one of the following prefixes:

For Organic Analyses:

S for Semivolatile Organics
F for TPH
EPH for Extractable Petroleum Hydrocarbons
O&G for Oil and Grease
H for Herbicides
P for Pesticides
B for PCBs
P is also used for CLP analysis when Pesticide and PCB are analyzed as a single analysis.

No differentiation is necessary for most inorganic analyses.

8.5.2 Sample Login:

Sample login system at MITKEM consists of computerized entry using Omega LIMS (Figure 8.5-1). The information recorded onto the Workorder Report includes:

- Workorder number
- Client name
- Final data report format
- Date of receipt
- Date sample collected
- Due date, fax and/or hardcopy
- Comments or notes on the workorder
- MITKEM Sample Identification numbers
- Client Sample Identification numbers
- Sample matrix
- Analyses required
- Case number, where used by the client
- SDG number, where used by the client

8.5.3 Sample Information:

After sample information is properly recorded (Sample Receipt Logbook, Sample Receipt Forms) and the samples have been properly logged into the LIMS, bottle labels are generated and applied to the sample containers. The Sample Custodian notifies the Project Manager or peer or supervisor to review the sample bottle labeling. This person reviews all the information associated with the samples. He/she verifies (by initialing) the correctness of the information on the Sample Condition Form or Sample Log-In Form. Sample login information is available through the Omega LIMS to all appropriate laboratory staff.

The Sample Custodian initiates a red workorder file. This file contains the original Sample Log-In Form or Sample Condition Form, air bills, SMO traffic reports, sample tags, workorder reports and all correspondence with the Client or SMO or others. The red workorder file is forwarded to the Project Manager for review of the login paperwork, and updating status of the workorder to Login Review in the LIMS. Once the login information is thoroughly reviewed for correctness, the red workorder file is stored in the data reporting area. Analysis data are placed in this as analyses are completed and data are reviewed.

8.6 Sample Storage and Disposal:

Samples at MITKEM are stored in a central storage facility. After sample receipt and login procedures are completed, the Sample Custodian places the samples in the centralized walk-in refrigerator. Volatile Organic sample aliquots are released to the volatile organic lab with documentation (Figure 8.6-1).

The sample storage area is for samples only; no standards or reagents are to be stored there. Access to the centralized sample storage area is locked at all times.

All sample/extract refrigerators are maintained at 4°C ± 2°C. Standards are kept in freezers maintained at -10 to -20°C. Temperatures are recorded every working day in the Temperature Log (Figure 8.6-2). .

When analysis is complete, any remaining sample is retained in the central storage area until it may be removed for disposal (see SOP 30.0024 for Sample Disposal). Broken and damaged samples are promptly disposed in a safe manner. Unless there is a specific request by the client, excess, unused sample aliquots are stored for at least 30 days after the submission of compliant data. The samples are then disposed after such period. USEPA and NYS ASP extracts are stored under refrigeration for at least one year. Other extracts are stored under refrigeration for up to three months, unless there is a specific agreement with the client. After such time, the extracts are disposed. All disposals are documented in a manner compliant with federal and state regulations.

8.6.1 Extract Transfer:

The extracts generated during the preparation for the organic analyses are transferred from the Organic Prep Lab to the Analysis Labs. The extracts, for Semivolatiles, TPH, Pesticides and PCBs, are checked in the Analysis Lab by entries in the appropriate Extract Transfer Logbook (Figures 8.6-3 and 8.6-4).

Metals analysis samples that are transferred from the prep area to the analysis room are signed for by the metals analyst. This entry occurs in the Metals Preparation Logbooks at the time of the transfer.

There is no extract transfer that occurs with either Wet Chemistry or VOA samples.

8.6.2 Extract Storage:

Semivolatile, Pesticide/PCB, and TPH extracts, which are contained in crimp top vials or screw cap vials with Teflon lined septa, are stored at 4°C ± 2°C. Semivolatile and Pesticide/PCB extracts are stored in refrigerators in the Organic Analysis room. They are catalogued numerically by workorder number that approximates chronological order, according to date of receipt. USEPA CLP extracts are stored separately within the refrigerator from sample extracts of other clients.

Excess Pesticide extracts, not analyzed, are stored in screw cap vials with Teflon lined septa in the Organic Prep Lab. In most instances, they consist of the remaining 8.5mL portions of aqueous and soil sample extracts and are chronologically ordered.

8.7 Sample Tracking:

When a sample is removed from storage, the analyst who has custody signs the Sample Receipt Log. This information indicates the location of the sample at any point in time.

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

1. The chain-of-custody form from the field describes the origin and transportation of a sample;
2. The laboratory Sample Receipt Log and supporting login records document acceptance of a sample by the Mitkem laboratory; and

3. The MITKEM Sample Receipt Logbook documents which analyst has custody of the sample after removal from storage.

Figure 8.4-1
Sample Receipt Tracking Logbook Form

Sample Receiving Logbook

Workorder No. ____________________ **Disposal Date:** ______________________

Client Name: ____________________________________ **Date Disposed:** _____________________

Date Recv'd ____________ **Sample #s** ________________________ **Storage Locations:** ________________________

Date Recv'd ____________ **Sample #s** ________________________ **Storage Locations:** ________________________

Date Recv'd ____________ **Sample #s** ________________________ **Storage Locations:** ________________________

Date Recv'd ____________ **Sample #s** ________________________ **Storage Locations:** ________________________

Date Recv'd ____________ **Sample #s** ________________________ **Storage Locations:** ________________________

Date Recv'd ____________ **Sample #s** ________________________ **Storage Locations:** ________________________

OUT				IN			
Relinquished By		**Received By**		**Relinquished By**		**Received By**	
Date:	Init:	Date:	Init:	Date:	Init:	Date:	Init:
Samp. #s							
Date:	Init:	Date:	Init:	Date:	Init:	Date:	Init:
Samp. #s							
Date:	Init:	Date:	Init:	Date:	Init:	Date:	Init:
Samp. #s							
Date:	Init:	Date:	Init:	Date:	Init:	Date:	Init:
Samp. #s							
Date:	Init:	Date:	Init:	Date:	Init:	Date:	Init:
Samp. #s							
Date:	Init:	Date:	Init:	Date:	Init:	Date:	Init:
Samp. #s							
Date:	Init:	Date:	Init:	Date:	Init:	Date:	Init:
Samp. #s							
Date:	Init:	Date:	Init:	Date:	Init:	Date:	Init:
Samp. #s							

Comments: ____

____

Please record analyst's initials, date, and sample #s removed. Add any comments if necessary (broken bottles, empty jars, etc.)

Logbook ID: 30.0287-10/04 **Reviewed:** ______________ **Page:**

Figure 8.4-2
USEPA CLP Sample Login Form

SAMPLE LOG-IN SHEET

Lab Name Mitkem Corporation	Page __ of __
Received By (Print Name)	Log-in Date
Received By (Signature)	
Case Number	Sample Delivery Group No. / Client Number

(1) Please see associated sample/extract transfer logbook pages submitted with this data package
Remarks:

		EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc.
1. Custody Seal(s)	Present/Absent* Intact/Broken				
2. Custody Seal Nos.	_____ _____				
3. Chain of Custody Records	Present/Absent*				
4. Traffic Reports or Packing Lists	Present/Absent*				
5. Airbill	Airbill/Sticker Present/Absent*				
6. Airbill No.	_____ _____				
7. Sample Tags	Present/Absent*				
Sample Tag Nos.	Listed/Not Listed on Chain-of-Custody				
8. Sample Condition	Intact/Broken*/ Leaking				
9. Cooler Temperature Indicator Bottle	Present/Absent*				
10. Cooler Temperature	_____				
11. Does information on custody records, traffic reports, and sample tags agree?	Yes/No*				
12. Date Received at Lab	_____				
13. Time Received	_____				

Sample Transfer					
(1) Fraction BNA + Pest/PCB	(1) Fraction VOA				
Area # RL	Area # VOA lab				
By	By				
On	On				

* Contact SMO and attach record of resolution

Reviewed By	Logbook No.
Date	Logbook Page No.

SAMPLE LOG-IN SHEET

Lab Name: Mitkem Corporation	Page __ of __
Received By (Print Name)	Log-in Date
Received By (Signature)	
Case Number	Sample Delivery Group No. / SAS Number

Remarks: (1) Please see associated Sample/extract transfer logbook pages submitted with this data package

		EPA Sample #	Corresponding: Sample Tag #	Corresponding: Assigned Lab #	Remarks: Condition of Sample Shipment, etc.
1. Custody Seal(s)	Present/Absent* Intact/Broken				
2. Custody Seal Nos.	_____				
	_____				
3. Chain of Custody Records	Present/Absent*				
4. Traffic Reports or Packing Lists	Present/Absent*				
5. Airbill	Airbill/Sticker Present/Absent*				
6. Airbill No.	_____				
	_____				
7. Sample Tags	Present/Absent*				
Sample Tag Numbers	Listed/Not Listed on Chain-of-Custody				
8. Sample Condition	Intact/Broken*/ Leaking				
9. Cooler Temperature	_____				
10. Does information on custody records, traffic reports, and sample tags agree?	Yes/No*				
11. Date Received at Lab	_____				
12. Time Received	_____				

Sample Transfer					
Fraction BNA & Pest/PCB (1)	Fraction VOA (1)				
Area # R1	Area # VOA Lab				
By	By				
On	On				

* Contact SMO and attach record of resolution

Reviewed By	Logbook No.
Date	Logbook Page No.

Figure 8.4-3
Sample Condition Form

MITKEM CORPORATION
Sample Condition Form

Page ___ of ___

Received By:	Reviewed By:	Date:	MITKEM Project #:
Client Project:		Client:	

Cooler Sealed Yes / No

1) Custody Seal(s) Present / Absent
Coolers / Bottles
Intact / Broken

2) Custody Seal Number(s) ______________

3) Chain-of-Custody Present / Absent

4) Cooler Temperature ______________
Coolant Condition ______________

5) Airbill(s) Present / Absent
Airbill Number(s) ______________

6) Sample Bottles Intact/Broken/Leakin

7) Date Received ______________

8) Time Received ______________

Preservative Name/Lot No:
____
____
____

Lab Sample ID		Preservation (pH) HNO3	H2SO4	HCl	NaOH	VOA Matrix	Soil Headspace or Air Bubbles ≥ 1/4"

UNCONTROLLED DOCUMENT

VOA Matrix Key:
US = Unpreserved Soil **A** = Air
UA = Unpreserved Aqueo **H** = HCl
M/N = MeOH & $NaHSO_4$ **E** = Encore
N = $NaHSO_4$ **M** = MeOH

See Sample Condition Notification/Corrective Action Form yes / no

Rad OK yes/ no

Form ID: SampleCond.Form-11/04

Figure 8.4-4
Sample Condition Notification Form

Sample Condition Notification

Mitkem Project#:_____ **Date of Receipt:**_____
Client:_____ **Received By:**_____
Client project #/name:_____

Unusual Occurance Description:

_____

_____

_____

_____

_____

_____

Client Contacted:

Contacted via: Phone/Fax/E-mail
Date:_____ **Time:**_____
Contacted By:_____
Name of person contacted:_____

Client Response:

Responded via: Phone/Fax/E-mail
Date:_____
Name of person responding:_____
Responding to:_____

_____

_____

_____

_____

_____

Mitkem Action Taken: _____

_____

_____

_____

_____

Are SOPs method compliant?	Yes / No
Do analysts follow the SOP?	Yes / No
Do analysts do an initial demonstration of proficiency study?	Yes / No
Are analysts adequately trained and knowledgeable?	Yes / No
Is ICAL documentation maintained on file in the lab?	Yes / No
When %RSD > 15%, is the average adopted?	Yes / No
Is a CCV run at the end of the analytical sequence? (USACE)	Yes / No
Is a Method Blank analyzed after each CCV?	Yes / No
Is DDT breakdown and tailing factors for benzidine and pentachlorophenol evaluated for acceptability?	Yes / No
Does analyst review data for false negatives?	Yes / No

Corrective Actions

Is there a system for corrective actions in place?	Yes / No

Safety

Are all reagents handled under a hood?	Yes / No
Are all safety equipment used?	Yes / No

VIII. Pesticides/PCBs:

Logbooks

Does a run logbook exist for each analytical instrument?	Yes / No
Does an instrument maintenance log exist for each instrument?	Yes / No
Are logbooks peer reviewed weekly?	Yes / No
Proper correction techniques?	Yes / No
Empty spaces "z"'d out?	Yes / No
Paginated?	Yes / No
Controlled?	Yes / No
Do logbooks contain all pertinent information to the procedure? (I.e., method, matrix, reagent lot #, etc.)	Yes / No

Standards

Are standards QC'd against a second source after each ICAL?	Yes / No
Are standards traceable throughout the lab?	Yes / No
Are expired standards present in the lab?	Yes / No
Is there a defined system for assigning expiration dates?	Yes / No
Is standard freezer temperature monitored?	Yes / No

Analytical Methods

Are SOPs method compliant?	Yes / No
Do analysts follow the SOP?	Yes / No

Do analysts do an initial demonstration of proficiency study?	Yes / No
Are analysts adequately trained and knowledgeable?	Yes / No
Is ICAL documentation maintained on file in the lab?	Yes / No
When %RSD > 15%, is the average adopted?	Yes / No
Is a CCV run after every 10 samples? (USACE)	Yes / No
Is a Method Blank analyzed after each CCV?	Yes / No
Is DDT & Endrin breakdown monitored for PCB only analyses?	Yes / No
Are QC samples run on same instrument as field samples?	Yes / No
Are retention time studies performed after each column change?	Yes / No
Is target analyte %D between primary and confirmation <40%?	Yes / No

Corrective Actions

Is there a system for corrective actions in place?	Yes / No

Safety

Are all reagents handled under a hood?	Yes / No
Are all safety equipment used?	Yes / No

IX. Organic Preparation:

Logbooks

Does a preparation logbook exist?	Yes / No
Does a run logbook exist for each instrument?	Yes / No
Does an instrument maintenance log exist for each instrument?	Yes / No
Are logbooks peer reviewed weekly?	Yes / No
Proper correction techniques?	Yes / No
Empty spaces "z"'d out?	Yes / No
Paginated?	Yes / No
Controlled?	Yes / No
Do logbooks contain all pertinent information to the procedure? (I.e., method, matrix, reagent lot #, pH, % solids, etc.)	Yes / No

Standards

Are standards QC'd against a second source after each ICAL?	Yes / No
Are standards traceable throughout the lab?	Yes / No
Are expired standards present in the lab?	Yes / No
Is there a defined system for assigning expiration dates?	Yes / No
Is standard freezer temperature monitored?	Yes / No
Are solvents traceable through preparation?	Yes / No
Are personnel aware of syringe tolerances?	Yes / No

Analytical Methods

Are SOPs method compliant?	Yes / No
Do analysts follow the SOP?	Yes / No
Do analysts do an initial demonstration of proficiency study?	Yes / No
Are analysts adequately trained and knowledgeable?	Yes / No
Is ICAL documentation maintained on file in the lab?	Yes / No
Are temperatures of water baths and hot plates monitored?	Yes / No
Is deionized, charcoal -filtered water used for Pest/PCB blanks?	Yes / No

Corrective Actions

Is there a system for corrective actions in place?	Yes / No

Safety

Are all safety equipment used?	Yes / No
Are all reagents handled under a hood?	Yes / No

Comments

Dept. Supervisor: _____ Date: _____

QA/QC Officer: _____ Date: _____

X. Department SOP Review and Analysis Checklist:

DEPARTMENT:_____ DATE:_____

• Have the SOPs been read and documented in the personnel training files?	YES/NO/NA
• Do the department personnel know where the SOPs are located?	YES/NO/NA
• Is the information documented in the SOPs accurate and follow the method procedures?	YES/NO/NA
• Is the "Summary of Procedure" accurate?	YES/NO/NA
• Is "Sample Preservation, Container, Handling, and Storage" correct?	YES/NO/NA
• Are the reagents and Equipment/Apparatus correct?	YES/NO/NA
• Does the "Procedure" section accurately state exact procedures being followed by the analysts?	YES/NO/NA
• Are second source standards being used for all analytes?	YES/NO/NA
• Are the criteria for the Initial Calibration, Continuing Calibration, and Initial Calibration Verification QC criteria stated in the SOPs?	YES/NO/NA
• Are the SOP calibration criteria being followed on a daily basis?	YES/NO/NA
• Are the QC criteria for the Blanks, Laboratory Control Standards, Fortified Blanks, Duplicates, Matrix Spikes and Matrix Spike Duplicates stated in the SOPs?	YES/NO/NA
• Are the SOP QC frequency and criteria being followed on a daily basis?	YES/NO/NA
• Are hold times stated in the SOP?	YES/NO/NA
• Are other QC criteria such as Tunes, Retention Times, Peak Separation, and Ion Abundance stated in the SOPs?	YES/NO/NA
• Are the SOP "other QC" criteria being followed on a daily basis?	YES/NO/NA
• Are calculations accurate and are being checked by the supervisor or analyst?	YES/NO/NA
• Is the "Quality Assurance/Quality Control" section accurate and all QC criteria Stated?	YES/NO/NA
• Is the "Data Validation and Reporting" section accurate and being followed?	YES/NO/NA
• Is the "Corrective Action" section accurate and do the analyst/analysts Understand the procedures for initiation and completion of corrective action procedures?	YES/NO/NA
• Are common routine and non-routine corrective action examples specific to this analysis included in the SOP?	YES/NO/NA
• Is all safety equipment accessible and being worn where appropriate?	YES/NO/NA
• Are balances being calibrated daily before use?	YES/NO/NA
• Does the balance calibration meet the SOP specified criteria?	YES/NO/NA
• Is corrective action being taken and documented if the balance calibration does not meet the criteria?	YES/NO/NA
• Are the balances being calibrated at least once a month and documented in the balance calibration logbook?	YES/NO/NA
• Is the oven temperature being checked and recorded each day of use?	YES/NO/NA
• Is corrective action being taken if the oven temperature does not meet the Criteria stated in the SOP?	YES/NO/NA

SOPs Reviewed:_____

Comments (on reverse side)

Requirement/Aspect of Standard	Reference	Y	N	NA	Comments
5.5- 44 Does the laboratory establish and maintain a documented quality system appropriate to the type, range and volume of environmental testing activities it undertakes?	5.5.1, 5.5.1.a,				
5.6 PERSONNEL					
5.6- 1 Does the laboratory maintain records to indicate that it has sufficient personnel, having the necessary education, training, technical knowledge and experience for their assigned functions?	5.6.1				
5.6- 2 Are personnel responsible for complying with all quality assurance/quality control requirements that pertain to their organizational/technical function?	5.6.1				
5.6- 3 Does each technical staff member have a combination of experience and education to adequately demonstrate a specific knowledge of their particular function?	5.6.1				
5.6- 4 Does each technical staff member have a combination of experience and education to adequately demonstrate a general knowledge of laboratory operations, analytical methods, quality assurance/quality control procedures and records management?	5.6.1				
5.6- 5 Is there a defined minimum level of qualification, experience, and skills (including basic lab skills such as using a balance, colony counting, aseptic or quantitative techniques) necessary for all positions in the lab?	5.6.2.a				
5.6- 6 Does the laboratory management maintain records to assure that all technical laboratory staff and/or work cells have demonstrated and documented initial and ongoing proficiency in the activities for which they are responsible.	5.6.2.b C.1				
5.6- 7 Does laboratory management ensure that training records are kept up-to-date for all technical staff that include: a.___ Evidence that the employee has read, understands, and is using the latest version of the lab's in-house quality documentation; b.___ Training courses or workshops on specific equipment, analytical techniques, or lab procedures; c.___ Training courses in ethical and legal responsibilities including the potential punishments & penalties for violations. d.___ Evidence that the employee has read; acknowledges, and understands their personal & legal responsibilities including potential punishments & penalties for violations; and e.___ Documentation certifying that the employee has read, understands, and agrees to use the latest version of a test method used?	5.6.2.c.1-3 5.6.3				CONTROLLED DOCUMENT

Relevant Aspects of Standards	Reference				Comments
5.6- 8 Does laboratory management ensure that the training records of each of the technical staff is updated by including documentation of continuing proficiency by at least one of the following once per year by one of the following: a.___ Acceptable performance of a blind sample; b.___ Another demonstration of capability; c.___ Successful analysis of a blind performance sample on a similar test method using the same technology; d.___ Analysis of at least 4 consecutive lab control samples with acceptable levels of precision and accuracy; or e.___ If one of the above cannot be performed, the analysis of authentic samples that have been analyzed by another trained analyst with statistically indistinguishable results?	5.6.2.c.4				
5.6- 9 Does the laboratory document all analytical and operational activities of the laboratory?	5.6.2.d				
5.6- 10 Does the laboratory management ensure all sample acceptance criteria (Section 5.11) are verified and that samples are logged into the sample tracking system and properly labeled and stored?	5.6.2.f				
5.6- 11 Does the laboratory management document the quality of all data reported by the laboratory?	5.6.2.g				
5.6- 12 Has the laboratory management developed a proactive program for the detection of improper, unethical, or illegal actions?	5.6.2.h				
5.6-13 Does the laboratory maintain records on the relevant qualifications, training, skills, and experience of the technical personnel of the laboratory?	5.6.3				
5.7 PHYSICAL FACILITIES					
5.7- 1 Do the laboratory accommodations, test areas, energy sources, lighting, heating and ventilation facilitate proper performance of tests?	5.7.1.a				
5.7- 2 Is the environment in which performance of tests take place such that the results are not invalidated or the required accuracy of measurement is not adversely affected?	5.7.1.b, 5.7.2.c				
5.7-3 Is particular care taken when such performance of tests are undertaken at sites other than the permanent laboratory premises?	5.7.1.b				
5.7- 4 Does the laboratory provide for the effective monitoring, control and recording of environmental conditions, as appropriate?	5.7.1.c				
5.7-5 In instances where monitoring or control of any of the above mentioned items are specified in a test method or by regulation, does the laboratory meet and document adherence to the laboratory facility requirements?	5.7.1.d				

Requirements/Standards	Reference				Comments
5.8-9 Do equipment and reference materials records include the following: a.___ The name of the item of equipment b.___ The manufacturer's name, type identification, and serial number or other unique identification c.___ Date received and date placed in service d.___ Current location, where appropriate e.___ If available, condition when received (e.g. new, used, reconditioned) f.___ Copy of the manufacturer's instructions, where available g.___ Dates and results of calibrations and/or verifications and date of the next calibration and/or verification h.___ Details of maintenance carried out to date and planned for the future i.___ History of any damage, malfunction, modification or repair	5.8.e				UNCONTROLLED DOCUMENT
5.9 MEASUREMENT TRACEABILITY AND CALIBRATION					
5.9-1 Are all measuring operations and testing equipment having an effect on the accuracy or validity of tests calibrated and/or verified before being put into service and on a continuing basis?	5.9.1				
5.9-2 Does the laboratory have an established program for the calibration and verification of its measuring and test equipment including balances, thermometers and control standards?	5.9.1				
5.9-3 Are measurements made by the labs traceable to national standards of measurement where available?	5.9.2.a				
5.9-4 Does the laboratory maintain a record of all calibration certificates that indicate traceability to national standards of measurement and associated uncertainty of measurement and/or a statement of compliance with an identified metrological specification?	5.9.2.b				
5.9-5 Does the laboratory provide satisfactory evidence of correlation of results in those cases where traceability to national standards of measurement is not applicable? (For example: participation in a suitable program of inter-laboratory comparisons, proficiency testing, or independent analysis.)	5.9.2.c				
5.9-6 Are reference standards of measurement (such as Class S or equivalent weights or traceable thermometers) used for calibration only and for no other purpose, unless it is demonstrated that their performance as reference standards has not been invalidated?	5.9.3.a				

Requirements/Specific Elements	Ref	Yes	No	N/A	Comments
5.9-7 Are reference standards of measurement calibrated by a body that can provide, where possible, traceability to national or international standard reference materials?	5.9.3.a, 5.9.3.c				
5.9-8 Is there a program of calibration and verification for reference standards?	5.9.3.b				
5.9-9 Are reference standards and measuring and testing equipment subject to in-service checks between calibrations and verifications, where relevant?	5.9.3.c				
5.9-10 Is all support equipment maintained in proper working order and records of all activities including service calls kept?	5.9.4.1.a				
5.9-11 Is all support equipment calibrated annually, using NIST traceable references when available, over the entire range in which the equipment is used?	5.9.4.1.b				
5.9-12 Are the results of support equipment calibration within the specifications required of the application for which it is used?	5.9.4.1.b				
5.9-13 Is support equipment that is not within the specifications required of the application: a.___ Removed from service until it is repaired, or b. ___ Are correction factors to correct all measurements established?	5.9.4.1.b				
5.9-14 Are all raw data records retained to document equipment performance?	5.9.4.1.c				
5.9-15 Prior to use on each working day, are balances, ovens, refrigerators, freezers, incubators and water baths checked with NIST traceable references (where available) in the expected use range?	5.9.4.1.d				
5.9-16 Is the acceptability for use or continued use of balances, ovens, refrigerators, freezers, incubators and water baths according to the needs of the analysis or application for which it is used?	5.9.4.1.d				
5.9-17 Are mechanical volumetric devices, including burettes, checked for accuracy on at least a quarterly use basis?	5.9.4.1.e				
5.9-18 Do glass microliter syringes come with a certificate attesting to established accuracy or is the accuracy initially demonstrated and documented by the laboratory.	5.9.4.1.e				
5.9-19 Is the temperature, cycle time, and pressure of each autoclave run for chemical tests documented by use of appropriate chemical indicators or temperature recorders and pressure gauges	5.9.4.1.f				
5.10 TEST METHODS AND SOPs					
5.10-1 Does the laboratory have documented instructions on the use and operation of all relevant equipment, on the handling and preparation of samples and for calibration and/or testing, where the absence of such instructions could jeopardize the calibrations or tests?	5.10.1.a				

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5.10-2 Are all instructions, standards, manuals and reference data relevant to the work of the laboratory maintained up-to-dated and are readily available to the staff?	5.10.1.b					
5.10-3 Does the laboratory have SOPs that accurately reflect all phases of current laboratory activities such as assessing data integrity, corrective actions, handling customer complaints, and all test methods?	5.10.1.1					
5.10-4 Are copies of SOPs organized and accessible to all personnel?	5.10.1.1.c, 5.10.1.1.d					
5.10-5 Does each SOP clearly indicate: ___ Effective date of the SOP ___ Revision number ___ Signature(s) of approving authority	5.10.1.1.e					
5.10-6 Does the laboratory have in-house method manual(s) for each accredited analyte or test method that clearly describes the lab's method?	5.10.1.2.a, 5.10.1.2.b					
5.10-7 If test methods are copies of published methods are any changes or selected options in the methods documented and included in the methods manual?	5.10.1.2.b					
5.10-8 Each test method includes or references the following where applicable: a.___ Identification of the test method b.___ Applicable matrix or matrices c.___ Detection limit d.___ Scope and application, including components to be analyzed. e.___ Summary of the test method f.___ Definitions g.___ Interferences h.___ Safety i.___ Equipment and supplies j.___ Reagents and standards; k.___ Sample collection, preservation, shipment and storage; l.___ Quality control; m.___ Calibration and standardization; n.___ Procedure; o.___ Calculations; p.___ Method performance (precision & accuracy data, IDC, etc.); q.___ Pollution prevention; r.___ Data assessment and acceptance criteria for quality control measures; s.___ Corrective actions for out-of-control data; t.___ Contingencies for handling out-of-control or unacceptable data; u.___ Waste management; v.___ References; and w.___ Any tables, diagrams, flowcharts and validation data	5.10.1.2.b					

Requirement/Specification/Standard	Reference				Comment
5.10-9 Does the laboratory use appropriate test methods and procedures for all tests and related activities within its responsibility (including sample collection, handling, transport, storage, preparation, and analysis)?	5.10.2				
5.10-10 Are the test methods and procedures used consistent with the accuracy required and with any standard specifications relevant to the calibrations or test concerned?	5.10.2				
5.10-11 Does the laboratory use only the test method specified when the test method is mandated or requested?	5.10.2.a				
5.10-12 When specific test methods are not required as in the PBMS approach, does the laboratory use only fully documented and validated test methods (DOC per 5.10.2.1 and Appendix C) that are available to the client and other recipients of relevant reports?	5.10.2.b				
5.10-13 Is there a record of a satisfactory initial demonstration of method capability performed prior to and institution of any test method? (Not required for a test method that was in use by the lab prior to 7/99 and where there has been no significant changes)	5.6.3 5.10.2.1.a 5.10.2.1.c Appendix C				
5.10-14 Does the laboratory have records on file to demonstrate that an initial demonstration of capability is not required for unchanged methods in use prior to 7/99?	5.10.2.1.c				
5.10-15 Does the laboratory complete a new demonstration of capability whenever there is a significant change in instrument type, personnel, or test method?	5.10.2.1.e				
5.10-16 In a laboratory with specialized work cells, does the group as a unit complete a demonstration of capability?	5.10.2.1.f				
5.10-17 When a work cell is employed, and the members of the cell change, does the new employee work with experienced analysts in the area of the work cell where they are employed?	5.10.2.1.g				
5.10-18 Does the laboratory demonstrate and document acceptable continuing performance checks (e.g. laboratory control samples) each time members in the work cell change?	5.10.2.1.g				
5.10-19 Is the demonstration of capability repeated with the new work cell if there is a failure in the first 4 sample batch acceptance criteria?	5.10.2.1.g				
5.10-20 Does the laboratory repeat a DOC if the entire work cell is changed or replaced?	5.10.2.1.g				
5.10-21 Is the performance of the work cell as a group linked to the training records of the individual members of the work cell?	5.10.2.1.h				

Relevant Assessment Standards	Reference	Yes	No	N/A	Comments
5.10-22 Where sampling (as in obtaining sample aliquots from a submitted sample) is carried out as part of the test method, does the laboratory use documented procedures and appropriate techniques to obtain representative sub-samples?	5.10.3				
5.10-23 Does the laboratory establish SOPs to ensure that the reported data is free from transcription and calculation errors?	5.10.4.a				
5.10-24 Does the laboratory establish SOPs to ensure that all quality control measures are reviewed, and evaluated before data is reported?	5.10.4.b				
5.10-25 Does the laboratory establish SOPs addressing manual calculations including manual integrations?	5.10.4.c				
5.10-26 Are calculations and data transfers subject to appropriate checks as established in the laboratory's SOPs?	5.10.4				
5.10-27 Do documented procedures exist for the purchase, reception and storage of consumable materials used for the technical operations of the laboratory?	5.10.5				UNCONTROLLED DOCUMENT
5.10-28 Does the laboratory retain records for all standards, reagents and media including manufacturer/vendor, the manufacturer's Certificate of Analysis or purity (if supplied), date of receipt, recommended storage conditions, and an expiration date after which the material shall not be used unless its reliability is verified by the laboratory?	5.10.5.a				
5.10-29 Are original reagents and standards containers labeled with an expiration date?	5.10.5.b				
5.10-30 Are detailed records maintained on reagent and standard preparation?	5.10.5.c				
5.10-31 Do the records of reagent and standard preparation include traceability to purchased stocks or neat compounds, reference to method preparation, date of preparation, expiration date and preparer's initials?	5.10.5.c				
5.10-32 Do all containers of prepared reagents and standards bear a unique identifier and expiration date and can it be linked to the documentation of its preparation?	5.10.5.d				
5.10-33 Does the laboratory ensure that all requirements of Chapter 5 are complied with where computers, automated equipment, or microprocessors are used for the capture, processing, manipulation, recording, reporting, storage or retrieval of test data?	5.10.6.a				
5.10-34 Is computer software tested documented to be adequate for use? (internal audits, personnel training, focus point of QA & QC)	5.10.6.b				

Key Part/Aspect of Standards	Reference	Yes	No	N/A	Comments
5.10-35 Are procedures [ ] established and [ ] implemented for protecting the integrity of data?	5.10.6.c				
5.10-36 Do the procedures include, but not limited to, integrity of data entry or capture, data storage, data transmission and data processing?	5.10.6.c				
5.10-37 Are computer and automated equipment maintained to ensure proper functioning and provided with the environmental and operating conditions necessary to maintain the integrity of calibration and test data?	5.10.6.d				
5.10-38 Does the laboratory [ ] **establish** appropriate procedures for the maintenance of security of data including the prevention of unauthorized access to, and the unauthorized amendment of, computer records and [ ] does the laboratory **implement** those procedures? (ex. Are access codes used?)	5.10.6.e				
SAMPLE HANDLING					
5.11-1 Does the laboratory have a documented system for uniquely identifying the items to be tested, to ensure that there can be no confusion regarding the identity of such items at any time?	5.11.1.a				
5.11-2 Does the system include identification for all samples, sub-samples and subsequent extracts and/or digestates?	5.11.1.a				
5.11-3 Does the laboratory assign a unique identification (ID) code to each sample container received in the laboratory? (In cases where the sample collector and analyst are the same individual or the laboratory pre-assigns numbers to sample containers, the laboratory ID code may be the same as the field ID code.)	5.11.1.a, 5.11.1.e				CONTROLLED DOCUMENT
5.11-4 Does the laboratory sample code maintain an unequivocal link with the unique field ID code assigned each container?	5.11.1.b				
5.11-5 Is the laboratory ID code placed on the sample container as a durable label?	5.11.1.c				
5.11-6 Is the laboratory ID code entered into the laboratory records and is it the link that associates the sample with related laboratory activities such as sample preparation or calibration?	5.11.1.d				
5.11-7 Does the laboratory have a written sample acceptance policy that clearly outlines the circumstances under which samples will be accepted or rejected?	5.11.2				
5.11-8 Is data from any sample which does not meet the acceptance policy criteria flagged in an unambiguous manner clearly defining the nature and substance of the variation?	5.11.2				

D.1 APPENDIX D Chemical Testing Detailed Method Requirements

The findings and observations recorded here are based upon the evaluation of the following records:

Records Aspect/Requirements	Reference	Y	N	N/A	Comments
D.1-1 Does the laboratory demonstrate that it meets all requirements contained in a mandated test method or by regulation, even if the requirement is more stringent than the corresponding NELAC standard? (If it is unclear which requirements are more stringent, the standard from the method of regulation shall be followed)	5.1.b, 5.9.4.2				
D.1-2 Are the quality control protocols specified by the laboratory's method manual followed by all analysts?	D				
D.1-3 Are all essential quality control measures in Appendix D incorporated in the lab's method manual?	D				
D.1-4 Are all quality control measures assessed and evaluated on an on-going basis and is quality control acceptance criteria used to determine the validity of the data?	D				
D.1-5 Does the laboratory have procedures for developing acceptance/rejection criteria where no method or regulatory criteria exists?	D.1.1.a				
D.1-6 Is the method blank processed along with and under the same conditions as the associated samples include all steps of the analytical procedure?	D.1.1.a				
D.1-7 Are any affected samples associated with a contaminated method blank reprocessed for analysis or are the results reported with appropriate data qualifying codes?	D.1.1.a				
D.1-8 Is a method blank performed 1 per preparation batch, per matrix type?	D.1.1.a				
D.1-9 In those instances for which there is no separate preparation method is the batch defined as environmental samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples?	D.1.1.a				

Essential Aspect of Standard	Reference	Y	N	NA	Comments
D.1-10 Does the method blank consist of a matrix that is similar to the associated samples and is known to be free of the analytes of interest?	D.1.1.a				
D.1-11 Is each method blank critically evaluated as to the nature of the interference and the effect on the analysis of each sample within the batch?	D.1.1.a				
D.1-12 a.___ Is the source of contamination investigated and measures taken to minimize or eliminate the problem and affected samples reprocessed; **or** b.___Is data appropriately qualified if: 1. The concentration of a targeted analyte in the blank is at or above the reporting limit as established by the test method or by regulation, AND is greater than 1/10 of the amount measured in any sample. 2. The blank contamination affects the sample results as per the test method requirements or the individual project data quality objectives.	D.1.1.a D.1.1.a.1 D.1.1.a.2				
A LCS (sample matrix free of analytes of interest, spiked with a verified known amount of analyte) or a media containing known and verified concentrations of analytes or as Certified Reference Material is called a _____ by the laboratory.					
D.1-13 Is an LCS performed at a frequency of 1 per preparation batch of per matrix type, except for analytes for which spiking solutions are not available?	D.1.1.b.1				
D.1-14 In those instances for which no separate preparation method is used (example: volatiles in water) is the batch defined as environmental samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples?	D.1.1.b.1				
D.1-15 If the matrix spike is used as the LCS, is the acceptance criteria as stringent as the LCS?	D.1.1.b.1				
D.1-16 Are the components spiked those that are specified by the mandated test method or other regulatory requirement or as requested by the client, except for those circumstances in **D.1-17** below?	D.1.1.b.1				

Test Methods	Reference	Y	N	NA	Comments
D.1-17 . In the absence of specified spiking components does the laboratory spike per the following: a. ___ For those components that interfere with an accurate assessment such as spiking simultaneously with technical chlordane, toxaphene and PCBs, is the spike chosen so that it represents the chemistries and elution patterns of the components to be reported? b.___ For those test methods that have extremely long lists of analytes, is a representative number chosen as below? 1.___ Are the analytes selected that representative of all analytes reported? 2___ Is the following criteria used for determining the minimum number of analytes to be spiked. a) ___ Does the laboratory insure that all targeted components are included in the spike mixture over a 2 year period.? b)___ For methods that include 1-10 targets, are all components spiked?; c)___ For methods that include 11-20 targets, are at least 10 or 80% spiked, whichever is greater; d)___ For methods with more than 20 targets, are at least 16 components spiked?	D.1.1.b.1				
D.1-18 Are the results of the individual batch LCS calculated in percent recovery.	D.1.1.b.1				
D.1-19 Does the laboratory document the calculation for percent recovery?	D.1.1.b.1				
D.1-20 Is the individual LCS compared to the acceptance criteria as published in the mandated test method or where there are no established criteria, does the laboratory determine internal criteria and document the method used to establish the limits or utilize client specified assessment criteria?	D.1.1.b.1				
D.1-21 Are samples analyzed along with a LCS determined to be "out of control" considered suspect and the samples reprocessed and re-analyzed or is the data reported with appropriate data qualifying codes?	D.1.1.b.1				

Requirements/Standard	Reference	Yes	No	N/A	Comments
Sample prepared by adding a known mass of target analyte to a specific amount of matrix sample are called _____ by the laboratory					
D.1-22 Does the laboratory document procedures for determining the effect of the sample matrix on method performance?	D.1.1.c				
D.1-23 Does the laboratory have procedures in place for tracking, managing, and handling matrix specific QC criteria including spiking appropriate components at appropriate concentrations, calculating recoveries and relative percent difference, evaluating and reporting results based on performance of the QC samples?	D.1.1.c				
D.1-24 Is the frequency of the analysis of matrix specific samples determined as part of a systematic planning process (e.g. Data Quality Objectives) or as specified by the required mandated test method?	D.1.1.c				
D.1-25 Are the components spiked those specified by the mandated test method, where applicable?	D.1.1.c				
D.1-26 Are any permit specified analytes, as specified by regulation or client requested analytes also included?	D.1.1.c				
D.1-27 If there are no specified components, does the laboratory spike per the following: a.___ For those components that interfere with an accurate assessment such as spiking simultaneously with technical chlordane, toxaphene and PCBs, is the spike chosen which represents the chemistries and elution patterns of the components to be reported? b.___ For those test methods that have extremely long lists of analytes, are all analytes used, or are a representative number chosen using the following criteria: 1. For methods that include 1-10 targets, spike all components; 2.For methods that include 11-20 targets, spike at least 10 or 80%, whichever is greater; 3. For methods with more than 20 targets, spike at least 16 components.	D.1.1.c D.1.1.c.a D.1.1.c.b D.1.1.c.c				
D.1-28 Does, the laboratory include all targeted components in the spike mixture over a 2 year period?	D.1.1.c				

Element/Test Requirements	Reference					
D.1-29 Is the matrix spike used to assess the precision and accuracy of analytical results in a given matrix and are they expressed as percent recovery (%R) and relative percent difference (RPD)?	D.1.1.c					
D.1-30 Does the laboratory document the calculation for relative percent difference?	D.1.1.c					
D.1-31 Are the results compared to the acceptance criteria in the mandated test method when published?	D.1.1.c					
D.1-32 Where there are no established criteria, does the laboratory determine internal criteria and document the method used to establish the limits?	D.1.1.c					
D.1-33 For matrix spike results outside established criteria, is corrective action documented or is the data reported with appropriate data qualifying codes?	D.1.1.c					
Replicate aliquots of the same sample taken through the entire analytical procedure are known as by the laboratory.						
D.1-34 Is the frequency of the analysis of matrix duplicates determined as part of a systematic planning process (e.g. Data Quality Objectives) or as specified by the mandated test method?	D.1.1.d					
D.1-35 Are matrix duplicates performed on replicate aliquots of actual sample?	D.1.1.d					
D.1-36 Are the results from matrix duplicates primarily designed to assess the precision of analytical results in a given matrix and are they expressed as relative percent difference (RPD) or another statistical treatment (e.g., absolute differences)?	D.1.1.d					
D.1-37 Does the laboratory document the calculation for relative percent difference or other statistical treatments?	D.1.1.d					
D.1-38 Are the results compared to the method acceptance criteria when published in the mandated test method?	D.1.1.d					
D.1-39 Where there are no established criteria, does the laboratory determine internal criteria and document the method used to establish the limits?	D.1.1.d					
D.1-40 For matrix duplicates results outside established criteria, is corrective action documented or is the data reported with appropriate data qualifying codes?	D.1.1.d					
D.1-41 Are surrogate compounds added to all samples, standards, and blanks, whenever possible, for all organic chromatography methods?	D.1.1.e					

Requirements/Standards	Reference					Comments
D.1-42 Are the results of surrogate recoveries compared to the acceptance criteria published in the mandated test method?	D.1.1.e					
D.1-43 Where there are no established criteria, does the laboratory determine internal criteria and document the method used to establish the limits?	D.1.1.e					
D.1-44 Are surrogates outside the acceptance criteria evaluated for the effect indicated for the individual sample results?	D.1.1.e					
D.1-45 Is the appropriate corrective action guided by the data quality objectives or other site specific requirements?	D.1.1.e					
D.1-46 Are results reported from analyses with surrogate recoveries outside the acceptance criteria with appropriate data qualifiers.?	D.1.1.e					
D.1-47 Does the laboratory utilize test methods that provide detection limits that are appropriate and relevant for the intended use of the data?	D.1.2					
D.1-48 Does the laboratory use detection limits that are determined by the protocol in the mandated test method or applicable regulation?	D.1.2					
D.1-49 If the protocol for determining detection limits is not specified, does the selection made by the laboratory reflect instrument limitations and the intended application of the test method?	D.1.2					
D.1-50 Are detection limits initially determined [ ] in a matrix free of target analytes or interferences or in the matrix of interest or [ ] determined in the matrix of interest?	D.1.2.b					
D.1-51 Are detection limits determined each time there is a change that affects how the test is performed, or when a change in instrumentation occurs that affects the sensitivity of the analysis?	D.1.2.c					
D.1-52 Are all sample processing steps of the analytical method included in the determination of the detection limit?	D.1.2.d					
D.1-53 Are all procedures used to determine detection limits documented, including the matrix type and is all supporting data retained?	D.1.2.e					
D.1-54 Does the laboratory have established procedures to relate detection limits with quantitation limits?	D.1.2.f					
D.1-55 Are the test method's quantitation limits established and above the detection limit?	D.1.2.g					
D.1-56 Are procedures for data reduction, such as use of linear regression, documented?	D.1.3					
D.1-57 Is only the initial instrument calibration used directly for quantitation?	5.9.4.2, 5.9.4.2.1.c					

Program Aspect / Standard	Reference					Comments
D.1-58 Do the SOPs or the test method SOP reference include the details of the initial calibration procedures, including calculations integrations, and acceptance criteria associated statistics?	5.9.4.2.1.a					
D.1-59 When initial instrument calibration procedures are referenced in the test method, are the referenced material retained by the laboratory and be available for review?	5.9.4.2.1.a					
D.1-60 Are sufficient raw data records retained to permit reconstruction of the initial and continuing calibrations using as appropriate, but not limited to: a.___ Calibration date b.___ Test method c.___ Instrument d.___ Analysis date e.___ Each analyte name f.___ Analyst's initials or signature g.___ Concentration and response h.___ Response i.___ Calibration curve or response factor, or j.___ Unique equation or coefficient used to reduce instrument responses to concentration.	5.9.4.2.1.b, 5.9.4.2.2.c					
D.1-61 Are all initial calibrations verified with a standard obtained from a second source or lot that is traceable to a national standard when available? (If the lot can be demonstrated from the manufacturer as prepared independently from other lots)	5.9.4.2.1.d					
D.1-62 Is the criteria for the acceptance of an initial calibration established (correlation coefficient or relative percent difference)?	5.9.4.2.1.e					
D.1-63 If the results of samples are not bracketed by the initial calibration, are the results reported as having less certainty (defined qualifiers, flags, or explanation in the case narrative)?	5.9.4.2.1.f					
D.1-64 Is the lowest calibration standard of the initial calibration above the detection limit?	5.9.4.2.1.f					
D.1-65 Are corrective actions performed if the results of the initial calibration are outside of established acceptance criteria?	5.9.4.2.1.g					
D.1-66 Is data associated with unacceptable initial instrument calibration not reported?	5.9.4.2.1.g					
D.1-67 The initial calibration standards include concentrations that are at or below the regulatory limit/decision level, if these limits are known unless these are below the laboratory's demonstrated detection limit?	5.9.4.2.1.h					

Requirement/Specification/Standard	Reference				
D.1-68 If a reference or mandated method does not specify the number of calibration standards, is the minimum number used 2, not including a blank or zero standard?	5.9.4.2.1.i				
D.1-69 Does the laboratory have an SOP for determining the number of points for establishing the initial calibration?	5.9.4.2.1.i				
D.1-70 Is a continuing instrument calibration verification used to confirm the continued validity of the initial calibration with each sample batch?	5.9.4.2, 5.9.4.2.2				
D.1-71 Are the details of the continuing instrument calibration procedure, calculations, and associated statistics included or referenced in the test method SOP?	5.9.4.2.2.a				
D.1-72 Is a continuing instrument calibration verification repeated at the beginning and end of each analytical batch? (If an internal standard is used, only one continuing calibration verification must be analyzed per analytical batch)	5.9.4.2.2.b				
D.1-73 Are the concentrations of the continuing calibration standards at the beginning and the end varied within the established calibration range?	5.9.4.2.2.b				
D.1-74 Do the continuing calibration verification records explicitly connect the continuing verification data to the initial instrument calibration?	5.9.4.2.2.c				
D.1-75 Does the laboratory have established acceptance criteria (relative percent difference) of a continuing calibration verification analysis?	5.9.4.2.2.d				
D.1-76 Are corrective actions performed if the results of the continuing calibration verifications are outside of established acceptance criteria?	5.9.4.2.2.e				
D.1-77 If routine corrective action fails to produce a second consecutive (immediate) calibration verification within acceptance criteria, does the lab either perform a new initial calibration or analyze 2 consecutive acceptable calibration verifications before analyzing new samples?	5.9.4.2.2.e				
D.1-78 If sample data associated with a failed calibration verification is reported, does the laboratory qualify the data?	5.9.4.2.2.e				
D.1-79 If there was a high bias and there is a failed continuing calibration verification, is only data associated with samples that are only non-detects reported as qualified data? (Other affected samples are reanalyzed after a new curve has been established, evaluated and accepted)	5.9.4.2.2.e.i				

Relevant Aspect of Standard	Reference	Yes	No	N/A	Comments
D.1-80 If there was a low bias and there is a failed continuing calibration verification, is only data associated with samples that have a result greater than the maximum regulatory limit/decision level reported as qualified data? (Other affected samples are reanalyzed after a new curve has been established, evaluated and accepted)	5.9.4.2.2.e.ii				
D.1-81 Is the source of standards traceable to national standards or proven through inter-laboratory studies?	D.1.4.a 5.9.2.a - c				
D.1-82 In methods where the purity of reagents is not specified, is analytical reagent grade used?	D.1.4.b.1				
D.1-83 Does the laboratory use reagents of the purity or of greater purity than that specified in the method?	D.1.4.b.1				
D.1-84 Is the container label checked and documented to verify that the purity of the reagents meets the requirements of the particular method?	D.1.4.b.1				
D.1-85 Is the quality of water sources monitored and documented to meet method specified requirements?	D.1.4.b.2				
D.1-86 Does the laboratory verify the concentration of titrants in accordance with written laboratory procedures?	D.1.4.b.3				
D.1-87 Does the laboratory develop and document acceptance criteria for retention time windows?	D.1.5.a				
D.1-88 Is confirmation performed for organic tests such as pesticides, herbicides, or acid extractable or when recommended by the analytical method to verify the compound identification when positive results are detected on a sample from a location that has not been previously tested by the laboratory? Note: Confirmation is not required when the analysis involves the use of a mass spectrometer.	D.1.5.b				CONTROLLED DOCUMENT
D.1-89 If confirmation not performed, is it based on client written stipulation?	D.1.5.b				
D.1-90 Does the laboratory document all confirmations?	D.1.5.b				
D.1-91 Does the laboratory document acceptance criteria for mass spectral tuning?	D.1.5.c				
D.1-92 Does the laboratory assure that the test instruments consistently operate within the specifications required of the application for which the equipment is used?	D.1.6.a				
D.1-93 Is glassware cleaned to meet the sensitivity of method?	D.1.6.b				
D.1-94 Are all cleaning and storage procedures that are not specified by the method documented in laboratory records and SOPs?	D.1.6.b				

14.0 PREVENTIVE MAINTENANCE

Preventive maintenance is a routine practice at MITKEM for all instrumentation. Scheduled preventive maintenance minimizes instrument downtime and subsequent interruption of analysis. All major instrumentation is under service contracts so that downtime (due to catastrophic events) is minimized.

Only those equipment items meeting or exceeding applicable performance requirements are used for data collection. This includes items such as laboratory balances as well as major analytical instruments such as ICPs, GCs and GC/MSs.

MITKEM's laboratory personnel are familiar with the routine and non-routine maintenance requirements of the instruments they operate. This familiarity is based on education, hands-on experience and manufacturer's training courses.

GC Maintenance:

1. The injection septum will be replaced once approximately fifty (50) injections or earlier if a leak develops.

2. The injection liner will be replaced once approximately fifty (50) injections or when initial and/or continuing calibrations fails repeatedly to meet method requirements.

3. The gold seal will be replaced except for septum and liner, and the column will be trimmed whenever an initial calibration is run.

4. The column will be replaced if chromatograms show excessive peak tailing and/or initial and continuous calibration verifications fail repeatedly to meet method requirements.

5. Once a year, under service contract, all GC equipment under-go extensive maintenance by a manufacturer's service engineer.

GC/MS Maintenance:

1. GC injector and liner are cleaned daily for semivolatiles and monthly for volatiles.

2. The column will be replaced if chromatograms show excessive peak tailing and/or initial and continuous calibration verifications fail repeatedly to meet method requirements.

3. The ion source will be cleaned when initial and/or continuing calibration repeatedly fail method specified criteria.

4. The pump oil will be replaced once a year.

5. Once a year, under service contract, all GC equipment under-go extensive maintenance by a manufacturer's service engineer.

ICAP Maintenance:

1. Peristaltic pump tubing will be replaced every sixteen (16) hours of instrument time or sooner when memory effects are manifested.

2. The plasma torch is cleaned with (aqua regia) every 1-2 weeks. If memory effects are manifested the torch will be cleaned immediately.

3. The sample introduction (spray chamber and nebulizer) is cleaned every 2-3 weeks.

4. Air filters are cleaned each time the torch is cleaned or as needed upon visual inspection.

5. Once every six (6) months, under service contract, the instrument undergoes extensive maintenance by a manufacturer's service engineer.

Mercury FIMS 100 Maintenance:

1. Pump tubing is replaced every 48 hours of instrument run time.

2. Sample loops, gas tubing extensions and sample capillaries are replaced as needed.

Lachat 8000 Maintenance:

1. All pump tubing is replaced every 48 hours of instrument run time.

2. Auto sampler arm is lubricated every 48 hours of instrument run time.

3. The manifolds, tubing connections, valves, etc. are cleaned or replaced as needed.

TCLP/SPLP Tumbler Maintenance:

1. The tumbler is checked at every use for number of rotations per minute (30rpms) and the ambient temperature checked and documented in the RPS Logbook.

2. If the tumbler is not spinning at 30rpms, motor is cleaned and oiled.

3. If tumbler is not spinning at 30rpms after maintenance, the motor will be replaced.

Instrument maintenance logs are kept for each instrument (Figure 14-1). The person performing the maintenance is required to provide the following information in the log:

- Equipment identifier
- The inspection, maintenance, calibration or corrective action(s) performed.
- The trigger(s) for the maintenance action(s)
- The identity of the person(s) performing the maintenance
- The date on which the work was performed, and
- The condition of the equipment upon completion of the work.

MITKEM maintains an inventory of replacement parts required for preventive maintenance and spare parts that often need replacement, such as filaments for GC/MS systems and the more mundane electrical fuses and GC column ferrules. To control cost, the appropriate supervisor shall decide the types and numbers of spare parts kept on hand for each equipment item.

Figure 14-1
Example Instrument Maintenance Logbook Form

MITKEM CORPORATION: INSTRUMENT MAINTENANCE LOGBOOK	
Pesticides/PCB Instrument E	
Date	Maintenance Description

Figure 14-2
Instrument Maintenance Schedule

MITKEM CORPORATION
Preventive Maintenance Schedule

Instrument	Activity	Frequency
Gas Chromatograph (GC)	Injection septum replaced	Every 50 injections
	Injection liner replaced	Every 50 injections
	The column will be replaced if chromatograms show excessive peak tailing and/or initial and continuing calibration verifications fail repeatedly to meet method requirements.	As needed
	All GC equipment undergo extensive maintenance by the manufacturer's service engineer.	Annually
GC/MS	GC injector and liner replaced	Daily
	The column will be replaced if chromatograms show excessive peak tailing and/or initial and continuing calibration verifications fail repeatedly to meet method requirements.	As needed
	The ion source will be cleaned when initial and/or continuing calibration repeatedly fail method specified criteria.	As needed
	The pump oil is replaced.	Annually
	All GC/MS systems undergo extensive maintenance by a manufacturer's service engineer.	Annually
Inductively Coupled Plasma (ICP)	Peristaltic pump tubing is replaced	Every 16 hours of instrument run time
	The plasma torch is cleaned (aqua regia).	Weekly
	The sample introduction (spray chamber and nebulizer) is cleaned	Weekly
	Air filters are cleaned.	Biweekly
	The instrument undergoes extensive maintenance by the manufacturer's service engineer.	Semiannually
Mercury FIMS 100	Pump tubing is replaced	Every 48 hours of instrument run time
	Sample capillary and tubing are replaced	Every 48 hours of instrument run time
	Inside of optical cell is cleaned	Every 48 hours of instrument run time

MITKEM CORPORATION
Preventive Maintenance Schedule

Instrument	Activity	Frequency
Lachat 8000	All pump tubing is replaced	Every 48 hours of instrument run time
	Autosampler arm is lubricated	Every 48 hours of instrument run time
	The instrument undergoes extensive maintenance by the manufacturer's service engineer.	Semiannually

15.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, COMPLETENESS, METHODS DETECTION LIMIT AND LINEAR DYNAMIC RANGE

These mathematical equations represent the means of calculating analytical figures of merit on a routine basis at MITKEM. However, they may be supplanted with other calculations if requested by the client. Precision, accuracy and completeness are also discussed in Section 6.

15.1 Precision:

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

Sample standard deviation, *s*:

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

where a quantity, x_i (e.g. a concentration), is measured *n* times with a mean, $\bar{x}$.

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

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

or

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

In which: *RSD* = relative standard deviation, or
CV = coefficient of variation
s = standard deviation
$\bar{x}$ = mean

For duplicates (samples that result when an original sample have been split into two for identical analyses), the relative percent difference (*RPD*) between the two samples may be used to estimate precision.

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

In which: D_1 = first sample value
D_2 = second sample value (duplicate)

15.2 Accuracy:

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

$$Bias = X - T$$

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

In which: X = average observed value of measurement
T = "true" value

Accuracy also may be calculated in terms of the recoveries of analytes in spiked samples:

$$\%\,\mathrm{Recovery}(\%R) = 100 \times \frac{(SSR - SR)}{SA}$$

where: SSR = spikes sample result
SR = sample result
SA = spike added

15.3 Completeness:

Determine whether a database is complete or incomplete may be quite difficult. To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. Less obvious is whether the data are sufficient to achieve the goals of the project. All data are reviewed in terms of goals in order to determine if the data set is sufficient.

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

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

15.4 Method Detection Limit:

The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is not zero. It is computed as follows from data obtained by repeatedly determining an analyte in a given sample matrix:

1. Analyze at least seven samples of a homogeneous matrix spike that contains the analyte(s) of interest at concentrations of three to five times the expected MDL. The entire sample preparation and analysis protocol must be applied in each analysis; simply preparing one sample and repeating a measurement three or more times on the sample in not acceptable.

2. Upload the acceptable data into LIMS Omega.

3. The LIMS will compute the standard deviation of the results for each analyte using the following equation:

$$MDL = t_{(n-1,\ \alpha-0.99)}\ (s)$$

Where t is the one-sided student's t value appropriate for the number of samples analyzed, n; α is the statistical confidence level; and s is the standard deviation.

The one-sided t-values are presented below:

Number of samples	t-value
7	3.14
8	2.996
9	2.90
10	2.82

4. The MDL is then checked against 40CFR136 requirements by the QA Department. If the MDL is acceptable then it is uploaded into the LIMS by either the QA Department or LIMS Administrator.

5. Immediately following the determination of the MDL, MDL check samples are analyzed at a concentration approximately equal to 2 x the MDL. Recoveries must fall between 50-150% of the expected value.

6. An elevated MDL can be uploaded if necessary into the LIMS as long as documentation is available to show that the applicable method can produce an MDL at least that low. This can commonly occur for ICP analysis in which extremely low MDLs can cause method compliance issues.

15.5 Linear Dynamic Range:

The linear dynamic range is the concentration range over which the instrument response is linear. It is determined by analyzing a series of standard solutions that extends beyond the non-linear calibration region at both the low and high extremes, and selecting that range of standards which demonstrates a linear relationship between instrument response and concentration.

For ICP analysis the linear dynamic range is determined by analyzing each metal at 3 different concentrations. The concentration which produces results within a 10% error is determined to be the linear dynamic range. This procedure must be performed biannually per method requirements.

16.0 CORRECTIVE ACTION

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

Corrective actions for laboratory problems are described in MITKEM Corporation laboratory standard operating procedures. Personal experience often is most valuable in alerting the bench scientist to questionable results or the malfunctioning of equipment. Specific QC procedures are designed to help the analyst determine the need for corrective actions (see Section 11, Data Reduction, Validation and Reporting). Corrective actions taken by scientists in the laboratory help avoid the collection of poor quality data. Mitkem's corrective action program divides these issues into routine and non-routine corrective actions as described below.

Routine Corrective Action – A routine corrective action is taken when the out-of-control event encountered is one that is detected at the appropriate level in the QA process. Routine corrective actions are defined in the analytical SOP with specific steps to be taken as corrective action (i.e., low surrogate recovery, continuing calibration verifications, project specific protocols that do not meet acceptance criteria, etc.) Routine corrective actions must be documented as described in the analytical SOP, but do not require further documentation in the corrective action logbook. Examples of routine corrective action situations: surrogate/surrogates out, LCS out, CCV out, ICV out, IS area/areas out, typographical errors, random blank contamination, or false positive hit/spectral ID match corrected during data review.

Non-Routine Corrective Action – A non-routine corrective action is taken when the out-of-control event encountered is not typical for the method. For example, QC failures that pass through the final review to the client, procedural errors – not following the SOP, or a situation not being detected by normal QA procedures that could adversely impact the accuracy, precision, etc. of a result. Non-routine corrective actions must be documented in the Corrective Action Request (CAR) logbook. The analyst, using his/her own judgement, may deem any corrective action situation non-routine and formally document it on a CAR. When in doubt about a corrective action, the analysts are instructed to err on the side of formal CAR documentation. Examples of non-routine corrective action situations include: bad standard, expired standard mix being used, incorrect equation, "client-detected" problems, not following SOP protocols, using bad or contaminated lot of chemical/reagent/solvent, deciding to release data not conforming to SOP requirements, compound retention time outside of range, or improper library spectrum that leads to re-occurring mis-identification of compounds.

The essential steps in MITKEM Corporation corrective action system are:

1. Identify and define the problem.

2. Assign responsibility for investigating the problem. Usually this individual is the department supervisor.

3. Investigate and determine the cause of the problem.

4. Determine a corrective action to eliminate the problem and prevent recurrence.Any changes that result from the corrective action investigation must be documented.

5. Assign and accept responsibility for implementing the corrective action.

6. Establish effectiveness of the corrective action and implement it.

7. Verify that the corrective action has eliminated the problem.

8. Both the laboratory and the QA Department need to monitor the corrective action to ensure it is effective.

9. Any corrective actions that cast doubt on the laboratory's compliance with its own policies and procedures may require an internal audit by the QA Department.

This scheme is generally accomplished through the use of Corrective Action Request Forms (Figure 16-1) available to each of MITKEM's laboratories. Use of this form notifies the QA Department of a potential problem as described in SOP No. 80.0007. The QA Director initiates the corrective action by relating the problem to the appropriate laboratory managers and/or project managers who then investigate or assign responsibility for investigating the problem and determine its cause. Once determined, the QA Director will approve appropriate corrective action. Its implementation is later verified through and internal laboratory audit.

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

Nonconformance:

Any breech of standard protocols is a nonconformance item that is documented on the Corrective Action Request Form and management informed immediately. The following are nonconformance items:

1. Sample holding time exceeded.

2. Hoods, Class "S" weights, NIST Thermometers, balances, automatic pipettes, being used but not certified.

3. Expired standards being used.

4. Manual integration being misrepresented.

16.1 Client Complaints:

Mitkem Corporation ensures client complaints are dealt with quickly and completely. The policies are stated in the laboratory Client Complaint Standard Operating procedure (SOP No. 80.0002).

Figure 16-1
Quality Assurance Corrective Action Request Form

MITKEM CORPORATION

Quality Assurance Corrective Action Request

Originator:_____ Date:_____

Laboratory:_____ Project:_____

Problem:_____

Action Planned: Date Implemented:_____

Resolution:_____

QA/QC Director:_____ Date:_____

17.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The MITKEM Quality Assurance Director submits a QA report annually to the Operations Manager and the President of the Laboratory. The report should be completed and submitted no later than the 15th of July in any calendar year.

The report contains detailed laboratory information and QA activities during the previous twelve months. Items to include are the suitability of policies and procedures, client complaints, quality control activities, resources and staffing. See the following pages for the report format.

A copy of the report is kept on file in the QA department.

In case of a severe problem or difficulty, a special report is prepared by the QA Director and submitted immediately to management.

MITKEM CORPORATION
Annual Quality Assurance Report to Management

1. Status of Internal Audits.

2. Status of External Audits

3. Identification of Quality Control issues in the laboratory.

4. Discussion of corrective action issues.

5. Proficiency Testing.

6. Changes in volume and type of work undertaken.

7. Client Feedback.

8. Reports from management and supervisory personnel.

18.0 SAFETY

MITKEM maintains safety program managed by the Health and Safety Officer and the Safety Committee. Responsibilities include many aspects that comply with the Right-to-Know Laws. Training includes:

- Training seminars with information on OSHA safety instruction for new employees.
- Introductory training to include location of fire extinguishers, first aid supplies, etc.
- Chemical Hygiene Plan/Health and Safety manual review when hired initially and then annually thereafter.
- Monthly Safety Committee meetings.
- Centralized MSDS information.
- Maps with safety equipment and all exits noted.
- Posted safety rules.

If a chemical spill occurs, proper actions are described in Mitkem's Contingency Plan. Each department at Mitkem has its own copy of the Contingency Plan. Additionally, the local fire department (Warwick) and hospital (Kent County) also have a copy in case a need arises. All employees are required to review the plan when hired.

Emergency equipment, such as spill control kits, fire extinguishers and fire blankets are located throughout the laboratory areas. The Contingency Plan has instructions for evacuation, notification of emergency authorities and regulatory personnel in the event of a chemical accident.

19.0 WASTE MANAGEMENT

19.1 Pollution Prevention

The waste management option of choice is to prevent pollution by minimizing the amount or types of chemical wastes that are generated. Mitkem's ability to minimize waste generation is limited by the chemical analysis techniques that are required by the EPA or other authors of test methods. As new test methods are utilized in the laboratory, the type and volume of chemical waste generated by the new test is considered. Analysts and Supervisors are encouraged to look for ways to reduce the amount of chemical waste, or the type of chemical waste generated during the testing process; HOWEVER, no method is allowed to be modified without discussion among the Supervisor, Technical Director, QA Director and other management personnel to determine the affect of the change on the resulting data.

19.2. Waste Management

Mitkem has identifies and routinely disposes of chemical wastes in several hazardous waste streams. In general these are acids, caustics, solvent wastes and various laboratory waste solids. No laboratory chemical waste is disposed in the trash or dumped down the drain. All remaining sample volume following testing, and after contract-required disposal date has past, are disposed in one of these waste streams. These wastes are fully described in Mitkem's Waste Management Plan and in Mitkem's Profile Log that has been prepared by Univar, Mitkem's waste hauler. Other hazardous wastes are identified and properly disposed according to these documents.

Continued compliance is monitored monthly by an outside consultant to ensure all RI DEM regulations are met.

20.0 DEFINITIONS, ACRONYMS, ABBREVIATIONS:

ACCURACY: The closeness of agreement between an observed value and An accepted reference value.

BATCH: A group of samples of the same matrix that are processed as a unit. Unless defined differently by a specific analytical method (such as Oil & Grease by Method 1664), the maximum batch size is 20 samples.

BIAS: The deviation due to analytical or matrix effects of the measured value from a known spiked amount.

BLANK: A "clean" matrix analysis. Such as: Equipment Blank, Method Blank, Trip Blank.

CAS: Chemical Abstracts Service, a registry where chemicals are assigned identification numbers.

CCB: Continuing Calibration Blank

CCV: Continuing Calibration Verification standard.

CLP: Contract Laboratory Program. A contract used by EPA to purchase analytical services. Also refers to the test protocols described in that contract. The CLP analyses can be used for EPA or for other clients. CLP-format data reports are arranged as described in the EPA CLP contract, including specified data report pages and all raw data. The CLP analysis scheme includes OLM (Organic Low/Medium-soil and water), OLC (organic low concentration-waters only) and ILM (Inorganic Low/Medium-soil and water) analyses.

CONTROL SAMPLE A QC sample introduced into a process to monitor the performance of the system.

DL: Dilution, not used when the initial analysis is performed at dilution, but is used for a secondary dilution.

DUPLICATE: see Matrix Duplicate, Field Duplicate, and Matrix Spike Duplicate.

EQUIPMENT BLANK A sample of analyte-free water that has been used during sample collection to measure any contamination introduced during sample collection.

ICB: Initial Calibration Blank

ICV: Initial Calibration Verification standard

IDL: Instrument Detection Limit. Statistical value similar to MDL, but with analyses performed on standards that have not been through the sample preparation process.

FIELD DUPLICATES: Independent samples that are collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently. These duplicates are useful in documenting the precision of the sampling process.

LAB CONTROL SAMPLE(LCS): A blank spiked with compound(s) representative of the target analytes. This is used to document laboratory performance in a "clean" matrix.

MATRIX: The component or substrate (e.g., water, soil, air, and oil) which contains the analyte of interest.

MATRIX DUPE (DUP): A sample split by the laboratory that is used to document the precision of a method in a given sample matrix.

MATRIX SPIKE (MS): An aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.

MATRIX SPIKE DUPE (MSD): Laboratory split samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given Sample matrix.

METHOD BLANK (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

METHOD DETECTION LIMIT (MDL): 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 type containing the analyte. For operational purposes, when it is necessary to determine the MDL in the matrix, the

MDL should be determined by multiplying the appropriate one-sided 99% t-statistic by the standard deviation obtained from a minimum of seven analyses of a matrix spike containing the analyte of interest at a concentration estimated to be three to five times the MDL, where the t-statistic is obtained from standard references.

MSA: Method of Standard Additions

ND: Not Detected. Used in conjunction with the reporting limit.

ORGANIC-FREE REAGENT WATER: For volatiles, all references to water in the methods refer to water in which an interferent is not observed at the reporting limit of the compounds of interest. Organic-free reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionized water. For semivolatiles and nonvolatiles, all references to water in the methods refer to water in which an Interferent is not observed at the reporting limit of the compounds of interest. Organic-free reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionized water.

PPB: Parts Per Billion, ug/L, ug/Kg

PPM: Parts Per Million, mg/L, mg/Kg

PQL: Practical Quantitation Limit. Is equivalent to Reporting Limit.

PRECISION: The agreement among a set of replicate analyses.

PS: Post Spike. Spike added at the analysis level (as opposed to at the beginning of sample preparation) to determine interferences.

REPORTING LIMIT: The lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The RL is generally 5 to 10 times the MDL. However, it may be nominally chosen other than these guidelines to simplify data reporting. For many analytes the RL concentration is selected as the lowest non-zero standard in the calibration curve. Sample RLs are matrix-dependent, and are adjusted by the amount of sample analyzed, dilution, percent moisture.

RE: Reextraction or Reanalysis

RPD: Relative Percent Difference, used to determine precision.

RRF: Relative Response Factor. Used for quantification with the internal standard procedure.

RT: Retention Time for a chromatographic peak, as calculated from the time of injection.

SD: Serial Dilution

STANDARD ADDITION: The practice of adding a known amount of an analyte to a sample immediately prior to analysis. It is typically used to evaluate interferences.

STANDARD CURVE: A plot of concentrations of known analyte standards versus the instrument response to the analyte. Calibration standards are prepared by successively diluting a standard solution to produce working standards which cover the working range of the instrument. Standards should be prepared at the frequency specified in the appropriate method. The calibration standards should be prepared using the same type of acid or solvent and at the same concentration as will result in the samples following sample preparation. This is applicable to organic and inorganic chemical analyses.

SURROGATE: An organic compound that is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples.

TRIP BLANK: A sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organics samples.

From EPA SW-846, Revision 4, and other sources.

MITKEM CORPORATION

INSTRUMENTATION and EQUIPMENT LIST

APPENDIX A

Mitkem Corporation
Balance List 11/04

Equipment	Manufacturer	Serial #	Date Received	Date in Service	Condition New/Used	Equipment ID	Location
Top-Loaded Balance	OHAUS	1121230069	2000	2000	New	TL10	Organic
Analytical Balance	Denver	0077138	1995	1995	New	AB-1	Inorganic
Top-Loaded Balance	OHAUS Voyager	F2921120391055	2001	2001	New	TL9	Inorganic
Top-Loaded Balance	Denver	0079896	2000	2000	New	TL1	Metals
Top-Loaded Balance	OHAUS Precision Std.	C22427176	2002	NA	New	TL6	Backup
Top-Loaded Balance	OHAUS Navigator	1121122373	2002	2002	New	1121122373	Unit 3
Top-Loaded Balance	OHAUS	CD8910	2000	2000	New	TL-4	VOA
Top-Loaded Balance	OHAUS Navigator	1122173423	2003	NA	New	TL-11	Inorganic

Mitkem Corporation
Equipment List 11/04 **Department: Inorganics : Metals& Wet Chemistry**

Equipment	Manufacturer	Serial #	Date Received	Date in Service	Condition New/Used	Equipment ID	Location
Optima 4300DV	Perkin Elmer	077N3102302	Nov-03	Nov-03	New	Optima3	Metals
Optima 3100XL	Perkin Elmer	069N8060801	Nov-98	Nov-98	New	Optima2	Metals
FIMS 100	Perkin Elmer	1131	Mar-00	Mar-00	Used	FIMS	Metals
Genesys 20	Thermospectronic	3SGD332010	Apr-02	Apr-02	New	Spec 2	Wetchem
Spectronic Genesys 20	Spectronic Instruments	3SGB118022	Oct-00	Oct-00	New	Spec 1	Wetchem
GPR Centrifuge	Beckman Instruments	7M149	Apr-02	Apr-02	Used	Centrifuge	Unit 3
Apollo 9000	Tekmar/Dohrmann	US03035002	Apr-03	Apr-03	Demo	TOC	Unit 3
Quick Chem 8000	Lachat Instruments	A83000-1020	Apr-96	Apr-96	New	Lachat	Unit 3
IC	Dionex	95030498E980802	May-03	May-03	New	IC	Unit 3

Mitkem Corporation
Equipment List 11/04 Department: Organic Prep

Equipment	Manufacturer	Serial #	Date Received	Date in Service	Condition New/Used	Equipment ID	Location
Gel Permeation Chromatograph	ABC	796B-199	May-97	May-97	Used	GPC I	O Prep
Gel Permeation Chromatograph	OI Analytical	9417SI	Jun-98	Jun-98	New	GPC II	O Prep
Vortex Concentrator	Labconco	000493001C	Jul-98	Jul-98	New	RV I	O Prep
Vortex Concentrator	Labconco	010595103E	Apr-99	Apr-99	New	RV II	O Prep
Vortex Concentrator	Labconco	011196291E	Jun-01	Jun-01	New	RV III	O Prep
Nitrogen Concentrator Bath	Organomations	17033	Jun-97	Jun-97	New	NZ1	O Prep
Deionized Water Generator	Barnstead Thermodyne	582941018789	Jun-95	Jun-95	New	DI1	O Prep
Pressurized Fluid Extractor	Dionex	98070129	Jun-00	Jun-00	New	PFEI	O Prep

Mitkem Corporation
Equipment List 11/04 **Department: Pest/PCB**

Equipment	Manufacturer	Serial #	Date Received	Date in Service	Condition New/Used	Equipment ID	Location
ECD/GC	Hewelett Packard	3336A55650				E1	Pest/PCB
GC	Hewelett Packard	3336A59890				E2	Pest/PCB
GC	Hewelett Packard	3235A45554				E3	Pest/PCB
GC	Agilent	US00032017				E4	Pest/PCB
GC	Agilent	US00037060				E5	Pest/PCB
FID	Agilent	US00001898				FID1	Pest/PCB

Mitkem Corporation
Equipment List 11/04 Department: SVOA

Equipment	Manufacturer	Serial #	Date Received	Date in Service	Condition New/Used	Equipment ID	Location
GC/MS	Agilent	3435A01848				S1	SVOA
GC/MS	Agilent	3449A02133				S2	SVOA
GC/MS	Agilent	US72821130				S3	SVOA
GC/MS	Agilent	CN10315002	5/1/03	5/13/03	New	S4	SVOA

Mitkem Corporation
Equipment List 11/04 **Department: VOA**

Equipment	Manufacturer	Serial #	Date Received	Date In Service	Condition New/Used	Equipment ID	Location
GC/MS	Hewelett Packard	3336A55963				V1	VOA
Auto sampler	OI	13193				V1	VOA
Concentrator	OI	J651460769				V1	VOA
GC/MS	Hewelett Packard	3336A58222				V2	VOA
Auto sampler	OI	13091				V2	VOA
Concentrator	OI	H340460074				V2	VOA
GC	Hewelett Packard	3336A56504				V3	VOA
Auto sampler	OI	C508411868				V3	VOA
Concentrator	OI	J430460188				V3	VOA
GC	Hewelett Packard	2843A21041				V4	VOA
Auto sampler	Tekmar/Dohrmann	90312004				V4	VOA
Concentrator	Tekmar/Dohrmann	88341012				V4	VOA

Mitkem Corporation
Equipment List 11/04 **Department : VOA**

Equipment	Manufacturer	Serial #	Date Received	Date in Service	Condition New/Used	Equipment ID	Location
GC/MS	Hewelett Packard	US00007055				V5	VOA
Auto sampler	OI	13462				V5	VOA
Concentrator	OI	J651460769				V5	VOA
GC/MS	Hewelett Packard	US00031343				V6	VOA
Auto sampler	OI	B03745A407				V6	VOA
Concentrator	OI	J651460769				V6	VOA
GC	Hewelett Packard	3140A37463				V7	VOA
Auto sampler	Tekmar/Dohrmann	US01170015				V7	VOA

Mitkem Corporation
Equipment List 11/04 **Department: Receiving**

Equipment	Manufacturer	Serial #	Date Received	Date in Service	Condition New/Used	Equipment ID	Location
% Solid Oven	Thello Lab Oven	600011006			used		Unit 3
R2 Fridge	Kenmore 15	D74779289			used		Receiving
R11 Fridge	General Electric	FS116390			used		Receiving
Walk in Cooler		Not Applicable			used		Receiving

Weight Set Identification:

1. WT1-Organic Prep Weight Set
2. WT2-Organic Prep 100g
3. WT3-Organic Prep 300g
4. WT4-Organic Prep 1kg
5. WT5-Inorganics Weight Set
6. WT6-VOA Weight Set

Laboratory Information System Equipment

1. Data Collection:

1.1 12 - HP chem station software for collecting GC-ECD and GC-MS data
- 4 GC-ECD
- 4 GC-MS (SVOA)
- 4 GC-MS (VOA)

1.2 Hardware varies but is x86 compatible

1.3 OS is Windows, Various Versions

2. Data Storage:

2.1 Dell Poweredge server

2.2 Dual P IV Xeon processors

2.3 2 GB RAM

2.4 105 GB Storage expandable to 210 GB internally

2.5 LTO tape drive for daily backup and long term archiving.

2.6 OS is Windows, Various Versions

2.7 Tape software is Backup Exec

3. Compound Identification:

3.1 12 - Target 4.13 chromatographic software

3.2 Hardware is new P IV equivalent (2.4 GHZ, 500MB RAM, 80GB HD)

3.3 OS is Windows, Various Versions

4. Forms Generation:

4.1 In house Access module (similar to OLC module)

4.2 Hardware varies but is x86 compatible

4.3 OS is Windows, Various Versions

5. SEDD XML:

Mitkem LIMS in conjunction with DynCorp's SEDD Tool.

MITKEM CORPORATION

CONFIDENTIALITY, ETHICS, and DATA INTEGRITY AGREEMENT

APPENDIX B

CONFIDENTIALITY, ETHICS, AND DATA INTEGRITY

The confidentiality, ethics, and data integrity agreement below must be signed and dated by all new personnel associated with the data generated by Mitkem Corporation. All said personnel will complete a training course and understand the information stated in the agreement. The course must include the ethical and legal responsibilities including the potential punishments and penalties for improper, unethical, or illegal actions. All personnel must fully understand this information before signing the agreement.

Data Integrity training will be done on an annual basis. If changes to the enclosed integrity agreement are made, then all employees will be required to review and sign. All documents are stored in the employee's personnel file located in the QA Department.

MITKEM CORPORATION

CONFIDENTIALITY, ETHICS AND DATA INTEGRITY AGREEMENT

I. I, _____ *(Name)*, state that I understand the standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at Mitkem Corporation.

II. I agree that in the performance of my duties at Mitkem Corporation:

A. I shall not improperly use manual integrations to meet calibration or method QC criteria, such as peak shaving or peak enhancement.

B. I shall not intentionally misrepresent the date or time of analysis by resetting computer or instrument date/time.

C. I shall not falsify analytical results.

D. I shall not report analytical results without proper analysis documentation to support the results; dry-labbing.

E. I shall not selectively exclude data to meet QC criteria, such as calibration points, without technical or statistical justification.

F. I shall not misrepresent laboratory performance by presenting calibration data or QC limits within data reports that are not linked to the data set reported.

G. I shall not represent matrix interference as basis for exceeding acceptance criteria in interference-free matrices, such as method blanks and Laboratory Control Standards (LCS).

H. I shall not manipulate computer software for improper background subtraction or chromatographic baseline manipulations.

I. I shall not alter analytical conditions such as EM voltage, GC temperature program, etc. from standards analysis to sample analysis.

J. I shall not misrepresent QC samples such as adding surrogates after sample extraction, omitting sample preparation steps, or over-spiking/under-spiking.

K. I shall not report analytical results from the analysis of one sample for those of another.

L. I shall not intentionally represent another individual's work as my own.

III. I agree to report immediately any accidental or intentional reporting of non-authentic data either I or another employee may have committed. Such report must be made to any member of Mitkem Corporation's Management (Kin Chiu, Reinier Courant, David Darlington, Edward Lawler, Karen Gavitt, or Leonard Ranalli) either orally or in writing. Every incident will be investigated by senior management. A written corrective action is required of any findings from the investigation.

IV. Any incidents that violate the standards of data integrity can result in immediate termination of the employee as well as civil or criminal charges.

V. Questions pertaining to confidentiality, ethics, and integrity may be posed to any of the above individuals.

VI. I agree not to divulge any pertinent information including but not limited to data and any other information about a project to outside sources without the prior consent from the client.

I understand that failure to comply with the above ethics and data integrity agreement can result in my immediate dismissal from Mitkem Corporation.

_____ _____

(Signature) *(Date)*

_____

(Print Name)

Figure 8.4-5
MITKEM Chain-of-custody Form

MITKEM CORPORATION

175 Metro Center Boulevard
Warwick, Rhode Island 02886-1755
(401) 732-3400 • Fax (401) 732-3499
email: mitkem@mitkem.com

CHAIN-OF-CUSTODY RECORD

Page ____ of ____

REPORT TO		INVOICE TO		
COMPANY	PHONE	COMPANY	PHONE	LAB PROJECT #:
NAME	FAX	NAME	FAX	
ADDRESS		ADDRESS		TURNAROUND TIME
CITY/ST/ZIP		CITY/ST/ZIP		

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	REQUESTED ANALYSES	COMMENTS
	/									
	/									
	/									
	/									
	/									
	/									
	/									
	/									
	/									
	/									
	/									
	/									

UNCONTROLLED DOCUMENT

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS	COOLER TEMP
1		/		/		
2		/		/		
3				/		

WHITE: LABORATORY COPY YELLOW: REPORT COPY PINK: CLIENT'S COPY

Figure 8.5-1
Workorder Information Form

Mitkem Corporation

23/Nov/04 8:53

WorkOrder: C1175

Client ID: MITKEM_WARWICK
Project: INTERNAL TESTING
Location:
Comments: Internal test

Case:
SDG:
PO: --

Report Level: LEVEL 2
EDD:
HC Due: 10/04/04
Fax Due:

Sample ID	Client Sample ID	Collection Date	Date Received	Matrix	Test Code	Lab Test Comments	Iold	MS	SEL	Storage
C1175-01A	WW-9/20-G	09/20/04 0:00	09/20/04	Aqueous	E624		☐	☐	☐	VOA
C1175-01B	WW-9/20-G	09/20/04 0:00	09/20/04	Aqueous	E335.4		☐	☐	☐	B1
C1175-02A	WW-9/20-C	09/20/04 0:00	09/20/04	Aqueous	SM5220		☐	☐	☐	G2
C1175-02B	WW-9/20-C	09/20/04 0:00	09/20/04	Aqueous	E200.7	Cd, Cr, Cu, Pb, Ni, Ag, Zn	☐	☐	☑	M5

Client Rep: Edward A Lawler

Figure 8.6-1
Volatiles Receiving Logbook Form

MITKEM CORPORATION: VOLATILES RECEIVING LOGBOOK

VOA Log-In Date	Workorder	Client	Sample Numbers	Relinquished By	Comments

Logbook ID 90.0191-6/03

Reviewed By: Page Number _____

Figure 8.6-2
Temperature Logbook Form

MITKEM CORPORATION: Freezer Temperature Logbook

Date: _____ **Analyst** _____

Temperature Requirements:

Freezers between-10 and -20 degree C

Freezer ID	Time	Temp	Time	Temp	Time	Temp	Time	Temp	Comments
F3									
F4									
F5									
F7									
F9									
F10									
F13									
F15									
F16									
F17									
F18									

Figure 8.6-3
Extracts Transfer Logbook Form – Semivolatile Analysis

MITKEM CORPORATION EXTRACT TRANSFER LOGBOOK: SEMIVOLATILE ANALYSIS

Date Transferred from Prep Lab	Lab ID		Transferred By	Received By	Storage Location	Comments

Logbook ID 70.0141-10/04 **Reviewed By:** ____________________ **Logbook Page:**

Figure 8.6-4
Extracts Transfer Logbook Form – Pesticide/PCB Analysis

MITKEM CORPORATION EXTRACTS TRANSFER LOGBOOK: PESTICIDES/PCB ANALYSIS

Date Transferred from Prep Lab	Lab ID		Transferred by	Received by	Storage Location	Comments

9.0 CALIBRATION PROCEDURES AND FREQUENCIES

9.1 Instruments:

Specific calibration and check procedures are given in the analytical methods referenced in Section 10. The frequencies of calibration and the concentrations of calibration standards are determined by the cited methods and any special project or contract-specific requirements. Standard calibration curves of signal response versus concentration are generated on each analytical instrument used for a project, prior to analysis of samples. A calibration curve of the appropriate linear range is established for each parameter that is included in the analytical procedure employed and is verified on a regular basis with check standards as specified in the appropriate CLP Protocols. For non-CLP work, MITKEM adheres to the calibration criteria specified by SW-846 and/or Standard Methods for both organic and inorganic analyses. Where requested, other method specific calibration criteria are used.

For organic analyses whenever possible, unless otherwise specified in the individual methods, the initial calibration standards (ICAL), continuing calibration verification standards (CCV), laboratory control sample spike (LCS) and matrix spike (MS) will all be from the same source. The initial calibration verification (ICV) standards are prepared from a separate source. The following are examples of calibration procedures for various instrumental systems. Please refer to the Standard Operating Procedures for the specific calibration requirements.

GC/ECD and GC/FID – An initial calibration is performed using five different concentration levels for each parameter of interest for SW-846 analyses. The initial calibration is done on each column and each instrument, and is repeated each time a new column is installed or whenever a major change is made to the chromatographic system.

An initial calibration verification (ICV), near mid level concentration for all analytes, is performed immediately after the calibration. If the ICV does not meet method specific criteria, a new calibration curve is generated and an ICV is analyzed. If repeated ICV failures are encountered, the system is checked to find the cause of these failures, and the problem is corrected. For certain GC/FID analyses (i.e. GRO or DRO), the instrument is calibrated using individual compounds while the laboratory control sample or ICV uses a petroleum product (diesel or gasoline).

A continuing calibration verification (CCV), near a mid-level concentration for all analytes, is run at ten (10) sample intervals. If CCV values are determined outside the upper limit of the method specified range and if no analytes were detected in the samples, the run will be accepted as valid and 'No Detects'

reported for the sample. If an analyte is detected and the CCV is out at the high end, the problem will be identified and corrected and the affected samples will be re-analyzed with a compliant CCV.

If a CCV value is out of the method specified limits at the lower limit, the cause of the problem will be identified and corrected, and all samples affected by the out of control CCV will be rerun with a compliant CCV.

For CLP-type analyses, the continuing calibration takes place at the beginning of the analytical sequence and once every twelve (12) hours throughout the analytical sequence. The percent difference in calibration factors for each standard must not exceed the criteria specified by the method.

If a CCV fails to meet criteria limits, a new calibration curve will be generated and all samples affected will be re-analyzed.

GC/MS – For CLP methods, a minimum of five-level calibration (four-level for selected semivolatile compounds) is carried out for each analyte per system before analysis of samples take place.

Continuing calibrations, near midpoint levels, are analyzed every twelve hours of instrument analysis time for CLP analyses.

Re-calibration takes place whenever a major change occurs in the system, such as a column change in the GC or a source cleaning of the mass spectrometer or when the continuing calibration fails to meet method specific requirements.

Tunes are performed once every twelve (12) hours. The GC/MS system is tuned to USEPA specifications for bromofluorobenzene (BFB) or decafluorotriphenylphosphine (DFTPP) for volatile and semivolatile analyses, respectively. Verification of tuning criteria occurs every twelve hours of instrument run time for all CLP-type and SW846 analyses.

More detailed instrument and method-specific calibration procedures and criteria are described in the individual analysis SOPs.

ICAP – Instrument calibration, for each wavelength used, occurs at the start of each analysis. The calibration curve is constructed per method specification.

An initial calibration verification and initial calibration blank (ICB) are analyzed before analysis of samples. If the ICV and ICB do not meet method specific criteria for an analyte, the analyte is re-analyzed with a new calibration.

During the analysis, a continuing calibration verification (CCV) and continuing calibration blank (CCB) is analyzed at least every ten (10) samples. If either the CCV or CCB fails to meet method specific criteria for an analyte, the source of

the problem is investigated. If it can be determined that the failed CCV and/or CCB is not representative (such as for instrument carryover from previous sample or from an empty autosampler tube), the CCV and/or CCB are re-analyzed and the reason for the failure documented. If a failure still occurs, further corrective action is performed, and the analyte is re-analyzed with a new calibration.

The CCV is obtained from a source independent from that of the standards. The CCV concentration for the different analytes are at method specified levels.

The Flow Injection Mercury System (FIMS) - Instrument calibration occurs at the start of each analysis. The calibration curve is constructed per method specification.

An initial calibration verification (ICV) and initial calibration blank (ICB) are analyzed before analysis of samples. If the ICV and ICB do not meet method specific criteria for Mercury, re-calibration and reanalysis are required.

During the analysis, a continuing calibration verification (CCV) and continuing calibration blank (CCB) is analyzed at least every ten (10) samples. If either the CCV or CCB fails to meet method specific criteria for Mercury, the source of the problem is investigated. If it can be determined that the failed CCV and/or CCB is not representative (such as for instrument carryover from previous sample or from an empty autosampler tube), the CCV and/or CCB are re-analyzed and the reason for the failure documented. If a failure still occurs, further corrective action is performed, and the analyte is re-analyzed with a new calibration.

The CCV is obtained from a source independent from that of the standards. The CCV concentration for Mercury is at method specified levels.

Other instrumentation:

pH- the meter is calibrated at two pH levels (4.0 and 10.0) before analyses of samples. The pH 7.0 buffer is analyzed as an LCS and the recovery calculated.

Lachat 8000- automated flow-through spectrophotometer is calibrated per method specification before the analyses of samples.

An initial calibration verification and initial calibration blank (if required) are analyzed before analysis of samples. If the ICV and/or ICB do not meet method specific criteria for an analyte, re-calibration must occur.

During the analyses, a continuing calibration verification and continuing calibration blank is analyzed at least every ten (10) samples. If either the CCV or CCB fails to meet specified criteria for an analyte, the source of the problem is investigated. If it can be determined that the failed CCV and/or CCB is not representative (such as for instrument carryover from previous sample or from an

empty autosampler tube), the CCV and/or CCB are re-analyzed and the reason for the failure documented. If a failure still occurs, further corrective action is performed, and the analyte is re-analyzed with a new calibration.

The CCV is obtained from a source independent from that of the standards. The CCV concentration for the different analytes are at method specified levels.

SpecGenesys- manual spectrophotometer is calibrated per method specification.

A calibration curve calibration verification is analyzed at the beginning, end, and at least every 10 samples. The verification standard is from an independent source. If the calibration verification does not meet method specific criteria for an analyte, it is re-analyzed once. If failure still occurs, a new calibration curve is established and any affected samples are reanalyzed. Calibration curves are established at least quarterly.

The specs are calibrated twice yearly.

Balances: are calibrated by an outside source on an annual basis. A calibration check is performed with NIST traceable weights monthly. The balances are calibrated with Class 1 or 2 weights each day of use.

Class "S" weights are NIST certified by an outside certified service on a regular basis.

Thermometers are calibrated once a year against an NIST-verified thermometer or as they are replaced.

The NIST thermometers are certified by an outside certified service annually.

Gel Permeation Chromatography is used to clean samples according to CLP and client requirements. There are two GPC's in use. These are calibrated using a calibration standard provided by Ultra Scientific, Cat. # CLP-340. Once a successful calibration is achieved it is valid for a period of seven days.
The organic preparation lab uses several maintenance logbooks with distinctive ID's.
GPC's and RapidVap Maintenance Logbooks: 50.0010-50.0015
General Maintenance Logbook: 50.0020

9.2 Standards and Reagents:

Standard reference materials used for routine calibration, calibration checks, and accuracy are obtained from commercial manufacturers. These reference materials are traceable to the source and readily compared to EPA references. Most

standards are traceable to NIST; however, certain projects, especially those involving pesticide registration, may necessitate the use of reference standards supplied by the client. New standards are also routinely validated against known standards that are traceable to EPA or NBS reference materials.

Standards are purchased from valid vendors with proven expertise in their field. All standards come with a Certificate of Analysis which is kept on record in the appropriate laboratories. Intermediate standards, if necessary, are prepared in the labs and then QA'd by spiking reagent water with the standard. The spike sample is then carried through the normal extraction and analysis procedures. Criteria for the intermediate spike must meet the method or in-house criteria. If acceptable, the spike is able to be used. If unacceptable, another intermediate standard is prepared and the same steps repeated.

Intermediate and working standards are prepared in the same solvent or solution as the samples that the standard will be spiked.

Primary, intermediate and working standards are all named with specific nomenclature as designated in each department's SOP.

Standards are dated upon arrival. Any material exceeding its shelf life as described by the methods in Section 10.0 is discarded and replaced. Standards are periodically analyzed for concentration changes and inspected for signs of deterioration such as color change and precipitate formation. Standards Receiving and Preparation Logbooks, which contain all pertinent information regarding the source and preparation of each analytical standard, are maintained by each of the MITKEM laboratory departments (Figures 9.2-1 to 9.2-4).

See Mitkem analytical SOPs, sections 7 and 8 for standards preparation procedures

Solvents are examined for purity prior to use to ensure there is no external source of contamination. For organic solvents, each lot number of solvent is QC'd prior to use. This is accomplished by extracting an aliquot of solvent or reagent media in the same manner as the samples and analyzing it for contamination. Any detectable analyte could render the solvent or reagent unsuitable for use. Supervisors make the final decision as to the suitability of the solvent or reagent.

Reagents are stored in the respective laboratories during use. Backup supplies are stored in Mitkem's stockroom. All chemicals and reagents are given a 3-year expiration period unless designated otherwise by the manufacturer. Sometimes the viability of the reagent does not remain throughout the entire 3-year period. In this case, the chemical or reagent is readily discarded.

Chemicals and reagents are logged into the laboratory and each bottle is given a unique ID. The ID is based upon the date of its arrival at Mitkem. The only exceptions include cases of solvents and cases of acids.

Any applicable certificates of analysis are stored in the individual laboratories or in the QA Department. When a bottle is opened in the laboratory, it is inspected to ensure it meets the requirements of the method. The analyst records his or her initials on the bottle along with the date opened.

For wet chemistry most standards are prepared in DI reagent water. The DI water is monitored each day of use by recording the reading on the meter itself while drawing water through the DI system as well as reading the conductivity of the water with a hand-held conductivity meter.

9.3 All purchased equipment, materials, and services must meet either specific method requirements, standard requirements, or project specific requirements. These requirements are documented in the individual analytical or project SOPs. Reagents requirements are specified in the Mitkem SOP, Reagent Control, SOP 110.0014. The equipment requirements are specified in the individual methods and SOPs.

Figure 9.2-1
Metals Primary Standard Receipt Logbook – Instrument Laboratory

MITKEM CORPORATION **METALS PRIMARY STD RECEIPT LOGBOOK:INSTRUMENT LAB**

DATE REC	PRIMARY STD ID	VENDOR	CATALOG#	LOT #	ANALYTE(S)	REC BY	DATE OPENED	EXPIR. DATE	MITKEM ID

Figure 9.2-2
Semivolatile Primary Standard Logbook – Preparation Laboratory

MITKEM CORPORATION SEMIVOLATILES PRIMARY STD RECEIPT LOGBOOK: INSTRUMENT LAB

DATE REC	PRIMARY STD ID	VENDOR	CATALOG #	LOT #	CONC.	ANALYTE(S)	REC. BY	DATE OPENED	EXPIRATION DATE

Reviewed By: _____

PAGE: _____

Figure 9.2-3
Pesticide/PCB Primary Receipt Logbook

MITKEM CORPORATION PESTICIDE/PCB PRIMARY STD RECEIPT LOGBOOK

DATE REC	PRIMARY STD ID	VENDOR	CATALOG#	LOT #	CONC.	ANALYTE(S)	REC BY	DATE OPENED	DATE EXPIR.

Reviewed By: _____

Page: _____

Figure 9.2-4
Reagent Preparation Logbook – Preparation Laboratory

Mitkem Corporation
Inorganic Laboratory
Reagent Preparation Logbook

Date:_____

Reagent/Analysis	Chemical(s) Log In ID(s)	Chemical(s) Lot#(s)	g/mL	Final Volume (ml)	Diluent	Final Conc.	Reagent ID	Exp. Date	Analyst

10.0 ANALYTICAL PROCEDURES

MITKEM uses the methods specified in Tables 10-1 through 10-6 unless otherwise specified by the client.

Table 10-1
Potable Water Analytical Methods

Parameter	Method Description	Method Reference
Metals Aluminum, Barium, Chromium, Cobalt, Copper, Iron, Manganese, Molybdenum, Nickel, Silver, Sodium Vanadium, Zinc	ICAP Analysis*	200.7
Mercury	Cold Vapor Analysis	245.1
Residual Chlorine	Spectrophotometric	SM4500-Cl G
Trihalomethanes	Purge&Trap GC/MS Analysis	524.2
Volatile Organic Compounds	Purge&Trap GC/MS Analysis	524.2
1,2-Dibromo-3-chloropropane 1,2-Dibromomethane	Micro extraction GC\ECD Analysis	504.1

*** Please note; Antimony, Lead, Selenium, and Thallium analyses in potable water are subcontracted to a Drinking Water certified laboratory. Mitkem is not certified for Graphite Furnace Atomic Absorption (GFAA) analysis for these analytes.**

Table 10-2
Non-potable Water Priority Pollutant Analytical Methods

Parameter	Method Description	Method Reference
Metals Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Silver, Silver, Thallium, Potassium Vanadium, Zinc, Sodium	ICP	6010B
Mercury	Cold Vapor	7470A, 7471A
Alkalinity	Titration	SM2320
Chloride	Colorimetric	EPA 325.2
pH	Electrode	SM4500 H+ B
Sulfate	Turbidimetric	SM4500-SO4 E
Ammonia	Distillation/Nesslerization	SM4500-NH3 B
Nitrate	Autoanalyzer	EPA 353.2
Nitrite	Colorimetric	SM4500-NO2 B
Orthophosphate	Ascorbic, Manual	SM4500-P E
Total phosphate	Persulfate, Manual	SM4500-P B3 & E
Chemical Oxygen Demand	Spectrophotometric(Closed Reflux)	SM5220-D
Total Organic Carbon	Combustion	EPA 415.1
Phenols	Distillation, Color, Automated	SM5530 B
Total Dissolved Solids	Gravimetric	SM2540 C
Total Solids	Gravimetric	SM2540 B
Total Suspended Solids	Gravimetric	SM2540 D

Table 10-2
Non-potable Water Priority Pollutant Analytical Methods (cont.)

Parameter	Method description	Method Reference
Total Settleable Solids	Imhoff cones	SM2540 F
Volatile Organics		
Halocarbons	Purge & Trap, GC/MS	624
Aromatics	Purge & Trap, GC/MS	624
Semivolatile Organics	Extraction, GC/MS	625
Organochlorine Pesticides/ PCBs	Extraction, GC/ECD	608
Oil & Grease	Extraction, Gravimetric	1664

Table 10-3
SW-846 Inorganic Analytical Methods

Parameter	Method Description	Method Reference
Metals		
Aqueous	Acid digestion ICAP analysis	Method 3005A/3010A Method 6010B
Solid	Acid digestion ICAP analysis	Method 3050B Method 6010B
Mercury		
Aqueous	Permanganate digestion Cold Vapor analysis	Method 7470A
Solid	Permanganate digestion Cold Vapor analysis	Method 7471A
Hexavalent Chromium		
Aqueous	Diphenyl Carbazide Colorimetric	SM 3500Cr D
Solid	Acid Digestion colorimetric	Method , 3060A, 7196A
Cyanide		
Aqueous	Midi-distillation Automated	Method 9012B
Solid	Midi-distillation Automated	Method 9012B
pH		
Solid	Electrode	Method 9045C
Ignitability (Flashpoint)		
Aqueous	Pensky-Martens closed cup	Method 1010
Solid	Pensky-Martens closed cup	Method 1010 Mod.
Reactive Cyanide Solid & Aqueous	Distillation Automated	SW 846 7.3.3.2
Reactive Sulfide Solid & Aqueous	Distillation Colorimetric	SW 846 7.3.4.2

Table 10-3
SW-846 Inorganic Analytical Methods (cont.)

Parameter	Method Description	Method Reference
Toxicity Characteristic Leaching Procedure (TCLP)		
Aqueous	Leachate by Filtration	Method 1311
Solid	Leachate Generation	Method 1311
Synthetic Precipitation Leaching Procedure (SPLP)		
Aqueous	Leachate by Filtration	Method 1312
Solid	Leachate Generation	Method 1312

Table 10-4
SW-846 Organic Analytical Methods

Parameter	Sample Preparation	Sample Analysis
Volatile Organic Compounds		
Aqueous	Method 5030	Method 8260B
Solid	Method 5030 Method 5035	Method 8260B
Volatile Organic Compounds (Aromatic + Methyl t-butyl ether (MTBE))		
Aqueous	Method 5030	Method 8021B
Solid	Method 5030	Method 8021B
Semivolatile Organic Compounds		
Aqueous	Method 3510C Method 3520C	Method 8270C
Solid	Method 3540C Method 3550B Method 3545	Method 8270C
Organochlorine Pesticides		
Aqueous	Method 3510C Method 3520C	Method 8081A
Solid	Method 3540C Method 3550B Method 3545	Method 8081A
Polychlorinated Biphenyls (Aroclors and Congeners)		
Aqueous	Method 3510C Method 3520C	Method 8082
Solid	Method 3540C Method 3550B Method 3545	Method 8082
Total Petroleum Hydrocarbons		
Aqueous	Method 3510C Method 3520C	Method 8015M
Solid	Method 3540C Method 3550B, Method 3545	Method 8015M

Table 10-4
SW-846 Organic Analytical Methods (cont.)

Parameter	Sample Preparation	Sample Analysis
Herbicides		
Aqueous	Method 8151A	Method 8151A
Solid	Method 8151A	Method 8151A
Toxicity Characteristic Leaching Procedure (TCLP)		
Aqueous	Method 1311	
Solid	Method 1311	
Synthetic Precipitation Leaching Procedure (SPLP)		
Aqueous	Method 1312	
Solid	Method 1312	
Gel Permeation Chromatography (GPC)		
Aqueous	Method 3640A	
Solid	Method 3640A	
Florisil Cleanup		
Aqueous	Method 3620B	
Solid	Method 3620B	
Silica Gel Cleanup		
Aqueous	Method 3630C	
Solid	Method 3630C	
Sulfur Cleanup		
Aqueous	Method 3660B	
Solid	Method 3660B	
Sulfuric Acid Cleanup		
Aqueous	Method 3665A	
Solid	Method 3665A	

Table 10-5
CLP-Type Analytical Methods

Parameter	Method Reference
USEPA CLP Organics	OLM04.3
USEPA CLP Inorganics	ILM04.1 (Pending ILM05.2)
USEPA Low Level Organics	OLC03.2
NYS-ASP CLP Organics	ASP 2000/2003 SOW
NYS-ASP CLP Organics	ASP 2000/2003 SOW

Table 10-6
Other Analytical Methods

Parameter	Method Reference
Volatile Petroleum Hydrocarbons	
Aqueous	MADEP VPH 98-1
Solid	MADEP VPH 98-1
Extractable Petroleum Hydrocarbons	
Aqueous	MADEP EPH 98-1
Solid	MADEP EPH 98-1
New York State Total Petroleum Hydrocarbon	
Solid	310.13
Extractable Total Petroleum Hydrocarbons	
Aqueous	CT ETPH 99-3
Solid	CT ETPH 99-3

10.1 Analytical References

1. Analysis of Extractable Total Petroleum Hydrocarbons (ETPH) Using Methylene Chloride Gas Chromatograph/Flame Ionization Detection, Environmental Research Institute, University of Connecticut, March, 1999

2. Analytical Services Protocol, Volume 1-8, New York State Department of Environmental Conservation, September, 1989.

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

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

5. Federal Register. Vol. 55, No. 61, March 29, 1990

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

7. The EPA 600 Series. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, Appendix A, 40 CFR Part 136, Federal Register, Vol. 49, No. 209, 1984.

8. Methods of Soil Analysis. Part 2, Chemical and Microbiological Properties, Second Edition, American Society of Agronomy, Inc., Soil Science Society of America, Inc., Madison, WI, 1982.

9. Standard Methods for the Examination of Water and Wastewater, 20th Edition, APHA, Washington, D. C., 1998.

10. Test Methods for Evaluating Solid Waste-Physical/Chemical Methods, SW-846, 3rd Edition Update IV. Office of Solid Waste and Emergency Response, USEPA, Washington, D. C., 1998.

11. USEPA Contract Laboratory Program. Statement of Work for Organic Analysis, USEPA, OLM04.3 and OLC03.2.

12. USEPA Contract Laboratory Program. Statement of Work for Inorganic Analysis, USEPA, ILM04.1.

11.0 DATA COLLECTION, REDUCTION, VALIDATION AND REPORTING

11.1 Data Collection:

Most of Mitkem's data is uploaded into the Omega LIMS systems directly from the instruments. The exception is the GC's and GC/MS's in which data is first processed in Target and then uploaded into the LIMS. Mitkem is making progress in that the elimination of the Target processing will occur in the near future.

Either the instrument analysts or data reporting group will upload the data. The person who performs the upload does a technical review to ensure recoveries of CCVs, MS, MSD, LCS all seem to be correct. A completeness review is done at this time to ensure all applicable samples have been uploaded for all the necessary analytes.

In step 2 an employee with a technical background will perform the QA process of the uploaded data. This person is either a supervisor or someone with extensive experience in environmental chemistry. Corrections to the run are made at this step if necessary. When the review is complete, this technical person authorizes the data to be reported by "QA-ing" the run in the LIMS.

11.2 Data Reduction:

Instrument printouts, computer terminal displays, chromatograms, strip chart recordings and physical measurements provide raw data that are reduced to concentrations of analytes through the application of the appropriate calculations.

Equations are generally given within the analytical methods referenced in Section 10. Data reduction may be performed automatically by computerized data systems on the instrument, manually by the analyst, or by PCs using spreadsheet and/or data base software. This software includes Thru-Put's 'TARGET' for the analyses of organic analytes and Omega LIMS for metals, cyanide and mercury analysis. Currently all OLC analyses are processed and reported through Omega at this time. Mitkem forsees that all organic data, both CLP and non-CLP, will be processed completely through the LIMS System during 2005.

11.3 Data Verification:

The verification process requires the following checks to be made on data before they are submitted to the client:

- A completeness inspection is required which ensures that all required data are included in the data packages submitted to the client and that the appropriate signatures are present on the data packages.

- A contract compliance screening to ensure that contractual requirements have been satisfied.

- A consistency check to ensure that nominally identical or similar data appearing in different places within a data package are consistent with respect to value and units.

- A correctness check to ensure that reported data have been calculated correctly or transcribed correctly.

11.4 Data Validation:

Data validation is an essential element of the QA evaluation system. Validation is the process of data review and subsequent acceptance or rejection based on established criteria.

The following analytical criteria are employed by MITKEM in the technical evaluation of data:

- Accuracy requirements.
- Precision requirements.
- Detection limit requirements.
- Documentation requirements.

As in the case of EPA/CLP procedures, data acceptance limits may be defined within the method. As one means of tracking data acceptability, quality control charts are plotted for specific parameters determined in similar, homogeneous matrices. Control limits for non-CLP methods are statistically determined annually as analytical results are accumulated.

Upon completion of the evaluation, the evaluator dates and initials the data review checklist as described in Section 11.5 below.

11.5 Data Interpretation and Reporting:

Interpretation of raw data and calculation of results are performed by an analyst experienced in the analytical methodology. For all organic data, the laboratory supervisor reviews the raw data (to include peak integration) on the computer terminal. Upon completion of data reduction, the analyst and supervisor sign for the reported results on the data review checklist.

The laboratory supervisor is responsible for the data generated in that department. The supervisor or other senior technical staff performs an independent review of data and completed report forms. Members of the QA staff also check the results on selected sets of data (usually 10%).

11.5.1 Report Formats:

Mitkem uses a flexible data reporting system where final report format is based on the requirements of the client. The two most common types of data reports generated by Mitkem are Level 2 or "commercial-format" and Level 4 or "CLP-format". Mitkem adapts its data report format, wherever possible, to meet customer requirements. Occasionally reports are generated that are a compromise between "commercial" and CLP-format deliverables or are designed to meet the needs of a particular regulatory format or sampling program.

Commercial data reports are generated using the Omega LIMS or MS EXCEL. For the Omega LIMS system, all instrumental analysis data are uploaded from instruments to the LIMS by electronic data transfer. Non-instrumental analysis data or sample preparation data are manually entered into the LIMS. All manual data entry steps are double-checked to insure they are correct, and instrumental data are spot-checked to insure the proper functioning of the data upload system. For data entered into MS-EXCEL, all the pertinent client information and the analysis results are entered manually. The draft report is subject to a 100% technical and completeness review before it is printed in its final form. All data receive a 100% review before they are released to the client as final.
CLP data reports are generated using specialized software, Thru-Put TARGET for many organics analyses, and the CLP report modules in the Omega LIMS for all inorganic and certain organic analyses. These reports also undergo a 100% review before they are released to the client in their final form.

Records are maintained for all data, even those results that are rejected as invalid.

11.5.2 Data Reporting for Massachusetts Drinking Water Samples:

Drinking water data reports generated for clients in the State of Massachusetts need to be reported on state forms. These reports are sent to the client. The client is responsible for forwarding copies of the report to the regional DEP Offices and local officials.

11.6 Levels of Data Review:

MITKEM employs five (5) levels of data review. These are based on requirements outlined in several government and other environmental analysis programs including the U. S. Army Corps of Engineers, Air Force Center for Environmental Excellence (AFCEE), Naval Facilities Engineering Service Center

(NFESC), HAZWRAP, EPA Contract Laboratory Program (CLP), as well as commercial engineering firm programs.

The data review and evaluation process is structured to insure that all data reported to customers has been thoroughly reviewed and approved using a multi-step process designed to identify and correct any error. At any step in the data evaluation and review process, the reviewer has the responsibility and authority to return any data not meeting requirements back to the previous step for re-analysis or correction. No reports are released to the client as final data without successfully passing through each step in the data evaluation and review process. The steps of the data review process are documented, generally using a checklist. Several checklists are used, depending on the type and format of analysis data being reviewed. Any data released prior to the completion of the full review process are released with the statement that the data is preliminary pending final review. The word "Preliminary" is automatically printed on the bottom of all data sheets that are generated prior to completion of data review.

The five levels of data review are as follows:

11.6.1 Level 1:

The analyst or a qualified peer analyst within the analytical laboratory section that produced the results performs a Level 1 review. Level 1 review is comprehensive, evaluating 100% of the data for compliance with SOP and method requirements, as well as project-specific requirements. The analyst/peer reviews the data set to insure that sample preparation and analysis data are correct and complete. A checklist (Figures 11.5-1, 11.5-2 and 11.5-3) is used to document that Level 1 review has been completed for each data set produced. The LIMS stores the identification of the analyst who uploaded and calculated the analytical data. The specific items reviewed may vary by method, but generally include the items listed below:

- All manual calculations or data entry steps
- Use of proper significant figures and rounding
- That results are compliant with precision and accuracy requirements through evaluation of calibration, blank, LCS, spike, duplicate and/or duplicate spike QC results
- An evaluation of analysis dates in comparison to holding times

- That all analytes are within the calibration range of the test, and any necessary dilutions have been performed.

- That data are complete; that every sample for a batch, work order or Sample Delivery Group (SDG) that requires this test has been analyzed.

- That spectral identification for target analytes or tentatively identified compounds is correct.

- Spot - check data upload programs or spreadsheet calculations to insure they are being performed correctly.

- That any deviations from the SOP, method, or project-specific requirements, or any unusual occurrences during analysis are described for inclusion in the report narrative.

11.6.2 Level 2:

Level 2 review is a technical review performed by the supervisor of the analytical laboratory section producing the data, another senior chemist experienced in the particular analysis, or other senior laboratory management, such as the Technical Director, Operations Manager, or QA Director. The same individual may not perform Level 1 and Level 2 review on the same data set. Level 2 technical review is required to be performed and documented in the LIMS for all data reported through the LIMS. This function is password-protected such that only senior technical staff may perform QA review. Level 2 review is performed on 100% of the data generated. This review may be less comprehensive than Level 1 review in that it is designed to insure that the Level 1 review was completed for each data set produced. All items listed under Level 1 review above may be checked, with particular focus on the following:

- That all project-specific criteria have been met.

- That result flags have been properly applied for any dilutions, calibration failures, blank contamination, etc.

- That the results are reasonable when compared to historic or on-going data for this program or for this analysis in general.

- Spot-checks of manual calculations or data entry steps.

- Review of the sample preparation/analytical run/sample data information in the LIMS to double-check any manual data entry and to insure the analyst makes proper method and QC associations.

- Review the use of significant figures and rounding.

- That results are compliant with precision and accuracy requirements through evaluation of performance indicators such as blanks, LCS, surrogate and matrix spikes or duplicate QC results.

- Spot-check of spectral identifications for target analytes or tentatively identified compounds.

- That any notations regarding deviations from SOP, method or project specific requirements, or any unusual occurrences are properly described for inclusion in the report narrative, and to add review comments as necessary.

11.6.3 Level 3:

Level 3 review is an administrative or non-technical review. The report group coordinator, document control specialist, project manager, or other personnel in the data report group perform Level 3 review. The same person may not both enter the data and review the data entry. 100% of the data manually entered into the commercial data reporting system are reviewed to insure there are no data entry errors. All manual data entry steps used to produce electronic deliverables are also checked.

Data reported using MITKEM's commercial data reporting system are evaluated somewhat differently from those produced using the CLP-type data reporting system, based on the different potential sources of error in these systems. Depending on the type of data entry, a data review checklist or sign-off line of a data sheet is used to document Level 3 review has been completed on each data set. Additional forms are also used for CLP and CLP-type data assembly and review. The following items are checked during Level 3 review:

- All typographical data entry into commercial data reporting templates.

- The client sample identifications are listed correctly for every sample.

- The completeness of the data report in that every analysis on the workorder sheet has been accounted for in the final report.

- That results and units are consistent throughout the data set.
- That any special requests or other notes on the login sheet have been addressed.
- That a description of any flags and data qualifiers is included in the data report.

The review of all sample login and chain of custody information is also included in Level 3 review. The review is evaluated by the project manager immediately following receipt of the samples and production of login paperwork. This review is documented by completing appropriate field in the LIMS workorder computer file, which is password protected.

11.6.4 Level 4:

Level 4 review consists of the final management approval for the entire data report. Senior laboratory management personnel, such as the Technical Director, or Operations Manager, or QA Director, or Project Manager evaluates level 4 review. This review and sign-off constitutes MITKEM's approval to release the final data report to the client. The signature on the report narrative documents that Level 4 data review has been completed on the entire data report. Level 4 data review consists of:

- The documentation of any deviations from method or SOP requirements such that they will be clear and comprehensible to the client.
- That all unusual occurrences have been clearly described in the report narrative.
- That any special analytical requests made by the client have been addressed and adequately recorded in the report.
- That the analytical report meets the goals of the testing program.
- That the data are reasonable from an overall perspective, for example, that hexavalent chromium does not exceed total chromium, or that dissolved metals do not exceed total metal concentrations.
- That the final report format and appearance are professional and consistent with MITKEM's practice.

11.6.5 Level 5:

The fifth level of data review is performed by the QA/QC Director or his designee on a subset of all data produced by the laboratory. QA review is performed on approximately 10% of all data reports generated by the laboratory, with results from each analytical section being represented. Level 5/QA Review usually takes place following release of the data report to the client. During Level 5 review, reports are evaluated to check the proper functioning of data acquisition, reduction, evaluation, and reporting. This is accomplished through spot checks and detailed calculation reviews of various steps in the analysis and data reporting process. The specific items checked are at the discretion of the QA/QC Director. Level 5 review functions as an additional check that the laboratory's QA systems are operating properly. Any deficiencies encountered during Level 5 reviews are promptly reported to MITKEM senior management.

Flow charts of the data review process follow in Figure 11.5-4.

11.7 Document Control:

All login sheets, Chains-of-Custody (COC) and Sample Condition Forms (SCF) and other sample transmittal documentation are generated in Sample Receiving. A red Workorder File is initiated to contain all workorder-specific hard copy documents. Samples are signed in/out of the sample receiving area by analysts. In the Prep lab, samples and all pertinent information is recorded into logbooks. Once samples are moved to the instrument lab, the transfer of extracts is documented in the transfer logbook. In the instrument lab, the analysis of extracts is recorded in the instrument run log. All analysis data, including ICAL, CAL and raw data are acquired using computer-controlled instruments, and stored on the hard drive of the computer performing data acquisition. Data are automatically copied to the company file server after acquisition. Organics analysis data are processed using Thru-Put Systems' Target software. This system creates a folder on the file server for each analysis fraction for each work order or SDG. This folder contains raw data, processed analysis results, instrument tune, initial calibration and continuing calibration results as well as a copy of the data processing method used. This allows for long-term archiving and complete reconstruction of the data at any time in the future. Data reporting forms and raw data are printed and arranged with all appropriate sample-preparation logbook page copies for technical review.
(Need to add LIMS data processing here for organics)
Inorganic data files are uploaded into Omega LIMS and reporting forms are printed. The original instrument data files and the processed SDG are stored on the file server where they can later be archived by the LIMS Administrator. Hard copy printouts for reporting forms, instrument data hardcopy output and all

associated preparation logbook page copies are assembled for technical data review.

The company file server consists of two separate computers, each with an array of multiple hard disk drives, that are continuously mirrored, such that the failure of any single component or computer will not impact the operation of the system, or the ability to recover data. All new files or data are copied to magnetic tape on a daily basis. On a monthly basis full system back up to tape is performed. Following technical review, and generation of the report narrative results go into the workorder file in data reporting. The original copy of the report is sent to the client. The report is also scanned into an optical file database for long-term archiving. As documents are scanned into the database they are recorded for permanent storage on CD-ROM disks. Mitkem's system includes a "jukebox" to provide access to numerous CD-ROMS on an as-needed basis. All other information associated with the report, including data review checklists are kept in the red workorder file. The workorder files are kept onsite in a storage area for approximately 6 months. The files are then shipped to an offsite storage area where they will remain for a total of 7 years. After this time, the files will be destroyed.

11.7.1 Logbooks:

All logbooks are issued and controlled by the QA Department. All controlled documents including SOPs, QA Manuals, Logbooks, etc. are given a unique ID, which is the date the document is created. This document stays in force until the next officialcontrolled update. Laboratory personnel must sign for the document when it has been released by the QA Department.

When logbooks are complete, the QA Department archives them after a period of time for a minimum of ten (10) years. The logbooks are stored in an on-site storage facility for approximately 4-6 months and then boxed and stored in a locked off-site storage facility.

11.7.2 Workorder/Data Files:

MITKEM is a secured, limited access building. The doors are secured with a keypad entry system. All hard copy information pertaining to the analysis of samples is maintained and stored in a workorder file folder. This information includes all login sheets, COC, SCF, bench sheets and analytical data. Electronic data are also stored by laboratory workorder number on the company file server, and in the optical file database of completed reports. File folders containing all hard copy data and other workorder information are stored in an off-site storage facility for a total of 7 years. The off-site storage facility is a locked storage area. Access is limited to the CFO or his designee and request to retrieve a file will be made to this person.

In the event Mitkem Corporation changes ownership, the maintenance, control, storage and eventual disposal at the end of the appropriate time period, of all records, including client data and QA/QC files, will transfer to the new owners.

In the event Mitkem Corporation decides to cease operations, clients will be notified prior to the cessation of operations and their files/records will be made available to them. Within a designated time period after notification, the client will be responsible for taking custody and the future maintenance of their records. If the client determines they do not want to maintain the records, these will be disposed of properly.

11.7.3 Standard Operating Procedures (SOPs):

SOPs are prepared by the Lab Supervisor and laboratory personnel in conjunction with the QA/QC Director. The QA Director/Staff downloads a copy of the current SOP to the network. The SOPs can be found in Avogadro/Public/QA Public.

The laboratory staff revises the SOPs by making changes to the document which is then reviewed by the department supervisor only if the supervisor is not the party responsible for the revisions. Any additional changes are made at this point.

The QA Department is notified that revisions are completed. The QA Director/Staff moves the revised copy of the SOP to the QA directory, QA Safety/SOPs Needing QA Revision. The QA Director makes changes to the document to include revision number and date and title clarification, if necessary.

The QA Director prints a copy of the SOP that is signed both by the Operations Manager and the QA Director. Copies of the signed SOP are then made for the relevant departments. Each copy is assigned a unique ID which is recorded on the SOP cover sheet. Copies are distributed to the relevant departments with a review sheet attached. At this time the old copies of the SOP are collected from the labs and archived in the QA Department. Each analyst who performs any duties related to the SOP must review the new version and sign that he or she has read and understands the material there. The signed review sheets are then returned to the QA Department. The SOP copy is stored in the department for easy reference.

SOP revisions occur on an annual basis. . The procedure for preparing, reviewing, approving, revising and distributing SOPs as well as the SOP Revision Schedule are described in SOP No. 80.0012.

11.7.4 Method Updates:

In most cases it is the laboratory's policy to implement new revisions of frequently used methods within six months of the date the method revision is promulgated or published as a final method. The QA/QC Director and Technical Director make the final decision on when a method revision will be adopted by the laboratory. Additionally, if a client specifically requests or mandates that an "older" method, Mitkem will advise the client that it is not the most recent method. If the client still insists upon the older method, Mitkem will comply and make a note in the narrative.

When the laboratory is in the middle of a client's project, the lab will continue using the same revision for the entire sampling event unless advised otherwise by the client. Consequently, once the laboratory has formally adopted a new method revision, both the old and new revision may be in use at the same time, depending on the project.

If a client should not specify which methods to be used, the methods employed by the laboratory shall be fully documented and validated. Additionally, the methods shall be published in a reputable technical journal or text or by a reputable technical organization or instrument manufacturer.

Laboratory-developed methods can be used as long as they have been documented and validated by qualified personnel. In all cases the client should be notified.

Figure 11.5-1
Commercial Data Review Checklists

Mitkem Corporation

Batch Data Review Checklist - Organics

Batch ID:_____ Analysis:_____ Run ID:_____

Data Loaded to LIMS:_____ Batch QA'ed in LIMS:_____

Level 1 (Analyst) Review:_____ Level 2 (Technical) Review:_____

Workorders:_____

	Yes	No --List/Explain any Unusual Occurrences or Nonconformances
Calibration Acceptable *Tune/ICAL / CCAI.*		*List all non-conforming project analytes*
LCS Acceptable		*List all non-conforming project analytes*
Blank Acceptable		*List all non-conforming project analytes*
Matrix Spike Acceptable		*Reasonable recovery / Matrix effect / Spike to sample concentration ratio*
MSD / Dup Acceptable		*Reasonable precision / Sample non-homogeneity?*
Within Holding Time		*List runs/re-runs out of holding time; Explain*
Within Instrument Range		*Dilutions properly noted; Explain any "E" flag analytes or dilutions with no target hit*
Surrogates Accepable		*List non-conforming surrogates, Matrix effect?*
Identification Reviwed		*Potential for false positives checked?*
Calc/Data Xfer Check:		*Including proper significant figures, rounding*
Reasonableness Check:		*Compared to historic or on-going trends, or for this analysis in general?*

Notes:

Mitkem Corporation

Batch Data Review Checklist - Inorganics

Batch ID:_____ Analysis:_____ Run ID:_____

Data Loaded to LIMS:_____ Batch QA'ed in LIMS:_____

Level 1 (Analyst) Review:_____ Level 2 (Technical) Review:_____

Workorders:_____

	Yes	No --List/Explain any Unusual Occurrences or Nonconformances
Calibration Acceptable *ICAL / CCAL*		*List all non-conforming project analytes*
LCS Acceptable		*List all non-conforming project analytes*
Blank Acceptable		*List all non-conforming project analytes*
Spike Acceptable		*Reasonable recovery / Matrix effect / Spike to sample concentration ratio*
Dup Acceptable		*Reasonable precision / Sample non-homogeneity?*
Serial Dilution		*List all non-conforming analytes. Matrix effect?*
Post-Digestion Spike		*Matrix effect?*
Within Holding Time		*List runs/re-runs out of holding time; Explain*
Within Analysis Range		*Dilutions properly noted; Explain any "E" flag analytes or dilutions with no target hit*
Calc/Data Xfer Check		*Including proper significant figures, rounding*
Reasonableness Check:		*Compared to historic or on-going trends, or for this analysis in general?*

Notes:

Figure 11.5-2
CLP and CLP-type Data Review Checklist – Organics

Mitkem Corporation
CLP/CLP-like Deliverable Review Check List for Organics Analysis

Project Number:_____ Analysis:_____ Fraction:_____
Target:_____ Category:_____ (ASP only) Analyst:_____
Data Pack. Assembly:_____ Data Pack. Review:_____ Correction by Analyst:_____

Client:_____ **Analyst** Date:_____ **Reviewer** Date:_____

Items	Pages	OK/Unusual Observation	Check	Comments
SDG Summary Sheet				
Alkane Summary Sheet				
Sample Log-in Sheet				
Extraction Bench Sheet				
% Solid Bench Sheet				
Extract Transfer Log				
Instrument Run Log				
GPC Run Log				
Internal Sample Tracking Log				

	Client IDs	OK/Unusual Observation	Check	Comments
Holding Time				
Surrogate				
Initial Analysis at Dilution				
"RE" Samples				
"DL" Samples				
MS/MSD Samples				

	Sample /Set #	OK/Unusual Observation	Check	Comments
Blank				
LCS				
Tune				
Initial Calibration				
Continuing Calibration				
Internal Standard Area				

Note:

	Yes	No
Client ID Check		
ID Truncation		
Special Request		

Figure 11.5-3
CLP and CLP-type Data Review Checklist – Inorganics

MITKEM CORPORATION

Hard Copy Due: _____
Fax Copy Due: _____

CLP/CLP-like Deliverable Check List for Inorganic Analysis

Project Number: _____ Analysis: _____
Client: _____ Category: _____
Input by/date: _____ Reviewer: _____
Forms generated on/date: _____ (1)Date Reviewed: _____
Time completed: _____ (2)Date Reviewed: _____
Corrections by: _____

Elements Required:

Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Ni	K	Se	Ag	Na	Tl	V	Zn	B	Ti	Cn	Hg	Mo

Items:	Pages	Check	OK/Unusual Observation
Sample Log-In Sheet:	_____	_____	_____
Prep Log Sheet(AQ/SL):	_____	_____	_____
%Solid Bench Sheet:	_____	_____	_____
Tumbling Log (TCLP/SPLP):	_____	_____	_____

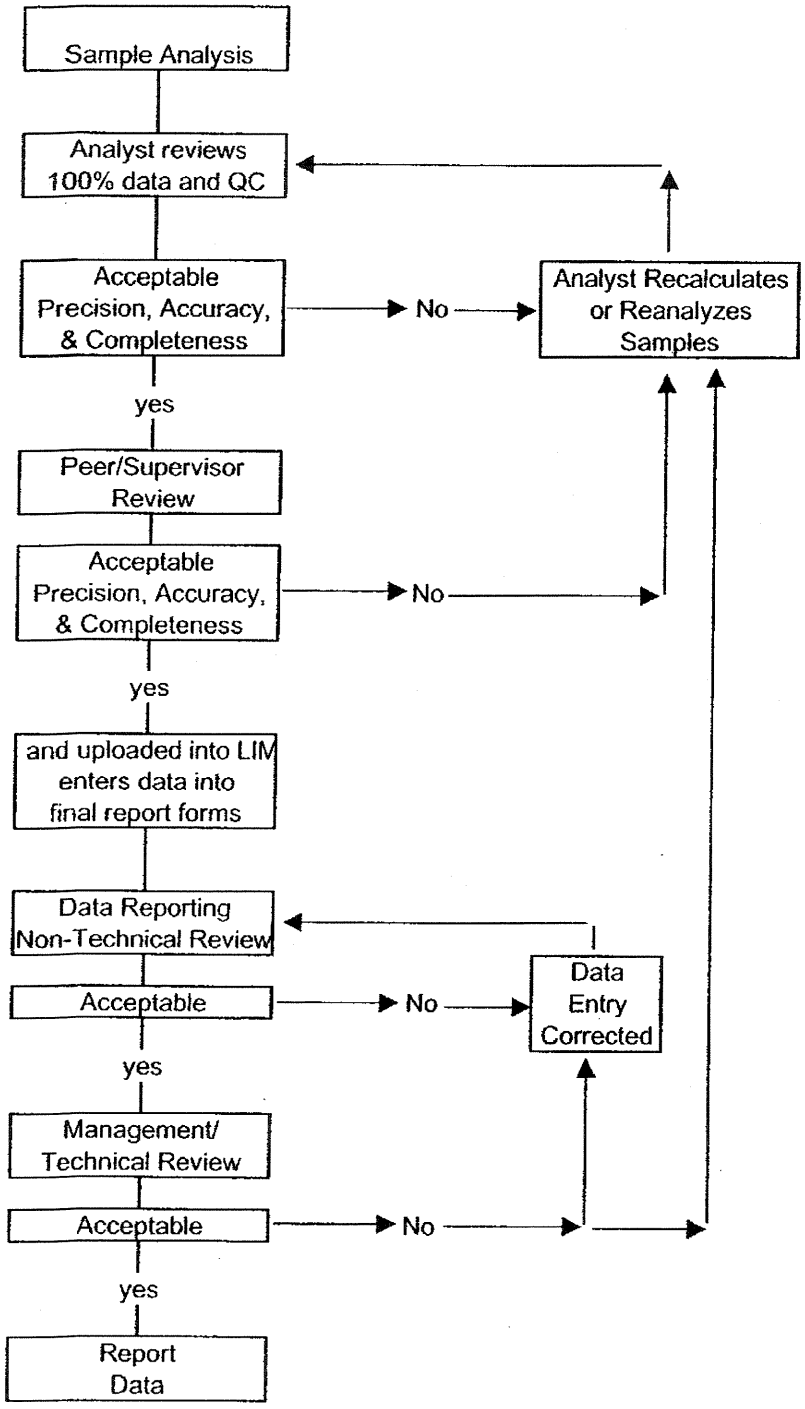
	Check	Lab ID	OK/Unusual Observation/Dev./Flags
ICV/CCV	_____	_____	_____
Spiked Samples(N)	_____	_____	_____
Duplicate Samples(*)	_____	_____	_____
Serial Dilutions(E)	_____	_____	_____
Blanks	_____	_____	_____
LCS	_____	_____	_____
ICP Interference	_____	_____	_____
CRA/CRI	_____	_____	_____

Prep Analysis Notes:

	Yes	No
Client ID Check:	_____	_____
ID Truncation:	_____	_____
Special Request:	_____	_____

Figure 11.5-4
Data Review Flow Diagram

MITKEM CORPORATION
Review Process Flow Diagram



12.0 LABORATORY QUALITY CONTROL CHECKS

MITKEM analytical procedures are based on sound quality control methodology, which derives from three primary sources:

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

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

Each of the MITKEM laboratory departments have an individual QC program, which includes, but is not limited to, the practices described below.

12.1 Detection Limit Determination/Verification:

Detection Limits are developed annually for all inorganic and organic target compounds.

12.2 Personnel Training:

Chemists who begin their employment at MITKEM are to be instructed under the MITKEM Safety Training Program within the first month. The Safety Training Program includes laboratory basics, safety video and testing, and MSDS instruction.

Before performing an analysis, a chemist is required to read the appropriate protocols and SOPs. The chemist is required to complete an SOP review form which lists all the SOPs he or she has read and understands.

The new analyst must become familiar with the laboratory equipment and the analytical methods, and begins a training period during which he or she works under strict supervision. Independent work is only permitted after the chemist successfully completes an accuracy and precision study.

The study is also commonly referred to as a Demonstration of Capability exercise. Upon the successful completion of the Demonstration of Capability exercise, the

QA Department issues a Demonstration of Capability Certificate which is signed by both the QA Director and Operations Manager and filed in the employee's personnel folder stored in the QA Department.

Demonstration of Capability studies require the acceptable recovery of 4 LCS samples for each matrix. Acceptance limits are established by the method. It is necessary to pass the study whether for extraction, analysis or both.
Initial and on-going personnel training do include data integrity training. The 4 required elements with the data integrity system include: 1) data integrity training, 2) signed data integrity documentation of all employees, 3) in-depth, periodic monitoring of data integrity, and 4) data integrity procedure documentation.

Data integrity training topics will include the need for honesty and full disclosure in all analytical reporting, how and when to report integrity issues and what those issues could be. Employees will understand that infractions of data integrity procedures can result in an investigation to could lead to serious consequences to include immediate termination, and civil or criminal prosecution. An attendance sheet will be generated for every integrity session.

Data integrity procedures are reviewed and updated annually by senior management.

Training for the EPA Statement of Work occurs according to the above requirements. In addition, analysts are required to read the CLP Statement of Work as a part of the documentation training.

12.3 Control Charts:

For organic and inorganic analyses, the recoveries of analytes in the lab control samples are plotted on control charts. These charts are used to establish control and warning limits.

12.3.1 Control limits are calculated and updated at least annually from the LCS, MS/MSD, and Surrogate data points for each analyte and matrix using the following equations:

$$Average(\bar{x}) = \frac{\left[\sum_{i=1}^{n} x_i\right]}{n}$$

$$SD = \sqrt{\frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{\quad}}$$

In which:

SD = Standard Deviation
N = number of data points

Warning Limits = Average ± 2 * SD

Control Limits = Average ± 3 * SD

12.3.2 Control limits must be approved by the QA/QC Director and by the Technical Director or Operations Manager prior to adoption by the laboratory. In the event that limits are wider than method recommended limits, the method recommended limits may be adopted and the analytical procedure will be re-evaluated and/or re-determined to identify possible causes. Additionally, in the event that control limits are tighter than 15% from the average, the lab may adopt a control limit of ±15% from the average. If in the experience of the laboratory, statistical control limits are unreasonably wide or narrow, alternative limits may be used until appropriate statistical limits are developed. Alternative limits are based on sources such as Army COE-published guidelines, EPA limits from the specific test method or from similar methods, laboratory experience with the method or other sources.

12.3.3 Control charts are plotted in EXCEL using the Omega LIMS system.

Data from each laboratory is uploaded into the LIMS. The compounds, recoveries, and date analyzed for each test are recorded in the system. In order for LIMS generated control limits to be valid, all data, including data not meeting existing recovery criteria, must be uploaded. As the laboratory uploads data for a wider range of tests, control charts will be available for these tests. Control charts may be generated for each analyte in the inorganic department to include both metals and wet chemistry parameters, and for a representative sampling of analytes in the organic sections. Each control chart is then printed for review by the QA/QC Director and by the Lab Supervisor. Out of control situations noted on the control chart are discussed with the Supervisor or Technical Director by the QA/QC Director.

An example control chart is presented as Figure 12.3-1. LCS data must be reviewed and evaluated daily against the Control Limits to establish that the system is in control.

12.3.4 The following situations constitute an out of control situation on a control chart:

- One data point above or below the Control Limit line.
- Two consecutive data points above or below the Warning Limit line.
- Six or more consecutive data points above the Average Line or six or more consecutive data points below the Average Line. This situation suggests a trend and suggests the procedure has been changed in some way (for better or worse). The cause for this trend must be investigated.

12.4 General QC Protocols:

Organics Laboratory:

- Trip blanks and holding blanks, when applicable, are analyzed to detect contamination during sample shipping, handling and storage.
- Method blanks, at a minimum of one in every 20 samples, are analyzed to detect contamination during analysis.
- Volatile organic method blanks are analyzed once during each analytical sequence.
- One blank spike (Laboratory Control Sample or LCS) consisting of an analytical sample of laboratory water or Ottawa sand with every batch of 20 or fewer samples, is analyzed to determine accuracy.
- Sample spikes and spike duplicates, as requisitioned, are analyzed to determine accuracy and the presence of matrix effects. The Relative Percent Difference (RPD) is also determined for matrix spike/matrix spike duplicates to measure precision. The criteria followed are stated in the individual methods. For batches without a sample duplicate (for example, if insufficient sample volume is provided), a duplicate blank spike (LCS) is performed to provide for precision measurement.
- Performance evaluation samples from EPA and state agencies are analyzed to verify continuing compliance with EPA QA/QC standards.
- Surrogate standards are added to samples and calculations of surrogate recoveries are performed to determine matrix effect.

- Internal standards for GC/MS analysis are added to sample extracts to account for sample-to-sample variation.

- GC analysis of EPA traceable standards to verify working standard accuracy and instrument performance.

- Initial multi-level calibrations are performed to establish calibration curves.

- Instrument calibration is established or verified with every analytical sequence.

- Tuning of GC/MS systems once every 12 hours for CLP and SW-846 methods or 24 hours for methods 624/625 to method specifications is implemented for consistency in data generation.

When QC limits are not met during an analytical run, the source of the problem must be investigated. Following an evaluation of the data, those samples affected must be re-analyzed after the problem has been solved. If QC limits continue to be out of control, the instrument must be checked and/or a service call made and/or further corrective action implemented.

Inorganic Laboratory:

- Trip blanks are analyzed when applicable, to detect contamination during sample shipping, handling and storage.

- Method blanks are analyzed at a minimum of one every 20 samples, to detect contamination during analysis.

One matrix spike and matrix duplicate of an analytical sample or laboratory water or soil is made and spike recoveries are computed with every batch up to 20 samples to determine accuracy. Duplicate samples are analyzed and the RPD between the sample and duplicate is calculated for every batch up to 20 samples. If insufficient volume of sample is received, a note is made in the appropriate preparation logbook.

- Performance evaluation samples from EPA and state agencies are analyzed to verify continuing compliance with EPA QA/QC standards.

- Metals analysis instruments are calibrated for every analytical run.

- QC/LCS checks samples are analyzed during every analytical batch of up to20 samples in order to document accuracy.

When QC limits are not met during an analytical run, the source of the problem must be investigated. Following an evaluation of the data, those samples affected must be re-analyzed after the problem has been solved. If QC limits continue to be out of control, the instrument must be checked and/or a service call made and/or further corrective action implemented.

Figure 12.3-1
Example Control Chart

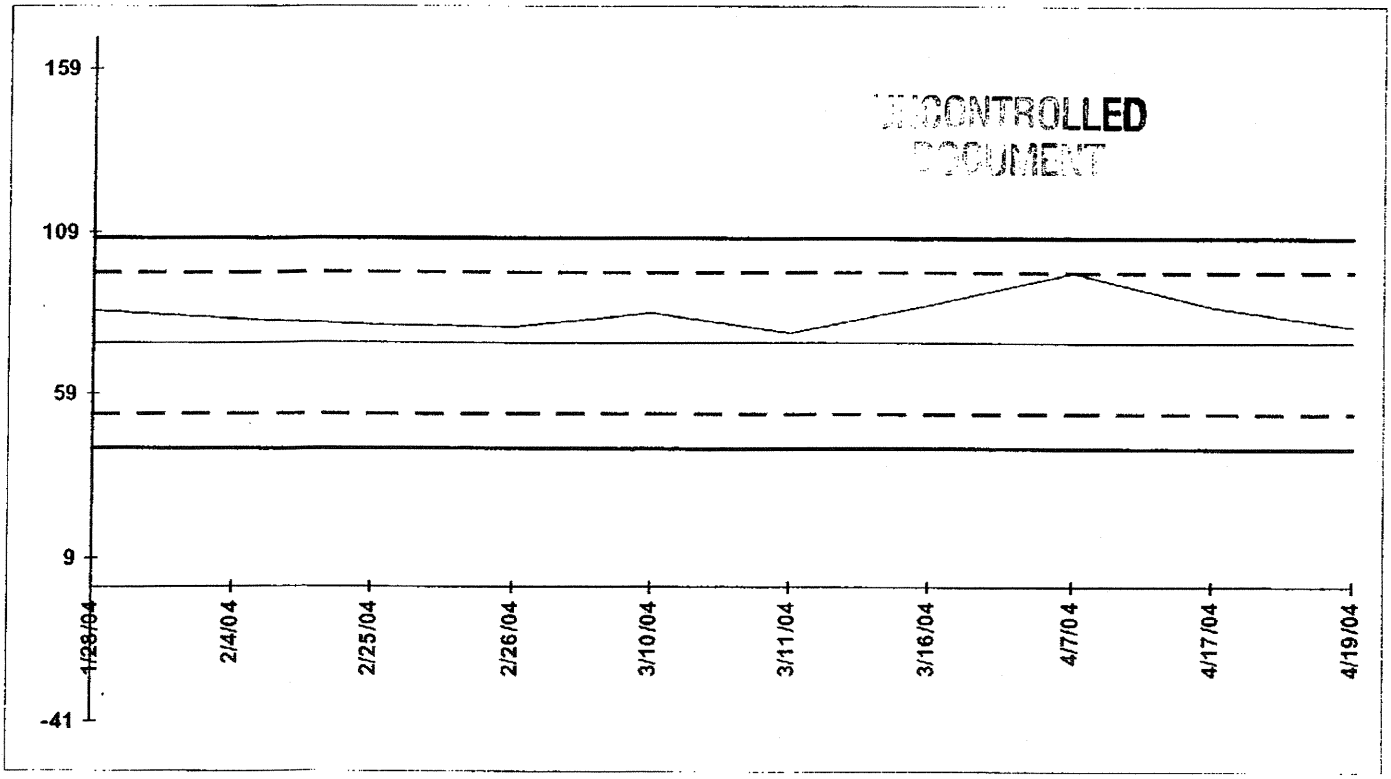
Mitkem Corporation

REC QUALITY CONTROL CHART

Date: *26-Apr-04*

Test Code: SW8270C_S **Analyte:** 1,2,4-TRICHLOROBENZENE

SampType	Sample ID	Analysis Date	Batch ID	Low Limit	High Limit	% Recovery
LCS	LCS-11428	1/28/04	11428	42	107	84.3
LCS	LCS-11558	2/4/04	11558	42	107	82.2
LCSD	LCSD-11799	2/25/04	11799	42	107	75.7
LCS	LCS-11799	2/25/04	11799	42	107	84.9
LCSD	LCSD-11799	2/26/04	11799	42	107	73.6
LCS	LCS-11799	2/26/04	11799	42	107	85.2
LCS	LCS-11994	3/10/04	11994	42	107	83.8
LCS	LCS-12002	3/11/04	12002	42	107	77.8
LCS	LCS-12075	3/16/04	12075	42	107	86.4
LCS	LCS-12294	4/7/04	12294	42	107	96.2
LCSD	LCSD-12415	4/17/04	12415	42	107	80.3
LCS	LCS-12415	4/17/04	12415	42	107	91.5
LCS	LCS-12434	4/19/04	12434	42	107	77.3
LCS	LCS-12454	4/19/04	12454	42	107	82.2



13.0 QUALITY ASSURANCE SYSTEMS AUDITS, PERFORMANCE AUDITS AND FREQUENCIES

The MITKEM Quality Assurance staff performs routine internal audits of the laboratory. The frequency of such audits depends on the workload in house but is done annually, at a minimum. These audits entail reviewing laboratory logbooks and all appropriate operations to ensure that all laboratory systems including sample control, analytical procedures, data generation and documentation meet contractual requirements and comply with good laboratory practices.

13.1 System Audits:

The QA/QC Director audits each individual laboratory annually in order to detect any sample flow, analytical or documentation problems and to ensure adherence to good laboratory practices as described in MITKEM's Standard Operating Procedures and Quality Assurance Plan. A checklist used in an internal systems audit at MITKEM is presented in Figure 13.1-1.

Areas covered by the internal audit include logbook documentation and review, standard traceability, standard storage and expiration dates, method criteria adherence, instrument maintenance records, SOP review, and knowledge of the analysts. Often, deficiencies that have been noted during "outside" audits will also be reviewed.

Upon the completion of the internal audit, a formal audit report is presented to the laboratory supervisor who is given a specific timeframe to respond in writing to the deficiencies. The QA Department will do a follow up audit to check that at least the major deficiencies have been corrected. The follow-up audit occurs within 30-45 days from the date of the audit response.

13.2 Performance Audits:

MITKEM participates in external Performance Test (PT) studies under the National Environmental Accreditation Program (NELAP) through the State of New Jersey (Mitkem Laboratory's Primary Accreditation Authority). The QA department of the laboratory administers the Performance Evaluation Samples [Drinking Water (DW) and Wastewater/Solid Waste (WW/SHW).

Several times a year outside agencies (federal, state, or private) may schedule an audit at Mitkem in order to check the laboratory's processes. Most often these audits begin and end with a meeting between auditors and laboratory management. Each individual laboratory is then examined. The QA Department and/or Senior Management Staff are most likely to remain with the auditors at all times during the audit.

Sometime after the audit, Mitkem receives a formal audit report to which it must respond. The audit report is initially reviewed by the QA Director who copies and distributes the report to each laboratory supervisor. The supervisors are required to respond in writing to the findings that pertain to his or her department. The QA Officer compiles the formal response that could be tweaked several times before the auditing authority accepts the results.

The QA Officer than sends a memo to each supervising to detail what needs to be done in each department within a specific timeframe. The QA Department then follows up with the labs to ensure procedures have been modified and the corrective actions are in place.

Internally, performance is monitored on a daily basis at MITKEM through the use of surrogate standards, LCS, and MS/MSD samples. Check samples from independent commercial sources are employed routinely in each of the MITKEM laboratory departments and ensure continuing high-level performance. The QA Director at a minimal frequency may distribute internal blind PE samples to each laboratory department annually. These blind PE samples can also be used to show on-going analyst proficiency in lieu of 4 LCS studies.

Figure 13.1-1
QA Systems Audit Checklist

MITKEM CORPORATION
QA Internal Audit

I. Quality Assurance:

QA/QC Director with assigned duties?	Yes / No
QA Report to Management submitted Quarterly?	Yes / No
Organizational Chart Up to Date? (Attachment A)	Yes / No
Quality Assurance Plan Updated Annually?	Yes / No
Date Revised:_____	
Is the Quality Assurance Plan a controlled document?	Yes / No

Laboratory Equipment

Is equipment adequate and up to date?	Yes / No
Attach current Equipment List (Attachment B)	

Audit Program

Internal Systems Audits performed annually?	Yes / No
Attach list of External Systems Audits from last year. (Attachment C)	
Internal Performance Audits performed annually?	Yes / No
Attach list of External Performance Audits from last year (Attachment D)	
Internal Data Audits performed on 10% of data generated?	Yes / No

Employee Training

Employee Training Files up to date?	Yes / No
Safety Training Record for all employees?	Yes / No

Standard Operating Procedures

Are the general SOPs updated annually?	Yes / No
Are SOPs updated annually for each analytical method?	Yes / No
Are SOPs updated annually for Sample Receiving?	Yes / No
Are SOPs updated annually for QA/QC Procedures?	Yes / No
Are SOPs updated annually for Data Reporting/Data Review?	Yes / No
Are SOPs updated annually for Standard Traceability?	Yes / No
Are SOPs controlled documents?	Yes / No
Are SOPs signed by appropriate individuals?	Yes / No

Method Validation

Initial Demonstration of Proficiency before method is implemented?	Yes / No

Are MDL studies up to date for each method?	Yes / No
Is the Amount Spiked equal to 3-5x the calculated MDL or per SOP?	Yes / No
Does the lab maintain a copy of each method it performs?	Yes / No

Corrective Actions

Is a formal system for Corrective Actions in place?	Yes / No
Does the QA/QC Director review CARs?	Yes / No
Are CARs controlled documents?	Yes / No

Logbooks

Are laboratory logbooks controlled and archived by QA?	Yes / No
Are logbook templates controlled and archived by QA?	Yes / No
Are logbooks peer reviewed weekly?	Yes / No
Proper correction techniques used?	Yes / No
Empty spaces properly "z"d out?	Yes / No
Are logbooks paginated?	Yes / No

II. Quality Control:

General Laboratory Equipment

Is an NIST traceable thermometer available?	Yes / No
Are lab thermometers calibrated annually against the NIST thermometer?	Yes / No
Are correction factors in use on lab thermometers?	Yes / No
Are Class "S" weights calibrated NIST every 2 years?	Yes / No
Are balances serviced annually?	Yes / No
Are balances calibrated as needed and the calibration recorded?	Yes / No
Is balance calibration acceptance criteria clearly defined and posted?	Yes / No

Control Charts

Are control charts in place for each method and matrix?	Yes / No
Does each chart have a minimum of 30 points?	Yes / No
Are control charts checked quarterly?	Yes / No
Are control limits updated annually or when major method changes are made?	Yes / No

Standard Traceability/Equivalency

Are standards labelled with standard name, concentration, solvent, working standard ID, expiration date, and preparer's initials?	Yes / No
Are expiration dates of standards clearly defined in an SOP?	Yes / No
Are standards QC's against a second source standard after each initial calibration?	Yes / No
Are standards traceable from working standard analysis back to the standard received date, manufacturer, and lot #?	Yes / No
Are solvents traceable from preparation logbook to date received, manufacturer, and lot #?	Yes / No

III. Sample Receiving:

Is an up to date SOP present in the area?	Yes / No
Is a sample receiving checklist used to receive samples?	Yes / No
Condition of samples on receipt?	Yes / No
Sample temperature on receipt?	Yes / No
Radiation screen?	Yes / No
C-O-C signed and properly filled out?	Yes / No

Sample Storage

Are samples, except aqueous metals, refrigerated at 4° ± 2°C?	Yes / No
Are refrigerator temperatures checked daily?	Yes / No
Are aqueous metals stored at room temperature?	Yes / No
Is sample pH checked and recorded for samples requiring acid/base preservation?	Yes / No
Are high concentration VOAs stored separately from other samples?	Yes / No
Are VOA samples stored separately from other samples?	Yes / No
Is a system of corrective actions in place?	Yes / No
A holding blank stored with each batch of VOA sample?	Yes / No

Sample Containers

Are sampling instructions provided with sample containers?	Yes / No
Are proper preservations, sample containers, etc. posted?	Yes / No
Are preservatives traceable to original manufacturer & lot?	Yes / No
Are containers precleaned by the manufacturer and a certificate of cleanliness supplied?	Yes / No

Sample Log-In

Is a unique ID assigned to each sample?	Yes / No
Is each sample container uniquely identified?	Yes / No
Is there a peer review of sample labelling procedures?	Yes / No

Waste Disposal

Do internal COC procedures exist from receipt to disposal?	Yes / No
Are samples disposed by a company certified to dispose of hazardous waste?	Yes / No
Is a certificate of disposal received and filed?	Yes / No

Safety

Are safety glasses, lab coat, and gloves worn by the sample custodian?	Yes / No
Are sample coolers opened under a ventilated hood?	Yes / No

IV. Data Reporting/Data Review:

Has the Data Review SOP been reviewed/updated annually?	Yes / No
Are Data Reviews clearly documented with the use of checklists?	Yes / No
Is 100% of data peer reviewed?	Yes / No
Is data reviewed technically by a Lab Supervisor/Lab Manager?	Yes / No
Is 10% of data reviewed by the QA/QC Department?	Yes / No
Are estimated concentrations reported for values found between the Reporting Limit and Method Detection Limit (USACOE)?	Yes / No
Is a system in place for archiving data reports?	Yes / No

How long are data reports kept? _____

V. Inorganics:

Logbooks

Does a run logbook exist for each analytical instrument?	Yes / No
Does an instrument maintenance log exist for each instrument?	Yes / No
Does a prep log exist for each procedure?	Yes / No
Are logbooks peer reviewed weekly?	Yes / No
Proper correction techniques?	Yes / No
Empty spaces "z"'d out?	Yes / No

Paginated?	Yes / No
Controlled?	Yes / No
Do logbooks contain all pertinent information to the procedure? (I.e., method, matrix, reagent lot #, digestion temp., etc.)	Yes / No

Standards

Are standards QC'd against a second source after each ICAL?	Yes / No
Are standards traceable throughout the lab?	Yes / No
Are expired standards present in the lab?	Yes / No
Is there a defined system for assigning expiration dates?	Yes / No

Analytical Methods

Are SOPs method compliant?	Yes / No
Do analysts follow the SOP?	Yes / No
Do analysts do an initial demonstration of proficiency study?	Yes / No
Are analysts adequately trained and knowledgeable?	Yes / No
Does the IEC contain all analytes that interfere with target analytes? (not just Ca, Fe, Al, Mg)	Yes / No
Is ICAL documentation maintained on file in the lab?	Yes / No

Corrective Actions

Is there a system for corrective actions in place?	Yes / No

Safety

Do analysts wear safety glasses, lab coats, and gloves?	Yes / No
Are all reagents which need to be handled under a hood, handled in this manner?	Yes / No

VI. Volatiles:

Logbooks

Does a run logbook exist for each analytical instrument?	Yes / No
Does an instrument maintenance log exist for each instrument?	Yes / No
Are logbooks peer reviewed weekly?	Yes / No
Proper correction techniques?	Yes / No
Empty spaces "z"'d out?	Yes / No
Paginated?	Yes / No
Controlled?	Yes / No
Do logbooks contain all pertinent information to the procedure? (I.e., method, matrix, reagent lot #, soil weight, etc.)	Yes / No

Standards

Are standards QC'd against a second source after each ICAL?	Yes / No

Are standards traceable throughout the lab?	Yes / No
Are expired standards present in the lab?	Yes / No
Is there a defined system for assigning expiration dates?	Yes / No
Is standard freezer temperature monitored?	Yes / No

Analytical Methods

Are SOPs method compliant?	Yes / No
Do analysts follow the SOP?	Yes / No
Do analysts do an initial demonstration of proficiency study?	Yes / No
Are analysts adequately trained and knowledgeable?	Yes / No
Is ICAL documentation maintained on file in the lab?	Yes / No
When %RSD > 15%, is the average adopted?	Yes / No
Is a CCV run at the end of the analytical sequence? (USACE)	Yes / No

Corrective Actions

Is there a system for corrective actions in place?	Yes / No

Safety

Are all reagents handled under a hood?	Yes / No
Are all safety equipment used?	Yes / No

VII. Semivolatiles:

Logbooks

Does a run logbook exist for each analytical instrument?	Yes / No
Does an instrument maintenance log exist for each instrument?	Yes / No
Are logbooks peer reviewed weekly?	Yes / No
Proper correction techniques?	Yes / No
Empty spaces "z"'d out?	Yes / No
Paginated?	Yes / No
Controlled?	Yes / No
Do logbooks contain all pertinent information to the procedure? (I.e., method, matrix, reagent lot #, etc.)	Yes / No

Standards

Are standards QC'd against a second source after each ICAL?	Yes / No
Are standards traceable throughout the lab?	Yes / No
Are expired standards present in the lab?	Yes / No
Is there a defined system for assigning expiration dates?	Yes / No
Is standard freezer temperature monitored?	Yes / No

Analytical Methods