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Supplemental Site Assessment Work Plan for the Gabriel Manufacturing Site Stony Point, New York

Prepared for
E.I. du Pont de Nemours and Company, Honeywell, Inc. and Union Carbide Corporation

Revised February 2007

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1.0 INTRODUCTION

1.1 Purpose/Objectives

E.I. du Pont de Nemours (DuPont), Union Carbide Corporation (a subsidiary of The Dow Chemical Company), and Honeywell International Inc. (Honeywell) —collectively referred to as the "Companies"—are submitting this work plan for the Gabriel Manufacturing facility in Stony Point, New York (the "site") in accordance with an Administrative Order on Consent expected to be signed by the Companies and the New York State Department of Environmental Conservation (NYSDEC). This work plan describes tasks to be conducted as part of a Supplemental Site Assessment (SSA) being performed to confirm and characterize the presence of chlorofluorocarbons (CFCs) in soils and groundwater at the site and to fill certain data gaps from the previously conducted Preliminary Site Assessment (PSA) (LMS, July 2000). The Companies supplied CFCs to the manufacturing operations at the Gabriel facility. This work plan is intended to describe and communicate to the NYSDEC the proposed field activities the Companies desire to undertake which will provide a better understanding of potential sources of contamination at the site, groundwater conditions, and site characteristics. This work plan addresses comments made by the NYSDEC in a letter, dated August 19, 2003, and reflects the resolution of those comments during meetings with the NYSDEC, New York State Department of Health (NYSDOH) and the Companies on September 15, 2003 and in August 2006, to the previously submitted SSA Work Plan (URS, October 2003).

Of the five constituents identified at the site (Constituents of Interest (COIs)), the Companies only delivered CFC11 and CFC12, in a 50/50 mixture, to the Gabriel Manufacturing facility. The remaining COIs associated with the PSA appear unrelated to the CFC product delivered.

1.2 Regulatory Framework

This SSA is being conducted pursuant to an Administrative Order on Consent expected to be signed between the Companies and the NYSDEC. The SSA is being conducted pursuant to Article 27, Title 13, of the Environmental Conservation Law of the State of New York. The Order will become effective pending signatures by authorized representatives of the companies and the NYSDEC.

2.0 SITE BACKGROUND

The Gabriel site is located at 125 South Liberty Drive, Stony Point, Rockland County, New York. The property is approximately 3 acres in extent and contains a 16,000 square-foot building. The building consists of a one-story office section and a two-story warehouse manufacturing facility. The building has reportedly been connected to a municipal sanitary sewer system since the late 1960's; however it is not known if the building is currently connected to the sewer. An on-site production well completed in bedrock is used to supply non-contact cooling water to the plant (LMS, July 2000).

The property is bordered to the north and west by residential neighborhoods, to the south by commercial property and Filors Lane, and to the east by South Liberty Drive/Route 9W.

2.1 Site History

The Gabriel facility manufactures metal and plastic accessories for office furniture. The site has been active since the late 1960's. Water from the on-site production well was sampled in 1988 by the Rockland County Department of Health (RCDOH), and volatile organic compounds (VOCs), including the CFCs trichlorofluoromethane (CFC11) and dichlorodifluoromethane (CFC12), were detected in the sample. The source of CFCs in the groundwater is unknown at this time. The source(s) of the other VOCs have not been established.

Groundwater from the on-site production well is reportedly used as non-contact cooling water; however, the current use of groundwater at the site is not known. The Gabriel facility was issued an SPDES permit by NYSDEC in 1993. The monitoring consists of monthly grab samples of the cooling water effluent discharged to Lake Tiorati (AKA Cedar Pond Brook). The samples are analyzed for CFC11, CFC12, 1,1,1-trichloroethane (1,1,1-TCA), and 1,1-dichloroethene (1,1-DCE).

2.2 Preliminary Site Assessment

A Preliminary Site Assessment (PSA) was performed on behalf of the NYSDEC (LMS, July 2000) at the site. The field activities for this PSA and a summary of the results are as follows:

- Collection of soil samples in the area of CFC unloading:
  - Eleven soil samples were collected from the CFC unloading area for laboratory analysis.
  - Sample depths ranged from surface to 57 feet below ground surface (bgs).
  - Soil Sample Volatile Organic Constituent (VOC) concentrations ranged from non-detect to 0.597 mg/kg (estimated) of 1,1,1-TCA.
  - No constituents were detected above the NYSDEC Recommended Soil Cleanup Objectives (TAGM 4046).
  - CFC constituents were not detected in the unsaturated zone soil samples.

    - Low levels of CFCs (0.002 mg/kg of CFC11 and 0.005 mg/kg of CFC12 estimated) were detected in boring GMGP-4 associated with soil samples collected from below the water table at 55 to 57 feet bgs.
- Collection of soil samples from the soil stock pile associated with the grading of the loading dock area:
    - Four grab soil samples were collected from the soil stockpile for laboratory analysis.
    - Soil sample VOC concentrations ranged from non-detect to 0.6 mg/kg (estimated) for 1,1,1-Trichloroethane.
    - No constituents were detected above the NYSDEC Recommended Soil Cleanup Objectives (TAGM 4046).
    - CFC constituents were not detected in the stockpile soil samples.
- Installation of three monitor wells in the overburden till underlying the site:
    - Three polyvinyl chloride (PVC) groundwater monitoring wells were installed in the overburden unit underlying the site.
    - Groundwater samples were collected from the monitoring wells for laboratory analysis. Laboratory results reported the following constituents detected in groundwater above the NYSDEC Class GA Standard: CFC11; CFC12; 1,1-DCE; 1,1-DCA; 1,1,1-TCA.
    - Water-level data from the three monitoring wells indicated that groundwater flow in the overburden unit is to the southwest (during facility pumping conditions) towards the pumping well.
    - Apparent hydraulically upgradient groundwater monitoring well GMMW-3, contained groundwater constituent concentrations above the NYSDEC GA Standards. The Companies are concerned as to whether this upgradient overburden well, GMMW-3, had been properly constructed. This well was installed in a boring that penetrated several feet into bedrock. The boring was then back-filled with sand to a depth of 60 feet bgs. As a result, a conduit was created that could allow impacted water to flow from the bedrock to the GMMW-3 screen interval and effect measurement of representative piezometric levels.
- Installation of two groundwater monitoring wells in the bedrock aquifer underlying the site:
    - Two monitoring wells, one constructed of PVC and the other with an "open-hole" construction, were installed in the bedrock (sandstone) aquifer underlying the site.
    - Determination of groundwater flow direction in the bedrock aquifer was not possible because only two bedrock monitor wells were installed.
    - Groundwater samples were collected from the bedrock monitor wells for laboratory analysis.
    - Laboratory results detected the following constituents above the NYSDEC Class GA Standards: CFC11; CFC12; 1,1-DCE; and 1,1,1-TCA.

Concerns by the Companies regarding well construction techniques were identified with bedrock monitoring well GMMW-4. This well was constructed in bedrock with two well screen intervals; no blocks or barriers were installed to prevent groundwater flow between the screened intervals. The associated open conduit between the two well screens has led to the Companies concern regarding the representativeness of the groundwater data derived from well GMMW-4.

2.3 Facility Water Supply Well

An on-site water supply well is located near the west corner of the building adjacent to the loading dock. The well is completed in bedrock. The well has reportedly been used to supply non-contact cooling water; however, the current use of the well is not known. Because of VOCs in the produced water, the water is run through an air stripper before being discharged under an SPDES permit to Cedar Pond Brook. Groundwater produced from the well may have been utilized as an on-site potable water supply prior to 1988 (LMS, July 2000). Details pertaining to the facility's well construction, pumping rates, pump intake elevation, etc. were not presented in the PSA report (LMS, 2000).

3.0 PRELIMINARY CONCEPTUAL SITE MODEL/DATA QUALITY OBJECTIVES

Based on the PSA soil borings and monitor wells installed at the site, the general geology underlying the site consists of 60 to 90 feet of glacial till consisting of relatively low permeability unstratified and unsorted clay, silt, sand, gravel and boulders underlain by sandstone bedrock. Groundwater in the till unit is encountered approximately 45 feet below ground surface (bgs). Based on the three shallow PSA groundwater monitoring wells, the shallow groundwater was interpreted to flow towards the south-southwest, although the Hudson River, a regional water discharge area, is located less than a mile to the east. The potentiometric surface associated with the bedrock aquifer is situated approximately 65 feet bgs based on the two on-site bedrock wells; groundwater flow direction in the bedrock aquifer is currently unknown (LMS, July 2000).

3.1 Area Characteristics

The area characteristics are summarized from the *Preliminary Site Assessment Report, Gabriel Manufacturing Site, Stony Point, New York, Site No. 3-44-041* (LMS, July 2000).

3.1.1 Geology

Unconsolidated glacial till deposits overlie bedrock at the site. The till consists of an unsorted, unstratified mixture and clay, silt, sand, and gravel, with occasional lenses of sand/gravel. The till is estimated to be 80-100 feet thick at the site. A hard till layer (red-brown clay layer) was encountered just above bedrock in some of the monitoring well borings installed at the site (LMS, July 2000).

The uppermost bedrock underlying the till at the site consists of arkose, mudstone, conglomerate, and siltstone of the Brunswick Formation of the Newark group. The Newark Group includes sandstone that is a principal aquifer in the area; in areas of well-developed fractures, bedding planes, and joints, the sandstone can yield up to 1500 gallons per minute (gpm) (LMS, July 2000). The encountered bedrock was described at boring GMMW-3 as a "very soft, red, mudstone, siltstone and conglomerate" and at boring GMMW-4 "only small amounts of water were encountered during drilling to 180 feet bgs. Two zones of water were encountered but initially yielded very small amounts – upon blowing out borehole with compressed air well began yielding much more water" (LMS, July 2000, boring logs).

3.1.2 Hydrogeology

The glacial till generally has low permeability, and is not a major source of groundwater in the area. The depth to groundwater in the till ranges from 42 ft to 47 ft bgs. Based on groundwater elevations measured in the three till monitoring wells in September and October 1999, groundwater in the till appears to flow southwest (during facility's production pumping), towards the facility pumping well.

A hard till consisting of a red-brown clay layer was encountered just above bedrock in some of the borings. It is not known if the hard till is continuous across the site.

During the PSA, two bedrock groundwater monitoring wells were installed at the site. The depth to groundwater in the two wells ranges from 56 ft to 63 ft. The well completion logs for the bedrock monitoring wells indicate that GMMW-2 is completed mainly in mudstone/siltstone to a total depth of 140 ft bgs, while GMMW-4 is completed in two water-bearing zones at 100-120 ft and 170-180 ft bgs.

The two monitoring wells are insufficient to evaluate the direction of groundwater flow. Regionally groundwater flow in the Newark Group is to the east toward the Hudson River. The flow direction at the site may be influenced by local geologic features and/or groundwater pumping from the on-site production well.

Transducers placed in the on-site wells for a week in 1999 indicated that the cyclic pumping of the on-site production well influenced water levels in the bedrock wells, but not the till wells (LMS, July 2000).

3.1.3 Hydrology

There are no surface water bodies on the site. The nearest downslope surface water body relative to the site is Cedar Pond Brook, which is located north, northeast, and east of the site. The most likely point of runoff entry (POE) to Cedar Pond Brook is approximately 1800 feet northeast of the site. Cedar Pond Brook is approximately two miles long and is a tributary of the Hudson River.

A New York State Designated Fresh Water Wetland (HS-3) is located approximately 1800 ft northeast of the site (at the POE to Cedar Pond Brook). Two New York State Freshwater Wetlands (HS-4, HS-5) are located downstream of the POE northeast and east of the site.

A series of downslope, off-site catchbasins collect runoff from Route 9W, and may also collect runoff from the site. It is not known if the catchbasins discharge to Cedar Pond Brook or the Hudson River (LMS, July 2000).

3.1.4 Adjacent Property Use

The site is bordered to the north and west by residential neighborhoods, to the south by commercial property, and to the east by South Liberty Drive/Route 9W.

3.1.5 Area Drinking Water Use

According to information from the New York State Atlas of Community Water Systems (NYSDOH) and the RCDOH, the nearest well currently used for drinking water purposes is the well of the Mt. View Trailer Park which is located approximately 2,000 ft northwest of the site. Information from the RCDOH indicates that the well serves approximately 240 people, is screened in bedrock, and, as of 1998, there were no VOCs detected in groundwater samples collected from the well. The depth of the well is unknown. According to the RCDOH, the trailer park was normally served by two wells but only one is operating at this time. One of the two wells was closed due to elevated levels of bacteria (LMS, July 2000).

According to information from the RCDOH, there are residential wells located approximately 1 mile northwest of the Site. It is not known in which aquifer these wells are screened. Additionally, this investigation had not determined the groundwater flow in the bedrock and consequently, it is not known if these wells may be impacted by the groundwater contamination detected in the groundwater on the site (LMS, July 2000).

The actual number of persons obtaining water from residential wells is unknown. The number of persons drawing water from the glacial till aquifer is unknown (LMS, July 2000).

According to information from the United Water Company, approximately 150,000 gallons per day of the total water supplied to area residents (1 .5 million gallons per day) is drawn from Lake De Forest. The water supplied by other public wells is not blended with surface water.

3.2 Data Quality Objectives

The types and quality of data needed to satisfy the different objectives of the SSA are governed by the Data Quality Objectives (DQOs). DQOs are statements that specify the quality and quantity of data required to satisfy specific problem statements associated with a particular objective (USEPA, February 2006). The objectives for conducting the SSA are summarized below:

1. The presence of CFCs in groundwater and soils, and potentially vapors below the facility slab above screening criteria to characterize source(s) and potential release mechanisms (sumps, sewers, etc.) need to be better understood.
2. The groundwater flow in the till overburden is based on the minimum number of data points (wells) required to define a plane, and during facility pumping conditions. The groundwater flow may vary spatially according to geologic heterogeneities, local boundary conditions, and needs to be better understood. Natural groundwater flow would be expected to flow easterly towards the Hudson River, rather than southwest as interpreted in the PSA.
3. An insufficient number of bedrock wells exist on the site to evaluate groundwater quality and flow in the bedrock.

To meet these objectives, the following scope of work has been developed:

- Phase I – Conduct interviews, review pertinent documents, perform an on-site walk-through that includes a building inspection, and identify potential locations for sub- slab vapor sampling.
- Phase II – Perform Membrane Interface Probe^{TM} (MIP) soil gas screening and perform sub-slab vapor sampling.
- Phase III – Collect unsaturated zone soil samples to confirm MIP results and collect sub-slab soil samples to confirm vapor sampling results, install overburden and bedrock monitor wells, and collect groundwater samples from all site monitoring wells.
- Phase IV – Perform groundwater elevation data collection activities during pumping and non-facility pumping conditions to understand site groundwater flow conditions.

Following Phase II, the Companies will meet with the NYSDEC and NYSDOH to present the results from that investigation. The purpose of this meeting will be to mutually evaluate further proposed SSA activities, if any.

4.0 SCOPE OF WORK

The scope of work has been designed to address the objectives identified in Section 3.2. Phases I, II, and III have been designed to address Objective 1. Objectives 2 and 3 will be addressed by scope identified in Phase IV.

4.1 Phase I—Understanding Facility Process Operations

To obtain a better understanding of the site historical and current process operations, including waste management, the following phased activities will be performed (activities summarized in Table 1):

- Interview current and former employees of Gabriel Manufacturing and review relevant historical documents to better understand CFC-related raw and waste material handling associated with the Gabriel Manufacturing facility. Information pertaining to material handling will include delivery, storage, use, and disposal, as well as any known relevant changes to site operations. The construction specifications and pumping rate of the on-site production well will be obtained, if available.
- Conduct a due-diligence type database search to obtain additional site and regional information including aerial photographs, if available.
- Conduct a building walk-through in coordination with the NYSDEC and site personnel to review manufacturing processes, CFC delivery, storage and management systems and waste management activities. The sub-slab vapor sampling locations will also be selected during the walk-through, as discussed in Section 4.2.1 of this work plan.
- Perform a reconnaissance to identify potential source areas and seeps. This site visit will also be instrumental in planning the specifics of the field investigation, in terms of identifying site access concerns and other constraints.

The information obtained as part of Phase I may be useful in: 1) identifying potential source areas; 2) determining how facility operations may have created potential source areas; 3) identifying potential locations for sub-slab vapor sampling; and 4) determining if delivery of product by the Companies may have been responsible for site contamination.

The Companies will make a diligent effort to coordinate the above activities with the current site owner (e.g., interviews, obtaining historical documents, and building walk though of manufacturing facility). If good faith efforts fail to allow the conduct of these tasks, the Companies may require assistance from NYSDEC.

4.2 Phase II—Shallow MIP Survey/Sub-Slab Vapor Sampling

To assist in further identifying potential on-site source areas, a (MIP) investigation and sub-slab vapor sampling will be performed (see Table 2 for summary).

4.2.1 Building Design/Construction

If available, building construction drawing(s) will be reviewed to identify features that could affect the release and migration of the CFCs. Features such as floor drains, sumps, etc. will be noted and verified during the building walk-through. Foundation construction will also be evaluated relative to CFC migration/ vapor intrusion.

The Phase I building walk-through will also include an inspection to identify construction characteristics such as slab cracks, floor drains or other utility penetrations, identify heating systems and exhaust fans that can affect pressure gradients, and the use or storage of solvents or petroleum products. This information will be utilized during the selection of the sub-slab sampling locations.

4.2.2 MIP Investigation

The MIP is a soil-screening investigation tool developed by Geoprobe Systems for logging VOCs in the subsurface. The permeable membrane device associated with the MIP is used to detect volatile contaminants as it is driven to depth. The data provided by the MIP are semi quantitative/qualitative information on VOC contaminant levels that lets the investigator collect targeted samples from contaminated zones.

Using Geoprobe percussion soil probing equipment or cone penetration testing (CPT) rig, the MIP, equipped with a field gas chromatograph, will be used throughout the site to identify areas containing VOCs in the near surface soils. As the MIP is pushed down a hole, the probe heats the soils and groundwater adjacent to the probe to approximately 120 degrees C. The heat increases volatility, and the vapor phase diffuses across a membrane into a closed, inert gas loop that carries these vapors to a series of detectors housed at the surface [expected detectors to be the GC, a PID, and an electron capture detector (ECD)]. Continuous profiles can be generated from each hole. Soil conductivity is also measured to help evaluate soil type and these logs can be compared to the chemical logs to better understand where the VOCs occur.

Potential boring locations are identified in Figure 1 – actual locations will be dependent on field reconnaissance and equipment access. Based on past experience at the site, the maximum push depth using Geoprobe equipment is 10 to 15 feet. In order to screen soils down to the water table (e.g., ~ 35-40 feet below ground surface), it will be necessary to utilize CPT equipment. The MIP soil gas activity is summarized in Table 2.

4.2.3 Sub-Slab Vapor Sampling

Sub-slab vapor sampling will be performed within the site facility to determine if facility activities have impacted subsurface soils underlying the building foundation (see Table 2 for summary). The vapor sampling locations identified during the Phase I site walk-through will be sampled. The sub-slab vapor sampling method utilized will be consistent with the New York State's *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (New York State Department of Health, Public Comment Draft, February 2005).

The installation of the probes is presented in SOP D-1 in Appendix C. In general, the vapor sampling activities will consist of the following:

- Drill 1-inch diameter hole partially through the slab. Drill a 3/8-inch hole in the center of the 1-inch hole completely through the slab.
- Insert a ¼-inch stainless steel tubing through the 3/8-inch hole into the sub-slab aggregate.
- Seal the annular space between the foundation slab and the ¼-inch tubing with a non-VOC containing, non-shrinking material.
- A small flush-mount cap will be placed in the floor over the probe.
- Perform leak testing to ensure that the probe is adequately sealed. The leak testing procedure involves flooding the air space around the probe with helium gas, as described in the state's vapor intrusion guidance.
- Connect the ¼-inch tubing to a valve and purge tubing.
- Connect ¼-inch tubing and valve to a 0.8 to 1 liter laboratory batch-certified SUMMA™ canister for sub-slab sampling.

The flow rate into the SUMMA canister will be metered to a rate of 100 to 200 milliliters/minutes, to provide adequate sample volume for VOC analysis.

Upon completion of the sub-slab vapor sampling activities, the Summa canisters will be shipped under chain-of-custody (COC) to a New York State ELAP-certified laboratory for analysis. The sub-slab vapor samples will be analyzed for the Target Compound List (TCL) using EPA Method TO-15; the TCL VOC list includes all targeted site COIs.

4.2.4 Assessment of Soil Screening and Vapor Sampling Results

Upon completion of the soil screening and vapor sampling activities, a meeting will be held with the NYSDEC to share the data collected (activity summarized in Table 2). Based upon the results of the Phase II activities, the NYSDEC and the Companies will agree on locations and depths for the Phase III confirmation soil sampling.

4.3 Phase III —Unsaturated Zone Soil Samples, Sub-Slab Soil Samples, Monitor Well Installation, Groundwater Samples

4.3.1 Confirmation Soil Samples – Unsaturated Zone

A Rotosonic™ or hollow-stem auger (HSA)/air rotary drill rig(s) will be used to collect soil samples to:1) confirm the results of the MIP study; and 2) assess the presence or absence of VOCs in soil within areas of interest such as the delivery area and above ground CFC storage tanks (ASTs). The locations for confirmation soil sampling will be selected during the NYSDEC/Companies meeting to assess the Phase II soil screening results (see Table 3 for summary of soil sampling activities).

The soil sampling activities will be performed as follows:

- At the proposed boring locations, soil cores or split spoon samples will be collected continuously; all cores will be collected using new plastic core sleeves.
- The maximum length of each core will be 10 feet; the boring depths will be determined during the NYSDEC/Companies assessment meeting; the maximum boring depth will be to the base of the unsaturated zone.

- Each collected core will be screened using a photoionization detector (PID) equipped with an 11.8eV lamp.
- If elevated PID measurements are observed within a core, then a single soil sample will be collected from the core within a 2-foot interval containing the highest PID reading for each section of core or split-spoon sample collected.
- If no elevated PID measurements are encountered within a core, then one soil sample will be selected from the core or split-spoon sample at random from each section of core collected.
- Soil samples will be collected from the Rotosonic soil cores using EnCore® samplers.

Following appropriate NYSDEC protocol, the soil samples collected will be shipped under chain-of-custody to a New York State ELAP-certified laboratory for analysis. The soil samples will be analyzed for the TCL VOCs using EPA SW846 Method 8260B; the TCL VOC list includes all targeted site COIs.

4.3.2 Confirmation Soil Samples – Sub-Slab

Based on the sub-slab MIP vapor sampling results, sub-slab soil sample locations will be identified during the NYSDEC/Companies assessment meeting. Sub-slab soil samples will be collected from beneath the site building slab to determine if manufacturing processes, or the sewer system, have impacted the subsurface with CFCs (Table 3 for summary).

The number and location of the borings will be dependent on the manufacturing and sewer system piping locations and upon the information obtained as part of the sub-slab vapor sampling activities discussed above in Section 4.2.2.

Currently, it is expected that concrete coring will be performed at selected locations, and soil samples will be collected from the underlying native soils using a portable Geoprobe system. The exact technique used for coring and sampling will be dependent on the foundation design, foundation construction, and access limitations.

The soil samples will be shipped under chain-of-custody following appropriate NYSDEC protocols to a New York State ELAP-certified laboratory for analysis. The soil samples will be analyzed for TCL VOCs using EPA SW846 Method 8260B; the TCL VOC list includes all targeted site COIs.

4.3.3 Borings/Monitor Well Installation

To better understand groundwater flow direction and the groundwater contaminant distribution, monitor wells will be installed in both the overburden unit and in the bedrock aquifer (see Table 3). The construction diagrams for overburden wells (deep and shallow) and bedrock wells are provided in Appendix D.

Overburden Monitor Wells

Five overburden (till) groundwater monitoring well locations have been selected for monitor well installation; these locations are identified in Figure 2 as MWT-1 through MWT-5. The monitoring wells will be installed using a Rotosonic or HSA drill rig. At each monitor well location the drill rig will collect continuous cores (Rotosonic method) or split-spoon samples (HSA method) every five feet down to the base of the overburden aquifer. Each soil core or split spoon sample will be screened with a PID as discussed in Section 4.3.1. Sample collection and analysis will follow the procedures presented in Section 4.3.1.

Upon completion of the Rotosonic boring, a monitoring well will be constructed of 2-inch I.D. Schedule 40 PVC equipped with a 10-foot screen.

The specifics regarding the well screen intervals at each well location are as follows:

- The overburden unit in the area of well location MWT-1 is expected to be 90 feet thick, with a 45-foot-thick saturated unit. Based on the overburden unit thickness, two monitoring wells will be installed. One monitoring well (MWT-1S) will be screened near the top of the overburden saturated unit (estimated screen interval 45 to 65 feet bgs); the other monitoring well (MWT-1D) will be screened near the bottom of the overburden unit (estimated screen interval 70 to 90 feet bgs). In addition to determining groundwater flow gradients, the clustered monitoring wells at MWT-1 will assist in defining the vertical, as well as the horizontal, distribution of the CFCs.
- The overburden unit in the area of well locations MWT-2, MWT-3, and MWT-4 is expected to be approximately 60 feet thick. If this approximate thickness is correct, then a single monitoring well will be installed at these locations; screen interval to straddle the water table (located at approximately 42 to 47 feet bgs). However, if it is determined that the overburden unit in these areas exceeds 70 feet in total thickness, then clustered monitoring wells, as described above for MWT-1, may be installed. Clustered wells in an overburden unit that exceed 70 feet in thickness will assist in defining the groundwater flow gradient and the vertical, as well as the horizontal, distribution of CFCs.
- The fifth monitoring well location has been designated MWT-5. The overburden unit in the area of MWT-5 is expected to be 80 to 90 feet thick. Due to the presence of nearby monitor well GMMW-1, screened near the top of the overburden, only a deep monitoring well will be installed at MWT-5. This monitoring well will be designated MWT-5D; the estimated screen interval for MWT-5 is approximately 80 to 90 feet bgs.

Bedrock Monitor Wells

Two monitoring well locations have been selected for the bedrock groundwater investigation; these locations are identified in Figure 3 as MWB-1 and MWB-2. The bedrock monitoring wells will be installed using a Rotosonic or air rotary drill rig. At each monitoring well location the drill rig will collect cores or split-spoon samples every five feet down to the base of the overburden aquifer. Rotosonic coring or air rotary drilling into the bedrock will likely fracture the bedrock core samples, however attempts at collecting representative cores will also be made. Bedrock samples will be screened with a PID as discussed in Section 4.3.1. Sample collection and analysis will follow the procedures presented in Section 4.3.1.

During the boring associated with bedrock monitoring well MWB-1, located in the same area as MWT-1, soil samples will not be collected. Soil screening and sampling for this area will be performed as part of the installation of MWT-1.

An open-hole bedrock monitoring well will be constructed upon completion of the boring approximately 25 feet into the bedrock. The overburden will be cased off to prevent cross contamination.

Specifics regarding the two bedrock monitoring well locations are as follows:

- The location of bedrock monitoring well MWB-1 is proposed to be located in the area of the on-site aboveground storage tanks and storage trailers, dependent upon access. The MWB-1 location was selected to 1) better define groundwater flow in bedrock and 2) to monitor the bedrock groundwater constituents underlying the on-site storage tanks and storage trailers.
- The location of bedrock monitoring well MWB-2 was selected as a replacement of bedrock monitoring well GMMW-4, as this bedrock well was constructed with two screen intervals.

4.3.4 Groundwater Sampling/Analysis

After the newly installed monitoring wells have been developed, allowed to equilibrate, and surveyed in place by a state-certified surveyor, depth-to-water measurements will be obtained, and groundwater samples will be collected from all on-site monitoring wells. Groundwater samples will be collected from each on-site monitoring well using low flow sampling methodology (see Table 3).

The groundwater samples collected will be shipped under chain-of-custody to a New York State ELAP-certified laboratory following appropriate NYSDEC protocol. The samples will be analyzed for the TCL VOC using EPA SW846 Method 8260B; the TCL VOC list includes all targeted site COIs.

4.4 Phase IV —Evaluation of Groundwater Conditions

4.4.1 Characterize Groundwater Flow Conditions During Facility Production Well Pumping and Non-Pumping Conditions

To better characterize the groundwater flow conditions in the overburden and bedrock hydrostratigraphic units, water levels will be obtained during facility pumping well pumping conditions, and during non-pumping conditions. Water levels obtained during pumping conditions will be conducted within 1 hour of each other. Water levels obtained during non-pumping conditions will be obtained preferably one week after pumping has ceased, however, this duration may need to be adjusted based on agreements reached with the Gabriel Manufacturing facility, but no less than 48 hours after pumping has ceased. The Companies will make a diligent effort to coordinate this activity with the current site owner. If good faith efforts fail to allow the test to be run for one week, the Companies may need to abbreviate the test as noted, or require assistance from NYSDEC to allow the production well shut-down test to be conducted for at least a one-week period.

Upon completion of the groundwater flow study, the collected groundwater elevation data will be downloaded and assessed. The groundwater flow characteristics during pumping and non-pumping conditions will be evaluated.

4.4.2 Evaluation of Groundwater

Summary of Area Hydrogeology and Hydrology

The area hydrogeology and hydrology discussed in this work plan were summarized from the PSA report (LMS, 2000). Additional publications/documents will be reviewed to verify and further develop the conceptual area hydrogeology and hydrology, which will be compared to the site specific data generated during the SSA.

Interpretation of Groundwater Flow Direction

After the newly installed monitor wells have been developed and surveyed, synoptic water levels will be measured in all on-site monitoring wells, and groundwater elevations will be calculated. Groundwater potentiometric maps will be prepared for pumping and nonpumping conditions, and will be used to estimate the horizontal hydraulic gradients in the till and bedrock water-bearing zones.

Groundwater flow directions in the till and bedrock water-bearing units will be interpreted from the potentiometric maps. The interpreted effects of the on-site production well will be used to evaluate the influence of pumping on lateral groundwater flow direction in the bedrock and on the potential influence of pumping on vertical groundwater flow between the till and the bedrock.

Private and Municipal Water Supplies

The area's private and municipal water supplies that were identified in the PSA will be verified by independent review of publicly available sources. The depth and construction of the on-site production well will also be verified, if possible.

Nature and Extent of Contamination

The results of the groundwater sampling will be evaluated in conjunction with the results of the source investigation and groundwater flow patterns to better understand the nature and extent of potential CFCs in soil and groundwater. Spatial dissolved-phase groundwater maps and cross-sections will be used as applicable to illustrate the lateral and vertical distribution of CFCs.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

The Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) are included in this SSA Work Plan as Appendix E and Appendix F, respectively.

5.1 Field Sampling/Observation Documentation

Field personnel will record each day's activities in field logbooks. Waterproof ink will be used for logbook notations. The logbook pages will be sequentially numbered, and the field personnel will provide their signature in the field logbook at the end of each day's activities.

Soil samples collected from soil borings will be described by the field geologist on boring logs. The monitor well construction specifications will be recorded on well completion logs, which will include screened, sand packed, and grouted intervals. Field measurements and water volumes from well development and well sampling will be recorded on well development and well sampling log forms. In a similar manner the sub-slab sampling will be documented on sampling log forms.

5.2 Laboratory Analysis and QA/QC Control Samples

Laboratory Analysis

As stated in Section 4.0, soil and groundwater samples will be shipped to a New York State ELAP-certified laboratory following appropriate NYSDEC protocol. The samples will be analyzed for the TCL VOCs using EPA SW846 Method 8260B.

The laboratory analytical data will undergo a data usability evaluation to determine whether the data meet the site/project-specific criteria for data quality and data use. The data usability evaluation results will be presented in a data usability summary report. The data usability evaluation and subsequent report will follow the NYSDEC *Guidance for Development of Data Usability Summary Reports* (see Appendix B).

The Companies understand that the NYSDEC may desire to collect duplicate samples at some or all of the sample locations described in this work plan. We will endeavor to provide adequate sample volume to enable the collection of duplicates, but in some cases sample volume may be limited by the recharge rates of certain monitoring wells or other media constraints.

QA/QC Control Samples

To ensure that sample integrity is maintained, quality assurance/quality control (QA/QC) samples will be collected during this investigation at the following frequency:

- Trip Blanks – one per sample shuttle
- Equipment Blanks – one per day
- Duplicate Samples – one per 20 field samples
- Matrix Spike/Matrix Spike Duplicates – one per 20 field samples

5.3 Sample Management

A COC form must accompany each shipment of samples through the sampling, laboratory analysis, data quality review and data storage processes. The form will ultimately become part of the project file. The COC form will be used to verify the accuracy and completeness of sample results received from the laboratories. It will also be the source of information to verify laboratory invoices and approve them for payment.

COC forms must contain information consistent with the sampling labels. The COCs must travel with the sample containers to the laboratory to verify samples taken, analyses requested, shipping dates, and receipt by the laboratory. Serial numbering of the COC forms will be used to identify each form.

The COC form for each sampling batch will contain the project number, project name, sampling team, station ID, depth, sample numbers, sampling dates, sampling time (when appropriate), sample matrix (soil, sediments, water), total number of containers, test methods requested for each sample, remarks, relinquished/received signatures with dates and times, shipping information, and name of laboratory to which samples were sent.

Each COC form must be signed by the sampler to indicate who is responsible for the sampling and the field information on the COC. Changes to a COC form must be written and initialed on the COC. Changes to the COC should not be made after shipping because of the potential for miscommunication that can occur between the field and the laboratory, and the likelihood that the change will not get recorded on the copy transmitted to the laboratory.

5.4 Field Equipment Decontamination/Documentation

To limit the concern of cross contamination from other sites, the drill rig will arrive at the Gabriel site free of dirt and debris, and will be high pressure washed prior to each sampling location. Once the rig has been inspected and determined to be free of dirt/debris, two methods of equipment cleaning will be applied during this project. Larger size equipment, such as the down-hole Rotosonic core barrels and related tools, will undergo a high-pressure washing (inside and outside of the cores) prior to use, as required during and between the installation of each boring, and at the completion of this investigation.

Smaller equipment will be cleaned using the following steps:

1. Scrub wash with non-phosphate detergent.
2. Rinse with potable water
3. Rinse with deionized/distilled water

5.5 Data Validation

Analytical data will be reviewed by the project chemist. QA/QC data in the laboratory reports, such as completed COC, holding times, instrument calibrations will be reviewed. The QA/QC samples results (duplicates, blanks, and matrix spike duplicates) will also be reviewed and applied to the final data as applicable.

6.0 DATA MANAGEMENT

Analytical and hydrogeological (e.g., water levels) data will be incorporated into a database. Tables, maps, and graphs will be generated with data from the database for use in the evaluation and presentation of information. All queries and data manipulations will be performed using the working database. Soil boring logs and well completion logs will be stored as original documents in the project files, and as PDF files in the project database stored on the LAN.

Data security may be provided in several ways, including passwords, restricted physical access to the software, and permission levels assigned to selected work areas through the internal security of the software operating system. All diskettes and electronic files received from outside sources, including contracted analytical laboratories, will be routinely scanned for viruses before use.

7.0 HEALTH AND SAFETY

A project-specific health and safety plan (HASP) will be prepared in accordance with Occupational Safety and Health Administration (OSHA) requirements, specifically 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response by CH2M HILL prior to initiating the SSA. At a minimum, the HASP will include precautions and procedures related to groundwater sampling, soil sampling, sub-slab soil gas sampling, direct push technology (DPT) and membrane interface probe (MIP) activities, well construction, and noise abatement. At a minimum, Level D PPE will be required for this project, including hard hats, steel toe work boots, safety glasses, and leather work gloves.

The HASP will include air monitoring protocols to assess the concentration of VOCs in the breathing zone. Composite air action levels for multiple constituents with varying volatility and toxicity will be compared to field readings, and any exceedances will be addressed through engineering controls, administrative controls, or personal protective equipment.

If ambient air sampling in the immediate area of the project work indicates VOC concentrations exceeding the HASP-established action level, the project will be halted until vapor mitigation can be addressed. The site Health and Safety Coordinator may authorize the collection of Drager^{TM} tube or SUMMA canister samples to further characterize the ambient air.

8.0 INVESTIGATION DERIVED WASTE PLAN

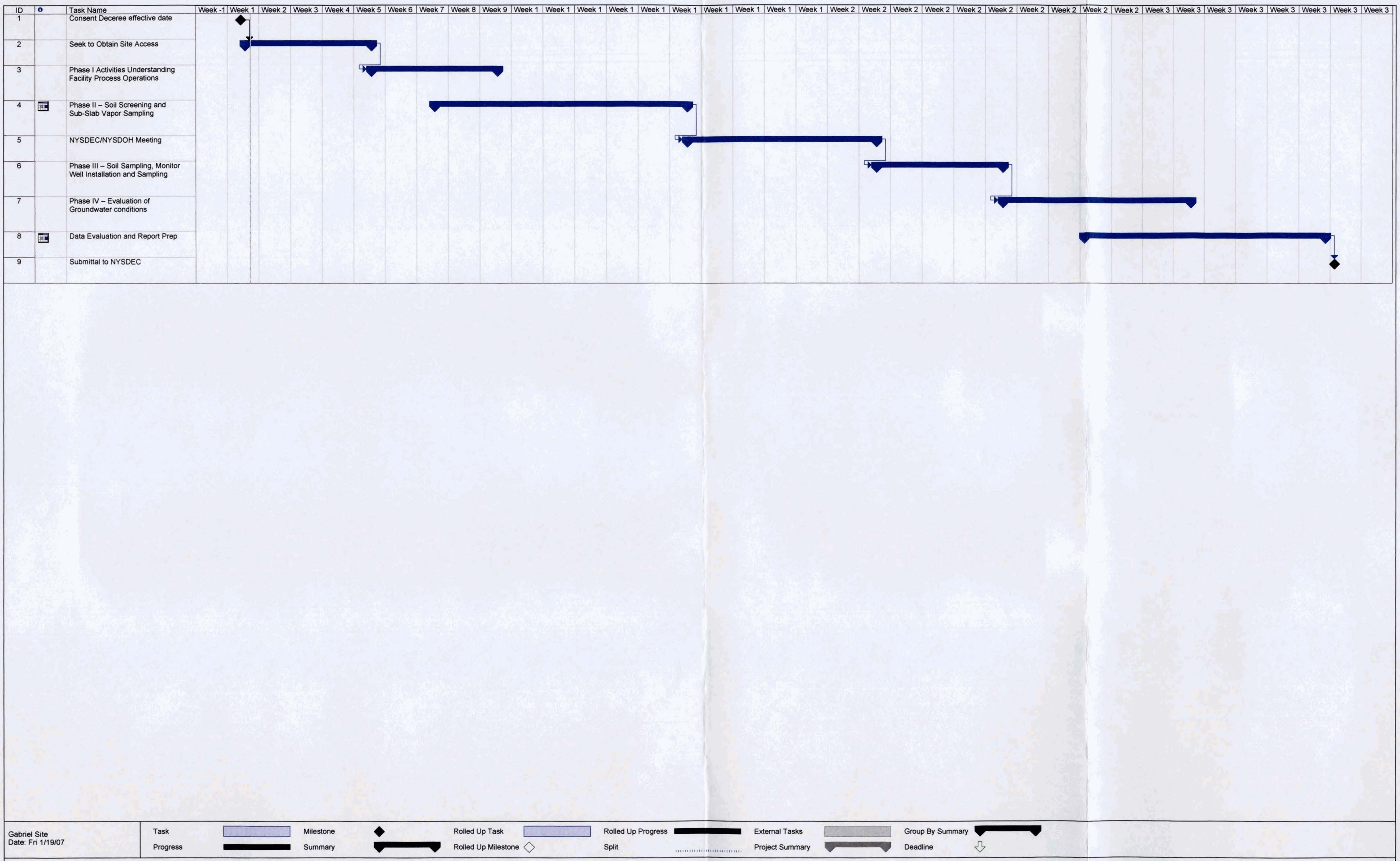
Soil cuttings, development and purge water, and disposable personal protective equipment, and decontamination fluids will be placed into drums and labeled. Investigation-derived waste (IDW) will be disposed as non-hazardous or hazardous waste dependent upon the results of laboratory analysis of field samples, and, if necessary, waste characterization.

9.0 SSA REPORT

Upon completion of the field activities presented in Section 4.1 through 4.4, a *Supplemental Site Assessment Report* will be produced and submitted to the NYSDEC for review. This SSA Report will provide a description of field activities and a summary of collected data.

10.0 SCHEDULE

The first task in the schedule begins with the effective date of the Consent Order. The schedule for the implementation of the SSA work plan is shown on the next page.



ID	Task Name
1	Consent Deceree effective date
2	Seek to Obtain Site Access
3	Phase I Activities Understanding Facility Process Operations
4	Phase II – Soil Screening and Sub-Slab Vapor Sampling
5	NYSDEC/NYSDOH Meeting
6	Phase III – Soil Sampling, Monitor Well Installation and Sampling
7	Phase IV – Evaluation of Groundwater conditions
8	Data Evaluation and Report Prep
9	Submittal to NYSDEC

Gabriel Site
Date: Fri 1/19/07

11.0 REFERENCES

Lawler, Matusky & Skelly Engineers LLP, (LMS). July 2000. *Prelimimary Site Assessment Report, Gabriel Manufacturing Site, Stony Point, New York,* Site No. 3-44-041, prepared for the NYSDEC Division of Environmental Remediation.

New York State Department of Environmental Conservation (NYSDEC), February 2005, *Draft Guidance for Evaluating Soil Vapor Intrusion in the State of New York.*

United States Environmental Protection Agency (USEPA), February 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process,* EPA/240/B-06/001

TABLES

TABLE 1
Phase I Understanding Facility Process Operations: Current and Historical

ACTIVITY	LOCATION	METHOD	PURPOSE
Review pertinent documents and Interview Current and Former Gabriel Employees	• Documents to be shipped for review, or reviewed at site • Interviews performed in-person or via telephone	• Visual review of documents. • Interview - Discuss subjects pertaining to facility operation and waste management using prepared questions as a starting point	• Obtain an understanding of site historical and current process operations and waste management
Conduct joint building walk-thru and on/off site reconnaissance.	• Gabriel Site in Stony Point NY	• Visit site to visually review current operations and activities • Identify sample locations • Identify potential on and off site source areas.	• Obtain better understanding of site historical and current process operations and waste management • Identify areas of interest on and off site.

TABLE 2
Phase II Unsaturated Zone Soil Screening (MIP), Sub-Slab Vapor Sampling

ACTIVITY	LOCATION	METHOD	DEPTH	PURPOSE	FIELD TASKS
Soil Screening	Site Wide Unsaturated Zone	• Membrane Interface Probe attached to a Geoprobe or CPT rig.	• Target depth is water table	• Attempt to obtain relative horizontal and vertical delineation of Total VOC concentrations • Results to be used in source identification	• Perform Soil screening on site-wide grid (thick wooded areas exempt) • Screen subsurface soils using MIP.
Sub-Slab Vapor Sampling	At areas to be identified in Gabriel Building	• Drill thru concrete foundation. • Collect vapor samples using SUMMA canisters.	• Approx. 1-2 inches into sub-slab aggregate.	• Screen sub-slab for potential areas of interest.	• Collect vapor samples from below building slab following NYSDOH acceptable procedures.
Meeting	Albany, New York	• Companies to present results of Phase II field activities to NYSDEC. • Mutually identify areas for confirmatory sampling.	• Not applicable	• Discuss Phase II field results	• Review MIP and Vapor results • Select locations for confirmatory soil samples.

TABLE 3
Phase III Field Activities: Soil Sampling, Well Installation, Groundwater Sampling

Confirmation Soil Samples: Unsaturated Zone and Sub-Slab

ACTIVITY	LOCATION	METHOD	DEPTH	PURPOSE	FIELD TASKS
Collection of Unsaturated Zone Soil Samples	Locations and depth of interest identified during Phase II meeting	Rotosonic Drill Rig with PID screening of soil cores	• Borings at selected locations of interest. • Depths based on MIP investigation and Phase II meeting.	• Attempt to ID Source Area • Verify results of MIP soil screening	• Soil cores to be screened with PID • Cores with elevated PID detection ➢ Collect 1 sample per core at 2-ft highest interval ➢ Ship samples for laboratory analysis (TCL VOCs including CFCs). • Cores with no elevated PID detections ➢ No soil samples to be collected
Core Through Floor of Gabriel Building and collect Sub-Slab Soil Samples.	At selected locations identified during Phase II meeting.	Installation method to be determined. Potential equipment: • Concrete coring drill • Skid Rig • Hand-driven split-spoon/geoprobes	As deep as possible. Depth likely to be determined by capability of equipment.	• Obtain soil samples to confirm sub-slab vapor sample detections and to assist in contaminant delineation. • If sub-slab vapor sampling does not detect VOC constituents this activity may not be performed – to be determined during Phase II meeting.	• Install borings through building foundation into till. • Collect Soil samples. • Ship samples for laboratory analysis (TCL VOCs including CFCs).

Constituents of Interest (COI) identified in the 1999 PSA = CFC 11, CFC 12, 1,1-DCA, 1,1-DCE, 1,1,1-TCA

TABLE 3 cont.
Phase III Field Activities: Soil Sampling, Well Installation, Groundwater Sampling

Overburden (Till) Monitor Wells
(See Figure 2)

ACTIVITY	LOCATION	METHOD	DEPTH	PURPOSE	FIELD TASKS
Overburden – Well Installation	Area Identified as MWT-1 through MWT-5	Rotosonic Drill Rig • Core at 10' intervals (max. length) • Scan soils with PID • Install PVC well	• Bore & PID Scan to Bottom of Overburden • Install 2-inch PVC well w/ 20ft screen • MWT-1 will contain nested well to evaluate vertical distribution. • Estimated Screen Intervals BGS ➢ MWT-1S = 45-55 ft ➢ MWT-1D = 70-80 ft ➢ MWT-2 thru 4 = 30-40 ft ➢ MWT-5 = 70-80 ft	• Attempt to evaluate vertical and horizontal distribution of VOCs in aquifer • Assist in plume delineation • Assist in source identification • Assist in determining GW flow direction	• Install boring via Rotosonic rig • PID screen soil cores • Cores with elevated PID detection ➢ Collect 1 sample per core at 2-ft highest interval ➢ Ship samples for laboratory analysis (TCL VOCs including CFCs). • Cores with no elevated PID detections ➢ No soil samples to be collected • Install monitoring well

Constituents of Interest (COI) identified in the 1999 PSA = CFC 11, CFC 12, 1,1-DCA, 1,1-DCE, 1,1,1-TCA

TABLE 3 cont.
Phase III Field Activities: Soil Sampling, Well Installation, Groundwater Sampling

Bedrock Monitor Wells
(See figure 3)

ACTIVITY	LOCATION	METHOD INSTALLATION	DEPTH	PURPOSE	FIELD TASKS
Bedrock Monitor Well Installation	Above Ground Tank Area	Rotosonic drill rig • Core overburden at 10' intervals (max. length) • Scan overburden soils with PID • Case off overburden • Install open-hole well	Approx. 25 ft into Bedrock Aquifer	• Monitor Plume • Monitor bedrock aquifer underlying Above Ground Tanks • Determine groundwater flow direction in bedrock	• Initiate boring • No soil samples to be collected ➢ PID screening and sampling of overburden performed during install. of MWT-1 • Install Monitor Well in Bedrock
Bedrock Monitor Well Installation	Area along Rt. 9W near GMMW-4	Rotosonic drill rig • Core overburden at 10' intervals (max. length) • Scan overburden soils with PID • Case off overburden • Install PVC well	Approx. 25 ft into Bedrock Aquifer	• Replace GMMW-4 which is of questionable construction. (screened at two intervals) • Monitor expected down-gradient perimeter of site. • Determine groundwater flow direction in bedrock	• Initiate boring • PID screen overburden cores • Cores with elevated PID detection ➢ Collect 1 sample per core at 2-ft highest interval ➢ Ship samples for laboratory analysis (TCL VOCs including CFCs). • Cores with no elevated PID detections ➢ No soil samples to be collected • Install Monitor Well in Bedrock

Constituents of Interest (COI) identified in the 1999 PSA = CFC 11, CFC 12, 1,1-DCA, 1,1-DCE, 1,1,1-TCA

TABLE 3 cont.
Phase III Field Activities: Soil Sampling, Well Installation, Groundwater Sampling

Site Wide Groundwater Sampling

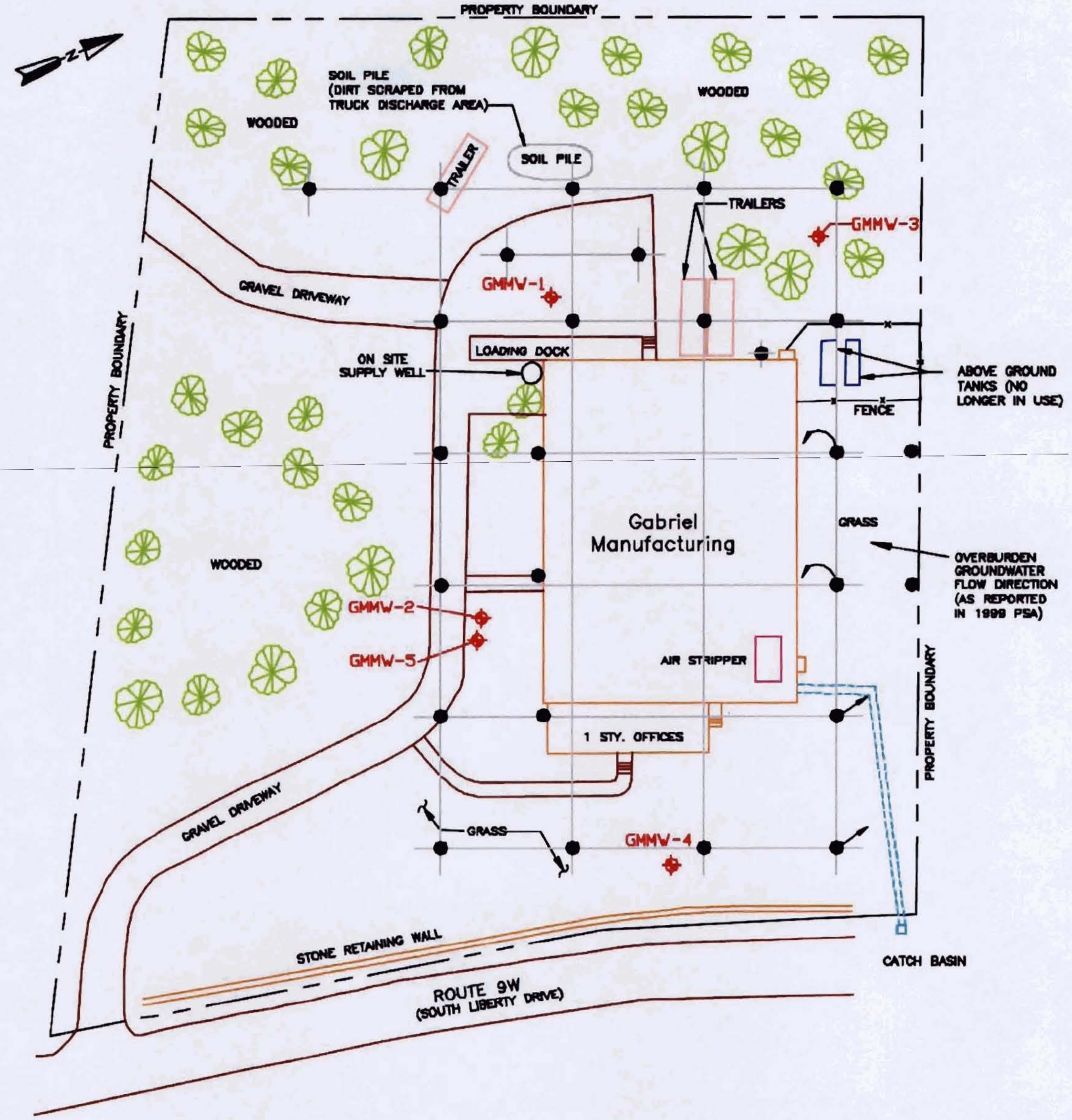
ACTIVITY	LOCATION	METHOD	DEPTH	PURPOSE	FIELD TASKS
Groundwater Sampling	All on-site monitor wells	• Low flow sampling methodology	• Groundwater pump to be situated just above well screen, or at a depth that allows for the collection of a quality sample (ex., pump will be placed at a lower depth interval if water level drops below pump).	• Collect groundwater samples for laboratory analysis. • Samples to be analyzed for TCL VOCs including COI. • Laboratory analytical results to be used to monitor groundwater conditions.	• Survey in-place (XYZ coordinates) all wells installed during Phase III • Collect water level readings • Purge and sample monitor wells

Constituents of Interest (COI) identified in the 1999 PSA = CFC 11, CFC 12, 1,1-DCA, 1,1-DCE, 1,1,1-TCA

TABLE 4
Phase IV Groundwater Elevation Data Collection

ACTIVITY	LOCATION	METHOD	DEPTH	PURPOSE	FIELD TASKS
Groundwater Elevation Data Collection	All on-site monitor wells (Site production well to be included if feasible and accessible)	• Water level indicators	• Water levels.	• Obtain groundwater flow directions during facility production well pumping and non-pumping conditions.	• Collect water level readings from all site monitor wells during pumping and non-pumping conditions, as described in the SSA Work Plan.

FIGURES



LEGEND

◆ Existing Monitoring Well Location (Installed 1999 PSA)

● Soil Gas Sample Point and potential Unsaturated Zone Soil Boring.

↗ Points can be adjusted towards areas of interest.

All Locations are approximate

APPROXIMATE SCALE

Figure 1
Unsaturated Zone Soil Gas Survey and Existing Monitoring Well Locations
Supplemental Site Assessment
Gabriel Manufacturing Co. Inc.

Source: Supplemental Site Assessment Work Plan for the Gabriel Site, Stony Point, New York. URS. 2003

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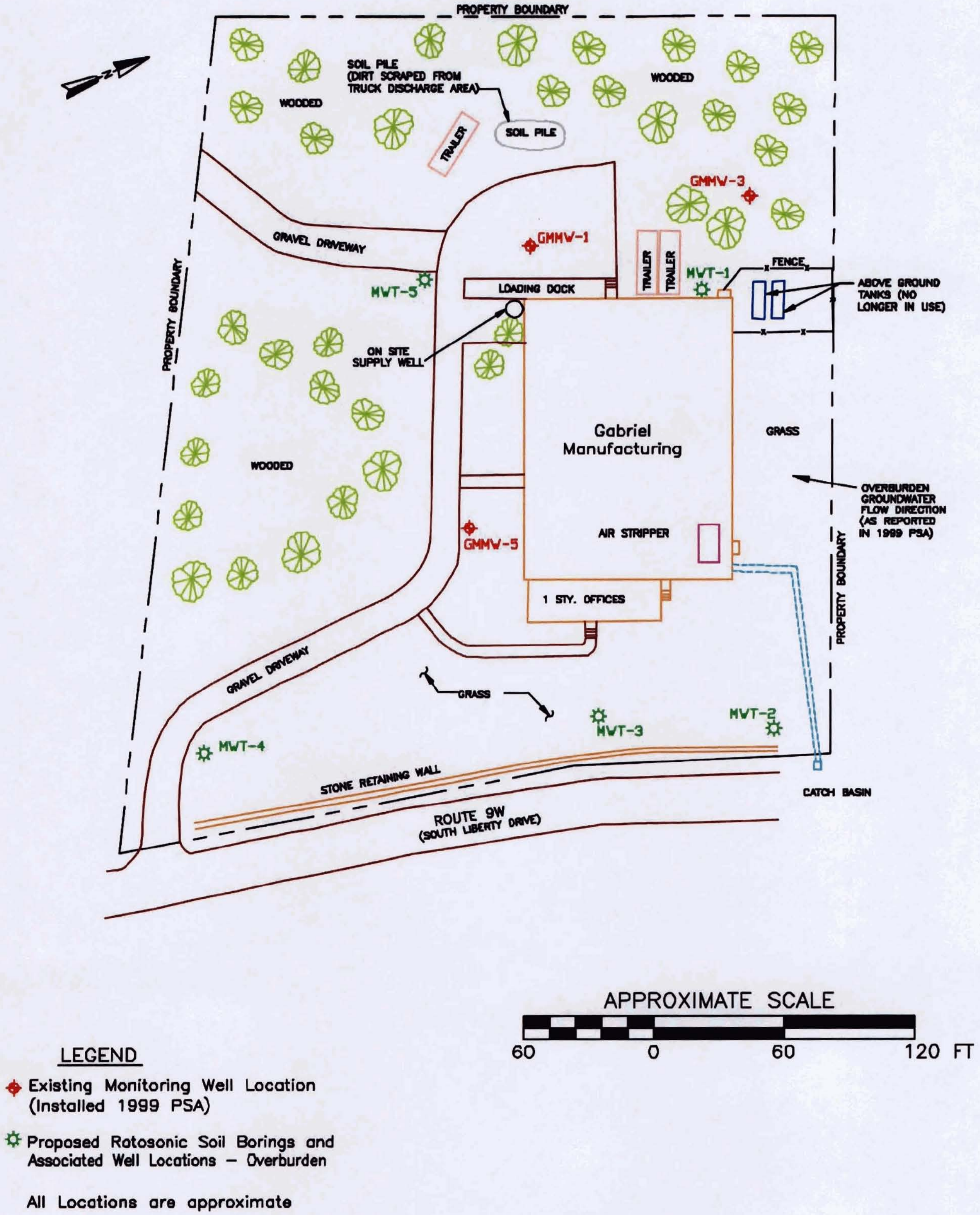

Figure 2
Overburden (Till) Monitor Well Location Map
Supplemental Site Assessment
Gabriel Manufacturing Co. Inc.

Source: Supplemental Site Assessment Work Plan for the Gabriel Site, Stony Point, New York. URS. 2003

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ES102006002MKE Figure 2_v2.ai 10-16-06 mjl

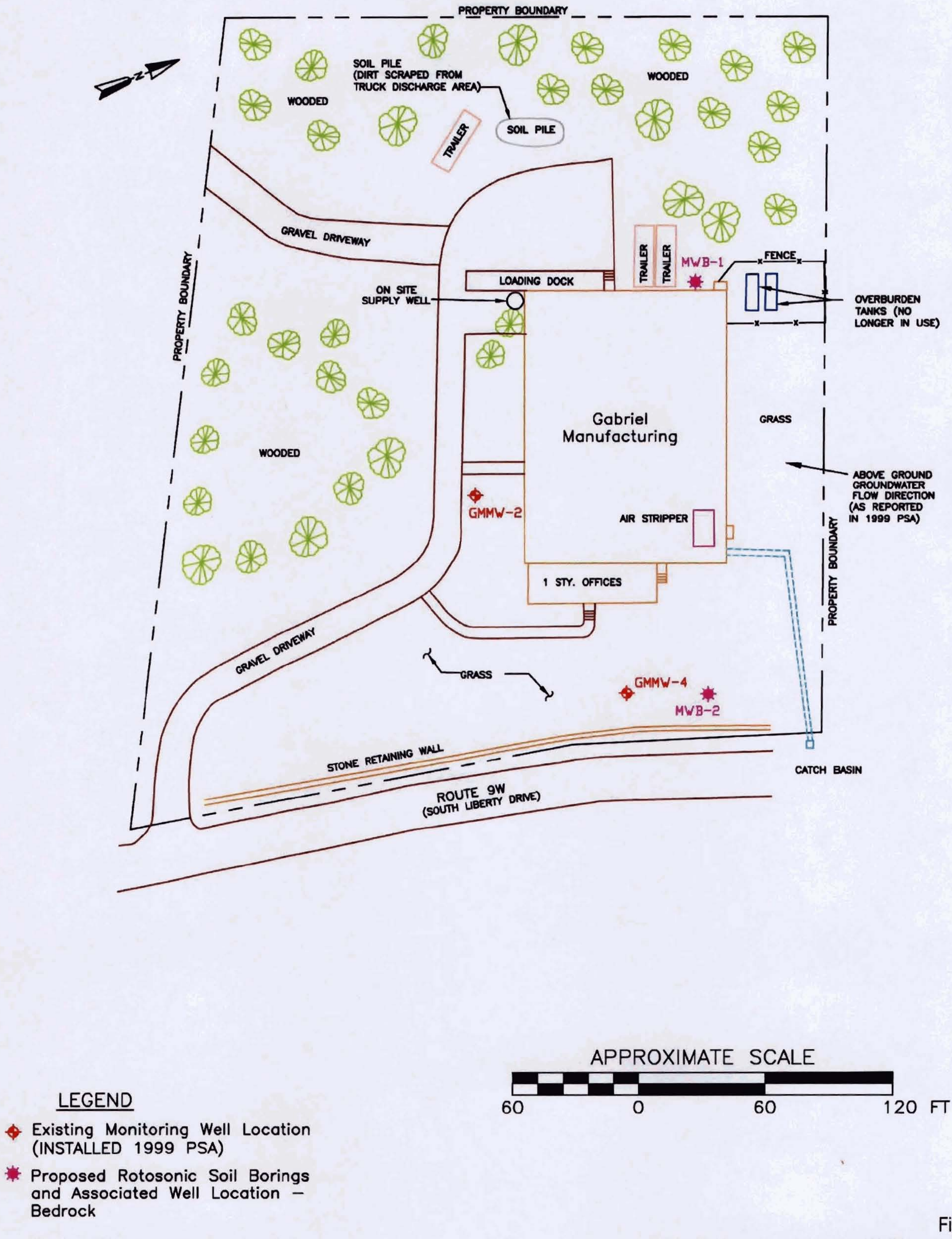

Figure 3
Bedrock (Sandstone) Monitor Well Location Map
Supplemental Site Assessment
Gabriel Manufacturing Co. Inc.

Source: Supplemental Site Assessment Work Plan for the Gabriel Site, Stony Point, New York. URS. 2003

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APPENDIX A

GUIDANCE FOR THE DEVELOPMENT OF DATA USABILITY SUMMARY REPORTS

New York State Department of Environmental Conservation • Home • Site Map

Quality Assurance Page

Guidance for the Development of Data Usability Summary Reports

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Background:

The Data Usability Summary Report (DUSR) provides a thorough evaluation of analytical data without the costly and time consuming process of third party data validation. The primary objective of a DUSR is to determine whether or not the data, as presented, meets the site/project specific criteria for data quality and data use.

Though the substitution of a DUSR for a full third party data validation may seem to be a relaxation of the Division's quality assurance requirements, this is definitely not the case. The development of the DUSR must be carried out by an experienced environmental scientist, such as the project Quality Assurance Officer, who is fully capable of conducting a full data validation. Furthermore, the DUSR is developed from a full New York State Department of Environmental Conservation Analytical Services Protocol (NYSDEC ASP) Category B or a United States Environmental Protection Agency Contract Laboratory Protocol (USEPA CLP) deliverables package.

The DUSR and the data deliverables package will be reviewed by quality assurance staff in the Technology Section, Division of Environmental Remediation. In most cases, we expect that this review will result in agreement or with only minor differences that can be easily reconciled. If data validation is found to be necessary (e.g. pending litigation) this can be carried out at a later date on the same data package used for the development of the DUSR.

Personnel Requirements:

The Environmental Scientist preparing the DUSR must hold a Bachelors Degree in a relevant natural or physical science or field of engineering and must submit a resume documenting experience in environmental sampling, analysis and data review.

Preparation of a DUSR:

The DUSR is developed by reviewing and evaluating the analytical data package. During the course of this review the following questions must be asked and answered:

1. Is the data package complete as defined under the requirements for the NYSDEC ASP Category B or USEPA CLP deliverables?
2. Have all holding times been met?
3. Do all the QC data: blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data fall within the protocol required limits and specifications?
4. Have all of the data been generated using established and agreed upon analytical protocols?
5. Does an evaluation of the raw data confirm the results provided in the data summary sheets and quality control verification forms?

6. Have the correct data qualifiers been used?

Evaluation of NYSDEC ASP Matrix Spike Blank (MSB) data - If the MSB recovery is less than the ASP criteria, the positive results should be qualified as J, estimated biased low. If the MSB recovery is less than the ASP criteria, but greater than 10%, the nondetects should be qualified J, biased low. If the MSB recovery is less than 10%, the nondetect data must be rejected.

Any Quality Control exceedances must be numerically specified in the DUSR and the corresponding QC summary sheet from the data package should be attached to the DUSR.

All data that would be rejected by the EPA Region 2 Data Validation Guidelines must also be rejected in the DUSR.

Once the data package has been reviewed and the above questions asked and answered the DUSR proceeds to describe the samples and the analytical parameters. Data deficiencies, analytical protocol deviations and quality control problems are identified and their effect on the data is discussed. The DUSR shall also include recommendations on resampling/reanalysis. All data qualifications must be documented following the NYSDEC ASP guidelines or the EPA Region 2 data validation guidelines.

Contact Tim LeBarron of the Technology Section, Division of Environmental Remediation at (518) 402-9761, with any questions on the preparation of a DUSR.

APPENDIX B

NEW YORK STATE DEPARTMENT OF HEALTH COMMUNITY AIR MONITORING PLAN

Appendix B
Community Air Monitoring Plan

The intent of a Community Air Monitoring Plan (CAMP) is to provide a measure of protection for the downwind community (i.e., off- site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities and to confirm that work activities did not spread contamination off-site through the air. The action levels specified herein (as per the NYSDOH Generic CAMP) require increased monitoring, corrective actions to abate emissions, and/or work shutdown.

General

Prior to any activities being performed, air monitoring will be performed downstream in order to collect baseline air data. Continuous real-time air monitoring for volatile organic compounds (VOCs) and particulate levels will be conducted for all ground intrusive activities. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells. In addition, periodic monitoring for VOCs will be conducted during non-intrusive activities such as groundwater sampling.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using a photoionization detector (PID) capable of calculating 15-minute running average concentrations. Monitoring equipment will be calibrated daily for the contaminant(s) of concern or for an appropriate surrogate.

If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone:

- exceeds 5 parts per million (ppm) above background for the 15- minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
- persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.
- is above 25 ppm, activities will be shutdown.

The 15-minute average readings and instantaneous readings used for decision purposes will be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored at the upwind and downwind perimeters of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Monitoring equipment will be capable of measuring particulate matter less than 10 micrometers in size (PM- 10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during work activities.

If the downwind PM-10 particulate level is 100 micrograms per cubic meter (ug/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 ug/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 ug/m^3 above the upwind level, work will be stopped and a reevaluation of activities initiated. Work will resume if dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 ug/m^3 above the upwind level and in preventing visible dust migration.

Readings will be recorded and be available for State (NYSDEC and NYSDOH) personnel to review.

APPENDIX C

STANDARD OPERATING PROCEDURES

SOP C1

Standard Operating Procedure for the Collection of Sub-Slab Vapor Samples Using Summa^{TM} Canisters

This procedure describes the approach for the collection of sub slab soil vapor samples in Summa canisters. It includes instruction on probe installation, leak checking, gas sampling, and probe abandonment. This SOP should be used in conjunction with project data quality objectives. Only persons trained in the collection of soil gas samples should attempt this procedure

1.0 Materials

1.1 Probe Installation
- Hammer drill and 7/8" or 1" and 5/16" or 3/8" bits
- Vacuum cleaner ('shop vac' type or hand held)
- Probe (1/4" stainless steel tube with Swagelock or equivalent nut and ferrule)
- Probe seal (1/8" NPT internal wrenching plug)
- Probe union (1/4" male Swagelock or equivalent to 1/8" female NPT)
- Nuts and ferrules (1/4" stainless steel Swagelock or equivalent)
- Hack saw
- Mortar consisting of Portland Cement mix, Fix-it-All, or similar
- Large Q-tips or paper towels and water
- Tongue depressor, putty knife, or similar tool
- Tape measure

1.2 Leak check
- Leak check enclosure
- Compressed helium tank (balloon grade), helium regulator, flow meter (0-500 ml/min)
- Helium detector, or equal
- (alternative) Isopropyl alcohol and paper towels

1.3 Sampling
- Sampling union (1/4" male Swagelock or equivalent to 1/4" male NPT)
- Vacuum pump, sampling manifold
- ¼" Teflon tubing, rubber tubing
- Flow controller
- Summa canister (sized appropriately for sampling requirements)
- Miscellaneous fitting to connect tubing to sampling union and Summa canister)

1.4 Probe Abandonment
- Probe removal fitting
- Crowbar

1.5 Miscellaneous
- Teflon tape
- 9/16", ½", crescent wrench, screw driver
- Extension cord

- Timer/watch
- Tools required to cut carpet, and/or tools needed for removal of other floor coverings

2.0 Probe Installation

2.1 Locate the sampling locations in accordance with the work plan. Check with local utility companies to identify utilities coming into the building from outside. If possible, look for known or suspected utility conduits and note their location on a map or in the field log. Be sure to confirm that the sample locations will not interfere with the known underground utilities. Also note the location of the probe, locations of significant features (walls, cracks, sumps, drains, etc), and conditions of the slab and soil.

2.2 If needed, expose the concrete by cutting the carpet or other loose floor coverings (Note: Carpet need not be removed, but rather a 'L' shape cut to expose the concrete for drilling and the leak check enclosure). Drill a 7/8" or 1" diameter hole to a depth of 1-3/4" (measured to the center of the hole) to allow room for the installation of the probe nut and probe union (See Figure 2). Remove the cuttings using a vacuum cleaner. Be careful to not compromise the integrity of the slab during drilling (i.e., cracking it), although note if this occurs. It is important that the slab and the probe hole remain air tight for sampling and that cracks are noted.

2.3 Drill a 5/16" or 3/8" diameter hole through the remainder of the slab and approx. 3" down into the sub-slab material (See Figure 3). Drilling into the sub slab material creates a void that is free of obstructions that might plug the probe during sampling. Record the total depth of the slab and the depth drilled into the sub slab material.

2.4 Once the total depth of the slab is known, be sure that the probe (1/4" stainless steel tube with Swagelock or equivalent nut and ferrule) is cut with a hacksaw so that it does not extend beyond the bottom of the slab. Attach the probe union (1/4" male Swagelock to 1/8" female NPT) to the probe and tighten. Wrap the probe seal with Teflon tape and tighten into the union. See Figure 8 for an expanded view of the probe parts.

2.5 Wet the walls of the hole using the Q-tip or moistened paper towel. This helps the mortar bond to the drilled concrete. Prepare the mortar in accordance with manufacturer's directions to a stiff consistency. Make sure that the consistency is such that the mixture will not run down the sides of the hole and potentially clog the probe or hole. Place sample probe and sample union part way into the hole as shown in Figure 4. The probe tip should be at least one inch into the smaller diameter hole, but not so far that mortar can not be easily placed in the large diameter hole around the probe fittings. It is critical that the mortar mixture does not get into either end of the probe and cause a plug. Using the tongue depressor or similar tool, apply mortar around the base of the sampling probe and sampling union such that it will be sealed once it is in place.

2.6 Fill the hole with mortar, and press the probe further into the hole until its top is flush with the floor. In doing so, slightly wiggle the probe to create good 'wetting' contact between the probe and the mortar as well as the mortar and the drilled concrete. Scrape off excess and make sure there is clear access to the probe. See Figure 5.

2.7 Let dry for 24 hours

2.8 Be sure to never leave the probe hole open to atmosphere for extended periods to minimize the effects of surface infiltration.

3.0 Manifold Assembly and leak check

3.1 Make sure the sampling system is assembled (as shown in Figure 1 or 10) by connecting the sampling manifold to the soil gas probe and the purge system. <u>Do not connect the flow controller or canister at this time</u>.

3.2 Make sure the gas probe valve (valve #1) is closed.

3.3 Open the sample valve (valve #2) and the purge valve (valve #3) and turn the vacuum pump on. Make sure that the flow meter on the vacuum pump exhaust is reading 200 ml/min. Let the pump run for 1 minute to allow purging of potential contaminants from the manifold

3.4 Now close valve #2 to achieve a vacuum gauge reading of 10 inches of mercury or to a vacuum that will be encountered during sampling, which ever is greater. Close the purge valve #3 and shut the vacuum pump off.

3.5 If the pressure in the manifold has not changed after a minute, then the manifold is considered leak free. If not, repair any leaks prior to use and re-check the manifold.

3.6 Record the leak check date and time on the field sampling log.

4.0 Probe Leak Check and Probe Purging

4.1 The sampling system needs to be leak-checked and purged before sampling. Two different methods supported by the available literature/guidance are presented. One method uses helium gas as a tracer and allows for the assessment of potential probe leak prior to sample collection. The other method uses isopropyl alcohol as a tracer and allows for the assessment of potential probe leak after sample collection and analysis. Both these methods are acceptable and are detailed below.

4.1.1 Helium leak checking technique and purge

4.1.1.1 Remove the probe seal insert, wrap the sampling union fitting threads (1/8" male NPT to ¼" male Swagelock or equivalent) with Teflon tape (wrap the NPT threads only), and tighten into the exposed probe fitting. Thread the Teflon sample tubing through the rubber grommet in the leak check enclosure from the outside, and attach the tube to the sampling union using a nut and ferrule. Slide the enclosure down so it seals on the concrete slab. Attach the other end of the sample tube to the sampling manifold. See Figure 6 and 7.

4.1.1.2 Attach tubing to the flow meter on the helium tank regulator and the other end to the enclosure. Attach the exhaust tube to the enclosure and position the other end as far away as possible to avoid detection by the helium leak detector. See figure 9.

4.1.1.3 Put the helium detector on the exhaust line from the sample pump. Make sure valve 1 is closed. Open valves 2 and 3. Turn on the sample pump and helium detector.

4.1.1.4 Open the helium tank and set the flow meter for approximately 200 ml/min. Allow it to flow for 1 minute to fill the leak check enclosure before starting the purge. Make sure that the detector is not reading any helium before starting the purge.

4.1.1.5 Two liters of sub slab gas need to be purged before sampling. The purge time is 10 minutes at a flow rate of 200 ml/min. Close valve #2 and open valve #1 simultaneously and start timing for the purge volume. During the purge, observe the helium detector for indication of probe leakage (e.g. infiltration of room air into the probe). If a reading of >5% is observed, then the probe leak check has failed, and corrective action is required – see step 4.2.2.

4.1.1.6 At the end of the purge time, close valves #1 and #3 and turn the pump off. If at any time during the purge the detector read < 5%, then the system is leak free and ready for sampling. If >5% was observed, then check the fittings and try again. If <5% cannot be achieved, then this probe must be abandoned and a new hole drilled. Be sure to record the helium leak check value on the field sheet.

4.1.1.7 Close the helium tank valve.

4.1.2 Isopropyl alcohol leak checking technique and purge

4.1.2.1 Moisten a paper towel with isopropyl alcohol. Wrap the isopropyl alcohol moistened paper towel around probe fittings at the slab surface. Note: It is important to keep the isopropyl alcohol completely away from the sample equipment and SUMMA Canister during the set up phase. The sampler must also change nitrile gloves between setting up the sample equipment and conducting the leak detection test. It is also important to instruct the laboratory to analyze for isopropyl alcohol. If isopropyl alcohol is detected by the laboratory at a concentration greater than 5% (50,000 ppmv) then the sample is deemed to be invalid due to a leak.

4.1.2.2 Two liters of sub slab gas need to be purged before sampling. The purge time is 10 minutes at a flow rate of 200 ml/min. Close valve #2 and open valve #1 simultaneously and start timing for the purge volume.

4.1.2.3 At the end of the purge time, close valves #1 and #3 and turn the pump off.

5.0 Sampling

5.1 The Summa canister has been evacuated to near absolute zero pressure. Care should be used at all times to prevent inadvertent loss of canister vacuum. Never open the valve affixed to the canister unless the intent is to collect sample or check the pressure. Use only a canister that has been certified to be clean.

5.2 Remove the canister valve cap, attach the vacuum gauge to the canister, and open the canister valve. Record the pressure reading and close and remove the valve. The pressure in the canister should be between 28" and 30" of mercury. If not, then the canister has leaked and should not be used for sampling.

5.3 Connect the flow controller to the manifold (at valve #2) and the Summa canister to the flow controller. The port on the flow controller that reads 'HP' or 'In' should be attached to the manifold. The port that reads 'LP' or 'Out' should be attached to the canister. Use only a flow controller that has been cleaned and properly adjusted.

5.4 To take the sample, <u>confirm valve #3 is closed</u>, and open valves #1 and #2. Slowly open the canister valve approximately one (1) full turn, and start timing. Record the start time on the field sampling log. During the sampling period, record the lowest pressure from the manifold gauge on the field log.

5.5 There are different sample time and flow rate protocols. These are subject to project requirements.

5.5.1 5 minute sample period, 850 ml canister: The flow controller is set for 150 ml/min. For an 850 cc Summa canister, it will take 5 minutes to collect a sample.

5.5.2 24 hour sample period, 6 liter canister: The flow controller is set for 3.75 ml/min. For a 6 liter Summa canister, it will take 24 hours to collect a sample.

5.6 At the end of the time, close the sample valve (valve #2) and the valve affixed to the canister. Remove the canister from the apparatus.

5.7 Re-attach the vacuum gauge and record the final pressure. The canister should only have 750 mls of sample in it based on a 150 ml/min sampling rate for 5 minutes. This should equate to between 2" and 5" final pressure in the canister. Record the sampling date, time, canister ID, flow controller ID, and any other observation pertinent to the sampling event on the field sampling log.

5.8 Remove the gauge from the can and tighten the cap back on with a wrench. Verify that canister valve is closed.

5.9 Fill out all appropriate documentation (sampling forms, sample labels, chain of custody, sample tags, etc.).

5.10 Disconnect the sample tubing from the probe, and remove the sampling union.

6.0 Probe Abandonment

6.1 After sampling, it is critical that the probe either be removed or plugged to prevent the creation of a new pathway for vapor intrusion.

6.2 If the probe is to be used again in the future, wrap the probe seal insert with Teflon tape, and tighten it into the probe opening using a hex key until it is tight and flush with the concrete floor.

6.3 If the probe is to be removed, insert the removal fitting into the probe. Using a crow bar, remove the entire probe assembly. If the probe can not be removed in this manner, then over drill the probe with the drill and 1" bit. Fill the hole with cement mix.

Figure 1 – Sub Slab Sampling

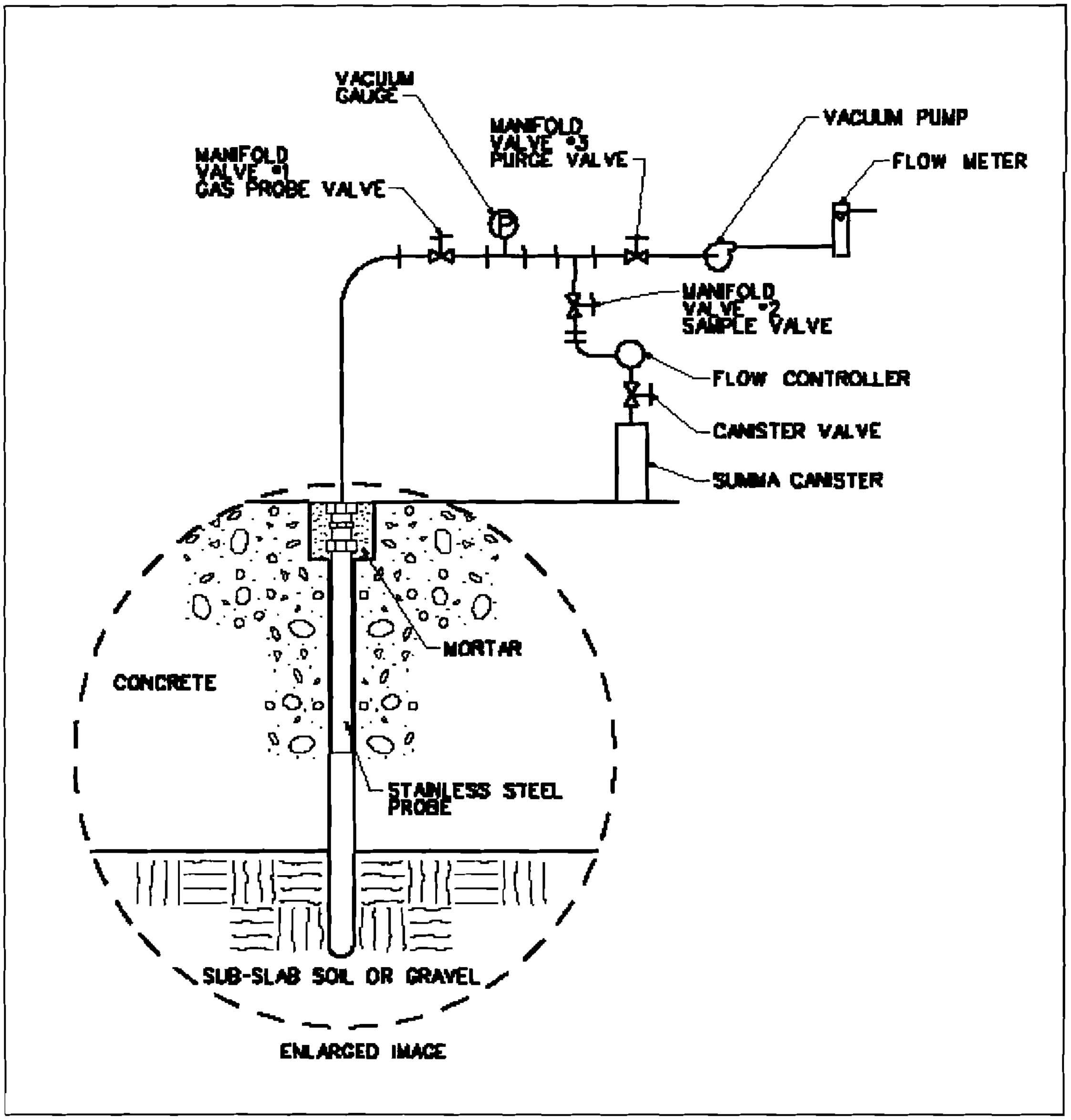


Figure 2 – Drilling 1" mortar hole to a depth of 1 ¾"

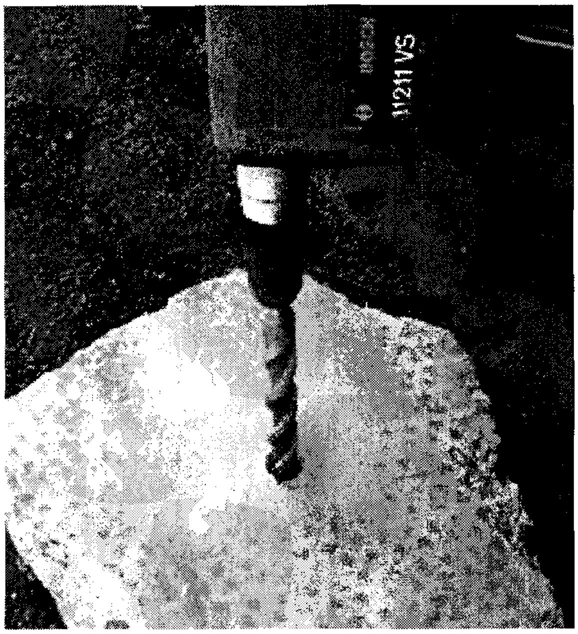
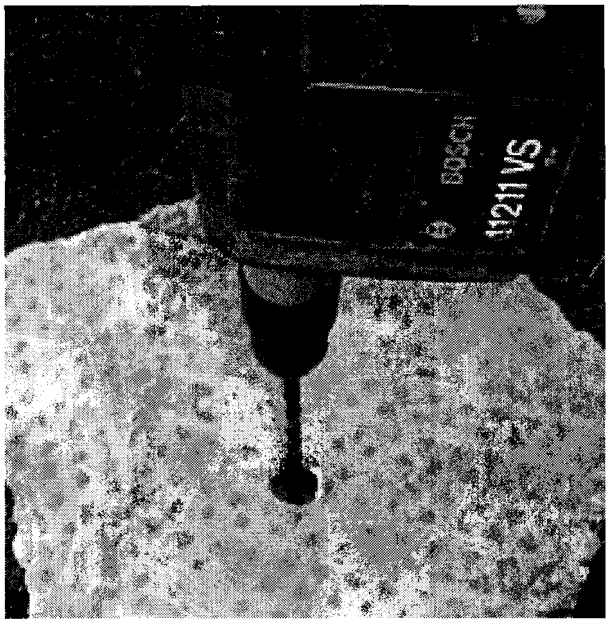


Figure 3 – Drilling 3/8" probe hole



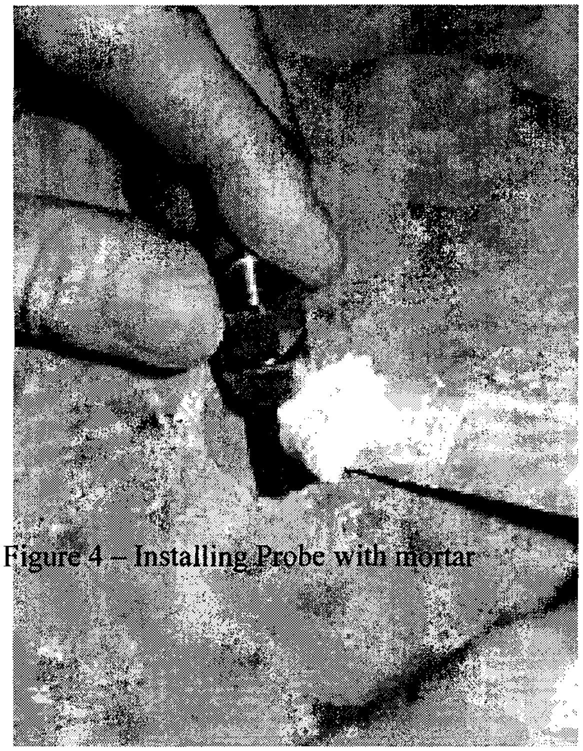


Figure 4 – Installing Probe with mortar

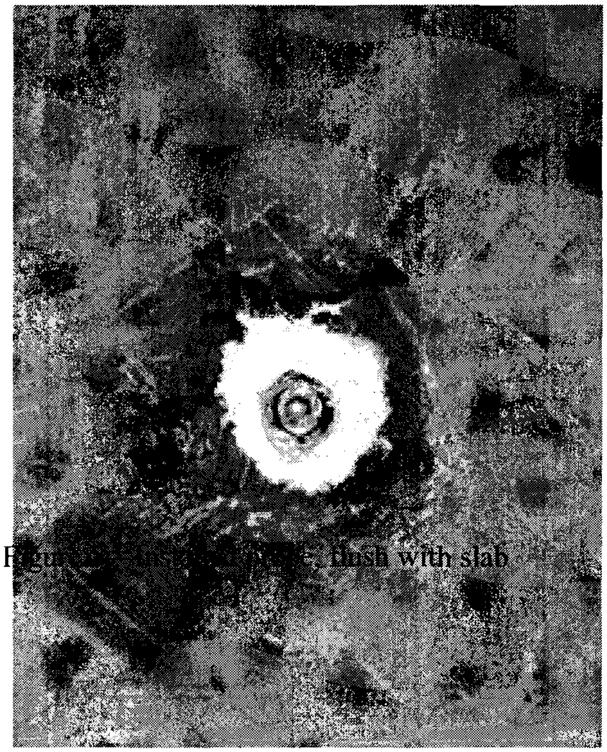


Figure 5 – Installed probe, flush with slab

Figure 6 – Installed probe with sample tube

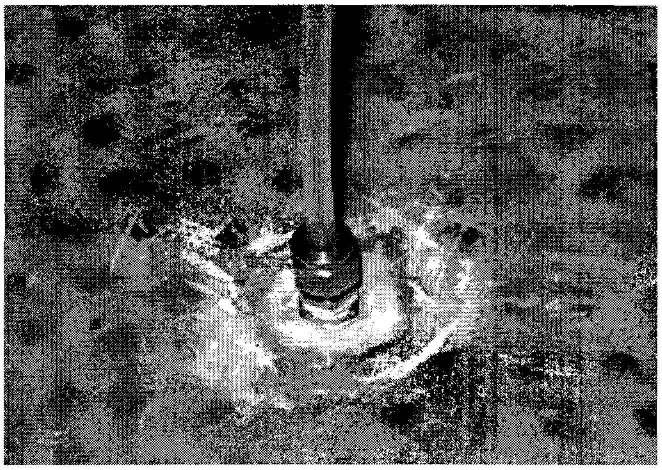
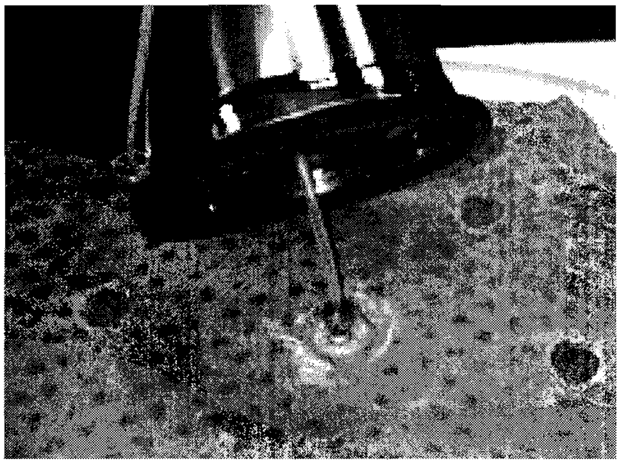


Figure 7 - Installing the helium leak check assembly



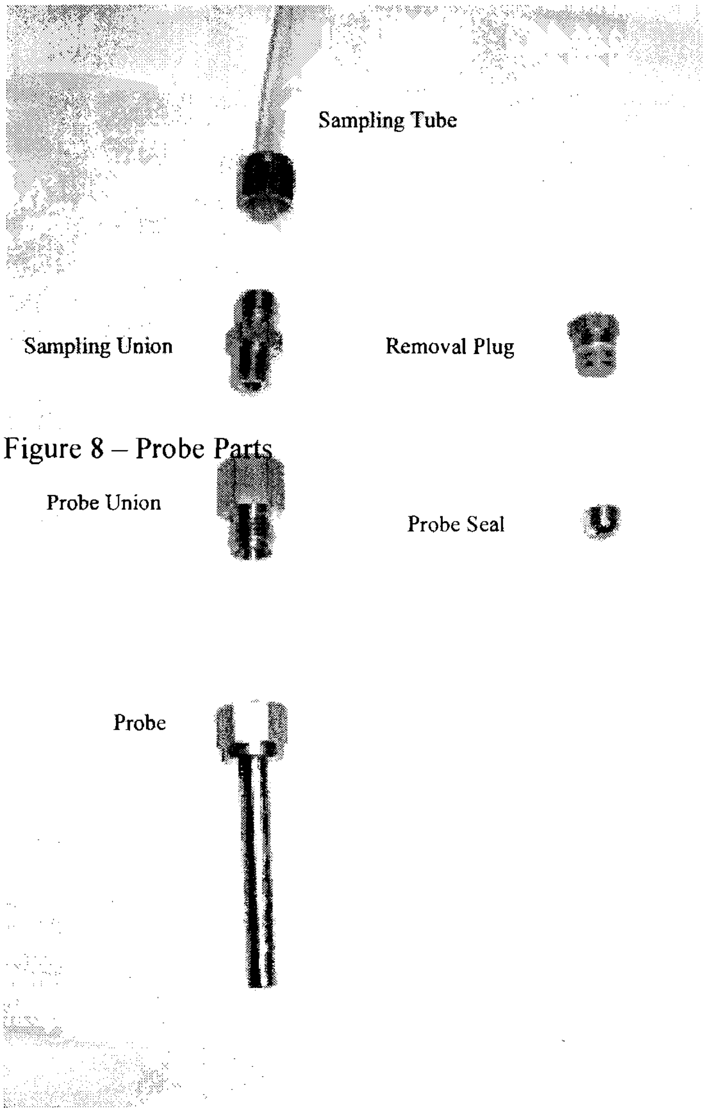


Figure 8 – Probe Parts

Figure 9 –Helium Leak Check Assembly

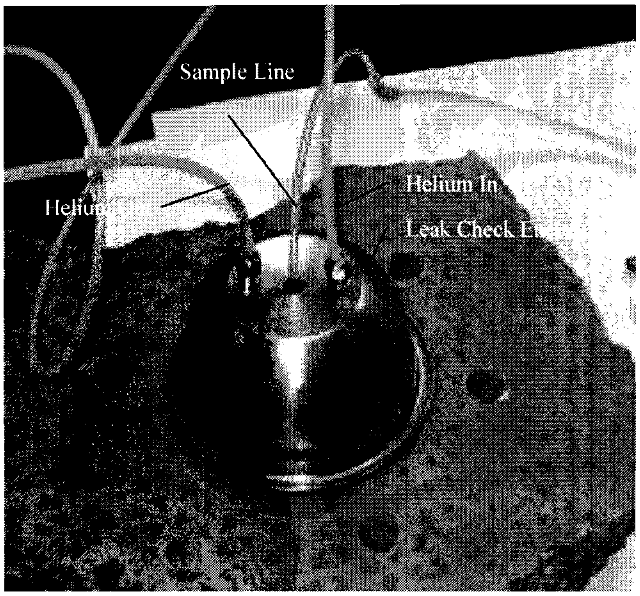
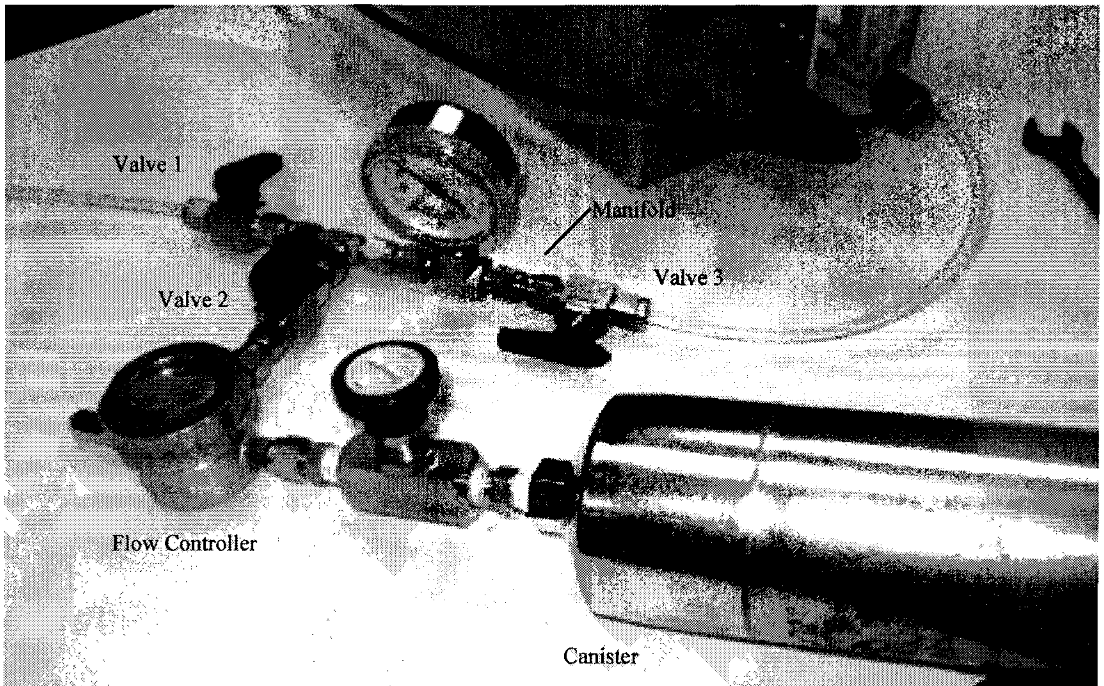


Figure 10 – Sampling Manifold



SOP C2

Boring Installation Methods, Bedrock Boring, And Soil Sampling: Rotosonic Drilling

Scope and Application

The purpose of this SOP is to specify the equipment, materials, and protocol for soil boring, bedrock coring, well drilling and the collection of subsurface soil samples using the RotoSonic drilling sampling method.

RotoSonic Materials

a. RotoSonic drill rig
b. 4" Sonic sampling barrels and 6" sonic overdrill barrels
c. 4" Soil Core Plastic Sheathing
d. Soil Boring Logs (provided and completed by CH2M HILL)
e. Photoionization Detector (provided by CH2M HILL)
f. Sample Containers (provided by CH2M HILL)

NOTE: All materials to be provided by CH2M HILL are indicated. Remaining materials are to be provided by drilling CONTRACTOR.

RotaSonic Procedures and Guidelines

1. Decontaminate drill stem and other non-dedicated downhole equipment in accordance with SOP No. 9 on Equipment Decontamination.

2. Sampling and drilling with RotoSonic equipment is a two-step process. First, a 4" diameter core barrel is advanced into the zone of interest to collect a soil or bedrock core sample. This barrel is 10-feet long, and up to two can be connected in series to retrieve a 4" by 20 ft. core sample. After the 4" diameter soil core barrel has been advanced to the terminal depth of the sample run, a larger diameter drill rod (6-inch) is advanced over the 4" rod to both ream the hole and dislodge the advanced 4" rod. The larger diameter rod also acts as temporary casing supporting the borehole from collapse while the 4" rod is removed from the borehole. The 4" rod is then removed from the borehole and the core is extruded from the barrel into plastic sheathing for examination by the site geologist. The sequence is repeated to collect the next length of soil core.

3. Rotosonic drilling equipment may also be used during the installation of bedrock monitoring wells. At each bedrock monitoring well location the drill rig will collect cores from the overburden interface to approximately 25' below the bedrock overburden interface. Rotosonic coring into the bedrock will likely fracture the bedrock core samples, however

attempts at collecting representative cores will also be made. Bedrock samples will be screened with a PID.

4. Each time a soil or bedrock core is extracted, record the depth interval bgs of the core and review the sampling plan and SOP on subsurface soil sampling in order to determine the depth intervals to be sampled.
5. Following retrieval of a plastic sheathed core, cut the plastic open with a sharp, decontaminated knife parallel to its length to expose the core. The 4 inch diameter core can then be broken open to expose a fresh surface. Observe the core, screen it with a PID and collect samples from the pre-determined intervals(s) following the SOP on Subsurface Soil Sampling. Record lithological information for preparation of a soil boring log.
6. Upon completion of a soil boring, construct a monitoring well or backfill the boring.
7. A site geologist will be present during all well drilling and installation activities and will fully describe and record all tasks performed in support of these activities in the field logbook. The site geologist will be responsible for the logging of samples, monitoring of drilling operations, recording of water losses/gains and groundwater data, preparing the boring logs and well diagrams, and recording the well installation procedures of the rig.
8. Decontamination of all well installation equipment and materials will be carried out.
9. Petroleum jelly, teflon tape, or lithium grease shall not be used on the threads of downhole drilling equipment. If a lubricating agent is required, the proposed lubricant MUST be reviewed for approval by the site geologist. Adequate time and information, such as Material Safety Data Sheets (MSDS), must be provided for the geologists review. Time spent for on-site review of the proposed material will be considered Down Time and will not be billable by the drilling contractor. Food grade vegetable oil is an example of an approved lubricant. Additives containing either lead or copper will not be allowed. In addition, polychlorinated biphenyls (PCBs) will not be contained in hydraulic fluids or other fluids used in the drilling rig, pumps, or other field equipment and vehicles. MSDS sheets must be available for all such fluids.
10. Surface runoff or other fluids will not be allowed to enter any boring or well during or after drilling/construction. Likewise, re-circulated drilling fluids will be contained in the work area during installation of borings and not allowed to runoff into the surrounding areas.
11. Antifreeze used to keep equipment from freezing will not contain rust inhibitors and sealants. If the antifreeze is added to a piece of machinery in contact with drilling fluid, the antifreeze will be completely purged from the equipment prior to use in drilling, mud mixing, or any integral part of the overall drilling operation. The contractor will note in the boring log, the following information in regard to the use of antifreeze: date, reason, quantities, and brand name. MSDS sheets will be available for review by the site geologist.
12. Proceed to the next drilling location after decontamination of all downhole equipment, including the working surfaces of the drill rig.

Collection and Disposal of Drill Cuttings

The drilling contractor will be responsible for containerizing all drill cuttings and other wastes generated by the drilling. Cuttings from the investigation locations will be placed into 55-gallon, open top, type 17E (1A2) DOT-approved drums. The contractor will transport all drums to an area designated for the storage of wastes within the site.

Precautions

1. Verify that the drill rig is clean and in proper working order.
2. Ensure that the drill rig operators thoroughly complete the decontamination process between sampling locations.
3. Use caution to ensure that soil core sections are oriented the correct way (top vs. bottom) when observing lithology and collecting samples.
4. Verify that the borehole made during sampling activities has been properly backfilled or abandoned.

SOP C3

Low-Flow Groundwater Sampling from Monitoring Wells

Purpose and Scope

This procedure presents general guidelines for the collection of groundwater samples from monitoring wells using low-flow purging and sampling procedures. Operations manuals should be consulted for specific calibration and operating procedures.

Equipment and Materials

- Flow-through cell with inlet/outlet ports for purged groundwater and watertight ports for each probe
- Meters to monitor water quality parameters (e.g., pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature) (e.g., Horiba® U-22 or similar)
- Water-level indicator
- In-line disposable 0.45μ filters (QED® FF8100 or equivalent)
- Adjustable-rate, positive-displacement pump, submersible, or peristaltic pump
- Generator
- Disposable polyethylene tubing
- Plastic sheeting
- Well-construction information
- Calibrated bucket or other container and watch with second indicator to determine flow rate
- Sample containers
- Shipping supplies (labels, coolers, and ice)
- Field logbook

Procedures and Guidelines

A. Setup and Purging

1. For the well to be sampled, information is obtained on well location, diameter(s), depth, and screened interval(s), and the method for disposal of purged water.

2. Instruments are calibrated according to manufacturer's instructions and information such as make/model and calibration and use specifications are recorded in the field logbook.

3. The well number, site, date, and condition are recorded in the field logbook.

4. Plastic sheeting is placed on the ground, and the well is unlocked and opened. All decontaminated equipment to be used in sampling will be placed only on the plastic sheeting until after the sampling has been completed. To avoid cross-contamination, do not let any downhole equipment touch the ground.

5. All sampling equipment and any other equipment to be placed in the well is cleaned and decontaminated before sampling in accordance with SOP D4 Field Sampling Equipment Decontamination.
6. Water level measurements are collected in accordance with SOP D6 Water Level Measurements. Do not measure the depth to the bottom of the well at this time; this reduces the possibility that any accumulated sediment in the well will be disturbed. Obtain depth to bottom information from well installation log.
7. Attach and secure the polyethylene tubing to the low-flow pump. Lower the pump slowly into the well such that the pump intake is at least 2 feet above the bottom of the well to avoid mobilization of any sediment present in the bottom. Preferably, the pump intake should be set in the middle of the screen.
8. Insert the measurement probes into the flow-through cell. The purged groundwater is directed through the cell, allowing measurements to be collected before the water contacts the atmosphere.
9. Start purging the well at 0.2 to 0.5 liters per minute. Avoid surging. Purging rates can be increased for more transmissive formations. Record the initial water quality parameters in the field logbook.
10. The water level should be monitored during purging, and, ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well (i.e., less than 0.5 feet). The water level should stabilize for the specific purge rate. There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.1 to 0.2 liters per minute) to avoid affecting well drawdown.
11. During purging, the water quality parameters are measured frequently (every 3 to 5 minutes) until the parameters have stabilized. Water quality parameters are considered stabilized when measurements meet the following criteria:
    - pH: within 10 percent
    - Specific conductance: within 3 percent
    - Dissolved oxygen: within 10 percent
    - Turbidity: within 10 percent or as low as practicable given sampling conditions
    - ORP: within 10 mV

B. Sample Collection

Once purging has been completed, the well is ready to be sampled. The elapsed time between completion of purging and collection of the groundwater sample from the well should be minimized. Typically, the sample is collected immediately after the well has been purged, but this is also dependent on well recovery.

Samples will be placed in bottles that are appropriate to the respective analysis and that have been cleaned to laboratory standards. Each bottle typically will have been previously prepared with the appropriate preservative, if any.

The following information, at a minimum, will be recorded in the logbook:

1. Sample identification (site name, location, and project number; sample name/number and location; sample type and matrix; whether the sample is filtered or not; time and date; sampler's identity)
2. Sample source and source description
3. Field observations and measurements (appearance, volatile screening, field chemistry, sampling method), volume of water purged prior to sampling, number of well volumes purged, and field parameter measurements
4. Sample disposition (preservatives added; laboratory sent to, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)

The steps to be followed for sample collection are as follows:

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.
2. The sample is slowly discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. The pumping rate should be reduced to approximately 100 ml per minute when sampling VOCs.
3. Samples may be field filtered before transfer to the sample bottle. Filtration must occur in the field immediately upon collection. The recommended method is through the use of a disposable in-line filtration module (0.45-micron filter) using the pressure provided by the pumping device for its operation.
4. Samples for analysis for volatile organic compounds should be collected first, if such samples are required.
5. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to overflowing and capped.
6. The bottle is capped, then labeled clearly and carefully.
7. Samples are placed in appropriate containers and, if necessary, packed with ice in coolers as soon as practical.

C. Additional remarks

1. If the well goes dry during purging, wait until it recovers sufficiently to remove the required volumes to sample all parameters. It may be necessary to return periodically to the well but a particular sample (e.g., large amber bottles for semivolatile analysis) should be filled at one time rather than over the course of two or more visits to the well.

2. It may not be possible to prevent drawdown in the well if the water-bearing unit has sufficiently low permeability. If the water level was in the screen to start with, do not worry about it because there is no stagnant water in the riser above the screen to begin with.

3. If the water level in the well is in the riser above the screen at the beginning of purging, then be sure you pump out sufficient volume from the well to remove the volume of water in the riser above the screen. For a 2-inch diameter well, each foot of riser contains 0.163 gallons; for a 4-inch riser, each foot of riser contains 0.653 gallons; for a 6-inch riser, each foot of riser contains 1.47 gallons.

4. Alternatively, the water in the riser above the screen can be removed by lowering the pump into the well until the pump intake is just below the water level, starting the pump, running it at a low rate, and slowly lowering the pump as the water level in the riser declines. This approach can be terminated when the water level reaches the top of the screen, at which time the stagnant water in the riser has been removed. This may not be a practical approach for dedicated sampling equipment. As with typical low-flow sampling, the flow rate should be kept as low as practicable.

5. There may be circumstances where a positive-displacement or submersible pump cannot be used. An example is at isolated, hard-to-reach locations where the required power supply cannot be brought. In this case, a peristaltic pump may be used. Samples can be collected by the procedures described above for all but those for VOC analysis. The water to be placed in the vials for VOC analysis should not be run through the peristaltic pump but instead should be collected by the following:

   - Stop the pump when it is time to collect the VOC sample.
   - Disconnect the tubing upstream from the pump (a connector must be installed in the line to do this).
   - Holding a finger over the end of the tubing to keep the water in the tubing, remove the tubing from the well. Be sure that the tubing does not contact other than clean surfaces.
   - Place the end of the tubing that was in the well into each VOC vial and fill the vial by removing the finger from the other end of the tube.
   - Once the vials are filled, return the tubing to the well and collect any other samples required.
     1. Non-dedicated sampling equipment is removed from the well, cleaned, and decontaminated in accordance with *Field Sampling Equipment Decontamination* SOP D4.

     2. Disposable polyethylene tubing is disposed of with contaminated PPE.

Key Checks and Preventative Maintenance

- The drawdown in the well should be minimized as much as possible (preferably no more than 0.5 to 1 foot) so that natural groundwater-flow conditions are maintained as closely as possible.
- Stirring up of sediment in the well should be avoided so that turbidity containing adsorbed chemicals is not suspended in the well and taken in by the pump.
- Overheating of the pump should be avoided to minimize the potential for losing VOCs through volatilization.
- Keep the working space clean with plastic sheeting and good housekeeping.
- Maintain field equipment in accordance with the manufacturer's recommendations. This will include, but is not limited to:
    - Inspect sampling pump regularly and replace as warranted
    - Inspect quick-connects regularly and replace as warranted
    - Verify battery charge, calibration, and proper working order of field measurement equipment prior to initial mobilization and daily during field efforts.

SOP C4

Field Sampling Equipment Decontamination

Purpose

To provide general guidelines for decontamination of soil sampling equipment, monitoring equipment, and sample containers used in potentially contaminated environments.

Equipment / Materials

- Demonstrated analyte-free deionized or distilled water.
- Potable water.
- Deionized or distilled water.
- Alconox (or other phosphate free detergent) and water solution.
- Large plastic pails or tubs for detergent and water, scrub brushes, squirt bottles for detergent, methanol and water, plastic bags and sheets.
- DOT approved 55-gallon drum for disposal of waste

Procedures / Guidelines

Sampling Equipment Decontamination

All soil, surface water, and sediment sampling equipment not to be steam cleaned (e.g., drilling equipment) will be decontaminated by personnel wearing disposable latex gloves or vinyl gloves using the following procedure:

1. Remove loose soil and gross contamination.
2. Rinse with potable water.
3. Wash all equipment surfaces that contacted the potentially contaminated soil or water with Alconox solution, using a brush as needed to remove particulate matter and surface films.
4. Rinse with potable water.
5. Rinse with deionized or distilled water and air dry.
6. Wrap the equipment with aluminum foil, if appropriate, to prevent contamination if the equipment is to be stored or transported.
7. Collect all decontamination fluids and dispose of in a DOT approved 55-gallon drum.

Monitoring Equipment Decontamination

1. Wrap soil contact points in plastic to reduce need for subsequent cleaning.
2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with detergent solution; and wipe three times with a towel wet with deionized or distilled water.
3. Dispose of all used paper towels in a DOT approved 55-gallon drum.

Sample Container Decontamination

The outer surface of sample containers filled in the field must be decontaminated before being packed for shipment or handled by personnel without dermal hand protection.

1. Wipe container with a paper towel dampened with detergent solution after the containers have been sealed.
2. Wipe container with a paper towel dampened with potable water.
3. Dispose of all used paper towels in a DOT approved 55-gallon drum.

Key Checks / Items

- Clean with solutions of detergent, methanol, and deionized or distilled water.
- Drum all contaminated rinsate and materials.
- Decontaminate sample bottles before relinquishing them to anyone.
- Document any deviations from above procedure.

SOP C5

Sample Handling and Shipping Custody Procedures

Purpose

This technical practice explains the procedures for packaging samples for shipment to the laboratory and shipping custody procedures.

Scope and Applicability

This technical practice is applicable to packaging, shipping, and shipping custody requirements for all analytical samples sent to a laboratory for testing.

Refer to the specific requirements of the project in the Work Plan/Sampling Plan (WP/SP) when using this SOP during field activities.

Example Equipment / Materials

- Coolers for shipping
- Tape (strapping tape, duct tape, wide clear tape)
- Mailing label with laboratory address, phone number, and return address
- Pre-formed polyfoam wrap, bubble wrap, or other temperature and shock insulating material
- Chain-of-custody (COC) forms
- Airbill
- Ice
- Plastic zip-lock bags
- Custody seals

Procedures / Guidelines

Samples shall be under COC protocols at all times. COC protocols shall include restricted access to all sample containers, and samples before, during, and after sample collection. Sampling materials that are not in the direct possession of a project team member shall be locked or sealed in a secure area to prevent tampering. After the samples have been collected, the team shall return to a clean facility and proceed with sample shipment preparations. Samples with analyses that have short holding times shall be shipped with a minimum of delay, preferable the same day as collection. The steps for shipping samples are as follows:

1. If the shipping cooler is equipped with drain holes, tape holes shut with duct tape, inside and out.

2. Place mailing label on lid of cooler, and cover with clear protective tape.
3. Fill bottom of cooler with preformed poly foam wrap, bubble wrap, or other temperature and shock insulating material.
4. Examine each sample bottle. Make sure that each bottle is appropriately labeled with the sample date and time, analysis, and sampler's initials and that the bottle caps are securely fastened. Cover the label with clear protective tape, completely encircling the bottle.
5. Place each bottle or group of bottles inside plastic zip-lock bags and seal bags.
6. Arrange bottles inside the cooler so they do not touch.
7. List all samples packaged inside cooler on the electronic COC and record sample numbers and COC number on a field sample log.
8. If ice is required to preserve the samples at 4° C, ice should be packaged in double zip-lock bags and placed on and around the sample containers (especially on volatile organic compound vials).
9. Fill remaining spaces with packing material to prevent contents from shifting during shipping.
10. Make sure all pertinent fields on the COC are filled out. The field team leader or lead sampler shall sign the COC and record the time and date.
11. Complete the shipping airbill. If appropriate, record the airbill tracking number on the COC form. Attach airbill or airbill receipt to the top of the sample cooler.
12. Separate the copies of the COC. Seal laboratory's copy in a zip-lock bag and tape zip-lock bag to the inside of the cooler lid.
13. Close and secure cooler lid.
14. Carefully peel custody seals from backings and place intact over lid openings, one in front and one in back. Cover seals with clear protection tape.
15. Tape cooler shut on both ends, making several complete revolutions with strapping tape. Do not cover custody seals, mailing label, or air bill with strapping tape.
16. Cooler is ready to be relinquished to the shipping carrier. Keep data user's copies of COC and shipper's copy of the airbill together. Put receipts in a binder for storage.
17. The sample data manager shall call or fax COC information to the laboratory each day that samples are shipped. The laboratory shall be provided with the airbill numbers, number of coolers, and number of samples.

Key Checks / Items

- Seal cooler drain holes.
- Package bottles in such a way to protect from breakage.

- Add sufficient ice (double bagged) to keep samples cool during shipment.
- Sign and date the completed COC form, and place laboratory's copies inside the cooler.
- Tape the lid shut and custody seal the cooler.
- Shipping label and airbill must be on cooler.
- Keep the user's copy of the COC and airbill together. Each day's paperwork is to be filed in a secure location.

SOP C6

Water-Level Measurements

Purpose and Scope

The purpose of this procedure is to provide a guideline for the measurement of the depth to groundwater in piezometers and monitoring wells, even where a second phase of floating liquid (e.g., gasoline) is encountered, and on staff gages in surface-water bodies. This SOP includes guidelines for discrete measurements of static water levels and does not cover the use of continuously recording loggers.

Equipment and Materials

- Electronic water-level meter (Solinst® or equivalent) with minimum increments of 0.01 foot; or
- Interface probe (Solinst® Model 122 Interface Meter or equivalent)

Procedures and Guidelines

Verify that the unit is turned on and functioning properly. Slowly lower the probe on its cable into the piezometer or well until the probe just contacts the water surface; the unit will respond with a tone or light signal. Note the depth from a reference point indicated on the piezometer or well riser. Typically this is the top of the protective casing. If no reference is clearly visible, measure the depth to water from the northern edge of the riser. If access to the top of the riser is difficult, sight across the top of the locking casing adjacent to the measuring point, recording the position of the cable when the probe is at the water surface.

Measure the distance from this point to the closest interval marker on the tape, and record the water level reading in the logbook. Water levels will be measured to the nearest 0.01-foot.

Free product light or dense nonaqueous phase liquid may be present in the piezometer or well. If the presence of free product is suspected, the thickness of the product should be determined using appropriate equipment (e.g., Solinst® Model 122 Interface Meter). The depth to water also is determined with this equipment and the water-level meter should not be used in the piezometer or well as long as product is present. Typically, a constant sound is emitted from the device when free product is encountered and an alternating on/off beep sound is emitted when water is encountered.

The apparent elevation of the water level in the well or piezometer is determined by measuring both the apparent depth to water and the thickness of free product. The corrected water-level elevation is calculated by the following equation:

WLc = Wla + (Free-product thickness x 0.80)

Where WLc = Corrected water-level elevation

Wla = Apparent water-level elevation

0.80 = Average value for the density of petroleum hydrocarbon products (density value of NAPL should be substituted, if known).

If free product is detected on the surface of the water in the piezometer or well, the value of sampling should be reconsidered because of the potential for contaminating the sampling equipment.

Staff gages may be installed in some surface-water bodies. These facilities typically are constructed by attaching a calibrated, marked staff gage to a wood or metal post, driving the post into the bottom of the surface-water body, and surveying the elevation of the top of the post to a resolution or 0.01-foot. The elevation of the water in the surface-water body then can be determined by reading off the distance the water level is from the top of the post. A shield or other protection may be needed to calm the fluctuations in water level if the gage is installed at a location exposed to wind.

Key Checks

Before each use, verify that the battery is charged by pressing the test button on the water-level meter. Verify that the unit is operating correctly by testing the probe in distilled or de-ionized water. Leave the unit turned off when not in use.

APPENDIX D

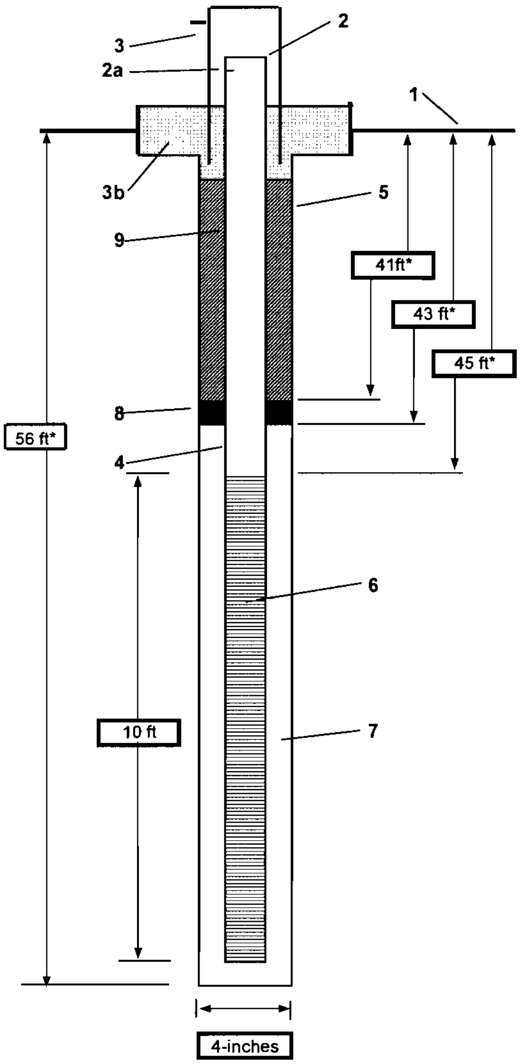
MONITORING WELL CONSTRUCTION DIAGRAMS

CH2MHILL

PROJECT NUMBER	**BORING NUMBER** SHEET 1 OF 1

SHALLOW OVERBURDEN MONITORING WELL COMPLETION DIAGRAM

PROJECT :
LOCATION:
ELEVATION :
DRILLING CONTRACTOR :
DRILLING METHOD AND EQUIPMENT USED :
WATER LEVELS :
START :
END :
LOGGER :



1- Ground elevation at well	To be surveyed
2- Top of Well Casing elevation	To be surveyed
3- Wellhead protection cover type	2 ft well stick-up enclosed with a 6-inch internal diameter protective casing with lockable cap 4 ft below surface; 3 bollards to be placed around the stick-up for protection.
b) concrete pad dimensions	2 ft x 2 ft
a) vent hole?	Yes
4- Diameter/type of well casing	2" ID; Schedule 40 PVC
5- Borehole diameter	4 inches
6- Type/slot size of screen	2" ID; 10 ft length; 0.010-inch slot-size Schedule 40 PVC. Target depth for screen interval is 45 ft to 55 ft.
7- Type screen filter	Morie 00 Sand
8- Type of seal	Hydrated bentonite chips (2 ft minimum);
9- Grout	
a) Grout mix used	Cement/betonite mix
b) Method of placement	Tremied into place
Comments	A 2-inch diameter well cap will be placed at the top of the PVC riser. Lockable well caps will be placed in flush-mounted wells.

* Approximate depth

CH2MHILL

PROJECT NUMBER

BORING NUMBER

SHEET 1 OF 1

DEEP OVERBURDEN MONITORING WELL COMPLETION DIAGRAM

PROJECT :

LOCATION:

ELEVATION :

DRILLING CONTRACTOR :

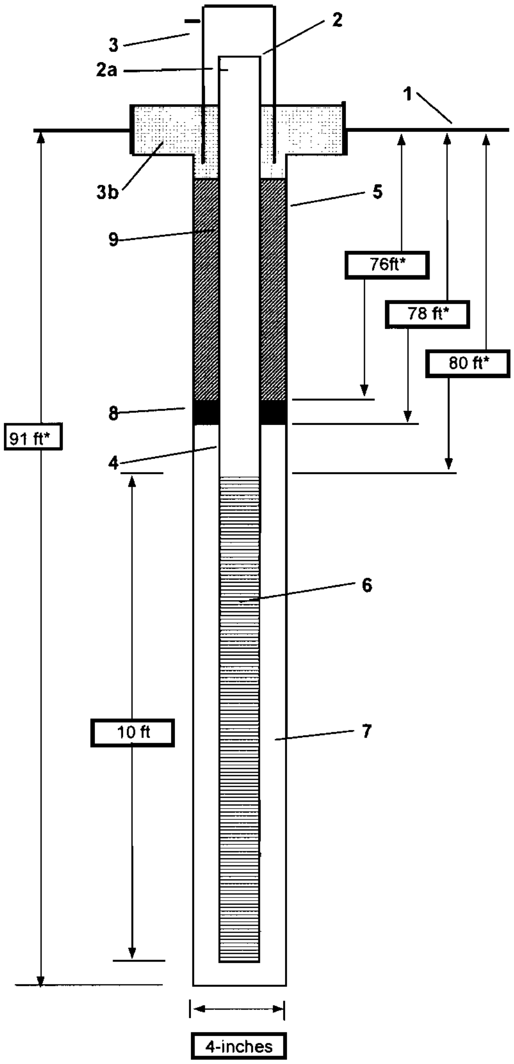
DRILLING METHOD AND EQUIPMENT USED :

WATER LEVELS :

START :

END :

LOGGER :



1- Ground elevation at well	To be surveyed
2- Top of Well Casing elevation	To be surveyed
3- Wellhead protection cover type	Completed to grade or 2 ft well stick-up enclosed with a 4-inch internal diameter protective casing with lockable cap to 4 ft below surface; 3 bollards to be placed around the stick-up for protection
b) concrete pad dimensions	2 ft x 2 ft
a) vent hole?	Yes
4- Diameter/type of well casing	2" ID; Schedule 40 PVC
5- Borehole diameter	4 inches
6- Type/slot size of screen	2" dia. ID; 10 ft length; 0.010-inch slot-size Schedule 40 PVC. Target depth for screen interval is 80 ft to 90 ft.
7- Type screen filter	Morie 00 Sand
8- Type of seal	Hydrated bentonite chips (2 ft minimum);
9- Grout	
a) Grout mix used	Cement/betonite mix
b) Method of placement	Tremied into place
Comments	A 2-inch diameter well cap will be placed at the top of the PVC riser. Lockable well caps will be placed in flush-mounted wells.

* Approximate depth

CH2MHILL

PROJECT NUMBER	**BORING NUMBER** SHEET 1 OF 1

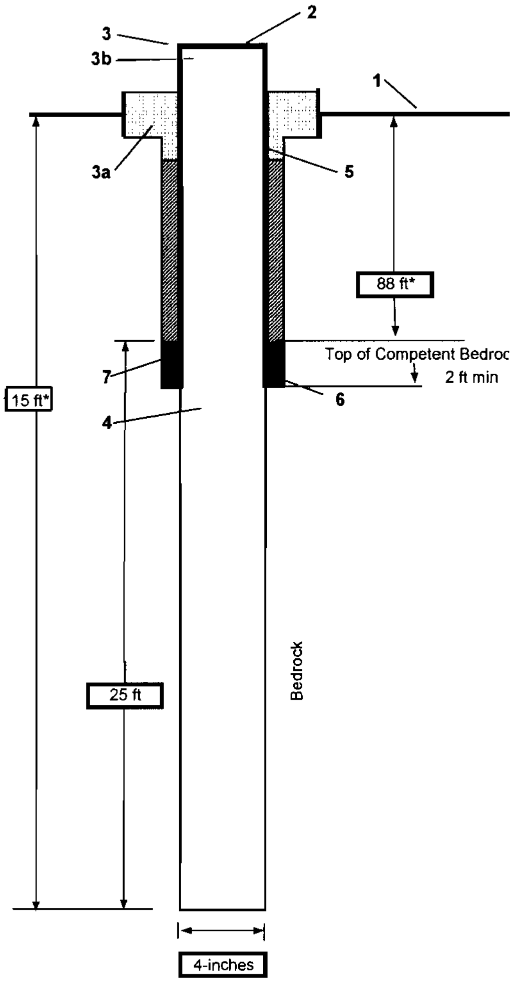
Open Borehole Bedrock Well Completion Diagram

PROJECT : LOCATION:

ELEVATION : DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

WATER LEVELS : START : END : LOGGER :



1- Ground elevation at well	To be Surveyed
2- Top of Well Casing elevation	Well stickup - 2 ft; To be surveyed
3- Wellhead protection cover type	6 in. dia. protective casing; 3 bollards to be placed around protective casing. Well cap and locking casing cover.
a) concrete pad dimensions	2 ft x 2 ft
b) vent hole?	Yes
4- Borehole diameter	4-inches
5- Diameter/type of isolation casing	2-in. ID PVC to be installed at least 2 ft into competent bedrock. 3 bollards to be placed around the protective casing.
6- Type of seal	Hydrated bentonite chips (2 ft minimum)
7- Grout	
a) Grout mix used	Cement/bentonite mix to a depth of 4 ft below surface.
b) Method of placement	Tremied into place
Comments	Isolation casing to be installed with a lockable well cap.

* Approximate depth.

APPENDIX E

QUALITY ASSURANCE PROJECT PLAN

APPENDIX E

QUALITY ASSURANCE PROJECT PLAN

GABRIEL MANUFACTURING SITE
STONY POINT, NEW YORK

Prepared For:

E.I. du Pont de Nemours and Company, Honeywell, Inc. and Union Carbide Corporation

Prepared By:
CH2M HILL

REVIEWED AND APPROVED BY:

Project Manager: ____________________ Date

Quality Manager: ____________________ Date

February 2007

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TABLES

SECTION 1
PROJECT MANAGEMENT ELEMENTS

1.1 PROJECT/TASK ORGANIZATION

The SSA Project Manager will be responsible for maintaining the Quality Assurance Project Plan (QAPP). The table below lists the individuals involved with major aspects of this project.

NAME	ORGANIZATION	ROLE
Mike Derosa	CH2M HILL	Project Manager
John Lowe	CH2M HILL	Vapor Intrusion Specialist
Terry Feng	CH2M HILL	Fate & Transport Subject Matter Expert
Scott Saroff	CH2M HILL	Hydrogeologist
David Boehnker	CH2M HILL	Quality Manager

1.2 OBJECTIVES/BACKGROUND

The purpose and general objectives for the SSA are presented in Section 1.0 of the SSA Work Plan. Background information is presented in Section 2.0.

1.3 PROJECT/TASK DESCRIPTION

The Supplemental Site Assessment (SSA) will supplement data collected during the previous Site Assessment (SA) performed at the Gabriel Site. The SSA will be performed in accordance with the schedule presented in the SSA Work Plan. The field investigation tasks will be performed in phases, and are included in Section 4.0 of the SSA Work Plan. In general the field investigation tasks included the following:

- Membrane interface probe (MIP) soil screening (Phase II);
- Sub-slab vapor sampling (Phase II);
- Confirmation soil sampling (Phase III);
- Groundwater monitoring well installations (Phase III);
- Groundwater Sampling and analysis (Phase III); and
- Water level measurement (Phase IV).

All field activities, including a schedule, maps, and tables are discussed in detail in the SSA Work Plan for this Site.

1.4 QUALITY OBJECTIVES AND CRITERIA

The purpose of the QAPP is to present the quality assurance/quality control (QA/QC) procedures and to set forth the analytical methods and procedures to be implemented during the SSA. The QAPP has been developed to provide data quality that is sufficient to meet the SSA objectives

The data produced during the SSA will be compared with the defined QA objectives and criteria for precision, accuracy, representativeness, completeness, and comparability (PARCC). The primary goal of these procedures is to ensure that the data reported are representative of actual conditions at the Site.

This data assessment activity is an on-going coordinated process with data production and is intended to assure that all data produced during the project are acceptable for use in subsequent evaluations. Both statistical and qualitative evaluations will be used to assess the quality of the data. The primary evaluation of the data will be based upon the control samples described in Section 2.5. The blank samples will be used to evaluate whether or not the laboratory represents a possible source of sample contamination and duplicate sample results will be used to evaluate data precision.

1.4.1 Data Quality Objectives

Section 3.2 of the SSA Work Plan discusses the data quality objectives (DQOs) for the SSA.

1.4.2 Precision

Precision is an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Specifically, it is a quantitative measurement of the variability of a group of measurements compared to their average value (USEPA, 1987). Precision is usually stated in terms of standard deviation, but other estimates such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum value), relative range, and relative percent difference (RPD) are common.

For this project, field sampling precision will be determined by analyzing duplicate samples for the same parameters, and then, during data validation (Section 4) calculating the RPD for duplicate sample results.

The laboratory will determine analytical precision by calculating the RPD for the results of the analysis of internal QC duplicates and matrix spike duplicates.

The formula for calculating RPD is as follows:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where:

RPD = Relative Percent Difference.
V1, V2= The two values to be compared.
|V1 - V2| = The absolute value of the difference between the two values.
(V1 + V2)/2 = The average of the two values.

The data quality objectives for analytical precision, calculated as the RPD between duplicate analyses, are presented in Tables 1-1 through 1-3.

1.4.3 Accuracy

Accuracy is a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern (Taylor, 1987), or the difference between a measured value and the true or accepted reference value. The accuracy of an analytical procedure is best determined by the analysis of a sample containing a known quantity of material, and is expressed as the percent of the known quantity that is recovered or measured. The recovery of a given analyte is dependent upon the sample matrix, method of analysis, and the specific compound or element being determined. The concentration of the analyte relative to the detection limit of the analytical method is also a major factor in determining the accuracy of the measurement. Concentrations of analytes that are close to the detection limits are less accurate because they are more affected by such factors as instrument "noise". Higher concentrations will not be as affected by instrument noise or other variables and thus will be more accurate.

Sampling accuracy may be determined through the assessment of the analytical results of field blanks and trip blanks for each sample set. Analytical accuracy is typically assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks. A Blank Spike/Laboratory Control Spike (LCS) will also be analyzed to provide additional information on analytical accuracy. Additionally, initial and continuing calibrations must be performed and accomplished within the established method control limits to define the instrument accuracy before analytical accuracy can be determined for any sample set.

Accuracy is normally measured as the percent recovery (%R) of a known amount of analyte, called a spike, added to a sample (matrix spike) or to a blank (blank spike).

The %R is calculated as follows:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where:

%R = Percent recovery.

SSR = Spike sample result: concentration of analyte obtained by analyzing the sample with the spike added.

SR = Sample result: the background value, i.e., the concentration of the analyte obtained by analyzing the sample.

SA = Spiked analyte: concentration of the analyte spike added to the sample.

The acceptance limits for accuracy for selected parameters are presented in Tables 1-1 through 1-3.

1.4.4 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter which is most concerned with the proper design of the sampling program (USEPA, 1987). Samples must be representative of the environmental media being sampled. Selection of sample locations and sampling procedures will incorporate consideration of obtaining the most representative sample possible.

Field and laboratory procedures will be performed in such a manner as to ensure, to the degree that is technically possible; that the data derived represents the in-place quality of the material sampled. Every effort will be made to ensure chemical compounds will not be introduced into the sample via sample containers, handling, and analysis. Decontamination of sampling equipment will be performed between samples as outlined in the FSP. Laboratory sample containers will be certified clean. Analysis of field blanks, trip blanks, and method blanks will also be performed to monitor for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated during data validation through the analysis of coded field duplicate samples.

Chain-of-custody procedures will be followed to document that contamination of samples has not occurred during container preparation, shipment, and sampling. Details of blank, duplicate and chain-of-custody procedures are presented in Section 2.

1.4.5 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid (USEPA, 1987). The QA objective for completeness is generation of valid (i.e., useable) data for at least 90 percent of the analyses requested. Completeness is defined as follows for all sample measurements:

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

where:

%C = Percent completeness.
V = Number of measurements judged valid.
T = Total number of measurements.

1.4.6 Comparability

Comparability expresses the degree of confidence with which one data set can be compared to another (USEPA, 1987). The comparability of all data collected for this project will be ensured by:

- Using identified standard methods for both sampling and analysis phases of this project;
- Requiring traceability of all analytical standards and/or source materials to the U.S. Environmental Protection Agency (USEPA) or National Institute of Standards and Technology (NIST);
- Requiring that all calibrations be verified with an independently prepared standard from a source other than that used for calibration (if applicable);
- Using standard reporting units and reporting formats including the reporting of QC data;
- Performing a minimal data validation/review of all QA/QC data associated with the analytical results;
- Performing a complete data validation on a representative fraction of the analytical results, including the use of data qualifiers in all cases where appropriate; and
- Requiring that all validation qualifiers be used any time an analytical result is used for any purpose.

These steps will ensure all future users of either the data or the conclusions drawn from them will be able to judge the comparability of these data and conclusions.

1.4.7 Sensitivity and Quantitation Limits

In addition to PARCC criteria in assessing data quality, the achievement of method detection limits depends on instrument sensitivity and matrix effects. Therefore, it is important to monitor the instrument sensitivity to ensure the data quality through constant instrument performance. The instrument sensitivity will be monitored through the analysis of method blanks and calibration check samples.

Tables 1-4 through 1-6 present the quantitation limits for all definitive data quality level laboratory analytical methods, compounds, and matrices to be addressed for this project.

1.5 DOCUMENTS AND RECORDS

The most current approved copy of the QAPP, SOPs, or other relevant documents will be distributed by the CH2M HILL Project Manager, or his designee. If or when a revised document is produced, the project manager or designee shall notify project staff verbally and then forward the current document.

Project data report packages will include selected reference materials, all field notes, (including soil boring logs, well construction logs, well development logs, sampling records, chain of custody forms, all well permits and records), analytical results and QA/QC data, and any other relevant documents produced during the SSA.

SECTION 2
DATA GENERATION AND ACQUISITION ELEMENTS

2.1 SAMPLING PROCESS DESIGN

This section presents sample container preparation procedures, sample preservation procedures, sample holding times, and field QC sample requirements. Sample locations and the number of environmental and QC samples to be collected are specified in the Work Plan and FSP. All sampling procedures are presented in the FSP.

2.2 SAMPLING METHODS

Soil, groundwater and sub-slab vapor will be sampled and analyzed for VOCs by SW-846 Method 8260B and EPA Compendium Method TO-15. Sampling procedures are presented in the FSP and the SSA Work Plan. Performance requirements are presented in Section 1.4 of this document.

Prior to collecting samples, all sample containers will be properly washed and decontaminated prior to their use by either the analytical laboratory or the container vendor. Samples shall be preserved according to the preservation techniques given in Table 1-7. Preservatives will be added to the sample bottles by the laboratory prior to their shipment in sufficient quantities to ensure that proper sample pH is met. Following sample collection, the sample bottles will be placed in the shipping cooler, and cooled to 4^{o}C with ice.

If a problem occurs with the sampling methods, the project manager will be notified immediately and a copy of the correspondence shall be placed into the files.

2.3 SAMPLE HANDLING AND CUSTODY

This section presents sample custody procedures for both the field and laboratory. Implementation of proper custody procedures for samples generated in the field is the responsibility of field personnel. Both laboratory and field personnel involved in the execution of the chain-of-custody and transfer of samples will be trained as to the purpose and procedures prior to implementation. The applicable holding times for each matrix and analysis are stated in Table 1-7. Sample identification and designation is indicated in the FSP.

Evidence of sample traceability and integrity is provided by chain-of-custody procedures. These procedures document the sample traceability from the selection and preparation of the sample containers by the laboratory, to sample collection, to sample shipment, to laboratory receipt and analysis. A sample is considered to be in a person's custody if the sample is:

- In a person's possession;
- Maintained in view after possession is accepted and documented;
- Locked and tagged with custody seals so that no one can tamper with it after having been in physical custody; or

- In a secured area that is restricted to authorized personnel.

2.3.1 Field Sample Custody

The chain-of-custody lists the field personnel responsible for taking samples, the project name and number, the name of the analytical laboratory to which the samples are sent, and the method of sample shipment. The chain-of-custody also lists a unique description of every sample bottle in the set. If samples are split and sent to different laboratories, a copy of the chain-of-custody record will be sent with each sample.

The Special Instructions space on the chain-of-custody is used to indicate if the sample is a matrix spike, matrix spike duplicate, or any other sample information for the laboratory. Since they are not specific to any one-sample point, trip and field blanks are indicated on separate rows. Once all bottles are properly accounted for on the form, a sampler will write his or her signature and the date and time on the first RELINQUISHED BY space. The sampler will also write the method of shipment, the shipping cooler identification number, and the shipper air bill number on the top of the chain-of-custody. Mistakes will be crossed out with a single line in ink and initialed by the author.

Sampling personnel retain one copy of the chain-of-custody and the other two copies are put into a sealable plastic bag and taped inside the lid of the shipping cooler. The cooler lid is closed, custody seals provided by the laboratory are affixed to the latch and across the back and front lids of the cooler, and the person relinquishing the samples signs his/her name across the seal. The seal is taped, and the cooler is wrapped tightly with clear packing tape. It is then relinquished by field personnel to personnel responsible for shipment, typically an overnight carrier. The chain-of-custody seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the Project Manager, and the sample will not be analyzed.

2.3.2 Laboratory Sample Custody

The Project Manager or Field Team Leader will notify the laboratory of upcoming field sampling activities, and the subsequent shipment of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped as well as the anticipated date of arrival.

The following laboratory sample custody procedures will be used:

- The laboratory will designate a sample custodian who will be responsible for maintaining custody of the samples, and for maintaining all associated records documenting that custody.
- Upon receipt of the samples, the custodian will check cooler temperature, and check the original chain-of-custody documents and compare them with the labeled contents of each sample container for correctness and traceability. The sample custodian will sign the chain-of-custody record and record the date and time received.
- Care will be exercised to annotate any labeling or descriptive errors. In the event of discrepant documentation, the laboratory will immediately contact the Project Manager

or Field Team Leader as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming chain-of-custody procedure.

- The samples will be stored in a secured area at a temperature of approximately 4 degrees Celsius until analyses commence.
- A laboratory tracking record will accompany the sample or sample fraction through final analysis for control.
- A copy of the tracking record will accompany the laboratory report and will become a permanent part of the project records.

2.4 ANALYTICAL METHODS

Samples will be analyzed according to the procedures specified by the current USEPA and USEPA SW-846 Methods. The methods to be used for the laboratory analysis of water and soil samples are presented in Table 1-6. Specific performance criteria are discussed in Section 1.4 of this document.

2.4.1 Volatile Organic Analysis

The organic analyses for ground water and soil samples will be performed for volatile organics by SW-846 Method 8260B. Analysis of ground water samples will utilize purge-and-trap "extraction" followed by GC/MS analysis, and soil samples will be analyzed by purge-and-trap or closed system purge-and-trap followed by GC/MS. Prior to analyzing any samples, the instrument(s) must be properly calibrated in accordance with the method and all QA/QC procedure.

2.4.2 Other Analysis

Selected soil samples will be analyzed for Total Organic Carbon (TOC) by SW-846 Method 9060. Prior to analyzing any samples, the instrument must be properly calibrated in accordance with the method and all QA/QC procedures. Selected soil samples will also be analyzed for grain size distribution using ASTM Method D-422.

2.4.3 Field Measurement Procedures

Field measurements of temperature, turbidity, pH, specific conductance, and water levels will be performed at the time of groundwater sample collection. SOPs for these procedures are presented in Appendix C.

Headspace screening measurements of organic vapor in soil samples will be collected using a PID. The detector will be operationally checked every day against the source gas. The units will also be periodically checked during periods of continued use.

2.5 QUALITY CONTROL

Each set of samples will be analyzed concurrently with calibration standards, method blanks, instrument blanks, storage blanks, internal standards, laboratory control spikes, matrix spikes

(MS), matrix spike duplicates (MSD) or laboratory duplicates, and QC check samples (if required by the protocol). The frequency of the QC checks will be in accordance with the analytical methods and the FSP. In addition, the required calibration procedures are discussed in Section 2.7. The field personnel will designate the MS/MSD samples, if no MS/MSD samples have been designated, the laboratory will contact the project manager for corrective action.

2.5.1 Calibration Standards and Surrogates

All organic standard and surrogate compounds are checked by the method of mass spectrometry for correct identification and gas chromatography for degree of purity and concentration. All standards are traceable to a source of known quality certified by the USEPA or NIST, or other similar program. When the compounds pass the identity and purity tests, they are certified for use in standard and surrogate solutions. Concentrations of the solutions are checked for accuracy before release for laboratory use. Standard solutions are replaced monthly or more frequently, based upon data indicating deterioration.

2.5.2 Organic Blanks

Analysis of blank samples verifies that the analytical method does not introduce contaminants or detect "false positives". The blank water can be generated by reverse osmosis and Super-Q filtration systems, or distillation of water containing $KMnO_4$. The laboratory control spike is generated by addition of standards containing surrogate and target compounds to a “clean matrix” such as blank water or Ottawa sand for organic analyses.

All blank water (trip blanks and lab-provided water for equipment rinsate blanks) will be prepared for the laboratory in the same manner as water used by the laboratory for analysis, and will be traceable to a specific laboratory method or instrument blank analysis.

2.5.3 Field QC Samples

To assess field sampling and decontamination performance, two types of "blanks" will be collected and submitted to the laboratory for analyses. In addition, the precision of field sampling procedures will be assessed by collecting coded field duplicates and matrix spike/matrix spike duplicates (MS/MSDs). The blanks will include:

- Trip Blanks - A Trip Blank will be prepared before the laboratory sends the sample containers. The trip blank will consist of a 40-ml VOA vial containing distilled, deionized water, which accompanies the other aqueous and soil sample bottles or EnCores into the field and back to the laboratory. A trip blank will be included with each shipment of water samples for target compound list (TCL) volatiles analysis. The trip blank will be analyzed for TCL volatile organic compounds to access any contamination from sampling and transport, and internal laboratory procedures.
- Equipment Blanks -Equipment Blanks will be taken at a frequency of one per decontamination event, maximum of one per day per sampling equipment type, minimum of one per week. Equipment blanks are used to determine the effectiveness of the decontamination procedures for sampling equipment. It is a sample of deionized, distilled water provided by the laboratory, which has passed through a decontaminated bailer or other sampling apparatus. It is usually collected as a last step in the decontamination procedure,

prior to taking an aqueous sample. The equipment blank may be analyzed for all of the parameters of interest.

- Duplicates will consist of:
  - Field Duplicate - To determine the representativeness of the sampling methods, field duplicates will be collected at a frequency of one per 20 environmental samples per matrix.
  - Matrix Spike/Matrix Spike Duplicate (MS/MSD) - MS/MSD samples (MS/MSD for organics; MS and laboratory duplicate for inorganics) will be taken at a frequency of one pair per 20 field samples for soil and groundwater. These samples are used to assess the effect of the sample matrix on the recovery of target compounds or target analytes. The percent recoveries and RPDs are given in Tables 1-1 and 1-2.

2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

2.6.1 Preventive Maintenance Procedures

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators.

The manufacturer established a list of critical spare parts, so that commonly needed parts can be inventoried and stored at the laboratory. These spare parts will be available for use in order to reduce the downtime. A service contract for rapid instrument repair or backup instruments may be substituted for the spare part inventory. A maintenance log is kept with each instrument to record all maintenance.

2.6.2 Schedules

Written procedures (i.e., SOPs, analytical methods, and operating manuals) will establish the schedule for servicing critical items in order to minimize the downtime of the measurement system. The laboratory will adhere to the maintenance schedule, and arrange any necessary and prompt service. Qualified personnel will perform required service.

2.6.3 Records

Logs shall be established to record and control maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories. The QAO may audit these records to verify complete adherence to these procedures.

2.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

2.7.1 Field Instruments

All field analytical equipment will be calibrated immediately prior to each day's use. The calibration procedures will conform to manufacturer's standard instructions. This calibration will ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. Records of all instrument calibration will be maintained by the Field Team Leader and will be subjected to audit by the project QAO. The Field Team Leader will maintain copies of all the instrument manuals on-site.

2.7.2 Laboratory Instruments

The laboratory will follow all calibration procedures and schedules as specified by the current methods for organic and inorganic analyses and the Laboratory SOP that apply to the instruments necessary for the analytical methods given in Table 1-7.

Gas Chromatography/Mass Spectrometry (GC/MS)

Prior to analysis of samples, the instrument is tuned with bromoflurobenzene (BFB) for volatile compounds and decafluorotriphenylphosphine (DFTPP) for semivolatile compounds or other tune criteria as specified by the method used. No samples are analyzed until the instrument has met the tuning criteria of the method.

In general, the instrument is then calibrated for all target compounds. An initial calibration curve is produced to define the working range to establish criteria for identification. This initial calibration is evaluated every 12 hours prior to the analysis of samples. If the daily standard does not meet the established criteria, the system is recalibrated.

2.8 DATA MANAGEMENT

2.8.1 Introduction

General aspects of data management are discussed in Section 6.0 of the SSA Work Plan. The management of analytical data is discussed below.

2.8.2 Analytical Data Reduction

The Data Package will consist of 2 CD's containing the data package in "PDF" format and one hardcopy package. The CH2M HILL Project Manager (PM) will be sent a CD, while the CH2M HILL Project Chemist (PC) will be sent a CD and the hardcopy data package. The CH2M HILL Data Manager will be sent the electronic disk deliverable, with a copy sent to the CH2M HILL Project Chemist. The laboratory will provide the data package deliverables 21 business days after sample receipt of a complete sample delivery group. The CH2M HILL PC or QA reviewer will check the package to ensure all deliverables have been provided by performing validation. If problems are identified, the laboratory will be alerted, and corrective actions will be requested. Upon completion of the data validation, the data will be used to generate summary tables. These tables will form the database for assessment of the site contamination condition.

The electronic deliverable formats will be submitted according to project EDD requirements. All compact disk/diskette deliverables must also undergo a QC check by the laboratory before delivery. The original data, tabulations, and electronic media are stored in a secure and retrievable fashion.

The Project Manager or Data Manager will maintain close contact with the PC or QA reviewer to ensure all non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the QA review has been completed, the Project Manager may direct the Team Leaders or others to initiate and finalize the analytical data assessment.

SECTION 3
ASSESSMENT AND OVERSIGHT

3.1 ASSESSMENT AND RESPONSE ACTIONS

3.1.1 Assessment

Quality assurance audits may be performed by or under the direction of the project QM (Quality Manager). These audits may be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). The QM may plan, schedule, and approve system and performance audits based upon CH2M HILL SOP customized to the project requirements. At times, the QM may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits. However, these personnel will not have responsibility for the project work associated with the performance audit.

3.1.2 System Audits

System audits, performed by the QM or designated auditors, may encompass a qualitative evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be system audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Project Manager requests, additional audits may occur.

3.1.3 Performance Audits

The laboratory may conduct an analysis of Performance Evaluation (PE) samples or provide proof that Performance Evaluation samples submitted by USEPA or a state agency have been analyzed within the past twelve (12) months.

3.1.4 Formal Audits

Formal audits refer to any system or performance audit that is documented and implemented by the QM. These audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that quality assurance requirements have been developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Auditors who have performed the site audit after gathering and evaluating all data will write audit reports. Items, activities, and documents determined by lead auditors to be in noncompliance shall be identified at exit interviews conducted with the involved management. Noncompliance's will be logged and documented through audit findings, which are attached to and are a part of the integral audit report. These audit-finding forms are directed to management to satisfactorily resolve the noncompliance in a specified and timely manner.

The Project Manager has overall responsibility to ensure that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the Project Manager within fifteen days of completion of the audit. Serious deficiencies will be reported to the Project Manager within 24 hours. All audit checklists; audit reports, audit findings, and acceptable resolutions will be approved by the QM prior to issue. Verification of acceptable resolutions may be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the QM will close out the audit report and findings.

3.1.5 Corrective Action

The following procedures have been established to ensure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected.

3.1.6 Procedure Description

When a significant condition adverse to quality is noted at site, laboratory, or subcontractor location, the cause of the condition will be determined and corrective action will be taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the QM, Project Manager, Field Team Leader and involved subcontractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action.

All project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality. Corrective actions will be initiated as follows:

- When predetermined acceptance standards are not attained;
- When procedure or data compiled are determined to be deficient;
- When equipment or instrumentation is found to be faulty;
- When samples and analytical test results are not clearly traceable;
- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits;
- As a result of a management assessment;
- As a result of laboratory/field comparison studies; and
- As required by USEPA SW-846 Methods.

Project management and staff, such as field investigation teams and laboratory groups, monitor on-going work performance in the normal course of daily responsibilities. Work may be audited at the CH2M HILL office, sites, laboratories, or subcontractor locations. Activities or documents ascertained to be noncompliant with quality assurance requirements will be documented. Corrective actions will be mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the Task Manager.

Personnel assigned to quality assurance functions will have the responsibility to issue and control Corrective Action Request (CAR) forms. The CAR identifies the out-of-compliance condition, reference document(s), and recommended corrective action(s) to be administered. The CAR is issued to the personnel responsible for the affected item or activity. A copy is also submitted to the Project Manager. The individual to whom the CAR is addressed returns the requested response promptly to the QA personnel, affixing his/her signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The QA personnel maintain the log for status of CARs, confirms the adequacy of the intended corrective action, and verifies its implementation. CARs will be retained in the project file for the records.

Any project personnel may identify noncompliance issues; however, the designated QA personnel are responsible for documenting, numbering, logging, and verifying the close out action. The Project Manager will be responsible for ensuring that all recommended corrective actions are implemented, documented, and approved.

3.2 REPORTS TO MANAGEMENT

CH2M HILL management personnel receive QA reports appropriate to their level of responsibility. The PM receives copies of all QA documentation. QC documentation is retained within the department that generated the product or service except where this documentation is a deliverable for a specific contract. QC documentation is also submitted to the QM for review and approval. Previous sections detailed the QA activities and the reports that they generate. A final audit report for each project may also be prepared. The reports may include:

- periodic assessment of measurement data accuracy, precision, and completeness;
- results of performance audits and/or system audits;
- significant QA problems and recommended solutions for future projects; and
- status of solutions to any problems previously identified.

Additionally, any incidents requiring corrective action will be fully documented.

SECTION 4
DATA VALIDATION AND USABILITY ELEMENTS

4.1 DATA REVIEW, VERIFICATION, AND VALIDATION

As discussed in the SSA Work Plan, analytical data and QA/QC data will be reviewed by the project chemist.

4.2 VERIFICATION AND VALIDATION METHODS

Records generated during field activities will be verified to ensure that field activity data is acceptable (i.e., correct sampling method was used and equipment calibrated properly). Instrument calibration logs, field notebooks and logs, and chain of custody forms will be reviewed for completeness and accuracy. A summary of all data collected will be created, and a list of any deviations and their impact on data quality will be summarized by the project chemist.

One hundred percent of the analytical data will be verified. Selected analytical data may undergo validation during future phases of work.

4.3 RECONCILIATION WITH USER REQUIREMENTS

The data collected during this project will undergo a systematic review for compliance with the objectives as stated in the SSA Work Plan. In particular, laboratory and field data will be reviewed for compliance with the method QC criteria for performance and accuracy. The chemical data will be qualified and reported. These data will be evaluated as to usability. In particular, data outside QC criteria, but not rejected, will be reviewed for the magnitude of possible positive and negative bias.

A data usability report, which summarizes the implications of the use of any data out of criteria, will be written for each round of data. In addition, the data usability report will include the percentage of sample completeness for critical and non-critical samples and a discussion of any issues in representativeness of the data that may develop as a result of validation. The data usability report will address overall data quality and achievement of PARCC and assess issues associated with the overall data.

The data will be evaluated as to consistency with site conditions and developed conceptual models. All data collected will be reconciled with the requirements stated in this Work Plan and determined usable for the project goals. In cases where data may be considered not usable (i.e., rejected during data validation), resampling may be required at a specific location due to sample matrix interferences, exceedances of holding times, poor laboratory performance, etc.

SECTION 5
REFERENCES

USEPA, 1989. CERCLA Quality Assurance Manual, Revision 1, dated October 1989. U.S. Environmental Protection Agency, Region II.

USEPA, 1996. USEPA SW-846 Test Methods for Evaluating Solid Waste, Physical and Chemical, dated December 1996. U.S. Environmental Protection Agency, Washington, D.C.

USEPA, 2002. "Guidance on Environmental Data Validation" (QA/G-8).

Table 1-1 through Table 1-7

TABLE 1-1

Quality Control Limits for Volatiles in Water, Method 8260B

Gabriel Manufacturing Site, Stony Point, NY

Compound	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
Acetone		32-166	24	53-154
Benzene		51-138	13	77-121
Bromodichloromethane		76-134	13	82-129
Bromoform		60-137	13	71-135
Bromomethane		62-137	15	68-133
2-Butanone		47-146	19	53-141
Carbon disulfide		54-135	15	52-134
Carbon tetrachloride		65-148	17	73-140
Chlorobenzene		76-120	12	80-118
Chloroethane		61-144	18	69-138
Chloroform		74-127	14	79-125
Chloromethane		53-142	20	55-152
Cyclohexane		50-148	15	62-124
1,2-Dibromo-3-chloropropane		65-136	14	68-132
Dibromochloromethane		70-128	11	80-125
1,2-Dibromoethane		73-124	12	79-122
1,2-Dichlorobenzene		73-123	10	79-116
1,3-Dichlorobenzene		75-120	12	76-120
1,4-Dichlorobenzene		71-120	12	77-119
Dichlorodifluoromethane		53-157	20	49-184
1,1-Dichloroethane		70-132	14	77-123
1,2-Dichloroethane		63-142	15	66-137
1,1-Dichloroethene		63-135	15	64-125
cis-1,2-Dichloroethene		70-130	10	75-120
trans-1,2-Dichloroethene		69-128	13	72-121
1,2-Dichloropropane		76-123	11	80-119
cis-1,3-Dichloropropene		74-123	12	79-120
trans-1,3-Dichloropropene		73-128	12	78-125
Ethylbenzene		51-142	14	80-124
Freon 113		62-140	17	73-133
2-Hexanone		51-145	18	52-147

TABLE 1-1

Quality Control Limits for Volatiles in Water, Method 8260B

Gabriel Manufacturing Site, Stony Point, NY

Compound	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
Isopropylbenzene		65-135	11	75-132
Methyl Acetate		45-151	16	52-147
Methylcyclohexane		56-142	16	71-128
Methyl Tert Butyl Ether		42-149	13	72-124
4-Methyl-2-pentanone		58-142	15	64-141
Methylene chloride		73-128	12	75-121
Styrene		74-131	10	82-128
1,1,2,2-Tetrachloroethane		70-126	11	72-123
Tetrachloroethene		66-129	14	65-135
Toluene		49-147	13	79-122
1,2,4-Trichlorobenzene		68-126	12	71-128
1,1,1-Trichloroethane		69-140	15	77-135
1,1,2-Trichloroethane		81-121	12	83-120
Trichloroethene		64-139	13	81-123
Trichlorofluoromethane		59-158	17	70-157
Vinyl chloride		56-146	18	61-150
Xylene (total)		46-146	13	82-121
1,2-Dichloroethane-d4	65-133			
4-Bromofluorobenzene	79-124			
Dibromofluoromethane	77-121			
Toluene-d8	80-117			

TABLE 1-2

Quality Control Limits for Volatiles in Soil, Method 8260B

Gabriel Manufacturing Site, Stony Point, NY

Compound	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
Acetone		20-185	32	32-171
Benzene		49-134	17	79-118
Bromodichloromethane		51-140	17	80-125
Bromoform		40-145	21	67-135
Bromomethane		10-141	30	61-133
2-Butanone		31-163	29	50-150
Carbon disulfide		35-136	22	58-131
Carbon tetrachloride		39-149	21	70-137
Chlorobenzene		42-142	20	80-120
Chloroethane		10-140	26	64-135
Chloroform		56-132	17	78-123
Chloromethane		43-137	21	54-150
Cyclohexane		30-149	24	62-129
1,2-Dibromo-3-chloropropane		35-148	27	61-132
Dibromochloromethane		48-145	19	76-132
1,2-Dibromoethane		52-139	20	80-125
1,2-Dichlorobenzene		31-150	26	78-120
1,3-Dichlorobenzene		29-151	27	78-120
1,4-Dichlorobenzene		30-145	27	76-117
Dichlorodifluoromethane		29-160	22	49-174
1,1-Dichloroethane		56-131	16	76-123
1,2-Dichloroethane		53-138	18	74-132
1,1-Dichloroethene		47-136	20	70-124
cis-1,2-Dichloroethene		52-134	17	77-120
trans-1,2-Dichloroethene		47-134	19	75-120
1,2-Dichloropropane		56-131	16	79-120
cis-1,3-Dichloropropene		47-136	18	80-120
trans-1,3-Dichloropropene		45-138	20	78-123
Ethylbenzene		37-148	23	81-122
Freon 113		35-145	22	60-136
2-Hexanone		25-166	30	47-154
Isopropylbenzene		31-156	26	75-126
Methyl Acetate		38-176	31	55-149
Methylcyclohexane		16-161	28	58-137
Methyl Tert Butyl Ether		55-135	19	74-125

TABLE 1-2

Quality Control Limits for Volatiles in Soil, Method 8260B

Gabriel Manufacturing Site, Stony Point, NY

Compound	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
4-Methyl-2-pentanone		45-145	26	67-137
Methylene chloride		54-132	17	74-122
Styrene		37-150	24	81-126
1,1,2,2-Tetrachloroethane		45-143	25	72-127
Tetrachloroethene		34-162	25	69-131
Toluene		41-143	19	81-120
1,2,4-Trichlorobenzene		10-165	31	48-140
1,1,1-Trichloroethane		48-139	19	75-129
1,1,2-Trichloroethane		55-137	19	80-122
Trichloroethene		42-145	19	79-121
Trichlorofluoromethane		37-143	25	64-147
Vinyl chloride		46-136	21	63-141
Xylene (total)		35-150	17	81-122
1,2-Dichloroethane-d4	61-133			
4-Bromofluorobenzene	65-142			
Dibromofluoromethane	70-120			
Toluene-d8	75-123			

TABLE 1-3

Quality Control Limits for Volatiles in Air, Method TO-15

Gabriel Manufacturing Site, Stony Point, NY

Compound	LCS Accuracy (% Rec.)	Lab Dup Precision (% RPD)
Benzene	75-127	≤20
Bromomethane	75-127	≤20
Carbon tetrachloride	75-127	≤20
Chlorobenzene	75-127	≤20
Chloroethane	75-127	≤20
Chloroform	75-127	≤20
Chloromethane	75-127	≤20
1,2-Dibromoethane	75-127	≤20
1,2-Dichlorobenzene	75-127	≤20
1,3-Dichlorobenzene	75-127	≤20
1,4-Dichlorobenzene	75-127	≤20
Dichlorodifluoromethane	75-127	≤20
1,1-Dichloroethane	75-127	≤20
1,2-Dichloroethane	75-127	≤20
1,1-Dichloroethene	75-127	≤20
cis-1,2-Dichloroethene	75-127	≤20
1,2-Dichloropropane	75-127	≤20
cis-1,3-Dichloropropene	75-127	≤20
trans-1,3-Dichloropropene	75-127	≤20
Freon 114	75-127	≤20
Ethylbenzene	75-127	≤20
Freon 113	75-127	≤20
Hexachloro-1,3-butadiene	75-127	≤20
Methylene chloride	75-127	≤20
Styrene	75-127	≤20
1,1,2,2-Tetrachloroethane	75-127	≤20

TABLE 1-3

Quality Control Limits for Volatiles in Air, Method TO-15

Gabriel Manufacturing Site, Stony Point, NY

Compound	LCS Accuracy (% Rec.)	Lab Dup Precision (% RPD)
Tetrachloroethene	75-127	≤20
Toluene	75-127	≤20
1,2,4-Trichlorobenzene	75-127	≤20
1,1,1-Trichloroethane	75-127	≤20
1,1,2-Trichloroethane	75-127	≤20
Trichloroethene	75-127	≤20
Trichlorofluoromethane	75-127	≤20
1,2,4-Trimethylbenzene	75-127	≤20
1,3,5-Trimethylbenzene	75-127	≤20
Vinyl chloride	75-127	≤20
m,p-Xylene (total)	75-127	≤20
o-Xylene	75-127	≤20

TABLE 1-4
VOC Target Analyte List and Reporting Limits in Water
Gabriel Manufacturing Site, Stony Point, NY

Compound	CAS Number	Reporting Limit (mg/l)	Method Detection Limit (mg/l)
Acetone	67-64-1	10	2.4
Benzene	71-43-2	1.0	0.21
Bromodichloromethane	75-27-4	1.0	0.17
Bromoform	75-25-2	4.0	0.54
Bromomethane	74-83-9	2.0	0.22
2-Butanone (MEK)	78-93-3	10	2.6
Carbon disulfide	75-15-0	2.0	0.21
Carbon tetrachloride	56-23-5	1.0	0.29
Chlorobenzene	108-90-7	1.0	0.22
Chloroethane	75-00-3	1.0	0.56
Chloroform	67-66-3	1.0	0.22
Chloromethane	74-87-3	1.0	0.35
Cyclohexane	110-82-7	5.0	0.5
1,2-Dibromo-3-chloropropane	96-12-8	5.0	1.1
Dibromochloromethane	124-48-1	1.0	0.19
1,2-Dibromoethane	106-93-4	2.0	0.52
1,2-Dichlorobenzene	95-50-1	1.0	0.2
1,3-Dichlorobenzene	541-73-1	1.0	0.32
1,4-Dichlorobenzene	106-46-7	1.0	0.24
Dichlorodifluoromethane	75-71-8	5.0	0.75
1,1-Dichloroethane	75-34-3	1.0	0.23
1,2-Dichloroethane	107-06-2	1.0	0.29
1,1-Dichloroethene	75-35-4	1.0	0.33
cis-1,2-Dichloroethene	156-59-2	1.0	0.18
trans-1,2-Dichloroethene	156-60-5	1.0	0.42
1,2-Dichloropropane	78-87-5	1.0	0.2
cis-1,3-Dichloropropene	10061-01-5	1.0	0.15
trans-1,3-Dichloropropene	10061-02-6	1.0	0.2
Ethylbenzene	100-41-4	1.0	0.2

TABLE 1-4
VOC Target Analyte List and Reporting Limits in Water
Gabriel Manufacturing Site, Stony Point, NY

Compound	CAS Number	Reporting Limit (mg/l)	Method Detection Limit (mg/l)
Freon 113	76-13-1	5.0	0.69
2-Hexanone	591-78-6	5.0	1.3
Isopropylbenzene	98-82-8	2.0	0.2
Methyl Acetate	79-20-9	5.0	2.1
Methylcyclohexane	108-87-2	5.0	0.18
Methyl Tert Butyl Ether	1634-04-4	1.0	0.31
4-Methyl-2-pentanone (MIBK)	108-10-1	5.0	1.1
Methylene chloride	75-09-2	2.0	0.27
Styrene	100-42-5	5.0	0.16
1,1,2,2-Tetrachloroethane	79-34-5	1.0	0.28
Tetrachloroethene	127-18-4	1.0	0.28
Toluene	108-88-3	1.0	0.2
1,2,4-Trichlorobenzene	120-82-1	5.0	0.16
1,1,1-Trichloroethane	71-55-6	1.0	0.28
1,1,2-Trichloroethane	79-00-5	1.0	0.32
Trichloroethene	79-01-6	1.0	0.29
Trichlorofluoromethane	75-69-4	5.0	0.25
Vinyl chloride	75-01-4	1.0	0.29
Xylene (total)	1330-20-7	1.0	0.31

TABLE 1-5

VOC Target Analyte List and Reporting Limits in Soil

Gabriel Manufacturing Site, Stony Point, NY

Compound	CAS Number	Reporting Limit (mg/kg)	Method Detection Limit (mg/kg)
Acetone	67-64-1	20	2.9
Benzene	71-43-2	5.0	0.48
Bromodichloromethane	75-27-4	5.0	0.46
Bromoform	75-25-2	5.0	0.43
Bromomethane	74-83-9	5.0	0.37
2-Butanone (MEK)	78-93-3	10	2.7
Carbon disulfide	75-15-0	5.0	0.55
Carbon tetrachloride	56-23-5	5.0	0.95
Chlorobenzene	108-90-7	5.0	0.43
Chloroethane	75-00-3	5.0	1.7
Chloroform	67-66-3	5.0	0.58
Chloromethane	74-87-3	5.0	0.46
Cyclohexane	110-82-7	5.0	1.3
1,2-Dibromo-3-chloropropane	96-12-8	5.0	2.2
Dibromochloromethane	124-48-1	5.0	0.55
1,2-Dibromoethane	106-93-4	5.0	0.57
1,2-Dichlorobenzene	95-50-1	5.0	0.46
1,3-Dichlorobenzene	541-73-1	5.0	0.49
1,4-Dichlorobenzene	106-46-7	5.0	0.46
Dichlorodifluoromethane	75-71-8	5.0	0.79
1,1-Dichloroethane	75-34-3	5.0	0.48
1,2-Dichloroethane	107-06-2	5.0	0.54
1,1-Dichloroethene	75-35-4	5.0	0.69
cis-1,2-Dichloroethene	156-59-2	5.0	0.67
trans-1,2-Dichloroethene	156-60-5	5.0	0.68
1,2-Dichloropropane	78-87-5	5.0	0.55
cis-1,3-Dichloropropene	10061-01-5	5.0	0.41
trans-1,3-Dichloropropene	10061-02-6	5.0	0.39

TABLE 1-5
VOC Target Analyte List and Reporting Limits in Soil
Gabriel Manufacturing Site, Stony Point, NY

Compound	CAS Number	Reporting Limit (mg/kg)	Method Detection Limit (mg/kg)
Ethylbenzene	100-41-4	5.0	0.45
Freon 113	76-13-1	10	0.86
2-Hexanone	591-78-6	10	1.4
Isopropylbenzene	98-82-8	5.0	0.47
Methyl Acetate	79-20-9	5.0	1.4
Methylcyclohexane	108-87-2	5.0	0.64
Methyl Tert Butyl Ether	1634-04-4	5.0	0.56
4-Methyl-2-pentanone (MIBK)	108-10-1	10	2
Methylene chloride	75-09-2	5.0	0.69
Styrene	100-42-5	5.0	0.33
1,1,2,2-Tetrachloroethane	79-34-5	5.0	0.57
Tetrachloroethene	127-18-4	5.0	0.82
Toluene	108-88-3	5.0	0.54
1,2,4-Trichlorobenzene	120-82-1	5.0	0.35
1,1,1-Trichloroethane	71-55-6	5.0	0.59
1,1,2-Trichloroethane	79-00-5	10	0.54
Trichloroethene	79-01-6	5.0	0.52
Trichlorofluoromethane	75-69-4	5.0	0.73
Vinyl chloride	75-01-4	5.0	0.65
Xylene (total)	1330-20-7	5.0	0.49

TABLE 1-6
VOC Target Analyte List and Reporting Limits in Air
Gabriel Manufacturing Site, Stony Point, NY

Compound	CAS Number	Reporting Limit (ppbv)	Reporting Limit (ug/L)
Benzene	71-43-2	2.0	0.008
Bromomethane	74-83-9	2.0	0.008
Carbon tetrachloride	56-23-5	2.0	0.013
Chlorobenzene	108-90-7	2.0	0.009
Chloroethane	75-00-3	2.0	0.005
Chloroform	67-66-3	2.0	0.010
Chloromethane	74-87-3	2.0	0.004
1,2-Dibromoethane	106-93-4	2.0	0.016
1,2-Dichlorobenzene	95-50-1	2.0	0.012
1,3-Dichlorobenzene	541-73-1	2.0	0.012
1,4-Dichlorobenzene	106-46-7	2.0	0.012
Dichlorodifluoromethane	75-71-8	2.0	0.010
1,1-Dichloroethane	75-34-3	2.0	0.008
1,2-Dichloroethane	107-06-2	2.0	0.008
1,1-Dichloroethene	75-35-4	2.0	0.008
cis-1,2-Dichloroethene	156-59-2	2.0	0.008
1,2-Dichloropropane	78-87-5	2.0	0.009
cis-1,3-Dichloropropene	10061-01-5	2.0	0.009
trans-1,3-Dichloropropene	10061-02-6	2.0	0.009
Freon 114	76-14-2	2.0	0.014
Ethylbenzene	100-41-4	2.0	0.009
Freon 113	76-13-1	2.0	0.016
Hexachloro-1,3-butadiene	87-68-3	2.0	0.021
Methylene chloride	75-09-2	2.0	0.007
Styrene	100-42-5	2.0	0.021
1,1,2,2-Tetrachloroethane	79-34-5	2.0	0.014
Tetrachloroethene	127-18-4	2.0	0.014
Toluene	108-88-3	2.0	0.008
1,2,4-Trichlorobenzene	120-82-1	2.0	0.015

TABLE 1-6
VOC Target Analyte List and Reporting Limits in Air
Gabriel Manufacturing Site, Stony Point, NY

Compound	CAS Number	Reporting Limit (ppbv)	Reporting Limit (ug/L)
1,1,1-Trichloroethane	71-55-6	2.0	0.011
1,1,2-Trichloroethane	79-00-5	2.0	0.011
Trichloroethene	79-01-6	2.0	0.011
Trichlorofluoromethane	75-69-4	2.0	0.011
1,2,4-Trimethylbenzene	95-63-6	2.0	0.010
1,3,5-Trimethylbenzene	108-67-8	2.0	0.010
Vinyl chloride	75-01-4	2.0	0.005
m,p-Xylene (total)		4.0	0.018
o-Xylene	95-47-6	2.0	0.009

TABLE 1-7

Required Analytical Method, Sample Containers, Preservation, and Holding Times

Gabriel Manufacturing Site, Stony Point, NY

Analyses	Analytical Method	Sample Matrix[a]	Container[b]	Qty	Preservative[c]	Holding Time[d]
Volatile Organic Compounds	SW-846 8260B	W	40-mL, glass	3	HCl, pH<2, cool to 4 °C	14 days
	SW-846 8260B	S	5 g – Encore or equivalent sampling technique	3	Cool 4°C	14 days
	TO-15	V	1-L SUMMA canister	1	Ambient temperature	<30 days
Total Organ Carbon	SW-846 9060	W	250-mL polyethylene	1	H_2SO_4 or HCl pH < 2, Cool 4°C	28 days
		S	4-oz glass	1	Cool 4°C	28 days
Grain Size	ASTM D-422	S	16-oz glass	1	None	NA

Notes:
Sample container, and volume requirements will be specified by the analytical laboratory performing the tests.
Three times the required volume should be collected for samples designated as MS/MSD samples.

[a] Sample matrix: S = surface soil, subsurface soil, sediment; W = surface water

[b] All containers will be sealed with Teflon®-lined screw caps.

[c] All samples will be stored promptly at 4°C in an insulated chest.

[d] Holding times are from the time of sample collection.

Source: SW-846, third edition, Update III (June 1997).

°C = Degrees Centigrade
HCl = Hydrochloric acid
mL = Milliliter
L = Liter
g = Gram
oz = Ounce
NA = Not applicable
ASTM = American Society for Testing and Materials
EPA = U.S. Environmental Protection Agency

APPENDIX F

FIELD SAMPLING PLAN

APPENDIX F

Field Sampling Plan

GABRIEL MANUFACTURING SITE
STONY POINT, NY

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Project Manager: ____________________ Date

Quality Manager: ____________________ Date

Revised February 2007

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1.0 Introduction

This Field Sampling Plan (FSP) describes the sampling and data gathering methods and procedures to be used during the Supplemental Site Assessment (SSA) field activities at the Gabriel Manufacturing Site in Stony Point, NY. A detailed description of the Site, the history and background, and a description of the site-related contamination are provided in Sections 1 and 2 of the SSA Work Plan, to which this FSP is an appendix. This FSP should be used in conjunction with the Quality Assurance Project Plan (QAPP) (Appendix D) to guide all field and laboratory sampling and measurement conducted as part of the SSA.

1.1 Sampling Objectives

The main objective of the field sampling is to determine the physical and chemical conditions at the site and their possible impact and risks posed to human health and the environment. In particular, the specific objectives of the SSA, as described in the work plan are:

- Confirm and characterize the presence of chlorofluorocarbons (CFCs) in soils and groundwater at the site.
- Fill certain data gaps from the previously conducted Preliminary Site Assessment (PSA) (LMS, July 2000).

1.2 Sample Locations and Investigations

Sub-slab Vapor Sampling Locations

Sub-slab vapor sampling locations will be selected following the Phase I building walk-through survey. The Phase I building walk-through, as described in the SSA Work Plan, will identify construction characteristics such as slab cracks, floor drains or other utility penetrations, identify heating systems and exhaust fans that can affect pressure gradients, and the use or storage of solvents or petroleum products. This information will be used during the selection of the sub-slab sampling locations.

Soil Screening Locations

Proposed boring locations are identified in Figure 1 of the SSA Work Plan. Twenty-six locations are proposed, but the actual locations will be dependent on field reconnaissance and equipment access. Based on past experience at the site, the maximum push depth using Geoprobe equipment is 10 to 15 feet. In order to screen soils down to the water table (e.g., ~ 35-40 feet below ground surface), it will be necessary to utilize cone penetrating testing (CPT) equipment. The membrane interface probe (MIP) soil gas activity is summarized in Table 2 of the SSA Work Plan. The number and location of the borings will be dependent on the manufacturing and sewer system piping locations and upon the information obtained as part of the sub-slab vapor sampling activities discussed above in Section 4.2.2 of the SSA Work Plan.

Confirmation Soil Samples

Based on the results of sub-slab sampling and soil screening, confirmation soil sampling locations will be determined. Soil samples will be collected from outdoor sampling locations using Rotasonic or hollow-stem auger/air rotary drill rigs. Soil samples will be collected from indoor sampling locations using a sampling technique that is appropriate for foundation design and access limitations.

Monitoring Well Locations

Two monitoring well locations have been selected for the bedrock groundwater investigation; these locations are identified in Figure 3 as MWB-1 and MWB-2. The location of bedrock monitoring well MWB-1 is proposed to be located in the area of the on-site aboveground storage tanks and storage trailers, dependent upon access. The MWB-1 location was selected to 1) better define groundwater flow in bedrock and 2) to monitor the bedrock groundwater constituents underlying the on-site storage tanks and storage trailers. The location of bedrock monitoring well MWB-2 was selected as a replacement of bedrock monitoring well GMMW-4, as this bedrock well was constructed with two screen intervals.

Five overburden (till) groundwater monitoring well locations have been selected for monitor well installation; these locations are identified in Figure 2 of the SSA Work Plan as MWT-1 through MWT-5.

Groundwater Sampling

Following the installation and development of the proposed overburden and bedrock monitoring wells, all monitoring wells at the site will be sampled, as described in Section 4.3.4 of the SSA Work Plan.

2.0 General Guidelines for Field Work

2.1 Surface Hazards

Potential on-site surface hazards, such as sharp objects, overhead power lines, and building hazards, will be identified during the Phase I on-site and off-site walkthrough, prior to the initiation of fieldwork.

2.2 Underground Utilities

All underground utilities, including electric lines, gas lines, and communication lines, will be identified prior to initiation of drilling and other subsurface work. This will be accomplished by contacting New York One Call: (800) 962-7962. A One Call representative(s) will mark all buried utility lines in the work area. New York State law requires that One Call be notified at least 2 working days before subsurface work is conducted. In addition to NY One Call, we will work with the facility personnel to determine the known locations of subsurface utilities.

2.3 Field Log Books

All field activities will be documented in field logbooks. Entries will be of sufficient detail that a complete daily record of significant events, observations, and measurements is obtained. The field books will provide legal record of the activities conducted at the site. Accordingly:

- Field books will be assigned a unique identification number.
- Field books will be bound with consecutively numbered pages.
- Field books will be controlled by the Field Team Leader while field work is in progress.
- Entries will be written in waterproof ink.
- Entries will be signed and dated at the conclusion of each day of field work.
- Erroneous entries made while field work is in progress will be corrected by the person that made the entries. Corrections will be made by drawing a line through the error, entering the correct information, and initialing the correction.
- Corrections made after departing the field will be made by the person who made the original entries. The correction will be made by drawling a line through the error, entering the correct information, and initialing and dating the time of the correction.

At a minimum, daily field book entries will include the following information:

- Date and page number on each page or set of pages.
- Location of field activity.
- Date and time of entry.
- Names and titles of field team members.
- Names and titles of any site visitors and site contacts.
- Weather information, temperature, cloud coverage, wind speed and direction.
- Purpose of field activity.
- A detailed description of the fieldwork conducted, observations, and any measurements or readings. Where appropriate, a hand-drawn sketch map will also be included that identifies significant landmarks, features, sample locations, and utilities.
- When appropriate, boring numbers, well numbers, sample point ID, or key activities should be identified on the top of each page to facilitate retrieval of data at a later date.

Soil samples collected from soil borings will be described by the field geologist on boring logs. The monitor well construction specifications will be recorded on well completion logs, which will include screened, sand packed, and grouted intervals. Field measurements and water volumes from well development and well sampling will be recorded on well development and well sampling log forms. In a similar manner the sub-slab sampling will be documented on sampling log forms.

3.0 Sampling Equipment and Procedures for Field Equipment Decontamination, Waste Management, and Equipment Calibration.

3.1 Field equipment checklist

A general list of equipment necessary for field measurement and sample collection includes:

- Appropriate sample containers (see QAPP).
- Chain-of Custody seals and record form.
- Field sample record form.
- Log book and ink markers.
- Phosphate-free decontamination detergent (such as Alconoc) and deionized water to be used for decontaminating equipment between sampling stations.
- Buckets, plastic wash basins, plastic drop cloths, and scrub brushes to be used for decontamination equipment.
- Camera and film for use in documenting sampling procedures and sample locations.
- Stakes to identify sampling locations.
- Shipping labels and forms.
- Knife.
- Bubble wrap or other packing/shipping materials for sample bottles.
- Strapping tape.
- Clear plastic tape.
- Coolers.
- Duct tape.
- Rope.
- Re-sealable plastic bags.
- Portable field instruments (photoionization detector, combustible gas indicator, pH/temperature/conductivity/dissolved oxygen meter, electronic water level indicator, etc.)
- Sampling equipment, such as bailers and scoops.
- Level D PPE, including hard hats, steel toe work boots, safety glasses, and leather work gloves.
- Health and safety plan

3.2 Equipment Decontamination

3.2.1 Drilling Equipment Decontamination

To limit the concern of cross contamination from other sites, the drill rig will arrive at the Gabriel site free of dirt and debris, and will be high pressure washed prior to each sampling location. Once the rig has been inspected and determined to be free of dirt/debris, two methods of equipment cleaning will be applied during this project. Larger size equipment, such as the down-hole Rotosonic core barrels and related tools, will undergo a high-pressure washing (inside and outside of the cores) prior to use, as required during and between the installation of each boring, and at the completion of this investigation.

Smaller equipment will be cleaned using the following steps:

1. Scrub wash with non-phosphate detergent.
2. Rinse with potable water
3. Rinse with deionized/distilled water

3.2.2 Well Materials

Monitoring well casing and screens will be decontaminated by the procedures described in Subsection 3.2.1 before installation. The screen and casing will be wrapped in polyethylene plastic following decontamination, transported from the designated decontamination area to the well location. If the polyvinyl chloride (PVC) well casings and screens are in factory sealed plastic sleeves, field decontamination will not be necessary.

3.2.3 Sampling Equipment

Decontamination of non-dedicated and non-disposable sampling equipment will be conducted in a decontamination pad when one is readily available, otherwise decontamination will be conducted in buckets on plastic sheeting. Prior to sampling, all bowls, spoons, augers, Geoprobe® rods, and Macrocore® samplers (usually Dedicated) will be washed in potable water and phosphate-free detergent (e.g. Alconox). The sampling equipment will then be rinsed with potable water followed by a distilled water rinse. Between rinses, equipment will be placed on polyethylene sheets or aluminum foil if necessary. Sample equipment may also be steam cleaned, if appropriate. Sampling equipment will undergo either a solvent rinse (for volatiles) or an acid rinse (for metals). Sampling equipment will be wrapped in aluminum foil for storage or transportation from the designated decontamination area to the sample locations. Decontaminated equipment will not be placed directly on the ground surface.

Low flow submersible sampling pumps will be decontaminated before use and between uses by submerging the pump and down-hole wiring in 8- to 10-gallon containers of potable water followed by an Alconox and water solution, followed by a second potable water rinse, followed by a distilled water rinse (1-2 gallons). The pump will be run for five minutes in each of the 4 decontamination stations. Pumps will undergo a solvent or acid rinse for volatile organic compounds (VOCs) and metals respectively.

3.3 Management of Investigation Derived Waste

3.3.1 Decontamination Liquids

All steam cleaning and decontamination fluids will be collected in 55-gallon drums or a plastic temporary holding tank and temporarily stored onsite. At the end of the field activities, a composite water sample will be collected and analyzed for parameters as required by the disposal facility. The water will then be transported offsite for proper treatment and disposal.

3.3.2 Drill Cuttings and Cores

Soil borings will be backfilled with bentonite pellets or cement bentonite slurry. Monitoring well soil boring cuttings and excess soil samples will be placed in drums and staged for proper disposal. Soils may be drummed separately according to soil type (i.e., fill, clay/silt, and sand). Based on soil sample results, the excess soil will be disposed of accordingly.

3.3.3 Development and Purge Water

Development and purge water will be containerized and stored on site. At the end of field activities if any water is containerized, a composite water sample will be collected and analyzed for parameters as required by the disposal facility. The water will then be transported offsite for proper treatment and disposal.

3.3.4 Personal Protective Equipment

All personal protective equipment (PPE) will be placed in garbage bags and disposed of as a solid waste.

3.4 Field Instrument Calibration

All field screening and sampling instruments (e.g., temperature-conductivity-pH probes, PID, etc.) that require calibration prior to operation will be calibrated daily in accordance with the manufacturer's instructions. All instrument calibrations will be documented in the project field book for the various pieces of equipment. Instrument operating manuals will be maintained on-site by the field team.

4.0 Sampling Equipment and Procedures

4.1 MIP Surveying (Soil Screening)

The MIP is a soil-screening investigation tool developed by Geoprobe Systems for logging VOCs in the subsurface. The permeable membrane device associated with the MIP is used to detect volatile contaminants as it is driven to depth. The Geoprobe percussion soil probing equipment or cone penetration testing (CPT) rig, the MIP, equipped with a field gas chromatograph, will be used throughout the site to identify areas containing VOCs in the near surface soils. Continuous profiles can be generated from each hole. Soil conductivity is also measured to help evaluate soil type and these logs can be compared to the chemical logs to better understand where the VOCs occur. In order to screen soils down to the water table (e.g., ~ 35-40 feet below ground surface), it will be necessary to utilize CPT equipment. The MIP soil gas activity is summarized in Table 2. Further MIP detail is included in Section 4.22 of the SSA Work Plan.

4.2 Soil Borings (Confirmatory Sampling)

A Rotosonic™ or hollow-stem auger (HSA)/air rotary drill rig(s) will be used to collect soil samples to: 1) confirm the results of the MIP study; and 2) assess the presence or absence of

VOCs in soil within areas of interest such as the delivery area and above ground CFC storage tanks (ASTs). The locations for confirmation soil sampling will be selected during the NYSDEC/Companies meeting to assess the Phase II soil screening results (see Table 3 for summary of soil sampling activities). The soil boring procedure is listed in detail in Section 4.31 of the SSA Work Plan.

Following appropriate New York State Department of Environmental Conservation (NYSDEC) protocol, the soil samples collected will be shipped under chain-of-custody to a New York State ELAP-certified laboratory for analysis. The soil samples will be analyzed for the TCL VOCs using EPA SW846 Method 8260B; the TCL VOC list includes all targeted site COIs.

4.3 Sub-Slab Vapor Sampling

Sub-slab vapor sampling will be performed within the site facility to determine if facility activities have impacted subsurface soils underlying the building foundation (see Table 2 for summary). The vapor sampling locations identified during the Phase I site walk-through will be sampled during Phase II. The sub-slab vapor sampling method utilized will be consistent with the New York State's *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (New York State Department of Health, October 2005). The installation of the probes is presented in SOP D-1 in Appendix C. Subslab vapor samples will be collected in specially prepared evacuated stainless steel (SUMMA) canisters.

Upon completion of the sub-slab vapor sampling activities, the SUMMA canisters will be shipped under chain-of-custody (COC) to a New York State ELAP-certified laboratory for analysis. The sub-slab vapor samples will be analyzed for the Target Compound List (TCL) using EPA Method TO-15; the TCL VOC list includes all targeted site COIs.

4.4 Monitoring Wells

To better understand groundwater flow direction and the groundwater contaminant distribution, monitor wells will be installed in both the overburden unit and in the bedrock aquifer (see Table 3 of the SSA Work Plan).

Overburden Monitor Wells

Five overburden (till) groundwater monitoring well locations have been selected for monitor well installation; these locations are identified in Figure 2 as MWT-1 through MWT-5. The monitoring wells will be installed using a Rotosonic or HSA drill rig. At each monitor well location the drill rig will collect continuous cores (Rotosonic method) or split-spoon samples (HSA method) every five feet down to the base of the overburden aquifer. Each soil core or split spoon sample will be screened with a PID as discussed in Section 4.3.1 of the SSA Work Plan. Sample collection and analysis will follow the procedures presented in Section 4.3.1. Upon completion of the Rotosonic boring, a monitoring well will be constructed of 2-inch I.D. Schedule 40 PVC equipped with a 10-foot screen. Specific boring and well construction details are included in Section 4.3.3 of the SSA Work Plan.

Bedrock Monitor Wells

Two monitoring well locations have been selected for the bedrock groundwater investigation; these locations are identified in Figure 3 as MWB-1 and MWB-2. The bedrock monitoring wells will be installed using a Rotosonic or air rotary drill rig. At each monitoring well location the drill rig will collect cores or split-spoon samples every five feet down to the base of the overburden aquifer. Rotosonic coring or air rotary drilling into the bedrock will likely fracture the bedrock core samples, however attempts at collecting representative cores will also be made. Bedrock samples will be screened with a PID as discussed in Section 4.3.1. Sample collection and analysis will follow the procedures presented in Section 4.3.1. Specific boring and well construction details are included in Section 4.3.3 of the SSA Work Plan.

4.5 Groundwater Sampling

After the newly installed monitoring wells have been developed, allowed to equilibrate, and surveyed in place by a state-certified surveyor, depth-to-water measurements will be obtained, and groundwater samples will be collected from all on-site monitoring wells. Groundwater samples will be collected from each on-site monitoring well using low flow sampling methodology (see Table 3 of the SSA Work Plan).

The groundwater samples collected will be shipped under chain-of-custody to a New York State Environmental Laboratory Accreditation Program (ELAP) certified laboratory following appropriate NYSDEC protocol. The samples will be analyzed for the TCL VOC using EPA SW846 Method 8260B; the TCL VOC list includes all targeted site COIs.

5.0 Sample Handling and Analysis

5.1 Sample Designation

Each sample will be identified, labeled and recorded at the time it is collected and placed in an appropriate container in the field. A label affixed to each sample container will contain the Sample Location, Sample Identifier, Sampling Date and Time, Sample Depth (if relevant) and the Initials of Samplers.

The sample identifier will be designated by an alpha-numeric code with the following format:

GAB-Sample Type-Number

Sample Type: The sample type will be designated by the following abbreviations.

GW	- Ground Water
S	- Subsurface Soil
V	- Sub-slab Vapor

A three digit sequential number will follow the sample type, indicating the sample location. For soil samples the top depth of the samples will follow the location number.

Duplicate samples will be designated by a D following the sample number. For example, the duplicate of sample GAB-V-009 would be designated GAB-V-009-D. Matrix spike and matrix spike duplicate samples will be designated by MS or MSD following the sample number.

5.2 Sample Containerization, Preservation, and Analysis

Sample containerization, holding time requirements, and preservation requirements are listed in Table 1-7 of the QAPP. Field handling and storage of samples and sample containers is described in Section 2.3 of the QAPP. Analytical methods for sample analyses are listed in Table 1-7 of the QAPP.

5.3 Chain-of-Custody

A Chain-of-Custody (COC) record will accompany the sample containers during selection and preparation at the laboratory, during shipment to the field, and during return shipment to the laboratory. The COC will identify each sample container and the analytical parameters for each, and will list the field personnel that collected the samples, the project name and number, the name of the analytical laboratory that will receive the samples, and the method of sample shipment. If samples are split and sent to different laboratories, a copy of the COC record will be sent with each sample shipment.

Method

- Field personnel will complete the COC as samples are collected and packed for shipment.
- Erroneous markings will be crossed out with a single line and initialed by the author.
- Trip and field blanks will be listed on separate rows.
- After the samples have been collected and sample information has been listed on the COC form, the method of shipment method will be entered on the COC.
- Finally, a member of the sampling team will write his/her signature, the date, and time on the first relinquished by space. Duplicate copies of each COC must be completed.
- Sampling personnel will retain one copy of the COC. The other copy and the original will be sealed in a plastic bag and taped inside the lid of the shipping cooler.
- Blind duplicate sample will be cross-referenced to the corresponding field sample only on the copy of the COC retained by the sampling personnel. The samples will remain blind samples on the two copies of the COC sent to the laboratory.
- Sample shipments going to chemical analytical laboratories will be refrigerated at 4°C, typically by packaging with ice, to preserve the samples during shipment.
- After the shipping cooler is closed, custody seals provided by the laboratory will be affixed to the latch and across the front and back of the cooler lid, and signed by the person relinquishing the samples to the shipper.
- The seal will be covered with clear tape, and the cooler lid will be secured by wrapping with packaging tape.

- Then the cooler will be relinquished to the laboratory or the shipper, typically an overnight carrier.
- The COC seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the CH2M HILL Project Manager, and the samples will not be analyzed.
- The chemical analytical samples must be delivered to the laboratory within 48 hours of collection.

5.4 Sample Documentation

The field team leader will retain a copy of the COC, and, in addition, the field team leader will ensure that the following information about each sample is recorded in the field book or sample log:

- Sample identifier.
- Sample identifier of blind duplicate samples and cross reference to corresponding field sample.
- Identification other QA/QC samples and cross reference to corresponding field sample.
- Identification of sampled media (e.g., soil or groundwater).
- Sample location with respect to known reference point.
- Physical description of sample location.
- Field measurements (e.g., pH, temperature, conductivity, and water levels).
- Date and time of collection.
- Sample collection method.
- Volume of groundwater purged before sampling.
- Number of sample containers.
- Analytical parameters.
- Preservatives used.
- Shipping information.