TOWN OF SALINA LANDFILL

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

SITE I.D. NO. 734036

FIELD SAMPLING PLAN

PREPARED FOR:

TOWN OF SALINA
201 School Road
Liverpool, New York 13088

May 15, 1998

PREPARED BY:

CLOUGH, HARBOUR & ASSOCIATES LLP
Engineers, Surveyors, Planners & Landscape Architects
109 South Warren Street, Suite 1300
Syracuse, New York 13202

CHA Project No. 6967

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1.0 INTRODUCTION

1.1 PROJECT OBJECTIVES

Clough, Harbour & Associates LLP (CHA) has been retained by the Town of Salina to conduct a Remedial Investigation and Feasibility Study (RI/FS) of the former Town of Salina Landfill (Site No. 7-34-036). The landfill has been designated a Class 2 Inactive Hazardous Waste Site by the New York State Department of Environmental Conservation (NYSDEC), and is also considered a sub-site to the Onondaga Lake National Priorities List (NPL) site by the United States Environmental Protection Agency (USEPA). The objectives of the project include the following:

- Obtain historical and site data to support cost recovery from potentially responsible parties (PRPs)
- Determine the nature and extent of contamination through a detailed field investigation. The investigation will include verification of current landfill dimensions, soil properties, and waste types, and will obtain other limited design data to support the Feasibility Study.
- Assess human exposure potential and current and potential impacts to flora and fauna.
- Conduct a Feasibility Study, with a presumptive focus on containment, especially construction of a landfill cap.
- Inform the public of investigation activities and their results, responding to concerns as required and appropriate under 6NYCRR Part 375, New York State Regulations for Inactive Hazardous Waste Sites.

The end product of this work will consist of an RI/FS Report which will support the selection of a remedy for the Town of Salina Landfill in accordance with 6NYCRR Part 375, and consistent with the most recent National Oil and Hazardous Substances Contingency Plan (NCP).

This Field Sampling Plan (FSP) is a stand alone document and should provide sufficient detail to conduct all field activities for the field investigation. However, the Health and Safety Plan (HASP) and the Quality Assurance Project Plan (QAPP) also provide important information that is relevant to performing the field work safely and obtaining data of the highest quality.

1.2 BACKGROUND INFORMATION

The Town of Salina Landfill is a 55 acre former municipal solid waste landfill located off of Route 11 in the Town of Salina (Figure 1). The landfill site is bounded to the east by Route 11 and to the north by the New York State Thruway. The Onondaga County Transfer Station is located immediately to the west of the landfill. Ley Creek has historically been considered the southern boundary of the landfill site, however, recent information indicates that waste disposal may have occurred to the south of the present Ley Creek channel, portions of which were apparently relocated in the early 1970s. Figure 2 illustrates the configuration of the landfill site.

The Town of Salina Landfill was in operation for a 15 year period between 1960 and 1975. In addition to municipal solid waste, hazardous wastes, including paint sludge, paint thinner, PCB-contaminated wastes, and contaminated sediment dredged from Ley Creek, were disposed of at the landfill site. Since the placement of a soil cover over the landfill in 1982, a number of environmental investigations have been performed at the site for the purpose of determining whether the landfill presented a threat to human health and the environment. These investigations detected contaminants in on-site soil and groundwater, as well as in surface water and sediment samples collected from Ley Creek. Typical contaminants encountered in soil and sediment included polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides and metals. Groundwater and surface water samples were also found to contain VOCs and SVOCs. Additionally, liquid phase hydrocarbons (LPH) were encountered in several on-site boreholes drilled along the bank of Ley Creek.

As a result of these investigations, the NYSDEC categorized the Town of Salina Landfill as a Class 2 Inactive Hazardous Waste Site in 1996. This classification signifies that the site represents a significant threat to public health or the environment, and that remedial action is required.

2.0 SAMPLING OBJECTIVES, SCHEDULE AND PERSONNEL

2.1 SAMPLING OBJECTIVES

The purpose of the sampling effort at the Town of Salina Landfill is to fill existing data gaps regarding the site setting, the potential contaminant sources and pathways, to properly assess the risk to human health and the environment, and to collect data that will aid in the evaluation of various remedial alternatives. The specific objective for each sampling task is described in Section 5.

2.2 SAMPLING SCHEDULE

The anticipated schedule for the field activities will extend from June through July of 1998. A schedule for the field activities is presented below.

Task Description	Start Date	End Date
Topographic Mapping	June 1, 1998	June 12, 1998
Spring Ecological Survey	June 1, 1998	June 5, 1998
Summer Ecological Survey	July 20, 1998	July 24, 1998
Test Pit Excavation	June 1, 1998	June 5, 1998
Soil Gas Survey	June 8, 1998	June 12, 1998
Drilling/Well Installation, Development, and Slug Testing	June 5, 1998	July 24, 1998
Round 1 of multi-media sampling	July 20, 1998	July 31, 1998
Conduct second round of well samples and other second-phase RI work as necessary	To Be Determined	To Be Determined

2.3 PROJECT PERSONNEL

The field activities will be performed and managed as per the organizational chart presented in Figure 3. A detailed description of the responsibilities of these personnel can be found in the QAPP.

3.0 FIELD DOCUMENTATION

Documentation of the field activities is critical to producing legally defensible and complete data. All pertinent field data will be recorded each day in bound logbooks. A logbook will be designated for each field activity. The field task leader will be responsible for ensuring that sufficient data is recorded. No general rules can specify the extent of information that must be entered in a logbook. However, logbooks shall contain sufficient information so that someone con reconstruct the field activity without relying on the memory of the field crew. All entries shall be made in indelible ink. Each day's entries will be initialed by the author, and a line will be drawn through the remainder of the page. All corrections shall consist of line-out deletions that are initialed. At a minimum, entries in a logbook shall include:

Refer to Standard Operating Procedure 101 in Appendix A for detailed information regarding the field documentation process.

4.0 SAMPLE DESIGNATIONS

It is important to develop a system for uniquely identifying all samples collected during this project. The following system will be used to designate a code for each sample collected. The first portion of every sample designation code will identify the site. The middle portion of the code will identify the media sampled, and the last portion of the code will identify the station number. Table 1 summarizes the sample designation codes for the entire project.

In addition to the primary environmental samples, a number of quality assurance/quality control (QA/QC) samples will also be collected. These QA/QC samples will be identified as follows:

- Duplicate samples will always be identified by a station location "22"
- Matrix spike and matrix spike duplicate samples will be identified by a suffix of "MS/MSD"
- Trip blanks will be identified by a suffix of "TB"
- Equipment rinseate blanks will be identified by a suffix of "EB"

Additionally, for some field activities, although no physical samples will be collected, it will also be necessary to have a unique code to denote location. The following abbreviations will be used in the second part of every code:

- "SG" to denote soil gas survey sampling points
- "TP" to denote test pit locations
- "B" to denote test boring locations
- "MW" to denote monitoring well locations
- "WP" to denote temporary well points
- "SW" to denote surface water sampling stations
- "SED" to denote sediment sampling points

- “SS” to denote surface soil sampling locations

Note that the total number and location of test pits has not been determined. Therefore, the station number for test pits will be determined in the field. Similarly, the total number of sampling points for the soil gas survey has not been determined so these points will be labeled in the field. For the 11 monitoring wells to be installed, the station numbering will begin with MW-6, because wells MW-0 through MW-5 already exist on-site. Deeper wells will be designated by a “D” (e.g., MW-2D). CHA will install seven (7) temporary well points to be designated WP-1 through WP-7. Additionally, four (4) exploratory test borings designated B-10 through B-14 will be advanced to bedrock.

5.0 PROJECT TASKS

This section describes the primary elements of the field investigation. A brief discussion of the objective, location, timing, and methods to be used for each element is provided. The methods are described in detail in Standard Operating Procedures (SOPs) which are included in Appendix A.

5.1 SITE SURVEY

OBJECTIVE

The objective of this task is to develop a topographic base map and to locate the horizontal and vertical position (where appropriate) of sample locations and relevant site features.

LOCATION

The base map shall be developed for approximately 75 acres to ensure that the entire site and surrounding area are covered. The on-site survey activities will largely be confined to the 55 acre site as defined by previous site investigations.

SCHEDULE

The field work for this task will commence in June, 1998 with the development of the base map. Survey work will continue as needed over several months to locate various sample locations, test pit locations, monitoring wells, etc.

METHODS

A baseline referenced to New York State Plane coordinates (NAD83) will be established, and spot elevations will be surveyed around the landfill to develop a topographic map of the site. The map will be plotted using a two (2) foot contour interval referenced to National Geodetic Vertical Datum of 1988. Horizontal and vertical control for the survey will be established using Global Portioning Systems (GPS).CHA will also use GPS equipment to locate existing wells and to locate new sampling locations (surface water/sediment sample locations, surface soil sample locations, etc.). Field survey data will be collected using electronic total stations and data collectors. The horizontal position of all sampling points will be located and the vertical elevations of all test pits, test borings, monitoring wells and well points will be surveyed to the nearest 0.01 feet.

5.2 ECOLOGICAL SURVEY

OBJECTIVE

The objective of this task is to characterize existing ecological resources in the survey area and identify potential exposure pathways to provide the basis for determining site-related impacts on terrestrial and aquatic flora and fauna occurring in the project area. Information collected during the ecological survey will also be utilized to determine the need for, and type of, measures to be implemented during site closure/remediation to protect sensitive ecological resources present in the project area.

LOCATION

The majority of the work will be performed on the site or in Ley Creek, which borders the site. The area of Ley Creek to be investigated in association with the fish survey will extend approximately two (2) miles downstream and one (1) mile upstream of the landfill. A cover type survey will be performed within a 0.5 mile radius of the site.

SCHEDULE

The schedule for this work will include a:

- A spring fish and wildlife survey will be performed at the project site in June, 1998.
- A summer survey of habitat types and wetlands present on the project site will be performed in July, 1998.
- A cover type survey will be conducted within a 0.5 mile radius of the project site in July, 1998.

METHODS

The ecological survey will include historic data collection and review, fish and wildlife surveys, and cover type and wetland surveys. The methods for these subtasks are described below.

Historic Data Collection, and Review

As early in the program as possible, a literature search and contacts with interested parties, local educational facilities, and regulatory agencies (e.g., U.S. Fish and Wildlife Service and NYSDEC) will be undertaken to document the flora and fauna present or likely to be present in the survey area. The documentation will also include information on listed threatened, endangered, or species of special concern. The species list will be used as a checklist in the field, will provide information on the likely presence of species of concern, and will help to evaluate the project site's potential for providing critical or significant habitat for these species. Sources of information will include:

- Previous studies conducted at the Town of Salina Landfills
- Breeding bird atlas
- Significant habitat maps

- NYSDEC significant habitat unit
- Natural Heritage Program
- NYSDEC local and regional offices
- Standard Natural History References
- Existing Environmental Impact Statements (EIS) for the area
- Local environmental and bird clubs (e.g., Audubon Society)
- College theses/dissertations and high school project summaries

A three-day wildlife survey of mammals, birds, reptiles, and amphibians will be conducted during the late spring or early summer. Bird species and numbers observed along set transects will be recorded during a summer breeding bird survey. We estimate that two or three transects will be run paralleling Ley Creek on the north side and one transects will be run on the south side of Ley Creek. (Transects will be established as appropriate during the first field day's efforts.) This method allows a relatively large area to be sampled in a short time and is an effective way of comparing relative abundance along transects. We will also survey selected areas to locate nests and will observe bird behavior/activity to determine whether nesting is probable. Birds will be identified by direct observation, song or call, nests, or their remains. Mammals will be identified by direct observation, burrows, tracks, scat, or remains. Reptiles and amphibians will be identified by observation or other evidence of their presence, including calls of frogs and toads, presence of eggs and larvae of amphibians and nests, eggs, and tracks of reptiles. For reptiles and amphibians, some of the debris along a transect under which a reptile or amphibian may reside will be turned over. Any freshwater pond along a transect will be examined for adult and larval amphibians (effort for this consists only of direct observation from along the shore).

Vegetation associations and habitats (including streams and wetlands) will be identified based on descriptions provided in the NYSDEC publication Ecological Communities of New York State (Reschke 1990). Dominant plant species in each stratum (i.e., overstory, understory, shrub layer, ground cover) will be identified along with species that contribute to the area food supply (browse, nuts, seeds, berries). Species dominance will be based on the estimated percent aerial coverage of each species in each vegetative layer or group, such as the canopy, understory, shrub/sapling layer, and ground cover. The locations of habitats will be placed on site base maps and aerial photographs of the site using field overlays. Flora in the survey area will be evaluated and vegetation adjacent to the site will be evaluated based on opportunistic observations made from area roadways and accessible public and private land. The cover type of the land area within 0.8-km (0.5 mile) of the site will be documented from aerial photographs, land use maps, soil conservation maps, and state and Federal wetlands maps. The cover type map will be opportunistically ground-truthed. Habitat types will be noted and that information will be transferred to the site maps.

A stream survey will be conducted in the near vicinity of the site, including up and downstream locations to note and characterize the surface water habitat. At four locations noted in Figure 8, the condition of the stream, including its substrate, fish species observed, and flow rate will be noted. At these locations measurements will be made of water temperature, conductivity, dissolved oxygen, and pH. These measurements and observations will be used to characterize both existing and potential surface water habitats near the site.

On-site wetlands will be verified, described, and located on the site base maps and their approximate area will be estimated. The wetland survey will be conducted during the time of the habitat survey. A two-person crew will inspect the landfill to verify wetland boundaries using a plant community assessment approach developed by the U.S. Army Corps of Engineers (USACE 1987). This criteria will be used to verify on-site wetlands unless acreage or quality trigger state review, then state criteria will also be used. Since the investigation is only at the RI stage, no formal delineation of wetlands will be conducted, but may be included at a later date. The field inspections will confirm the vegetation and hydrology regimes and document the dominant vegetation in each wetland area.

5.3 WASTE AREA INVESTIGATION

OBJECTIVE

This task will consist of three (3) elements: (1) review of historical records; (2) excavating test pits; and (3) performing a soil gas survey. The objectives of the waste area investigation are to further delineate the lateral extent of waste disposal at the landfill, to determine if the landfill is producing methane gas, and, if so, to determine whether the gas is migrating off-site.

LOCATION

This work will be performed over the entire landfill and in the area between the current and former Ley Creek channels. Test pits will be excavated around the perimeter of the landfill at approximately 100 foot intervals, and in the area between the current and former Ley Creek channels. Soil gas survey points will be located within the landfill footprint, as well as around the perimeter of the landfill.

SCHEDULE

Following the review of historical information, the field portion of the waste area investigation will be performed. The test pit program and soil gas survey are slated to be performed sequentially during June, 1998.

METHODS

Historical aerial photography, available from the Onondaga County Health Department, U.S. Soil Conservation Service, New York State Thruway Authority, and other sources, will be compiled and reviewed to provide information concerning landfill configuration.

Following the historical review, the test pit program will be executed (see SOP 307 in Appendix A). This work will be performed by a qualified excavation contractor under the supervision of a CHA scientist or engineer. Test pits or trenches will be excavated around the periphery of the landfill and in the area between the current and former Ley Creek channels to delineate the limits of waste in these areas. Test pits will also be excavated along the sewer line that crosses the site to investigate the bedding material as a preferential pathway for contaminant migration. Due to heavy vegetation cover in certain parts of the site, some clearing will likely be required at the start of this work element, which will be the responsibility of the subcontractor. The test pits will not exceed 10 feet in depth. The materials encountered in each test pit will be logged and the approximate location of each test pit will be marked on the base map with a unique number proceeding sequentially from

TSL-TP-1, TSL-TP-2, etc. Each test pit location will be staked in the field to be surveyed at a later time using GPS techniques.

A soil gas survey will be performed within the landfill limits defined as a result of the test pit program to determine if the landfill is producing methane gas (see SOP 323 in Appendix A). Sampling points will be located along several transects established within the waste limits. At each sample location a steel probe will be advanced approximately 3-4 feet below grade, and the concentration of methane gas within the probe will be measured using a field instrument designed to detect methane gas. The concentration at each sampling location will be recorded in a field log, and the sampling locations will be placed on the site base map. Should methane gas be detected within the landfill boundary, sampling points will also be established around the landfill perimeter, at approximately 100 foot intervals, to determine whether methane gas is migrating from the landfill. The gas survey will be conducted at 200 foot intervals across the top of the landfill.

5.4 GROUNDWATER INVESTIGATION

OBJECTIVE

The objective of this task is to supplement existing information concerning the physical and chemical characteristics of groundwater occurring beneath the project site for the purpose of determining:

- Groundwater elevations, flow direction, gradient, and velocity in both the upper-most water bearing zone and above the bedrock/overburden interface;
- Hydraulic conductivity of the upper-most water bearing zone and the zone occurring above the overburden/bedrock interface;
- Contaminant distribution in the water table aquifer occurring on-site and the vertical extent of contamination in overburden groundwater;
- The presence or absence of a confined sand and gravel aquifer on the landfill site; and
- Hydrologic relationship between the water table aquifer and Ley Creek.

Additionally, this task will provide information concerning the characteristics and thickness of waste, overburden geology, and the depth to bedrock across the landfill site.

LOCATION

This work will be performed over the entire landfill site and in the area between the current and former Ley Creek channels. Eight (8) permanent, shallow monitoring wells will be installed on the project site to supplement the six (6) existing wells. Five (5) of the new wells will be located on the landfill site to the north of Ley Creek, while the three (3) remaining wells will be installed to the south of Ley Creek. Seven (7) temporary, shallow well points will also be installed between the southern edge of the landfill and the current Ley Creek channel. Additionally, seven (7) test borings will be advanced to the top of bedrock on the landfill site north of Ley Creek, and three (3) of these test boring will be completed with permanent, deep monitoring wells. The locations of the test borings, monitoring wells and well points are depicted on Figures 4 and 5.

SCHEDULE

The drilling and installation of the monitoring wells and well points will be performed in June and July of 1998, and is anticipated to require approximately six (6) weeks for completion.

METHODS

The groundwater investigation to be implemented at the project site involves the installation of both permanent monitoring wells and temporary well points. The methods to be utilized to complete these subtasks are outlined below:

Temporary Well Point Installation Procedures

Seven (7) temporary well points will be installed between the southern limits of the landfill and the current Ley Creek channel. These well points will be installed using direct hydraulic push methods. Each of the well points will be screened across the water table and are expected to be a maximum of 20 feet deep. Continuous soil samples will be collected throughout the depth of each well point using a 48-inch long, 2-inch O.D. macro core sampler. The materials encountered during macro core sampling will be described in accordance with SOP 301 (Appendix A). Once the desired depth has been reached, the well point screen and riser will be installed in the annulus of the borehole. The well points will be constructed of 1.25-inch schedule 40 PVC. The screen for each piezometer will be 10-slot sized screen, approximately 10 feet long. Depending on the subsurface conditions and the depth to the water table at each location the screen length may be adjusted. The filter pack, consisting of No. 1 Morie graded sand or equivalent, will be added up to 2 ft. above the screened interval of the well point. One foot of bentonite pellets will be installed over the filter pack, and the remainder of the annulus will be backfilled to the surface using cuttings from the borehole. Each well point will be cut off approximately 3 ft. above the ground surface and fitted with an outer 3 to 4 in. PVC casing with a cap. Following completion of each well point, a log will be completed that will include a diagram of the well point, volume and type of material used, and intervals over which materials were installed.

To insure hydraulic connection with the subsurface material, each of the well points will be hand bailed with a small diameter disposable bailer for a short period of time. The hand bailing will also serve to remove any fine grained material from the well point and the sand pack. The water bailed from the well point will be discharged to the ground surface adjacent to the well head. The elevation and location of each well point will be surveyed after installation.

Permanent Monitoring Well Installation Procedures

Eleven (11) permanent monitoring wells will be installed on the project site. These monitoring wells will supplement the six (6) wells that currently exist on site (MW-0 through MW-5). The borings in which these wells will be installed will be advanced by hollow stem augers (see SOP 303 in Appendix A).

Eight (8) of the 11 wells will be screened across the water table with an estimated maximum depth of 20 feet. Three (3) of the monitoring wells will be installed at greater depths (estimated at 75 feet). Drilling methods for test borings for the water table (shallow) monitoring wells that penetrate the waste profile, and for deeper monitoring wells in which a lower confining layer is encountered will involve the installation of a casing to prevent the downward migration of potential contaminants in the borehole. These methods are outlined in SOP 303 in Appendix A.

As the drilling proceeds, samples of the subsurface material will be collected using split spoon samplers. The sample interval will be continuous from ground surface to the bottom of each boring. The materials encountered in the test boring will be described following SOP 301 (Appendix A).

After the borings are completed, a 2-inch diameter PVC well, with an anticipated slot size of 0.010 inches or less will be installed (see SOP 309 in Appendix A). The filter pack will be appropriately sized for the well screen and will extend approximately 2 feet above the top of the well screen. A 2 foot thick bentonite seal will be placed above the filter pack. The remainder of the annular space will be filled with a cement bentonite grout. All wells will be completed with a protective steel casing surrounded by a concrete pad.

After the wells are installed, the wells will be developed using airlift methods until turbidity is < 50 NTUs (see SOP 311 in Appendix A). If turbidity goals cannot be reached, for budgeting purposes, we are assuming that well development will proceed for a maximum of

4 hours per well. Development water will be discharged to the ground in low areas away from the well to allow for infiltration and prevent runoff.

To determine the hydraulic conductivity of the upper most water bearing zone as well as the water bearing zone located immediately above the overburden/bedrock interface, CHA proposes to perform falling and rising head slug tests in all of the newly installed permanent monitoring wells. The slug tests will be conducted using a data logger and pressure transducer to measure rapid changes in water levels over time (see SOPs 213 and 319 in Appendix A). The tests will be evaluated using AQTESOLV software with the appropriate methods for the type of aquifer (unconfined or confined - see SOP 701 in Appendix A).

Another survey will be required after the wells are installed. As with the temporary well points, the elevation of the wells will be surveyed to the nearest 0.01 feet using traditional line of sight techniques. The location of the wells will be determined using GPS techniques.

5.5 MULTIMEDIA SAMPLING

OBJECTIVE

This task will include sampling of groundwater, surface water and sediment, and surface soils. The objective of this task will be to collect information on the nature and extent of contamination in these media.

LOCATION

This work will be performed over the entire 55 acres of the landfill and adjacent areas, including Ley Creek. A total of twenty (20) surface water and sediment sampling locations will be established in the project area, including 17 along the current Ley Creek channel between the Route 11 bridge and the Seven North Street bridge, and three (3) along the drainage course located along the north side of the landfill (see Figure 6). A total of seven (7) surface soil samples will be collected, including four from the landfill site north of Ley Creek and three (3) to the south of Ley Creek (see Figure 7). Four (4) subsurface soil samples will be collected from the bedding material surrounding the sewer line that crosses the site. Groundwater samples will be collected from all of the existing and newly installed monitoring wells and well points depicted on Figures 4 and 5.

SCHEDULE

The schedule for this work involves sampling efforts extending over an approximate two (2) week period in July, 1998.

METHODS

Groundwater Sampling

Prior to the collection of groundwater samples at each well/well point, the water level within the wells/well points will be measured and recorded, and the presence or absence of Light Non-aqueous Phase Liquid (LNAPL) will be verified (see SOP 315 in Appendix A). Groundwater samples will be collected following the procedures described in SOP 313 (Appendix A). During sample collection, CHA will measure a number of parameters in the field (temperature, conductivity, pH, etc.) as a means of verifying the collection of representative groundwater samples (see SOPs 209, 801, 803, 805, and 807 in Appendix A). Purging will continue until these parameters have stabilized.

The samples collected from the six (6) pre-existing and 11 newly installed permanent monitoring wells will be analyzed for all TCL/TAL parameters, plus cyanide. In addition, these samples will be analyzed for dissolved metals and leachate indicator parameters (e.g., total dissolved solids, dissolved oxygen, hardness, etc.). The samples collected from the seven (7) temporary well points will be analyzed for leachate indicator parameters only. Table 2 summarizes the number of samples to be collected from each medium, and the type of analyses to be performed.

Surface Water and Sediment Sampling

Surface water and sediment samples will be collected in accordance with the procedures outlined in SOPs 401 and 403, respectively, at each of the 5 stations established along Ley Creek and the drainage course to the north of the landfill. At each station, a sediment sample will be collected from 0-6 inches depth, and if possible from 12-24 inches depth. The sediment sampling will not proceed deeper than any hardpan encountered without consulting NYSDEC. Sampling will proceed in a down-stream direction on Ley Creek beginning at the station located closest to the Route 11 bridge. Up to six leachate samples will also be collected from leachate seeps identified in the field from the south and north banks of Ley Creek. Prior to, and during, surface water sample collection, field parameter measurements will be collected from Ley Creek at each sampling station (see SOPs 209, 801, 803, 805 and 807). Surface water and sediment samples will be analyzed for all TCL/TAL parameters, plus cyanide. The sediment samples will also be analyzed for Total Organic Carbon (TOC).

Surface Soil Samples

Sample collection procedures for the seven (7) surface soil samples to be collected at the project site will follow those outlined in SOP 405 (Appendix A). The resulting soil samples will be analyzed for the full TCL/TAL, plus cyanide and TOC.

Subsurface Soil Samples

At least one subsurface soil sample will be collected from each boring drilled (total of fifteen – excluding the temporary wells). Additionally, two (2) samples of the bedding material surrounding the sewer line that crosses the site will be collected from test pits excavated along its length. Up to five (5) samples will also be collected from the test pits when unusual materials are encountered. Each of these samples will be collected as grab samples using a decontaminated stainless steel trowel or clean disposable plastic trowel. The location and depth from which the samples are collected will be recorded in the field log. The resulting samples will be analyzed for the full TCL/TAL, plus cyanide and TOC.

6.0 QA/QC SAMPLE COLLECTION

The collection of quality assurance/quality control samples is an integral part of this project. The types of QA/QC samples to be collected include matrix spike and matrix spike duplicates associated with organic analyses, matrix spike blanks and spike duplicates associated with metals and cyanide analyses, equipment rinseate blanks, and trip blanks. Generally, one set of QA/QC samples will be collected for every 20 environmental samples collected.

Matrix spike samples will be collected in the same manner as their corresponding routine samples and merely represent collection of additional sample volume for the laboratory. Equipment blanks are collected by pouring analyte-free water over decontaminated sampling equipment and collecting that water in a prepared sample container. Trip blanks are prepared in the laboratory and are shipped to and from the field site with the routine samples. One trip blank will be shipped with containers for each type of liquid sampling (e.g., groundwater sampling, surface water sampling, etc.).

7.0 SAMPLE HANDLING

Sample handling is another critical aspect of this project. As samples are collected, they must be labeled according to the scheme described previously. Then the samples must be placed into the proper containers and have the appropriate preservatives added. Sample preservation is necessary to prevent chemical or biological alteration of the samples prior to analysis in the laboratory. Table 4 summarizes the containers and preservatives to be used for specific analyses.

Once samples are properly preserved, the samples must be prepared for shipment to the laboratory. The samples will be listed on a Chain-of-Custody form. To verify sample integrity, the samples must always be in the possession of an authorized individual or in a secure area. Once the Chain-of-Custody form is complete, the samples should be placed into clear ziploc-type bags and packed into a cooler for shipment. Either freezer packs or ice shall be used to maintain the samples at the proper temperature. If ice is used, it will be double bagged to prevent leakage. The Chain-of-Custody form is then also sealed in a plastic bag and placed on top of the samples. The cooler is then sealed with tape and with custody seals. Samples will then be shipped via an overnight carrier to the laboratory. See SOPs 607, 608, 609, 613, and 621 in Appendix A for more details).

8.0 DECONTAMINATION PROCEDURES

The objective of decontamination is to prevent the transmission of contaminants to personnel and equipment and prevent the spread of contaminants off site. Decontamination is performed both for quality assurance purposes and for safety.

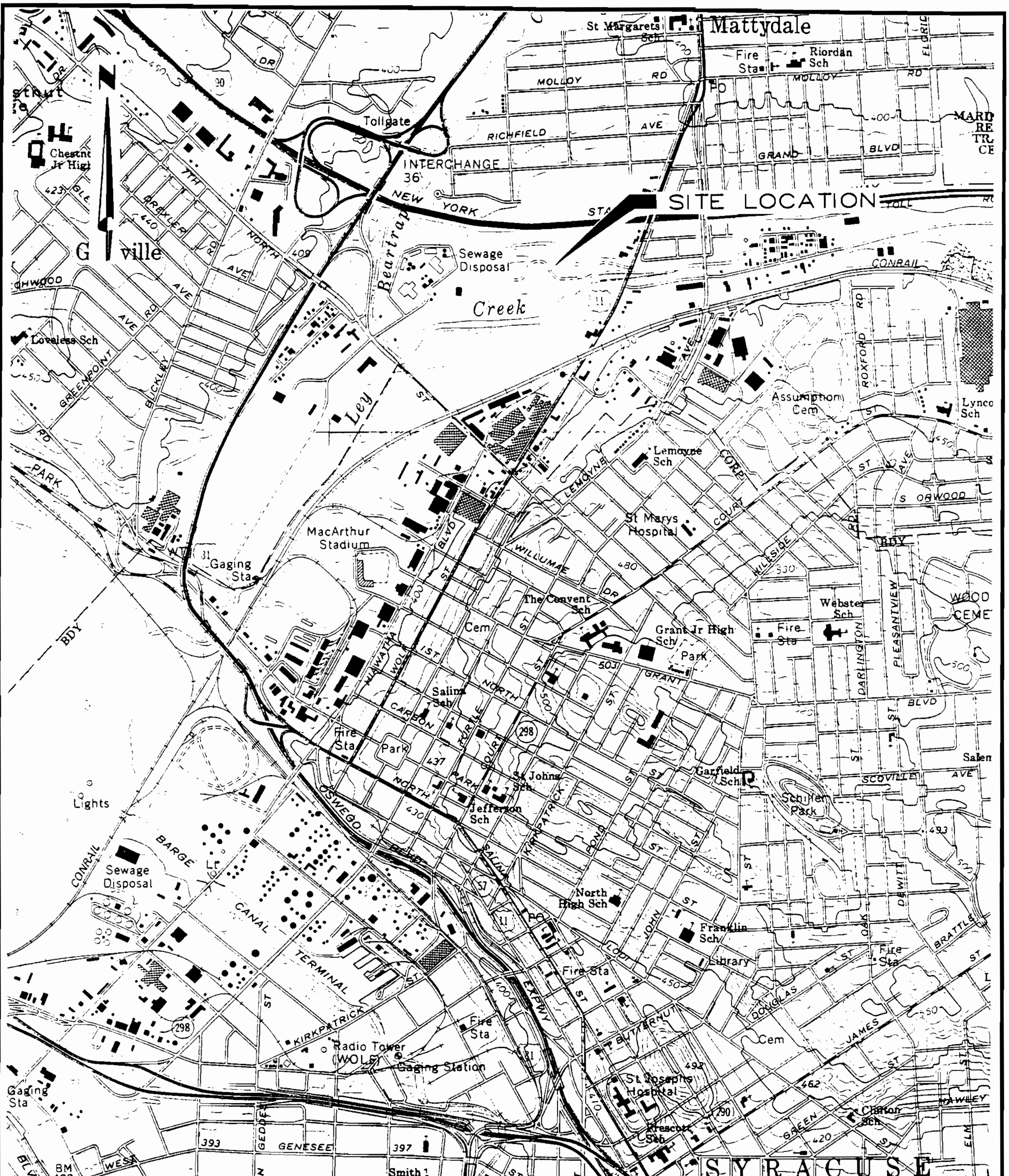
To the extent possible and appropriate dedicated sampling equipment will be used to minimize the potential for cross-contamination of sampling equipment.

Decontamination of personnel and equipment shall take place in separate areas. Decontamination of personnel shall be performed in accordance with the Health and Safety Plan. A dry decontamination procedure for personnel protective equipment will be used during this project. All disposable PPE (excludes hardhat, safety glasses, reflective vest, and respirator) will be removed and placed in heavy plastic bags . The hardhat, safety glasses, and vest may be kept within the contamination reduction zone and disposed of at the end of the project. The respirators will be cleaned after each use with non-alcoholic respirator wipes. For additional information see Appendix V for decontamination procedures.

All equipment that comes into contact with contaminated materials will be decontaminated prior between sampling locations and prior to leaving the site. Small equipment decontamination will be performed in accordance with SOP 501 in Appendix A. Large equipment decontamination will be performed on plastic sheeting in the contamination reduction zone and in accordance with SOP 503 (Appendix A). Note that if hexane is used for any aspect of decontamination, it shall be pesticide grade.

Soil residue and waste water removed during decontamination activities will be discharged on the ground to low areas to allow for infiltration and prevent runoff. Soiled plastic sheeting shall be bagged and properly disposed of.

FIGURES



SOURCE: USGS SYRACUSE WEST QUADRANGLE

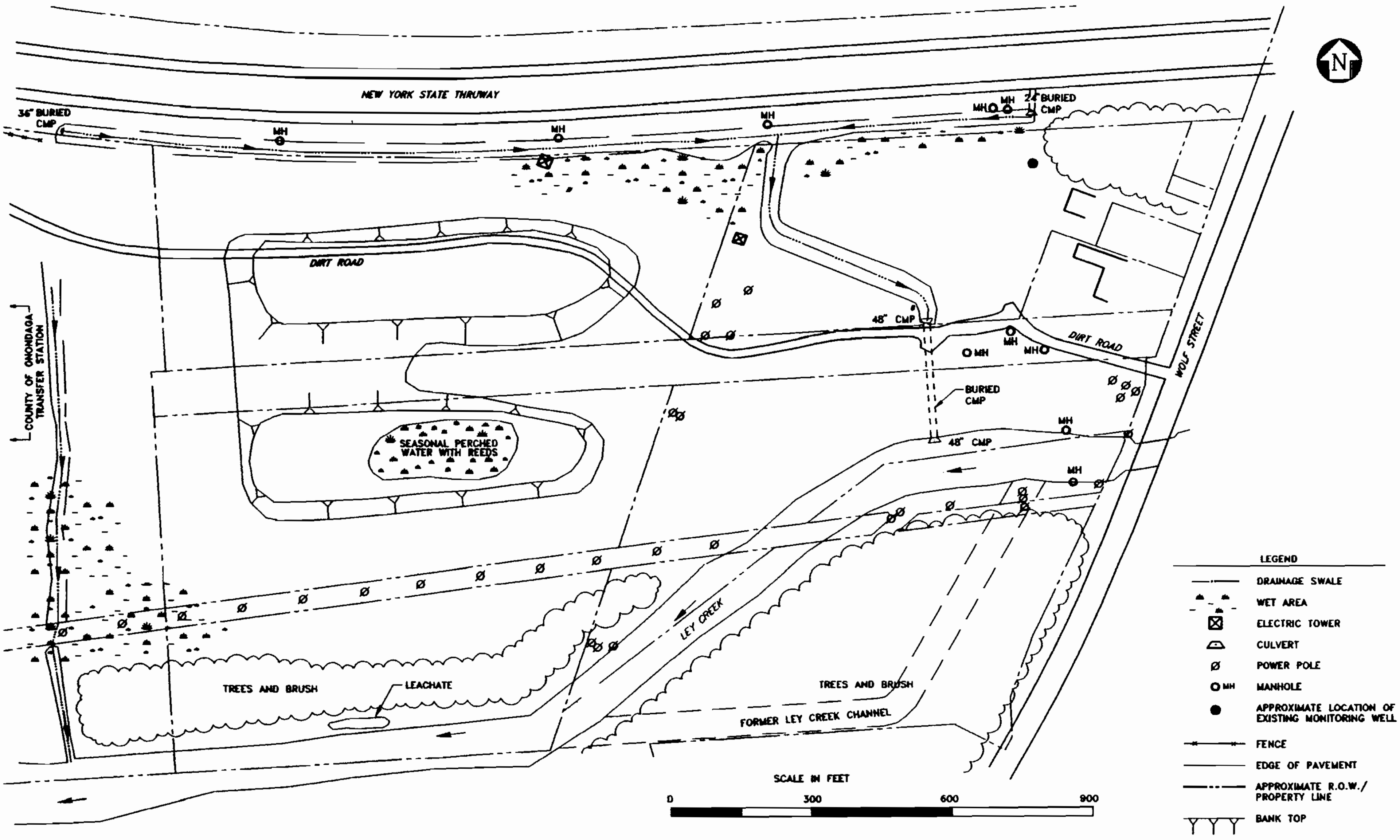
CLOUGH, HARBOUR & ASSOCIATES LLP
ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS

109 SOUTH WARREN STREET SYRACUSE, NEW YORK - 13202
315-471-3920

CHA FILE NO. 6967 | SCALE: 1"=2000'

FIGURE 1
SITE LOCATION MAP
TOWN OF SALINA LANDFILL
SYRACUSE, NEW YORK

I:\6967\DRAWINGS\FIG1.DWG

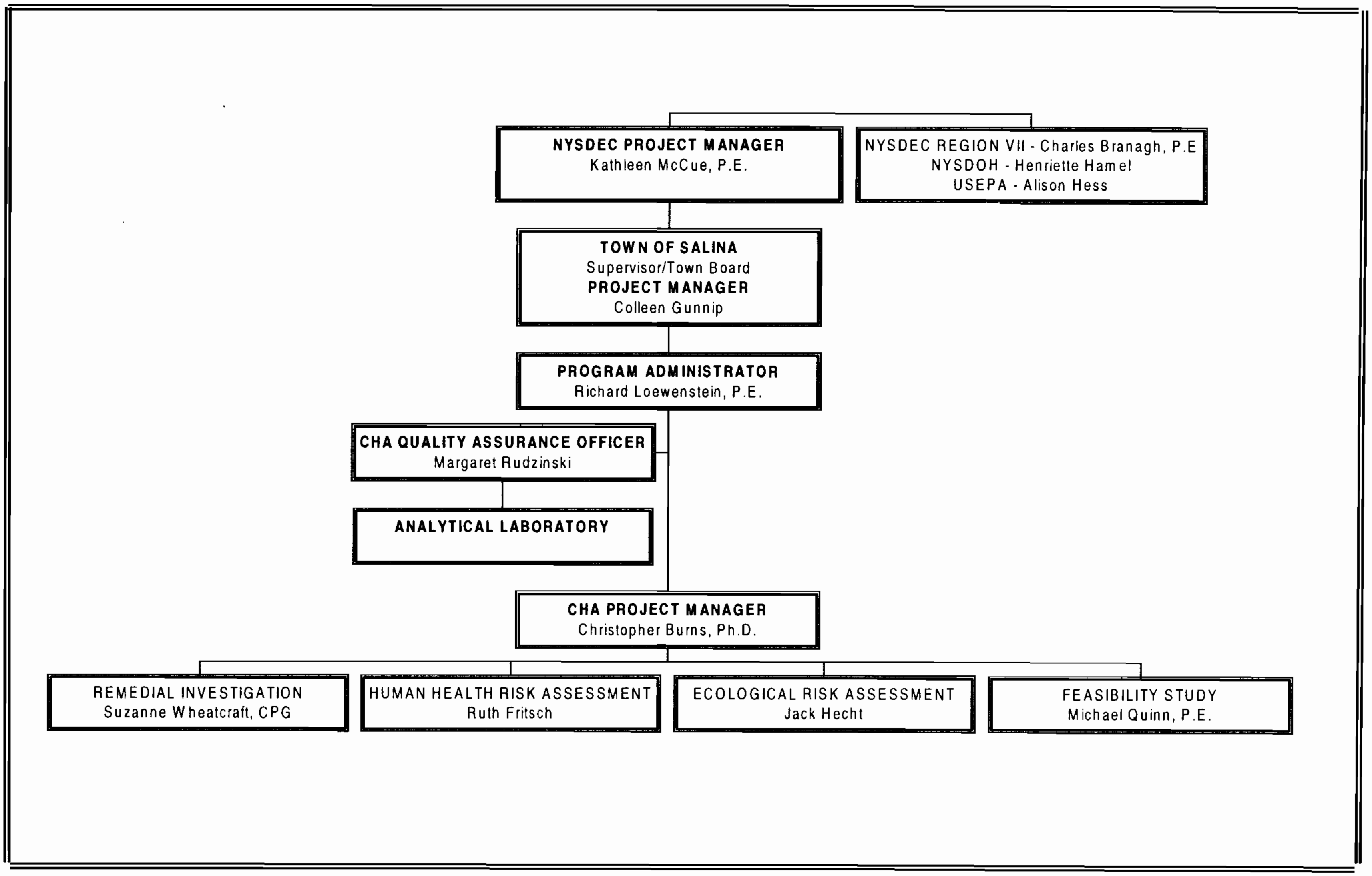


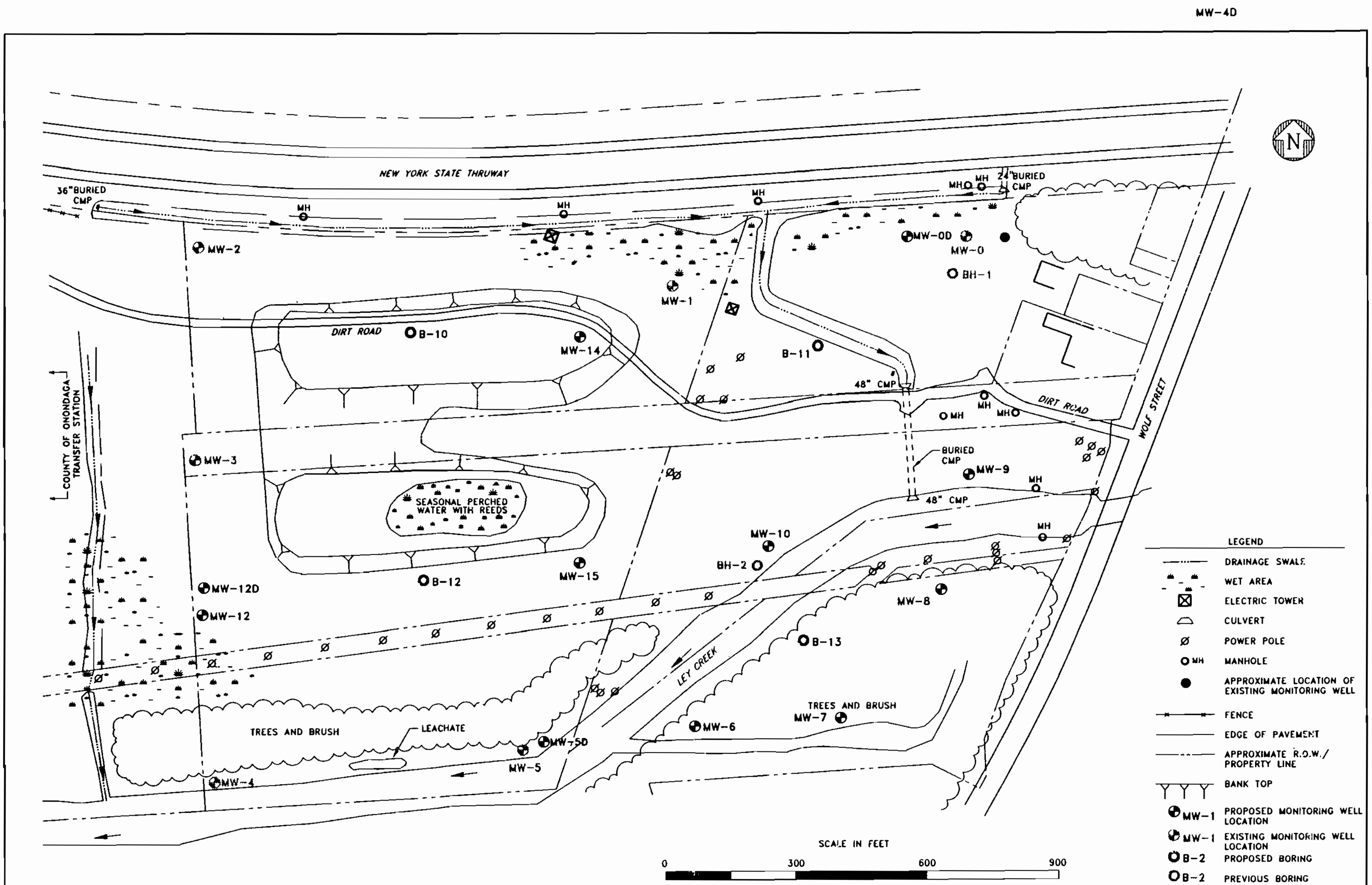
SITE PLAN

FIGURE NO. 2	PROJECT NO. 6967	CLOUGH, HARBOUR & ASSOCIATES ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS 109 SOUTH WARREN STREET SYRACUSE, NEW YORK, 13202	TOWN OF SALINA LANDFILL REMEDIAL INVESTIGATION/FEASIBILITY STUDY SALINA, NEW YORK
SCALE: 1"=300'±	DATE: FEBRUARY 1998		

FILENAME: I:\6967\FIG2

FIGURE 3
TOWN OF SALINA LANDFILL RI/FS
PROJECT MANAGEMENT PLAN

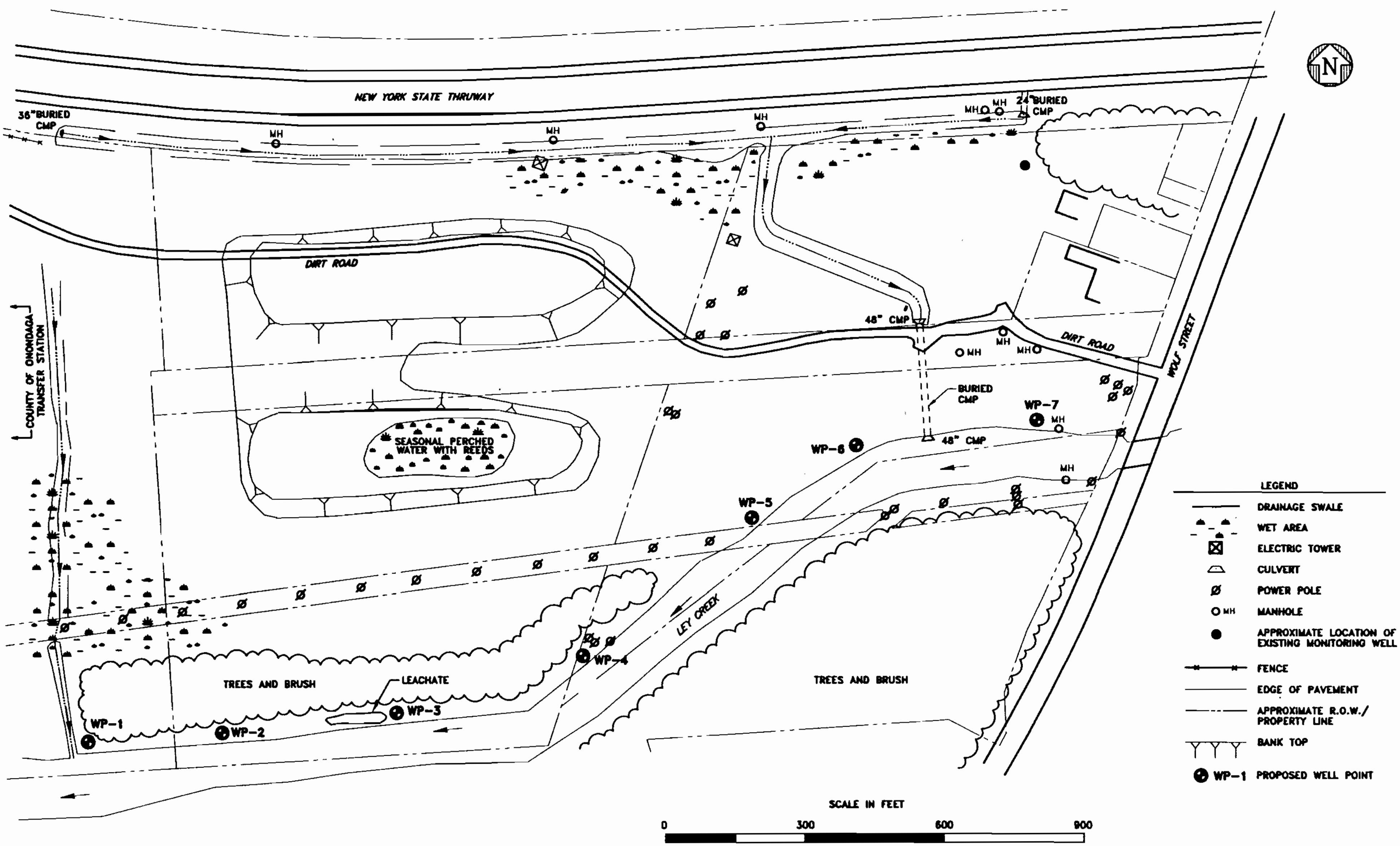




TEST BORING/MONITORING WELL LOCATION MAP

FIGURE NO. 4	PROJECT NO. 6967	CLOUGH, HARBOUR & ASSOCIATES ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS 109 SOUTH WARREN STREET SYRACUSE, NEW YORK 13202	TOWN OF SALINA LANDFILL REMEDIAL INVESTIGATION/FEASIBILITY STUDY SALINA, NEW YORK
SCALE: 1"=300'±	DATE: MAY 1998		

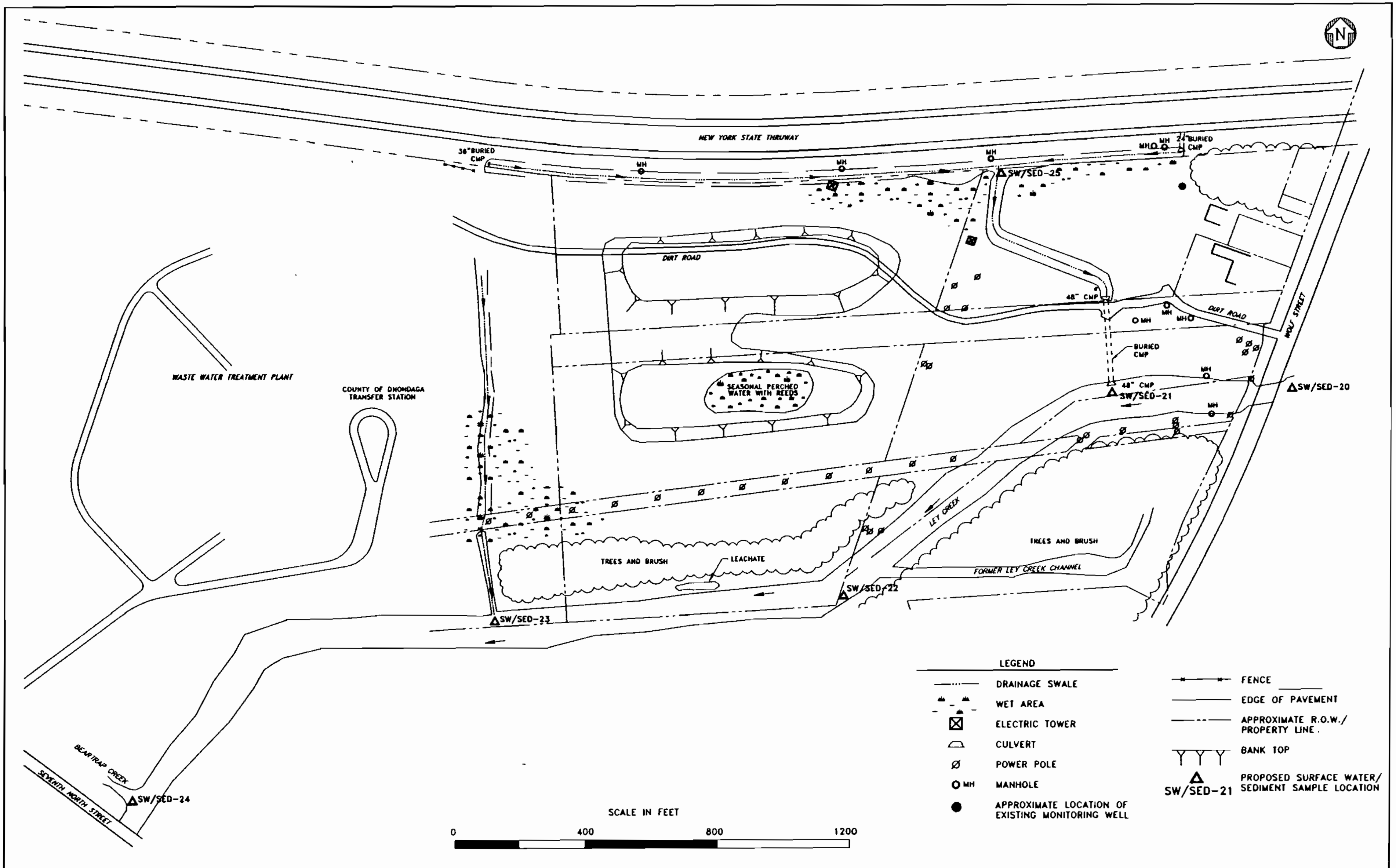
FILENAME: I:\6967\FIG4



WELL POINT LOCATION MAP

FIGURE NO. 5	PROJECT NO. 6967	CLOUGH, HARBOUR & ASSOCIATES ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS 109 SOUTH WARREN STREET SYRACUSE, NEW YORK 13202	TOWN OF SALINA LANDFILL REMEDIAL INVESTIGATION/FEASIBILITY STUDY SALINA, NEW YORK
SCALE: 1"=300'±	DATE: FEBRUARY 1998		

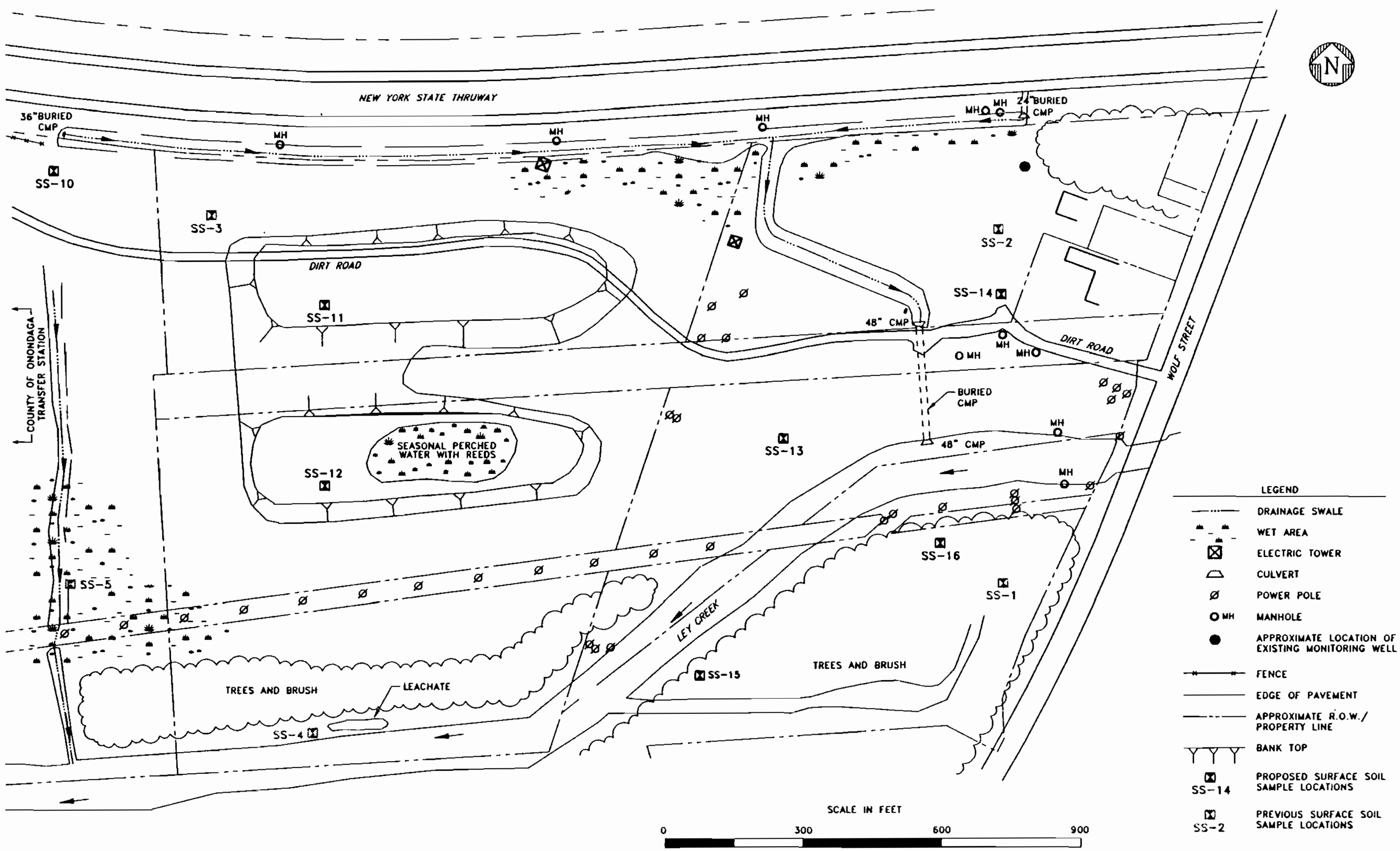
FILENAME: I:\6967\FIG5



SURFACE WATER/SEDIMENT SAMPLE LOCATION MAP

FIGURE NO. 6	PROJECT NO. 6967	CHA CLOUGH, HARBOUR & ASSOCIATES ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS 109 SOUTH WARREN STREET SYRACUSE, NEW YORK 13202	TOWN OF SALINA LANDFILL REMEDIAL INVESTIGATION/FEASIBILITY STUDY SALINA, NEW YORK
SCALE: 1"=400'±	DATE: MAY 1998		

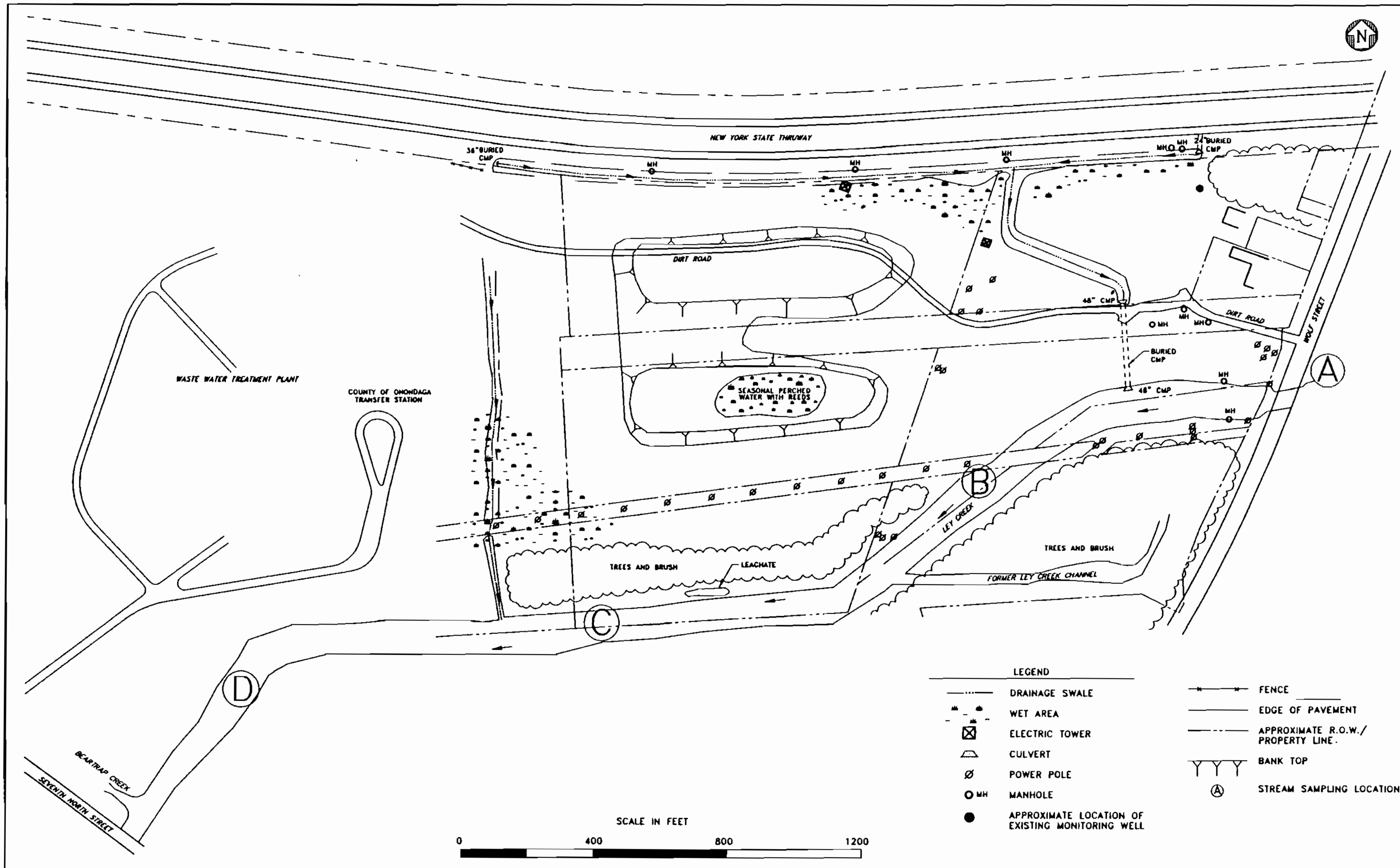
FILENAME: I:\6967\FIG6



SURFACE SOIL SAMPLE LOCATION MAP

FIGURE NO. 7	PROJECT NO. 6967	CLOUGH, HARBOUR & ASSOCIATES ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS 109 SOUTH WARREN STREET SYRACUSE, NEW YORK 13202	TOWN OF SALINA LANDFILL REMEDIAL INVESTIGATION/FEASIBILITY STUDY SALINA, NEW YORK
SCALE: 1"=300'±	DATE: MAY 1998		

FILENAME: I:\6967\FIG7



APPROXIMATE STREAM SAMPLING AREA FOR ECOLOGICAL RISK ASSESSMENT

FIGURE NO. 8	PROJECT NO. 6967	CHA CLOUGH, HARBOUR & ASSOCIATES ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS 109 SOUTH WARREN STREET SYRACUSE, NEW YORK 13202	TOWN OF SALINA LANDFILL REMEDIAL INVESTIGATION/FEASIBILITY STUDY SALINA, NEW YORK
SCALE: 1"=400'±	DATE: MAY 1998		

FILENAME: I:\6967\FIG6

TABLES

TABLE 1
SAMPLE DESIGNATIONS

NO.	GROUND-WATER	SURFACE WATER	SEDIMENT	SURFACE SOIL	SUBSUR-FACE SOIL	LEACHATE
1	TSL-MW-0	TSL-SW-20	TSL-SW-20	TSL-SS-10	TSL-*-*(depth)	TSL-L-1
2	TSL-MW-0D	TSL-SW-21	TSL-SW-21	TSL-SS-11		TSL-L-2
3	TSL-MW-1	TSL-SW-22	TSL-SW-22	TSL-SS-12		TSL-L-3
4	TSL-MW-2	TSL-SW-23	TSL-SW-23	TSL-SS-13		TSL-L-4
5	TSL-MW-3	TSL-SW-24	TSL-SW-24	TSL-SS-14		TSL-L-5
6	TSL-MW-4	TSL-SW-25	TSL-SW-25	TSL-SS-15		TSL-L-6
7	TSL-MW-5		TSL-SW-20D	TSL-SS-16		
8	TSL-MW-5D		TSL-SW-21D			
9	TSL-MW-6		TSL-SW-22D			
10	TSL-MW-7		TSL-SW-23D			
11	TSL-MW-8		TSL-SW-24D			
12	TSL-MW-9		TSL-SW-25D			
13	TSL-MW-10		TSL-SW-26D			
14	TSL-MW-12					
15	TSL-MW-12D					
16	TSL-MW-14					
17	TSL-MW-15					
18	TSL-WP-1					
19	TSL-WP-2					
20	TSL-WP-3					
21	TSL-WP-4					
22	TSL-WP-5					
23	TSL-WP-6					
24	TSL-WP-7					
25						
26						
27						
28						
29						

* Subsurface soil samples will be designated based upon the test boring, monitoring well, well point, or test pit location from which they originated and the depth below ground surface that they were collected from (e.g., TSL-WP-1(3-4'))

TABLE 2
ANALYTICAL SUMMARY
TOWN OF SALINA LANDFILL RI/FS

PARAMETER LIST	Surface Soil			Subsurface Soil			Groundwater Rnd 1			Surface Water Rnd 1			Leachate			Sediment Rnd 1		
	Primary	QC	Total	Primary	QC	Total	Primary	QC	Total	Primary	QC	Total	Primary	QC	Total	Primary	QC	Total
VOCs	7	3	10	22	3	25	17	6	23	5	3	8	6	3	9	10	4	14
Semi-VOCs	7	3	10	22	3	25	17	5	22	5	3	8	6	3	9	10	4	14
Pest/PCBs	7	3	10	22	3	25	17	5	22	5	3	8	6	3	9	10	4	14
Metals + Cn	7	1	8	22	1	23	17	3	20	5	1	6	6	1	7	10	1	11
Dissolved Metals							17	3	20									
Wet Chem Parameters																		
Turbidity							24	0	24									
BOD										20	0	20						
TOC	7	1	8	22	0	22	24	0	24							20	1	21
Hardness										5	0	5						
TDS							24	0	24									
Alkalinity							24	0	24									
Chloride							24	0	24									
Sulfate							24	0	24									
Sulfide							24	0	24									
Nitrate							24	0	24									
TKN							24	0	24									
Ammonia							24	0	24									
Phenols							24	0	24									
Hardness							24	0	24									
Field Parameters																		
Specific Conductance							24	0	24	20	0	20						
pH							24	0	24	20	0	20						
Temperature							24	0	24	20	0	20						
Dissolved Oxygen							24	0	24	20	0	20						

TABLE 3

ANALYTICAL PARAMETERS, PRESERVATION, HOLDING TIMES AND CONTAINERS FOR WATER SAMPLES

LABORATORY ANALYSES	METHOD	SAMPLE PRESERVATION	HOLDING TIME[a]	CONTAINER
Volatile Organics	95-1	Cool to 4°C	5 days	3 - 40 ml glass vials
Extractable Organics	95-2	Cool to 4°C	5 days	3 - 1 L amber glass bottles
Pesticides/PCBs	95-3	pH 5-9	7 days	3 - 1 L amber glass bottles
Metals	CLP Inorganics	HNO_3 to pH<2	28 days	1 - 1 L plastic bottle
Cyanide	335.2	NaOH to pH>12, 4°C	14 days	1 - 1 L plastic bottle

ANALYTICAL PARAMETERS, PRESERVATION, HOLDING TIMES AND CONTAINERS FOR SOIL/WASTE SAMPLES

LABORATORY ANALYSES	METHOD	SAMPLE PRESERVATION	HOLDING TIME[a]	CONTAINER
Volatile Organics	95-1	Cool to 4°C	14 days	2 - 40 ml glass vials
Extractable Organics	95-2	Cool to 4°C	5 days	2 - 4 oz glass jars w/teflon tops
Pesticides/PCBs	95-3	Cool to 4°C	7 days	2 - 4 oz glass jars w/teflon tops
Metals	CLP Inorganics		28 days	2 - 4 oz glass jars w/teflon tops
Cyanide	335.2	NaOH to pH>12, 4°C	14 days	2 - 4 oz glass jars w/teflon tops
Total Organic Carbon	415.1	Cool to 4°C	28 days	1 - 4 oz glass jars w/teflon tops

[a] *Holding times per ASP calculated from Verified Time of Sample Receipt at Laboratory*

TABLE 3
ANALYTICAL SUMMARY
TOWN OF SALINA LANDFILL RI/FS

PARAMETER LIST	Surface Soil			Subsurface Soil			Groundwater Rnd 1			Surface Water Rnd 1			Leachate			Sediment Rnd 1		
	Primary	QC	Total	Primary	QC	Total	Primary	QC	Total	Primary	QC	Total	Primary	QC	Total	Primary	QC	Total
VOCs	7	3	10	22	3	25	17	6	23	5	3	8	6	3	9	10	4	14
Semi-VOCs	7	3	10	22	3	25	17	5	22	5	3	8	6	3	9	10	4	14
Pest/PCBs	7	3	10	22	3	25	17	5	22	5	3	8	6	3	9	10	4	14
Metals + Cn	7	1	8	22	1	23	17	3	20	5	1	6	6	1	7	10	1	11
Dissolved Metals							17	3	20									
Wet Chem Parameters																		
Turbidity							24	0	24									
BOD										20	0	20						
TOC	7	1	8	22	0	22	24	0	24							20	1	21
Hardness										5	0	5						
TDS							24	0	24									
Alkalinity							24	0	24									
Chloride							24	0	24									
Sulfate							24	0	24									
Sulfide							24	0	24									
Nitrate							24	0	24									
TKN							24	0	24									
Ammonia							24	0	24									
Phenols							24	0	24									
Hardness							24	0	24									
Field Parameters																		
Specific Conductance							24	0	24	20	0	20						
pH							24	0	24	20	0	20						
Temperature							24	0	24	20	0	20						
Dissolved Oxygen							24	0	24	20	0	20						

APPENDIX A

FIELD LOGBOOK AND PHOTOGRAPHS

A. PURPOSE/SCOPE:

To produce an accurate and reliable record of all field activities, including field observations, sample collection activities, etc.

All pertinent field survey and sampling information shall be recorded in a logbook or on field logs during each day of the field effort.

In addition to keeping logs, photographs will be taken to provide a physical record to augment the field worker's written observations. They can be valuable to the field team during future inspections, informal meetings, and hearings. Photographs should be taken with a camera-lens system having a perspective similar to that afforded by the naked eye. A photograph must be documented if it is to be a valid representation of an existing situation.

B. EQUIPMENT/MATERIALS:

Bound Field Book (with waterproof paper), Field Logs, Chain-of-Custody, Other Appropriate Forms, Indelible Ink Pens, 35 mm Camera with 50 mm lens, 100 ASA 35 mm Film,

C. PROCEDURE:

1. At a minimum, entries in a logbook shall include:

- Date and time of starting work;
- Names of all personnel at site;
- Purpose of proposed work effort;
- Sampling equipment to be used and calibration of equipment;
- Description of work area;
- Location of work area, including map reference;
- Details of work effort, particularly any deviation from the field operations plan or standard operating procedures;
- Field observations;
- Field measurements (e.g., pH);
- Field laboratory analytical results;
- Personnel and equipment decontamination procedures;
- Daily health and safety entries, including levels of protection;

- Type and number of samples;
- Sampling method, particularly deviations from the standard operating procedures;
- Sample location and number; and
- Sample handling, packaging, labeling, and shipping information (including destination).

2. For each photograph taken, several items shall be recorded in the field logbooks:
   - Date and time;
   - Name of photographer;
   - General direction faced and description of the subject; and
   - Sequential number of the photograph and roll number.
3. Each day's entries will be initialed and dated at the end by the author, and a line will be drawn through the remainder of the page.

D. QA/QC:

All entries in the logbook shall be made in indelible ink. All corrections shall consist of single line-out deletions that are initialed.

The field task leader shall be responsible for ensuring that sufficient detail is recorded in the logbooks, and shall review the site logbooks daily.

E. SPECIAL CONDITIONS:

Once a roll of film is developed, the slides or prints will be placed in task files in the office. Photographic information from the logbooks will be photocopied and placed in the file accompanying the slides or prints.

F. REFERENCES:

None.

YSI MODEL 3500 WATER QUALITY SYSTEM

A. PURPOSE/SCOPE:

The YSI Model 3500 water quality system is used to measure pH, conductivity, temperature and oxidation reduction potential (ORP). The systems specifications are, pH 0 to 14 Ph units, conductivity 0 - 100 micrometer per centimeter, temperature -5.0 to 50.0°C and ORP -1500mV to 1500mV. This unit operates on a flow-through method. As the water flows in through the conductivity probe into the sample chamber it takes all the measurements simultaneously.

B. EQUIPMENT/MATERIALS:

YSI Model 3500, sample chamber, probes, calibration kit.

Battery Replacement
The unit uses 6 D size alkaline batteries. These can be replace by removing the back plate of the 3500 and placing the new batteries in the tubes provided.

C. PROCEDURE:

The frequency at which calibration is needed depends on the electrode, the Ph monitor and the characteristics of the water to which the electrode is exposed. Since normal life of a pH electrode is only three to six moths, it is advisable to calibrate the pH system before sampling at each site. The pH electrode should be tested for background noise and appropriately offset on a weekly basis.

1. Before connecting the pH electrode, zero the electronics with the shorting cap attached to the 3500. Turn on the 3500 and set the pH function switch to pH. Next, connect the shorting cap to the pH input jack and set the manual temperature compensation knob to 20°C. Then, adjust the CAL control to indicate 7.00 ±0.01 on the pH-mV display. Disconnect the shorting cap from the pH input and connect it to the mV input jack. The monitor is now zeroed.

2. Test the 3530 pH Electrode for noise and offset as follows. Rinse the 3530 and a YSI 3510 Temperature Probe with pH 7.00 buffer to remove any contaminants. Connect the 3530 to the pH input jack and the 3510 to the TEMP input jack. Pour pH 7.00 buffer into a 50 ml sample cup, such as one from the YSI 3565 Sample Cup Pack, then immerse both of the sensors into the buffer at 25.0 ±0.1°C (use the °C display to confirm the temperature). Allow the sensors to equilibrate. A display value other than 7.00 shows electrode background noise and offset. The 3530 background noise and offset at pH 7.00 should not exceed ±0.2 pH units at 25°C.

3. Once it has been established that the electrode offset is functioning properly, a two point calibration should be performed. pH buffers of 7.00 and 4.00 or of 7.00 and 10.00, whichever two are closer to the expected sample value, should be used. Proceed as follows to make a two point calibration.

   Rinse the 3530 and a YSI Temperature probe with pH 7.00 buffer to remove any contaminants. Connect the 3530 to the pH input jack and the 3510 to the TEMP input jack. Pour pH 7.00

buffer into a 50 ml sample cup, such as one from the YSI 3565 Sample Cup Pack, then immerse both of the sensors into the buffer. Allow the sensors to equilibrate in the buffer until a stable reading is obtained. Read the temperature and adjust the pH manual temperature compensation knob to the same value. Adjust the CAL control knob for 7.00 ±0.01 pH units on the display and discard the buffer. Rinse the sensors with deionized or distilled water, followed by a rinse of the next desired buffer (typically pH 4.00 or 10.00). Half fill another disposable 50 ml sample cup with the next buffer for calibration and immerse the sensors. Allow the sensors to equilibrate until a stable reading is obtained. The temperature of the two buffers should not differ by more than ±0.1°C. Adjust the SLOPE control until the display is within 0.01 pH units of the buffer's stated value. Discard the buffers. The pH system is now calibrated and ready for use.

4. After calibrating the pH connect the ORP and conductivity probes to the correct jacks and place them in the sampling chamber. After the system is ready for use connect it to the water source and start operation. This system is designed to operate at a velocity of no greater than 1.5 gallons per minute. If this is exceeded the system will not operate properly.

D. QA/QC REQUIREMENTS:

Only the pH on this instrument can be calibrated in the field. The temperature, conductivity and ORP are all factory calibrated.

E. SPECIAL CONDITIONS

1. The pH and ORP probes must be stored in a pH solution of 4 to operate properly.
2. The conductivity probe should be stored in deionized water.
3. This instrument is not waterproof. It must not be submerged in water or left out in the rain.

F. REFERENCES:

YSI Model 3560 Operation and Maintenance Manual.

HERMIT DATA LOGGER

A. PURPOSE/SCOPE:

This procedure describes the use of the Hermit Data Logger linked to a pressure transducer to record changes in water level over time. The system can record many measurements in a short period of time and store the measurements electronically. These measurements may then be transferred to a computer for further analysis. This SOP describes use of the data logger for both pump tests and slug tests.

B. EQUIPMENT/MATERIALS:

Hermit 2 channel Data Logger, pressure transducer.

C. PROCEDURE:

PUMP TEST PROCEDURES

1. Measure the static water level in well from TOR and ground.

2. Put transducer down well ~ 1 hour prior to test to allow temperature equilibration. Transducer should be above pump but below anticipated maximum drawdown. Tape transducer to outside of well casing.

3. Wake up data logger and hit XD. The depth of the transducer below the current water level will be shown. Pull transducer up ~1' and hold. Press XD again, W.L. should change by 1'. Press start, then press enter.

4. Enter 0 as the reference water level. All levels will then be drawdowns and AQTESOLV will accept. Scan down to enter scale, offs and linearity from transducer reel (use Quadratic Coefficients).

5. After entering test number, data logger asks for rate. Select LOG.

6. Scan down menu with down arrow and enter input channel (1).

7. Scan down to enter type, enter LEVEL

8. Press STOP/NEXT to back out of menu.

9. Press ENTER and XD at the same time.

10. Scan down to dsp (Display). Scan to and enter desired units and measurement mode. En-english, SI-metric, TOC - down is increase, up is decrease, SUR - down is decrease, up is increase.

11. Recommended En: TOC, thus, all areas in ft. and drawdown will be in positive numbers, considering reference level is 0 (step 4).

<u>SLUG TEST PROCEDURES</u>

1. Measure static water level TOR.

2. If discharge tubing is present in well, drain water from tubing into well and remove tubing from well (place in clean plastic bag)

3. Put the data logger transducer probe down the well. Make sure it's deep enough so it won't interfere with the bailer or slug, but not sitting in bottom sediments.

4. Tape the Transducer Probe's cable to the outside of the well casing. (Put paper towel over cable so tape does not touch probe cable)

5. Take a water level (TOR)

6. Plug data logger interface cable into input 1 plug and into transducer spool's plug.

7. Press any key to wake up the data logger.

10A. Press the Enter key and hold down and press the DATA key - will see SEL "Flashing Test #"

10B. Press ENTER if the flashing number is the next test you want.

11. Once the test # is entered, hit STOP/NEXT key repeatedly until you get a blank screen with the ready dot in the middle.

12. Press ENTER and hold down, then press XD key (screen will read :REF)

13. Take another water level. If this level is the same or very close to the level taken originally (static) proceed to step 14. If the level is changing rapidly, wait until static or near static is obtained. (see Appendix A if water level is significantly higher than static level and recharge is slow).

14. Get into the display menu by pressing and holding down the ENTER key and the XD key together. Use the SCN UP or SCN DOWN keys to scroll through the menu options until you see DSP. Hit ENTER. Choose En:SUR for your first test (Falling head). Hit ENTER then escape out of this menu by pressing the NEXT key.

14A. Enter the reference level as 0 by pressing the ENTER key (you may have to wake machine up and get back into the XD menu = Step #12). You will see a number with one digit flashing. Use the STOP/NEXT and SCAN keys to input the reference level.

STARTING A TEST (Falling Head)

15. Press STOP/NEXT to clear screen

16. Press XD to get Transducer probes depth - this measures the column of water above the probe. This number should always be greater than the length of the bailer. If it's ;not, lower the transducer probe further into the hole or shorten the bailer. Pull transducer ~1 foot and press XD again. W.L. should have changed by 1'.

    - Press the STOP/NEXT key to clear the screen.

17. Press the START key

18. Press ENTER

19. Rapidly insert the slug into the well, trying not to create a splash in the well.

    Once the test is started you will see the screen go from Log 1, Log 2 to Log 3. It will stay on Log 3 for 10 minutes. After the Log 3 cycle is completed, the screen will read "RUN". Once run is seen, you can view the data.

20. To view data - press the DATA key, scan the data to view different sections of the test

21. To stop a test: press ENTER and hold down and pres the STOP/NEXT key. You will see "STOP" on screen. Press ENTER to confirm the stop. If you decide you don't want to stop press STOP/NEXT to continue the test (See Appendix B on when to stop a test).

22. Press the STOP/NEXT key to put the machine to sleep once the test has been stopped.

Rising Head Test:

23. Choose the next test #. (step 10). Get into the display menu and change the display mode from En:Sur to En:Toc. (step 14).

24. Recheck the reference level to make sure it is still set at zero.

25. Start the test and rapidly pull the slug from the well. Be careful not to get the slug stuck on the transducer cable.

26. Stop the test when you are sure enough data has been collected. (Step 21 and appendix B)

APPENDIX A

If water level is significantly higher (than static) when the transducer probe are set and recharge is slow (in clays and tills), pull a volume of water from the well to try to get the water level slightly below or at static.

APPENDIX B

When to stop a test:

A. When static level is reached or

B. After 30 minutes and 75% of the recharge has occurred.

to find 75% of recharge scan the data and find the maximum offset from the reference level. Subtract this number from the reference level. Multiply by 0.75 and subtract from the maximum offset number.

D. QA/QC REQUIREMENTS:

E. SPECIAL CONDITIONS

NOTE: Transducer will not measure water levels if column of water above transducer is > ~40 feet.

-CAUTION- In sunny hot weather keep the data logger lid closed as much as possible.

F. REFERENCES:

Owner's Manual

FIELD DESCRIPTION OF SOILS

A. PURPOSE/SCOPE:

To develop a standard methodology for field descriptions of soils.

B. EQUIPMENT/MATERIALS:

No equipment is necessary to perform this task. A Munsel Soil Color Chart and a standard grain size chart may be helpful.

C. PROCEDURE:

The Burmister Method is used for the verbal description of soil samples. In addition, a Unified Soil Classification System (USCS) symbol is assigned to each sample. The following step by step procedure should be followed for the field classification of soils.

A complete soil description should contain the following information in the order indicated.

- Major grain size component
- Minor grain size component(s) with modifier
- Miscellaneous characteristics (bedding, odors, etc.)
- Color
- Density/Consistency
- Soil Moisture
- USCS symbol

1. Grain Size: There are five major grain sizes: Boulders, Cobbles, Gravel, Sand, and Silt/Clay.

- Boulders are > 8"

- Cobbles are 3" to 8"

- Gravels range in size from 0.2" to 3.0" in diameter and are subdivided into Fine (>0.2" to 0.75" in diameter and Coarse (>0.75" to 3.0")

- Sands range in size from 0.002" to 0.2" and are subdivided into coarse, medium and fine. Standard comparison cards are available for field use.

- Silt and clay are difficult to distinguish in the field. An attempt is made, however, to describe the soil as one of the six following classifications: silt, clayey silt, silt and clay, clay and silt, silty clay, or clay. The field description may be later verified in a lab hydrometer test. For field descriptions of silts and clays, the following guidelines should be used:

  SILT: gritty, no threads can be rolled
  Clayey SILT: rough to smooth, difficult to roll threads
  SILT and CLAY: rough to smooth, difficult to roll threads
  CLAY and SILT: smooth and dull, threads can be rolled readily

Silty CLAY: smooth and shiny, threads can be rolled very readily
CLAY: very shiny and waxy, threads can be rolled very easily

Grain size descriptions are written with the major grain size component listed first. In order to be considered a major grain size component, the component must constitute greater than 50% of the sample. Major grain size components are written in all capital letters and are underlined. If no grain size component constitutes greater than 50% of the sample, the sample is classified by describing the distribution of the sand component of the sample first (ex. f.m. Sand). Then, the other grain size components are described and the appropriate percentage modifier (see section C.2.) are assigned. The reader can then determine the percentage of sand in the sample by subtracting the sum of the modifier percentages from 100%. An example is shown in section C.7.

2. Other grain size components, if present, are listed in order of decreasing percentage.

The following modifiers are used to indicate the relative proportion of a minor grain size component in the soil:

Estimated amount: Modifier

- < 10 percent: Trace
- 10 percent to 20 percent: Little
- 20 percent to 35 percent: Some
- 35 percent to 50 percent: And

Minor grain size components assigned a trace or little modifier are written in lower case letters. Minor grain size components assigned a some or and modifier are written with the first letter of the grain size capitalized (ex. f. Sand). When multiple minor grain size components are described with the same modifier, finer grain sizes precede coarser grain sizes.

3. <u>Color</u>: Common colors and their abbreviations are listed below.

- Orange: Or
- Tan: Tan
- Black: Blk
- Brown: Br
- Grey: Gr
- Red: Red

4. <u>Density/Consistency</u>: The density or consistency of the soils is classified according to the "n" value of the soil. The "n" value is the sum of the middle two blow counts determined during a standard penetration test (see SOP #303). The following classifications are used:

For Granular Soils (clean silts and coarser)
- 0 to 4: Very Loose
- 4 to 10: Loose
- 10 to 30: Medium Compact
- 30 to 50: Compact
- >50: Very Compact

For Cohesive Soils (silt and clay mixtures or clay)

- 0 to 2 : Very Soft
- 2 to 4 : Soft
- 4 to 8 : Medium Stiff
- 8 to 15 : Stiff
- 15 to 30: Very Stiff
- >30 : Hard

5. Moisture content: The moisture content is determined in the field and is described using the following terms:

    - Dry (dab finger in soil, no moisture on finger)
    - Moist (dab finger in soil, moisture on finger)
    - Wet (water visible)
    - Saturated (all pore spaces filled)

6. USCS symbol: A USCS symbol is assigned to each symbol.

7. Example:

    A. Sample with Major Component:

    f. SAND, some Silt, little m.c. sand and f. gravel, trace c. gravel, petroleum odor, brown, m. compact, wet (SM)

    B. Sample with No Major Component:

    f.m.c. Sand, some Silt and f. Gravel, brown, v. compact, moist (SM)
    (In this sample, the describer classified the sample as containing 30% silt and 30% f. gravel. The percentage of sand would then be determined as: 100%-30%-30%=40%.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS:

None.

F. REFERENCES:

Burmister, D.M., Suggested Methods of Test for Identification of Soils.
The Unified Soil Classification System (USCS).

STANDARD PENETRATION TEST BORINGS

A. PURPOSE/SCOPE:

The purpose of drilling test borings is typically to characterize the lateral and vertical extent of contamination in the unsaturated zone. The test borings may also be used to allow the installation of ground water monitoring wells. Test borings may also be used to determine the subsurface characteristics for the purpose of geotechnical investigations.

B. EQUIPMENT/MATERIALS:

Drilling will be performed by a licensed drilling firm under the direction of Clough, Harbour and Associates. The drilling field crew will consist of a driller, a driller's assistant, and a CHA field geologist/engineer. The field geologist will supervise drilling operations and conduct the geologic logging of the boreholes. A list of typical equipment needed for installation of monitoring wells at the site is summarized in the table included in SOP #309.

C. PROCEDURE:

1. The drilling rig and sampling equipment may be required to be decontaminated by steam-cleaning (high pressure, hot water) prior to drilling and in between borings depending on the job requirements

2. The borings will be drilled with a hollow-stem augers, flush joint casing, open hole or any combination depending on the type of information needed, geologic conditions, and other limitations that may be imposed due to contamination or state or federal guidelines. The boring shall be advanced to match the sampling interval (continuous or standard sampling).

3. Drilling progress and information about the formations encountered shall be recorded by the geologist on the field boring log. The information should include total depth drilled, depths and thickness of strata, problems with borehole advancement, fill materials encountered, and water levels.

4. At the chosen depth interval, drive a clean, standard, 24-inch long, 2-inch O.D. split-spoon sampler into the soil a distance of 24 inches using a 140 lb hammer, free falling 30 inches. Record the number of blows required to drive the sampler every 6 inches on the field boring log. Discontinue driving the sampler if 100 blows have been applied and the sampler has not been driven 6 inches. If 6 inches of penetration has been achieved, discontinue driving the sampler after 50 blows has failed to penetrate fully any of the remaining 6 inch intervals. The first six inches seats the spoon, the next 12 inches represents the Standard Penetration Resistance, the last six inches is driven to insure sample recovery.

5. Retrieve the sampler from the borehole and place it on a clean, flat surface. Open the sampler and immediately scan the sample with an air monitoring instrument (e.g., HNu or OVA) if appropriate to the purpose of the investigation. Record instrument readings on field boring log.

Further, describe and record the following properties of the sample: Sample length recovered, presence of any slough in sampler, basic soil type (e.g., sand, gravel, clay), structure, texture, sorting, grain size, grain shape, degree of saturation, competency, color, odor, staining, and presence of foreign material(s). Refer to SOP#301, Field Description of Soils.

6. After the soil within the sampler has been described, it will be placed in sealed sample jars.

7. If appropriate to the investigation, the air space surrounding the borehole shall be scanned with a FID or PID and Explosimeter during all drilling activities to determine the absence of volatile organic compounds. Results of this air monitoring shall be recorded on the Geologic Field Log. Activities shall proceed according to the site HSP if the presence of volatile organic compounds is indicated.

8. If appropriate to the investigation, between boreholes, the down-hole drilling tools shall be steam-cleaned.

9. Upon completion of the test boring, all drill cuttings shall be placed back in the borehole.

10. Note the locations of the borings on a site map and/or mark the locations of the boreholes with a labelled wooden stake.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS:

None.

F. REFERENCES:

ASTM Standard D 1586

EXCAVATION OF TEST PITS

A. PURPOSE/SCOPE:

To evaluate subsurface soils and/or to search for buried objects within 12 to 20 feet of surface grade.

B. EQUIPMENT/MATERIALS:

Backhoe and operator (subcontractor), shovel, wooden stakes, indelible ink pens, hammers, a combustible gas meter, a photoionization detector, the appropriate sample jars, test pit field logs, camera.

C. PROCEDURE:

1. Personnel should stand at the opposite end of the pit from the backhoe. From this position, it is possible to see in the pit, yet be out of the backhoe operators way. Screening with a photoionization or flame ionization detector and a combustible gas meter should be performed on a continual basis if specified in the Health and Safety Plan.

2. Evaluation of the soils in the test pit should be made according to SOP #301. The following information should also be recorded in the field log book:

   - Test pit # and location of the pit on the site
   - Total depth, width, and length
   - The soil types encountered and the depth from ground surface at which that soil was encountered.
   - The depth at which water is encountered

3. The excavated material should be placed on one side of the pit, at least 4 feet from the edge of the pit. If soil samples are to be collected, that bucket of material should be placed on the other side of the pit from the normal spoils.

4. Excavation will not proceed past the water table in any test pit. Should buried drums (or other material that presents an immediate threat be encountered in a test pit, work will stop and the Project Manager will be notified.

5. Samples will be collected directly from the backhoe bucket. Volatile organic sample jars will be filled first if testing of volatile organic compounds is specified in the site investigation plan. Then pack all other sample fractions.

6. Photographs of the test pit and material excavated may be taken as necessary.

7. After sampling is completed, the test pit will be backfilled and its location will be marked by a wooden stake. The station number and date of sampling should be written on the stake in indelible ink. Then use the measuring tape to determine the distance and direction to the nearest landmark.

8. Decontaminate the backhoe and all other sampling equipment as specified in SOP #503.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS:

None.

F. REFERENCES:

None.

MONITORING WELL INSTALLATION

A. PURPOSE/SCOPE:

Monitoring wells are used to define the lateral and vertical extent of ground-water contamination, to determine the elevation and fluctuations in the water table, as an observation point during pump tests, to aid in determining the hyraulic conductivity of screened soil layers, and to establish a background level for the local groundwater chemistry. The procedures described below are intended to provide access to ground water with minimum disturbance to the aquifer. Additionally, the procedures are intended to prevent cross-contamination between aquifers.

B. EQUIPMENT/MATERIALS:

Drilling will be performed by a licensed drilling firm under the direction of a Clough Harbour representative. The drilling field crew will consist of a driller, a driller's assistant, and a Clough Harbour field geologist/engineer. The field geologist will supervise drilling operations and conduct the geologic logging of the boreholes.

C. PROCEDURE:

Two types of monitoring wells will be discussed in this SOP. One type of monitoring well is installed in unconsolidated material in an unconfined aquifer. The second type of well is installed in a confined aquifer. Before proceeding with any work, refer to any applicable site Health and Safety Plans.

Wells installed in Unconfined Aquifers

Refer to SOP #303 for drilling procedures used to advance boreholes.

The following procedure describes construction of a monitoring well using 2-inch diameter water-tight flush threaded PVC well casing and screen. The slot size of the screen will be determined depending on the data required and the type of soil screened. Filter pack sand size used will be dependent on the screen slot size and various state and federal regulations.

It should be noted however, that the diameter and type of well casing material may differ according to different specific applications.

1. All well casing and screens shall be new and brought to the site enclosed in plastic. Contact of casing or screen with the ground prior to installation shall be avoided. Plastic sheeting (e.g., visqueen) shall be placed on the ground and used as a cover to protect stockpiled materials from contamination.

2. If monitoring for contaminants less dense than water, drilling will proceed to a depth of several feet below the water table. The well will be screened across the water table, using approximately ten feet of screen.

3. If monitoring for contaminants more dense than water, drilling will proceed until the first confining surface (e.g., clay layer, top of bedrock, etc.) is encountered. In these situations, ten feet of screen will be placed immediately above the confining surface.

4. A sand pack composed of washed sand will be tremmied in the annular space of each well from 0.5 feet below the screen to two feet or 20 percent of the screen length, whichever is greater, above the screen. A six inch to 12 inch choke of #00 sand must be placed immediately below and above a bentonite seal at least 3 feet thick. All well measurements will be recorded in the field logbook. The remaining annulus to the ground surface will be filled with a cement-bentonite grout using a tremie pipe. Depending on local requirements a certain amount of setting time for the bentonite seal may be required before the bentonite/cement grout is placed.

5. The wells shall extend 3 feet above grade with a 4-6 inch diameter protective steel surface casing. The surface casing will be surrounded by a three-foot square concrete pad extending below the frost line. The pad should be shaped to shed rainwater. The protective casing shall be fitted with a lockable water-tight cap. Weep holes should be drilled at the base of the protective steel casing and a vent hole must be drilled at the top of the PVC casing to allow water levels to respond to barometeric changes and prevent explosive gas buildup. The annular space of the protective casing should be filled with gravel or coarse sand.

   In cases where wells must be installed in high traffic areas, the protective steel casing may be replaced with a manhole which is mounted flush with surface grade.

Wells Installed in Confined Aquifers

Wells installed in confined aquifers must penetrate a confining layer. That confining layer may be a clay lense in more porous unconsolidated materials or unfractured bedrock in consolidated materials.

1. Drill to the top of the confining surface. Steel casing will then be driven at least 6 inches into the confining layer. The steel casing will then be grouted in place. After the grout has set, drilling will proceed until the desired depth is reached. If drilling proceeds through more than 1 confining layer, the same process as described above will be repeated, except the first aquifer will be cased off with a a wider casing and the second aquifer will be cased off with narrower diameter casing, etc.

2. A well will then be constructed in this borehole in the same manner as described in steps 1 through 5 above.

   When installing a well in fractured rock, it may be possible to leave the open borehole as is, depending upon the competency of the rock.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS:

None.

F. REFERENCES:

Handbook of Suggested Practices for the Design and Installation of Ground-water Monitoring Wells.

TYPICAL EQUIPMENT NEEDED FOR INSTALLATION OF BOREHOLES AND GROUND-WATER MONITORING WELLS

Heavy Equipment

Drill rig
Water truck (if needed)
Grout Mixer
Steam cleaner
Generator for steam cleaner

Sampling Tools

2-inch I.D split-barrel samplers
3-inch I.D. thin-walled sampling tubes

Well Casing Materials

Varies with job requirements

Other Well Construction Materials

Type I Portland cement
Bentonite pellets
Washed sand of various grain sizes depending on screen or geologic conditions

Miscellaneous Equipment/Materials

Bore brush
55-gallon drums
Stainless steel tape (100 feet)
Tremie pipe
Shovels

WELL DEVELOPMENT

A. PURPOSE/SCOPE:

Well development is performed to ensure the free flow of turbid-free water into the well. It can be accomplished using either a combination of mechanical surging and pumping or using compressed air.

Mechanical surging forces water to flow into and out of a screen by operating a plunger up and down in the casing, similar to a piston in a cylinder. The tool normally used is called a surge block, surge plunger, or swab. The combination of mechanical surging and pumping are generally used in 2 to 4-inch diameter monitoring wells.

Compressed air can also be used to develop wells in consolidated and unconsolidated formations. Most air rotary drilling rigs have sufficient air capacity to develop 6-inch to 12-inch diameter wells.

B. EQUIPMENT/MATERIALS:

Surge block, inertial or submersible pump, bailer or Air compressor, air line

C. PROCEDURE:

Mechanical Surging and Pumping

1. Before starting to surge, the well should be evacuated to make sure that water will flow into it.

2. Lower the surge block into the well until it is 10 to 15 feet beneath the static water level, but above the well screen. The water column will effectively transmit the action of the surge block to the screen section. The initial surging motion should be relatively gentle, allowing any material blocking the screen to break up, go into suspension, and then move into the well.

3. As water begins to move easily both into and out of the screen, the surging tool is usually lowered progressively downward through the entire length of the screen. As the block is lowered, the force of the surging movement is increased.

4. Continue surging for approximately 20 minutes, then pull the block from the well. A pump or bailer may be used to remove the sediment out of the well. Pumping should continue for approximately 20 minutes.

5. Continue alternating the surging and pumping action until little or no sand or fines can be pulled into the well. The turbidity of the final discharge water should be below 50 NTU.

Airlift Development

1. Place the airline into the water at a shallow depth. Initially, the air lift should be operated to pump fluids at a reduced rate from the well. Once a constant flow rate from the well has been established, the airline is lowered to within 5 ft. of the bottom of the screen, assuming that sufficient pressure is available to overcome the static head. Development can also start near the top of the screen, depending on the preference of the driller.

2. A surging action is created by injecting air into the well to lift the water to the surface. As the water reaches the top of the casing, the air supply is shut off, allowing the aerated water column to fall (this procedure is called "rawhiding"). This tends to drive the water outward through the well screen openings.

3. After surging the well for a period of 20 - 30 minutes, the air should be applied in a continuous manner so that the water is expelled from the casing. The airline should be lowered to the bottom of the well so that accumulated sediment will be expelled. Surging and lifting cycles are repeated until the water is relatively free of sand and fine particles. The turbidity of the final discharge water should be below 50 NTU.

D. QA/QC REQUIREMENTS:

If an air compressor is used to develop the wells, make sure a filter is present on the compressor. Otherwise, oil from the compressor will be present in the airstream that enters the well.

E. SPECIAL CONDITIONS:

The surge block should be operated with care in cases where excessive sand will be introduced through the well screen to prevent the tool from becoming sand locked.

Air development procedures should begin by determining that groundwater can flow freely into the screen. Application of too much air volume in the borehole when the formation is clogged can result in a collapsed screen.

F. REFERENCES:

Driscoll, F.E., Groundwater and Wells. Second Edition, Johnson Division, St. Paul, MN. 1986, P. 504-506

GROUNDWATER SAMPLING

A. PURPOSE/SCOPE:

To obtain representative ground-water samples from an aquifer.

B. EQUIPMENT/MATERIALS:

Inertial pump, submersible pump, disposable bailers, generator, sample bottles, bailing twine and rope, field analyses meters, sampling gloves, water level meters, filtration system, 2-inch Grundfos Rediflow pump and controller, well sampling forms.

C. PROCEDURE:

1. The wells will be sampled in order from the least contaminated well to the most contaminated well.

2. Using a decontaminated measurement probe, determine the water level in the well; then calculate the fluid volume in the casing.

3. Using a decontaminated surface pump, submersible pump or disposable bailer, purge the well of a minimum of one well volume. Purging will be conducted at the lowest flow rate possible to purge the well within a reasonable time frame and to decrease the potential for elevating the turbidity of the well water. Conductivity, pH, Eh, turbidity, and temperature readings shall be taken and recorded during the well purging. The well will be considered properly purged when a minimum of one well volume has been purged and the conductivity, pH, Eh, turbidity and temperature have stabilized. Turbidity should be below 50 NTU, if possible. Record these readings on the well sampling log.

   It is important that none of the sampling equipment (pump, bailer, pump tubing, electrical cords, rope, etc.) come into contact with the ground.

4. Sample collection will be performed utilizing either an inertial pump system, submersible pump or disposable bailer. If the inertial pump system or submersible pump is used, samples will be obtained through the dedicated polyethylene tubing. Should disposable bailers be utilized, the sampling will be performed as follows:

   Attach a new bailer line to the disposable bailer equipped with a single check valve. Check the operation of the check valve assembly to confirm free operation. Lower the single check valve bailer slowly into the well until it contacts the water surface. Then lower the bailer just below the water surface with a minimum of disturbance. When filled with groundwater, slowly raise the bailer to the surface. Discharge the first bailer to the ground. Tip the bailer to allow the water to slowly discharge from the top and to flow gently down the inside of the sample bottle with minimum entry turbulence and aeration.

5. The order in which samples are to be collected is as follows:

   volatile organic compounds,
   purgable organic carbon,
   purgeable organic halogens
   total organic halogens

total organic carbon
extractable organic
total metals
dissolved metals
phenols
cyanide
sulfate and chloride
turbidity
nitrate and ammonia
radionuclides.

6. When collecting aliquots for analysis of volatile organic compounds, make absolutely certain that there are no bubbles adhering to the walls or the top of the VOA container.

7. Add appropriate preservatives to samples as described in SOP #605.

8. Label the sample containers with all necessary information and complete all chain-of-custody documents and seals.

9. Place the properly labeled and sealed sample bottles in a cooler with ice and maintain at 4°C for the duration of the sampling and transportation period. Do not allow samples to freeze.

D. QA/QC REQUIREMENTS:

To the extent possible, all samples should be collected using the same type of equipment and in the same manner to ensure comparability of data.

E. SPECIAL CONDITIONS:

Under Step 3, if sample turbidity cannot be reduced below 50 NTU, then the samplers should collect all portions of the sample except for the metals. The samplers should then return within 24 hours and collect a sample for total metals analysis from the top of the water column.

Step 4 can be replaced if purging and sampling is being performed with a Grundfos Rediflow pump. In this case, after well purging was completed, the discharge rate for the pump would be reduced to approximately 40 ml/minute. Sampling can then proceed as described above.

E. REFERENCES:

None.

MEASUREMENT OF WATER LEVEL/FREE PRODUCT THICKNESS

A. PURPOSE/SCOPE:

The objective of measuring ground-water levels is to evaluate horizontal and vertical flow gradients in an aquifer. Additionally, water level measurements made over a period of time are used to assess the extent of seasonal fluctuation of the water table. Free product thickness is measured to determine the lateral extent of free product contamination in an unconfined aquifer. It is needed to in the estimation of actual formation free product thickness.

B. EQUIPMENT/MATERIALS:

oil/water interface probe (e.g., Oil Recovery System probe), or an electric water level indicator and a clear teflon bailer.

C. PROCEDURE:

1. If it is known that free product is not present in the well, the electric water level indicator may be used to measure the depth to water. From an established measuring point on the well casing, measure the depth to water to the nearest 0.01 foot.

2. If it is unknown whether free product is present in a well, first lower the clear bailer into the well until liquid is encountered. Remove the bailer from the well and record the thickness of free product, if any is present, to the nearest 0.01 foot. Then measure the depth to water as described in #1 above.

3. If free product is known to exist in a well, the use of an oil/water interface probe is recommended. The probe typically emits two different types of signals or tones; one for free product and one for water. Lower the probe until the first signal indicates the interface between air and free product has been reached. Then continue to slowly lower the probe until the second signal indicates the interface between free product and water. Record all measurements to the nearest 0.01 foot.

4. Note the measuring point on the well casing (i.e., top of inner PVC casing, top of steel protective casing, etc.) on the Field Data Sheet.

5. Record the measured depths on the Field Data Sheet. Measurements will eventually be converted to a common datum (mean sea level) using the surveyed elevations of each well.

6. Decontaminate the probe (and bailer, if used) after each use.

D. QA/QC REQUIREMENTS:

Use of a clear bailer and an electric water level meter are not as accurate as use of an oil/water interface probe. If free product is known to exist in the well, the oil/water interface probe is recommended.

E. SPECIAL CONDITIONS:

When measuring water levels in multiple wells on a site, all measurements should be collected in as short of time as possible to minimize the effects of daily fluctuations in water levels. This is particularly important in areas near where groundwater levels may be tidally-influenced.

F. REFERENCES:

None.

SLUG TESTS

A. PURPOSE/SCOPE:

Slug tests are performed to determine the hydraulic conductivity of the aquifer being tested. Hydraulic conductivity measurements are used to determine the rate of groundwater movement within the aquifer around the point of measurement. In terms of the volume of area tested, hydraulic conductivity determinations from slug tests are considered intermediate in scale between pump tests (largest scale) and lab top experiments (smallest scale). Slug test derived hydraulic conductivities are considered accurate within one order of magnitude. A standard slug tests consists of two individual tests, the falling head test (FHT) and the rising head test (RHT).

B. EQUIPMENT/MATERIALS:

The equipment necessary to perform slug tests includes:

Sand filled pvc pipe (slug)
Rope
Water level indicator
In-Situ Hermit 1000C datalogger and transducer
Decontamination materials (liquinox, distilled water, scrub brush, etc.)
Large plastic bags for temporary Waterra tubing storage

C. PROCEDURE:

Slug tests are optimally performed following proper development of the well being tested (SOP # 311).

1. Prior to starting the slug test, record a static water level. The water level should be measured and recorded from the top of the pvc riser pipe (TOR). Time must be allowed following well development to insure that the water level is fully recovered by the time of the slug test.

2. If present, Waterra tubing must be inverted to purge water from the tubing. The Waterra tubing must then be removed from the well by carefully coiling the tubing and storing it temporarily in a plastic bag.

3. After removing tubing, install the datalogger transducer in the well. Refer to SOP # 213 for In-Situ Hermit 1000C datalogger usage. The transducer should be properly decontaminated prior to inserting into well. A transducer depth should be selected which places the transducer no less than five (5) feet deeper than the fully submerged slug and at least two (2) feet above the bottom of the well. The transducer cable should be temporarily attached to the well casing so that the transducer probe depth remains stable during the test.

   The transducer manufacturer recommends that the transducer sit in the well for one (1) hour prior to testing to allow for temperature equilibration.

   THE TRANSDUCER SHOULD NEVER BE INSTALLED MORE THAN 40 FEET BELOW THE WATER SURFACE. The maximum psi the transducer probe can read is equivalent to the psi created by 40 feet of water.

4. After installing the transducer, the water level in the well should be allowed to return to static (Step 1). If the water level after installing the transducer is substantially above the static water level, a bailer can be used to remove water from the well.

5. Determine the optimal slug length. The standard slug length is ten (10) feet. However, if the water column in the well is to small to fit the transducer and a ten (10) foot long slug, a shorter slug must be assembled. Five (5) foot and one (1) foot pvc sections can be used to construct a shorter slug. The slug should be properly decontaminated prior to inserting in well.

6. Once the water level has returned to static, the first part of the slug test, the FHT, can be conducted. After starting the In-Situ Hermit 1000C datalogger, quickly lower the slug into the water column until the slug is completely submerged. Data collection should continue for a minimum of 15 minutes, or until the water level returns to static.

7. The water level should be allowed to return to static following the FHT. If the water level is substantially above the static water level, a bailer can be used to remove water from the well.

8. Once the water level has returned to static, the second part of the slug test, the RHT, can be conducted. Once starting the In-Situ Hermit 1000C datalogger, the slug should be quickly removed from the water column. The slug should be removed from the well to prevent water level impacts from water dripping off the slug. Care should be taken to avoid tangling the slug (or rope attached to the slug) with the transducer cable. If the slug and cable do become tangled, the transducer probe will be raised temporarily, thereby distorting the water levels recorded.

D. QA/QC REQUIREMENTS:

Prior to leaving the project site, all tests should be reviewed to confirm that accurate and useful data has been collected.

E. SPECIAL CONDITIONS:

None.

F. REFERENCES:

Bouwer, H. and R.C. Rice, 1976. A Slug Test for Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells. Water Resources Research, Vol. 12, No. 3, p. 423-428.

Freeze, R. Allan and John A. Cherry, 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 604 p.

Hvorslev, M.J., 1951. Time Lag and Soil Permeability in Groundwater Observations. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, Bull. No. 36, 51 p.

SOIL GAS SURVEYS

A. PURPOSE/SCOPE:

Soil gas sampling is performed to measure the relative concentration of combustible gasses in the shallow subsurface soils of a site. This sampling is performed to determine whether combustible gasses are migrating off-site or into on-site buildings creating a potential explosion hazard.

B. EQUIPMENT/MATERIALS:

Scott D-15 Combustible Gas Meter, Soil Probe, Barometer, Compass, Windspeed Indicator, Thermometer, Gas Survey Log, Site Map with Sampling Locations.

C. PROCEDURE:

1. The survey is optimally performed when the ground surface is wet or frozen, wind velocity is low, and barometric pressure is low.

2. Calibrate the meter following manufacturer's specification using methane gas.

3. Identify the points to be sampled on-site with the Gas Survey Point Location Map. These points should be at no more than 100 foot intervals around the perimeter of the landfill unless permanent gas monitoring wells are constructed. If permanent gas monitoring wells are available, sampling locations are to be at maximum 400 foot intervals.

4. Note the barometric pressure on the Gas Survey Log.

5. Note the windspeed and direction on the Gas Survey Log

6. Note the temperature on the Gas Survey Log.

7. At each point location advance the soil probe 1.5 feet below grade. Check to make sure that the D-15 is set to the 0-5% scale.

8. Remove the soil probe and insert the gas meter probe into the hole made by the soil probe. Pump the aspirator of the D-15 5 to 10 times. While pumping read the highest peak shown. If the meter goes off-scale, switch to the 0 to 100% scale and re-aspirate the meter. Again, read the highest peak.

9. Note the gas reading on the Gas Survey Log in the correct point location.

10. If the initial reading for the location is above 0.5% gas, perform an offset reading as above 50 feet away from the point away from the waste mass. Note the reading on the Gas Survey Log in the correct Offset location. Continue to perform Offset readings until the percent gas is less than 0.5%.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS:

Offset readings are not necessary for any readings obtained from building interiors or on the waste mass.

This survey technique may also be used to identify and track sources of volatile organic compounds located in subsurface soils or shallow aquifers. In this case, a photoionization or a flame ionization detector is used in place of the combustible gas meter.

F. REFERENCES:

None.

SURFACE WATER SAMPLING

A. PURPOSE/SCOPE:

The objective of sampling surface water in various streams, lakes, or ponds on or adjacent to a site is to determine the presence and extent of contamination emanating from the site and to determine the necessity for ecological studies.

B. EQUIPMENT/MATERIALS:

Dedicated sample bottles, glass and/or stainless steel collection vessel/pitcher, Water Quality Measurement Meter (including pH, Eh, dissolved oxygen (DO), temperature, specific conductance), tape measure, stopwatch, Surface Water/Sediment Sampling Log (attached).

C. PROCEDURE:

1. When collecting both water and sediment at the same location, the surface water sample will be collected first, followed by the collection of the sediment sample to agitation of sediments into the water column.

2. The samples will be collected from areas of stream bottom where there is predominantly fine-grained sediment. These areas should also be characterized by a steady, but non-turbulent, flow of water. These criteria are designed to maximize sample quality by maximizing the adsorption of metals and organics in the sediments and the retention of volatile constituents in the water column, respectively. Adjust the field sampling locations to accomodate the above considerations, making sure to measure and record relocation information (e.g., distance from proposed location in what direction), if any, in the field logbook.

3. Once the sampling location has been established, describe the location in terms of water flow rate and descriptive parameters as described below (refer to sampling log):

   FLOW RATE - Measure, or estimate if too large to measure, the average stream width and depth. Measure flow velocity three times by measuring off a 10-foot stretch and timing how long is required for a floating object to traverse the 10-foot length. Average the three measurements of stream velocity (add the three and then divide by three) in units of ft/sec. Multiply the average velocity (in feet/sec) by the average stream width (in feet), then multiply by the stream average depth (in feet). The product will be the average flow volume in units of cubic feet/sec.

   WATER QUALITY PARAMETERS - Using the collection vessel, transfer the necessary amount of surface water from the water body to a container for field measurements of Eh, pH, specific conductance, turbidity, dissolved oxygen, and temperature. Alternatively, some instruments are equipped with specially designed cups to hold the water or may have submersible probes that are placed into the actual water body itself, etc. Record the field parameter measurements on the log.

   DESCRIPTIVE PARAMETERS - Describe the surface water/sediment sampling location by describing both the stream bed and the stream water. Describe the amount of organic material seen in the stream, from toppled trees and branches to fine particles on the bed.

Estimate the texture of the stream sediment (% rocks, gravel, sand, silt/clay) and estimate the depth of sediment sample collection. Note the presence of odors, if any. Describe the stream at the sampling location in terms of the percentage of pool (deep, calm, pooled areas), % riffle (shallow, swift-flowing, with the surface broken e.g., tumbling over rocks), and % run (smoothly flowing). The sum of the three types should total 100%. Describe the adjacent banks and surrounding area in terms of amount and type of vegetation, steepness of the banks, rocky versus muddy banks, outcrops, sunny vs. shady, etc.

4. One team member will perform the actual sample collection; he will carefully adopt an optimal sampling position, and once in that position, will not move his feet until all sampling at that locality is concluded in order to minimize agitation of the sediment and water.

5. Stream sediments are to remain undisturbed by the water collection vessel. Should contact with the bottom and resuspension of sediment occur, the sampling team is to halt sampling until the water has cleared. If the water does not clear within a few minutes, the team is to proceed slightly upstream (about 1 meter or just above the disturbed area) and resume the sampling effort.

6. Submerge the open water collection vessel in water with mouth below the water surface. Take care not to collect any floating solids or materials disturbed from the bottom of the water body. In areas of active flow, point bottle mouth upstream. (A stainless steel pitcher may be used to facilitate collection of the portion of the sample for analysis of organics, but should not be used to collect the portion to be analyzed for inorganics).

7. Use the collection vessel to fill all designated sample bottles. Collect the volatile organic fraction first, if it is to be collected. Add appropriate preservatives to samples as given in SOP #605.

8. Label the sample bottles with all necessary information.

9. Place the properly labeled sample bottles in a cooler with ice and maintain at 4°C for the duration of the sampling and transportation period. Do not allow samples to freeze.

10. Record all sampling information on the log and complete all chain-of-custody documents.

D. <u>QA/QC REQUIREMENTS:</u>

None.

E. <u>SPECIAL CONDITIONS:</u>

None.

F. <u>REFERENCES:</u>

Sediment samples are often collected at the same time surface water samples are collected. Refer to SOP #403 for more details regarding sediment sampling.

SEDIMENT SAMPLING

A. PURPOSE/SCOPE:

This procedure is applicable to collecting disturbed samples of bottom sediments in shallow water bodies that are less than 2 feet deep. Either a stainless-steel scoop with several 5 mm holes drilled in the upper portion of the back and rear sides, or a hard-driven corer may be used to collect the samples. In fine-grained sediment, deeper and less disturbed samples can be obtained with the corer.

B. EQUIPMENT/MATERIALS:

Stainless-steel scoop, plastic scoops, hand auger or corer, sample bottles, Surface Water/Sediment Sampling Log

C. PROCEDURE:

1. When collecting both water and sediment at the same location, the surface water sample will be collected first, followed by the collection of the sediment sample to avoid agitation of sediments into the water column.

2. The samples will be collected from areas of stream bottom where there is predominantly fine-grained sediment. These areas should also be characterized by a steady, but non-turbulent, flow of water. These criteria are designed to maximize sample quality by maximizing the adsorption of metals and organics in the sediments and the retention of volatile constituents in the water column, respectively.

3. Insert scoop or corer into sediment to be sampled. (Stainless steel should be used to collect organic portion and plastic should be used to collect inorganic portion). Slowly lift the sample from the water and allow excess water to drain slowly, being careful not to lose fine-grained particles. Depending on the area to be covered, up to five component samples should be collected to form a composite sample. Samples for volatile organics analysis should be placed directly in sample containers and not mixed or composited.

4. Place the component samples for each sediment composite in a clean, stainless-steel bowl for homogenization. Remove any objects larger than approximately 0.5 inches in diameter using clean, stainless-steel forceps.

5. Thoroughly mix the sediment in the bowl and separate into quarters. Place an aliquot from each quarter into an appropriate sample container. Fill the container completely, leaving no headspace.

6. Label the sample container with all necessary information. Record the information on the Surface Water/Sediment Sampling Log and complete all chain-of-custody documents and seals.

7. Place the properly labeled and sealed sample bottle in a cooler with ice and maintain at 4°C for the duration of the sampling and transportation period. Do not allow samples to freeze.

D. QA/QC REQUIREMENTS:

None

E. SPECIAL CONDITIONS:

None

F. REFERENCES:

Surface water samples are often collected at the same time sediment samples are collected. Refer to SOP #401 for more details regarding surface water sampling.

SURFACE SOIL SAMPLING

A. PURPOSE/SCOPE:

To determine whether the surface soils are contaminated and to determine the risk associated with exposure to the potentially contaminated surface soils at a site.

B. EQUIPMENT/MATERIALS:

The equipment needed for this task includes a hand auger, a shovel, stainless-steel bowls, wooden stakes, a hammer, indelible ink pens, a 300-foot measuring tape, a Brunton compass, appropriate sample jars.

C. PROCEDURE:

1. Use the shovel to clear any surface debris from the sampling location, including grasses or other vegetation.

2. Collect the samples with the hand auger from 0-6 inches depth. Carefully push the soil out of the auger into a stainless-steel bowl.

3. Pack the volatile organic sample jars first. Then pack all other sample fractions. The samples should be preserved by cooling to 4°C.

4. After sampling is completed, the sampling location should be marked by a wooden stake. The station number and date of sampling should be written on the stake in indelible ink. Then use the measuring tape to the distance and direction to the nearest landmark. Record the location in the field logbook.

5. Decontaminate the sampling equipment as specified in SOP #501 and move to the next sampling location. Repeat steps 1 through 4.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS

None.

F. REFERENCES:

None.

SMALL EQUIPMENT DECONTAMINATION

A. PURPOSE/SCOPE:

Decontamination will be performed between each sample collection point. (Waste products produced by the decontamination procedures such as waste liquids, solids, rags, gloves, etc., will be collected and disposed of properly based on the nature of contamination). See SOP #507 for specific details on the handling of decontamination wastes.

Decontamination of sampling equipment is performed to prevent cross contamination between samples.

B. EQUIPMENT/MATERIALS:

Alconox, tap water, distilled water, 20% methanol, 10% nitric acid, 1 gallon pressure spray bottles, long-handled brushes, 5 gallon plastic buckets

C. PROCEDURE:

1. Disassemble equipment, as required.
2. Remove gross contamination from the equipment by brushing and then rinsing with tap water.
3. Wash with Alconox and tap water.
4. Rinse with tap water.
5. Rinse with methanol when sampling for organics only.
6. Rinse with nitric acid when sampling for inorganics only.
7. Rinse with methanol and then with nitric acid when sampling for both organic and inorganic analytes.
8. Rinse with distilled water.
9. Air dry equipment.
10. Field personnel will use a new pair of outer gloves before handling sample equipment after it is cleaned.
11. If equipment is not to be used again immediately, it will be wrapped in aluminum foil.

D. QA/QC:

Field equipment rinsate blanks will be collected and used to assess the quality of equipment decontamination.

E. SPECIAL CONDITIONS:

Reusable PPE, such as respirators, chemical-resistant overboots, gloves shall also undergo the equipment decontamination sequence.

F. REFERENCES:

OSHA Health and Safety Manual for Hazardous Waste Site Activities.

LARGE EQUIPMENT DECONTAMINATION

A. PURPOSE/SCOPE:

Decontamination of large equipment (drilling rigs, backhoe excavators, bulldozers, etc., is necessary to prevent cross-contamination between sampling points and to prevent the removal of contaminants from a hazardous waste site.

B. EQUIPMENT/MATERIALS:

Steam cleaner, generator, decontamination pad, 55-gallon drums, centrifugal pump, discharge hose.

C. PROCEDURE:

1) Unless otherwise noted, all decontamination of large equipment will take place on a decontamination pad designed to collect all rinsate generated during the cleaning activity.

2) The drilling rig/excavation equipment and materials need to arrive on-site in a clean condition, and should be free of oil, grease, and debris. Inspect the rig for any fluid leaks.

3) Steam clean the drill rig/excavator, tools, drill bits, buckets, etc., are steam cleaned prior to the start of work. After steam cleaning, the equipment should be inspected for residues such as machine oil. If residues are observed, the equipment should be steam cleaned until such residues are removed.

4) In the event that equipment is contaminated with heavy oils or products that cannot be removed by the standard decontamination procedures outlined above, the following modifications will be made. First, wipe all excess oil/tar from the equipment with a paper towel or clean rag. Second, with a paper towel or clean rag that has been soaked in hexane, wipe any residual contamination off the equipment. When equipment is relatively free of gross oil or tar contamination, proceed with the usual decontamination procedure.

5) At the completion of the project, or when required, all rinsate generated from decontamination activities shall be pumped from the decontamination pad to 55-gallon drums for disposal.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS:

None.

F. REFERENCES:

None.

SAMPLE PRESERVATION AQUEOUS SAMPLES

A. PURPOSE/SCOPE:

Water samples collected in the field may undergo biological, chemical, or physical changes after removal from their environment. In order to minimize those changes, many samples must have preservatives in the form of strong acids or bases immediately added prior to delivery to the laboratory. Because of the inherent danger in working with these acids and bases, this SOP describes procedures for safe preservation of the samples.

B. EQUIPMENT/MATERIALS:

Hydrochloric (HCL) Acid Reagent A.S.C. 38%, Nitric (HNO3) Acid Reagent, A.S.C. 71%, Sodium Hydroxide (NaOH) 97%, 10 ml glass pipettes, narrow range (0-3, and 12-14) pH paper, nitrile gloves.

C. PROCEDURE:

Volatile Organic Compounds

1. Put on a clean pair of nitrile gloves.

2. In a clean, non-dusty environment, remove the cap of the 40-mL glass vial.

3. Using a clean, 10 ml glass pipette draw approximately 2 ml of Hydrochloric (HCL) Acid from the acid container and insert into the VOA vial.

4. Immediately after the HCL acid is placed into the sample bottle, replace and tighten the cap.

Total and Dissolved Metals, Mercury

1. Put on a clean pair of nitrile gloves.

2. In a clean, non-dusty environment, remove the cap of the 1-L high density polyethylene bottle.

3. Using a clean 10 mL glass pipette draw approximately 5 mL of Nitric (HNO3) acid from the acid container and insert into the polyethylene bottle.

4. Immediately after the HNO3 is placed into the sample bottle, replace and tighten the cap.

Cyanide

1. Put on a clean pair of nitrile gloves.

2. In a clean, non-dusty environment, remove the cap of the high density polyethylene bottle.

3. Using your hands remove approximately 15-20 Sodium Hydroxide (NaOH) pellets from the NaOH container and place into the sample bottle.

4. Immediately after the NaOH is placed into the sample bottle, replace and tighten the cap.

COD, Oil and Grease, Organic Carbon, Phenolics, Total Dissolved Phosphorus, Hydrolyzable Phosphorus, Ammonia, Nitrate plus Nitrite

1. Put on a clean pair of nitrile gloves.

2. In a clean, non-dusty environment, remove the cap of the appropriate sample bottle.

3. Using a clean 10 mL glass pipette, remove approximately 5 ml of Sulfuric (H2SO4) acid and insert into the sample container.

4. Immediately after the H2SO4 is placed into the sample container, replace and tighten the cap.

D. QA/QC REQUIREMENTS:

E. SPECIAL CONDITIONS:

Sample preservation should be done prior to collecting the sample to minimize the potential of contaminating the sample. Sample preservatives may need to be added to samples in the field if QA/QC field measurements indicate that the samples have not been preserved to the proper pH (see SOP for field measurement of pH for aqueous samples).

F. REFERENCES:

None.

QA/QC CHECK OF SAMPLE pH

A. PURPOSE/SCOPE:

To provide a QA/QC check of the aqueous samples to ensure that the samples have been preserved to the proper pH prior to being shipped to a laboratory for analysis.

B. EQUIPMENT/MATERIALS:

10 mL glass pipettes, nitrile gloves, narrow range (0-3 and 12-14) pH paper

D. PROCEDURE:

Volatile Organic Compounds

1. Collect one additional VOA vial at every third aqueous sampling location.

2. Fill the extra vial with the sample.

3 Using the extra VOA vial, remove the cap and using a clean, 10 mL glass pipette extract approximately 1 mL of water.

4. Place two drops of the water on a 1-inch strip of 0-3 range pH paper.

5. Compare pH strip's color while wet with that of the color key included on the pH paper container.

6. If pH is not less than 2, add additional HCL to the remaining 3 VOA vials prior to collecting the sample.

7. Discard the vial used to check the pH.

Total and Dissolved Metals, Mercury, Ammonia, Nitrate plus Nitrite, Total Dissolved Phosphorus, COD, Oil & Grease, Organic Carbon, Phenolics

1. Collect sample, and reseal the cap.

2. Shake sample gently to mix the acid and water.

3. Open cap, and using a clean, 10 mL glass pipette extract approximately 1 mL of sample.

4. Place approximately two drops of sample on a 1 inch strip of 0-3 range pH paper.

5. Compare pH strip's color while wet with that of the color key included on the pH paper container.

6. If pH is not less than 2, add appropriate additional preservative to the sample using a clean pipette.

7. Recheck sample using steps 2 through 6 until sample pH is less than 2.

Cyanide

1. Collect sample and tightly reseal the cap.

2. Agitate the sample by gently shaking the sample bottle until the NaOH pellets are dissolved.

3. Remove the cap and, using a clean 10 mL glass pipette, extract approximately 1 mL of sample.

4. Place approximately two drops of sample on a 1-inch strip of 12-14 range pH paper.

5. Compare pH strip's color while wet with that of the color key included on the pH paper container.

6. If pH is not greater than 12, add additional NaOH to the sample using standard procedures.

7. Recheck sample using steps 2 through 6 until sample pH is greater than 12.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS:

Personnel performing the pH QA/QC check must wear nitrile gloves while performing this task.

F. REFERENCES:

None.

QA/QC SAMPLES

A. PURPOSE/SCOPE:

Quality control samples are used to trace routes of contamination. Each type of sample traces a different route of contamination.

B. EQUIPMENT/MATERIALS:

Analyte-free water, appropriate sample containers.

C. PROCEDURE:

1. Duplicate Samples

   Duplicate samples will be collected for every twenty (20) routine samples collected per matrix, per analysis. The duplicates will be collected in the same manner as their corresponding routine samples.

2. Matrix Spike and Matrix Spike Duplicate Samples

   Matrix spikes and matrix spike duplicates are laboratory required quality control samples. However, the laboratory must be provided with additional sample volume for each sample matrix to complete their analysis. One matrix spike/matrix spike duplicate (MS/MSD) pair will be collected per matrix per 20 samples. Again, the MS/MSD pairs will be collected in the same manner as their corresponding routine samples.

3. Field Blank Samples

   Field blanks are blanks prepared prior to the sampling event from clean, analyte-free materials most closely resembling the sample matrices to be collected in the field. The blanks are transported to the field along with the containers in which the routine samples will be collected. Once in the field, the caps of the field blanks are removed so that the field blanks are exposed to the same conditions as the routine samples. At the end of each location sampling event, the caps to the field blanks are replaced, and the blanks are then subjected to the same protocol as the routine samples. Field blanks are collected for water only.

4. Equipment Rinsate Samples

One equipment rinseate sample will be collected per every 20 samples collected, per analysis, per matrix. The equipment rinseate blank will be collected by pouring analyte-free water, directly over decontaminated sampling equipment into a prepared sample container. The equipment rinseate blanks are then shipped to the laboratory with the other routine samples collected.

5. Trip Blank Samples

Trip blanks for volatile organic samples are prepared in the laboratory prior to the sampling event using analyte-free water. The trip blanks accompany the routine sample containers to the field, during collection of the samples in the field, and during transport of the routine volatile organic samples back to the laboratory. Trip blanks must remain un-opened until time of analysis. One trip blank sample will be used for each day of sampling for volatile organic compounds.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS:

None.

F. REFERENCES:

None.

CHAIN OF CUSTODY FORM

A. PURPOSE/SCOPE:

Sample custody is a necessary aspect to ensuring sample integrity. Sample custody is to be maintained during all sample handling activities. By definition, samples are in custody if they:

- are in the possession of an authorized individual;
- are in the field of vision of an authorized individual; and
- are in a secure area or a locked container.

In order to verify sample integrity, written conclusive proof is required that samples are collected, transferred, prepared, and analyzed in an unbroken chain. That written proof is a Chain-of-Custody form.

B. EQUIPMENT/MATERIALS:

Black ink pen, Chain-of-Custody forms

C. PROCEDURE:

To complete the form, the following information must be provided:

- The project number
- The project name
- The sampler's signature;
- The station number which may be equivalent to the station location;
- The date and time the sample was taken;
- Whether the sample is composite or grab;
- The number of containers in which the sample has been placed;
- The type of analyses requested;
- Under "Remarks" (in the lower right corner of the record), the airbill number of the container in which the samples will be shipped to the laboratory. (When samples are shipped to the laboratory via commercial carrier, the airbill serves as an extension of the chain-of-custody.); and
- Under "Relinquished by" and "Received by", the signature of every authorized person who maintains custody of the samples.

D. QA/QC REQUIREMENTS:

A second person should review all entries before the form is sealed in the sample cooler.

Mistakes should be corrected by crossing out the incorrect entry with a single line, initialing the line out, and entering the correct entry immediately adjacent to the incorrect entry.

E. SPECIAL CONDITIONS

None.

F. REFERENCES:

None.

SAMPLE SHIPPING

A. PURPOSE/SCOPE:

This procedure describes proper packaging of samples for shipment to the laboratory.

B. EQUIPMENT/MATERIALS:

40-quart ice coolers, vermiculite, ziploc bags, lawn and leaf trash bags, ice or freezer packs, chain-of-custody seals, packing tape, 1-gallon paint cans with lids.

C. PROCEDURE:

Once the samples have been collected, properly labeled and tagged, these steps should be followed to properly pack and ship the samples:

1. Seal all containers in clear plastic bags.

2. Double line the sample cooler with 2 plastic trash bags.

3. Place all samples within the inner trash bags in the cooler.

4. Surround the samples with vermiculite and seal the inner trash bag.

5. Use freezer packs or ice to cool the organic low level water samples to 4°C. (Do not cool dioxin or organic high level water samples; cooling of inorganic water samples is optional). The freezer packs or ice should be placed between the inner and outer trash bags. Then the outer trash bag should be sealed.

6. Tape paperwork in plastic bag on inside of cooler lid (The paper work includes the chain-of-custody record, and the bottom two copies of the traffic report); and

7. Close cooler and seal with custody seals.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS:

Pack all high concentration samples in metal paint cans. The paint cans should be labelled with sample number of sample contained inside and the contents of the can should be surrounded with vermiculite.

F. REFERENCES:

None.

USING AQTESOLV FOR ANALYSIS OF SLUG TEST DATA

A. PURPOSE/SCOPE:

Slug test data is analyzed using the AQTESOLV software package to determine the hydraulic conductivity of a specific strata. Usually the hermit data logger is used to collect the field data which is then downloaded onto a disk using the Hermit data transfer program.

B. EQUIPMENT/MATERIALS:

AQTESOLV software, data disk and printout of field data from the Hermit Data Logger.

C. PROCEDURE:

1. Select AQTESOLV from the GEO network menu.

2. Insert slug test data disk.

3. Choose: Data Set Manager

4. Choose: Create New Data Set, Answer Yes when asked are you sure you want to initialize the data.

5. Enter the title for the data set- this is the title that will appear above the final graph.

6. Choose: Slug Test Data. These data must be entered in units consistent with those used for drawdown. For example, if drawdown data is in feet, all well casing diameters, well diameters, etc. must be entered in feet.

   - Drawdown- the displacement at the start of the test. It may be necessary to look through a printout of the data to eliminate the erratic readings taken as the slug is inserted or removed. It is best to choose a starting point where the data increases or decreases consistently throughout the test.

   - Radius of well casing- PVC radius (in feet if drawdown data is in feet)

   - Radius of well- borehole/filter pack radius (in feet if drawdown data is in feet)

   - Saturated thickness- depth to an impermeable layer minus depth to water table

   - Screen length- length of well screen

   - Static height of water in well- depth of well minus depth to water table

8. Choose: Observation Well Measurements

   - Choose: Import Comma & " " delimited file
   - Enter: the numeric file name saved on the data disk. Example: B:ncha-3T3

- Order of Variables:
  Enter: 1 for time
  2 for drawdown
  0 for weights (the Hermit doesn't provide weight data)

9. To modify data, choose: Enter Data from Keyboard

   - Use the F7 key (Math function) to change the data to true drawdowns if you did not use zero as your reference level for the data logger.

   - Assign weights of zero to all data points recorded before and during slug insertion/removal and after 95% recharge has been obtained. This causes the computer to ignore these data. This will help AQTESOLV match a line to the more important early time data. Alternatively, you can manually manipulate the line to the data plot (described below).

10. Choose: Length and Time conversions. Choose an appropriate multiplier if different units are desired. Note this function converts all slug test data also.

   - Enter: 30.48 for a length multiplier. This changes foot data to cm.
   - Enter: 60 for time multiplier. This changes minute data to seconds.

11. Press Escape:

   - Save the data as a data set file.

   - Open an output file. The output file is used for final presentation along with the data plot and can be printed through the DOS editor. The output file should be named with the extension .OUT.

12. Escape to: Program Control

   - Choose: Slug Test Solutions

   - Choose: Bouwer-Rice for unconfined aquifers. Note this method is valid for both fully and partially penetrating wells. This method creates a semi-log plot of drawdown vs. time. A straight line is matched to the early time data where the majority of recharge occurs. In unconfined wells, avoid matching a line to the earliest, most rapid recharge data. This data represents the draining of the sandpack, not flow through the formation. In this case, a second data trend, slightly less steep than the first, can be seen.

   - Choose: Cooper et. al for confined aquifers. Note this method is valid for only fully penetrating wells.

13. Choose: Estimate Aquifer Parameters from Parameter Estimate Control.

   - When asked if additional iterations are necessary, answer no (generally one run of iterations is sufficient).

14. Choose: Configure Plot:

    - Units - Change to centimeters and seconds, if necessary.

    - X Axis - It may be helpful to limit the maximum time on the X axis. If the plot includes all data collected, the early time data may become compressed. This will make line matching more difficult.

15. Choose: Plot Graph.

    - If the graph is acceptable, print by pressing the "ALT" and "L" keys simultaneously. Generally, AQTESOLV does a poor job of matching the data and manual matching is necessary.

    - The curve or line on the graph can be manipulated manually to achieve a better fit. Use the F2 key to anchor a start point for the match curve or line. Select F3 to draw a line between the start point (F2) and the current cursor position. Select escape to draw a line between the two points. Select F4 to calculate and display a new result based on the new line position. Use the "ALT" and "L" keys simultaneously to print the graph. Use the "ALT" and "T" keys simultaneously to save the graph into the output file.

16. Escape to the Results Analysis Menu and choose: Print Results to Disk.

17. Printing Output File

    The output file presents the raw slug test data and final hydraulic conductivity results. To print the output file, enter in the DOS Editor from the GEO network menu. Select the correct disk drive and file and select print.

D. <u>QA/QC REQUIREMENTS:</u>

None.

E. <u>SPECIAL CONDITIONS</u>

None.

F. <u>REFERENCES:</u>

AQTESOLV Manual

<u>Applied Hydrogeology</u> , by Fetter.

FIELD MEASUREMENT OF WATER TEMPERATURE

A. PURPOSE/SCOPE:

To record accurate temperature of surface water for site characterization purposes.

B. EQUIPMENT/MATERIALS:

NBS - calibrated thermometers or YSI Flow Thru meter

C. PROCEDURE:

1. If using thermometer:

   - Check thermometer for cracks or gaps in the mercury.
   - Draw sample of at least 200 mL into beaker or sample bottle.
   - Place thermometer in sample. Do not allow thermometer bulb to touch sides of beaker. Allow to equilibrate (about 1 min).
   - Record temperature to nearest 1° C in field logbook.

2. If using YSI Flow Thru meter:

   - Draw sample of at least 200 mL into beaker or sample bottle.
   - Place temperature probe in sample. Do not allow probe to touch sides of beaker. Allow to equilibrate (about 1 min).
   - Record temperature to nearest 1° C in field logbook.

D. QA/QC REQUIREMENTS:

On a quarterly basis, check against NBS-calibrated field laboratory thermometer. Agreement should be within 0.5° C.

E. SPECIAL CONDITIONS:

None.

F. REFERENCES:

See SOP #207 for information regarding use of YSI Flow Thru meter.

FIELD MEASUREMENT OF pH FOR SURFACE AND GROUND WATERS

A. PURPOSE/SCOPE:

To accurately record the pH of water for site characterization purposes.

B. EQUIPMENT/MATERIALS:

Markson 611 pH meter or YSI Flow Thru meter, spare battery, plastic beakers, buffer solution of pH 4, 7, and 10.

C. PROCEDURE:

1. Rinse 500-mL plastic beaker with small portions of sample water 3 times.

2. Rinse electrodes with sample water.

3. Immerse electrode in sample while swirling the sample, if needed, to provide thorough mixing. Turn on meter. Read pH to nearest 0.1 unit once the reading is stabilized.

4. Record sample pH. Note any problems such as drift of meter.

D. QA/QC REQUIREMENTS:

Calibrate pH meter according to manufacturer's instructions in the field at the beginning and end of every work day, or at a minimum of every 10 samples analyzed.

Check batteries each time meter is used. Carry a spare battery pack and a screwdriver into the field in the pH meter case.

E. SPECIAL CONDITIONS:

None.

F. REFERENCES:

Refer to SOP's # 207 and 209 for further information.

FIELD MEASUREMENT OF SPECIFIC CONDUCTANCE

A. PURPOSE/SCOPE:

To accurately record the specific conductance of water for site characterization purposes.

B. EQUIPMENT/MATERIALS:

YSI Flow Thru Meter, plastic or glass beaker

C. PROCEDURE:

1. Mechanically zero the instrument while the instrument is OFF using screwdriver adjustment on the meter face.
2. Collect water sample in 500-mL plastic beaker.
3. Swirl conductivity probe in sample; discard sample.
4. Collect fresh sample in beaker.
5. Measure sample temperature to nearest 1° C.
6. Adjust the temperature setting on conductivity meter as per recorded temperature.
7. Turn on meter and immerse conductivity probe in sample. Move probe around in sample to displace any air bubbles.
8. Select the lowest appropriate multiplier setting to obtain the greatest meter needle deflection. Read the conductivity from the dial and record in field notebook.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS

None.

F. REFERENCES:

See SOP #207 for further information.

FIELD MEASUREMENT OF DISSOLVED OXYGEN

A. PURPOSE/SCOPE:

To accurately record the dissolved oxygen content of water for site characterization purposes.

B. EQUIPMENT/MATERIALS:

dissolved oxygen meter, plastic beaker, KCl solution (17 grams of KCl per 92 ml of distilled water).

C. PROCEDURE:

On the morning of a sampling trip, check meter batteries and electrode.

1. Check that meter pointer is exactly at zero when meter is upright. If necessary, adjust its position with the screw in the center of the meter panel.

2. Switch to Red Line and adjust knob until needle aligns with red line. If needle cannot be brought up to red line, replace instrument batteries (four size C batteries).

3. Examine electrode. If membrane is damaged, or there are bubbles beneath it, or it is wrinkled or pinched under the O-ring, replace membrane.

   a. Take off the O-ring and remove old membrane.

   b. Fill electrode with half-saturated KCl solution. Holding probe sensor-end up, drip solution into the top while pumping gently on the probe diaphragm with the eraser end of a pencil. Continue until no more bubbles appear.

   c. Secure a membrane against the probe body under your left thumb. Add more electrolyte to the probe until a large meniscus completely covers the gold cathode. NOTE: Handle membrane material with care, keeping it clean and dust free, touching it only at the ends.

   d. With the thumb and forefinger of your other hand, grasp the free end of the membrane.

   e. Using a continuous motion stretch the membrane up, over, and down the other side of the sensor.

   f. Secure the end of the membrane under the forefinger of the hand holding the probe.

   g. Roll the O-ring over the end of the probe. There should be no wrinkles in the membrane or trapped air bubbles. Some wrinkles may be removed by lightly tugging on the edges of the membrane beyond the O-ring. Trim off excess membrane with scissors or sharp knife. Check that the stainless steel temperature sensor is not covered by excess membrane.

4. Store probe attached to meter, with the electrode end inserted in the special plastic bottle.

Check that Kimwipe in bottom of bottle is moist. If necessary, add distilled water.

5. At each station, air-calibrate the probe according to the manufacturer's instructions before taking a reading.

6. Immerse probe in sample water. For groundwater, have pump discharge tube in the bottom of a beaker, allow water to overflow. For surface water, probe is immersed in a beaker which has been dipped from the stream with minimal turbulence.

7. Allow probe to acclimate to sample temperature for 30 sec.

8. Switch to 0-10 setting and read dissolved oxygen concentration to nearest 0.1 mg/L. If the reading is less than 5, switch to 0-5 setting. In a quiescent beaker of water, the probe must be gently moved up and down while the reading is taken.

9. Check meter calibration against replicate Winkler determinations at the beginning and end of each day in the field according to the manufacturer's instructions. The water used may be distilled or tap water brought into the field.

D. QA/QC REQUIREMENTS:

None.

E. SPECIAL CONDITIONS:

None.

F. REFERENCES:

None.