Final

~~Draft~~

# Remedial Action Work Plan

25 Melville Park Road Site
Melville, New York

with February 2004 Addendum Attached.

ARCADIS

Infrastructure, buildings, environment, communications

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# Remedial Action Work Plan

## 25 Melville Park Road Site
## Melville, New York

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D December 11, 2002 Response to NYSDEC Comments, Draft Remedial Action Plan, 25 Melville Park Road Site, Melville, New York; and NYSDEC letter of March 4, 2003, Response to Comments

E Community Air Monitoring Plan

## Disclosure Statement

The laws of New York State require that the corporations which render engineering services in New York be owned by individuals licensed to practice engineering in the State. ARCADIS cannot meet that requirement. Therefore, all engineering services rendered to 25 MPR, LLC in New York are being performed by ARCADIS Engineers and Architects of New York, P.C., a New York Professional corporation qualified to render professional engineering in New York. There is no surcharge or extra expense associated with the rendering of professional services by ARCADIS Engineers and Architects of New York, P.C.

ARCADIS is performing all those services that do not constitute professional engineering, and is providing administrative and personnel support to ARCADIS Engineers and Architects of New York, P.C. All matters relating to the administration of the contract with 25 MPR, LLC are being performed by ARCADIS pursuant to its Amended and Restated Services Agreement with ARCADIS Engineers and Architects of New York, P.C.

## 1. Introduction

ARCADIS and ARCADIS Engineers and Architects of New York, P.C., on behalf of 25 MPR, L.L.C. (25 MPR), has prepared this Remedial Action Work Plan (RAWP) for the 25 Melville Park Road Site (hereinafter referred to as the "Site") in Melville, New York. Under the provisions of the New York State Voluntary Cleanup Program, WHCS Melville, L.L.C. (WHCS) and the New York State Department of Environmental Conservation (NYSDEC) entered into a Voluntary Remediation Agreement (Agreement) on January 13, 1998 to remediate to the extent practical the on-site portion of the groundwater that is impacted with volatile organic compounds (VOCs). The property was sold by WHCS on October 9, 2002. As a result of this property transaction, the executed Agreement between WHCS and the NYSDEC was transferred to the new property owner, 25 MPR. 25 MPR's obligations under this Agreement are limited to the on-site portion of the VOC plume, and they are not responsible for the investigation and remediation of off-site conditions.

The objective of this RAWP is to identify the most appropriate groundwater remedial options for on-site conditions, recommend a preferred remedial alternative, and present a Work Plan for implementation of the recommended alternative. This RAWP is intended to satisfy the requirement in the Agreement and submit to the NYSDEC a work plan to remediate on-site VOC-impacted groundwater to a level that is sufficiently protective of human health and the environment for use of the property as an office building or other commercial facility ("Contemplated Use").

Voluntary Cleanup Program (VCP) sites listed on the Registry of Inactive Hazardous Waste Disposal Sites as Class 2 require that the Citizen Participation requirements in 6 NYCRR Part 375 be followed. Therefore, the NYSDEC will be preparing a Proposed Remedial Action Plan (PRAP) and Record of Decision (ROD) to fulfill the Part 375 requirements, even though the Site will remain under the VCP. The information provided in the RAWP, and other technical support and citizen participation assistance provided by ARCADIS, will be used by the NYSDEC during the remedy selection process. This RAWP has been revised based on ARCADIS' December 11, 2002 Response to NYSDEC Comments on the Draft Remedial Action Plan, and a March 4, 2003 response from the NYSDEC providing additional input and requesting the submission of a revised RAWP.

The RAWP is organized into the following sections:

Section 1. Introduction

Section 2. Site Background
Section 3 Enhanced Reductive Dechlorination (ERD) Pilot Test Baseline Groundwater Monitoring Results and Non-Aqueous Phase Liquid (NAPL) Characteristics
Section 4. Remedial Action Objectives
Section 5. Identification and Evaluation of Remedial Action Technologies
Section 6. Identification and Detailed Analysis of Remedial Action Alternatives
Section 7. Selected Remedial Action Alternative
Section 8. Detailed Description of Selected Remedial Action Alternative
Section 9. Long-Term Groundwater Monitoring
Section 10. Ambient Air Quality Monitoring
Section 11. Project Schedule
Section 12. Reporting
Section 13. References

## 2. Site Background

The following sections discuss the location and setting of the Site, including past ownership and Site use; a description of the Site and current operations; identification of surrounding properties; and regional and site-specific geology and hydrogeology.

### 2.1 Physical Setting

The Site is located slightly south and east of the intersection of Broadhollow Road (Route 110) and the Long Island Expressway (Route 495) in the Village of Melville, Suffolk County, New York. The Site is located in an industrial and commercial area and is bounded to the south by Melville Park Road and to the west, north, and east by adjoining properties. The location of the Site is shown on Figure 1.

### 2.2 Current Setting

The Site is presently occupied by a two-story office building and parking facilities. Figure 2 shows the current Site features. The property, located within the South Huntington Water District, is served by municipal water and has two on-site septic systems located south of the building. The nearest public water supply well is located approximately 3,000 feet (ft) northwest of the Site. The other nearby well field (two wells) is located approximately 3,500 ft southwest of the Site in a general downgradient direction. However, this well field is somewhat side-gradient of the Site, the wells are screened approximately 500 feet below land surface (ft bls), and they are not impacted by VOCs. Figure 3 shows the locations of public water supply wells in the general vicinity of the Site.

### 2.3 Historical Setting and Operations

The Site was occupied by the New York Twist Drill Company (NYTD) from 1966 (when the building was originally constructed) through 1984. After NYTD vacated the building, it was converted into a two-story office complex. This renovation involved the expansion of the building footprint to the southeast.

The process of manufacturing twist drills consisted of modifying steel bars, which ranged from ¼-inch to 2-inches in diameter. These bars were cut to the desired length and shipped to the Heat Treatment Department to be thermally tempered. In the Heat Treatment Department a degreasing agent was used on the bars before they were transported to the Grinding Department. From the Grinding Department the material was transported to the Cleaning Department, where the cutting edge of the drill was produced. The drill was then pointed, finished, and subsequently sent to the Packaging Department for shipment.

The Suffolk County Department of Health Services (SCDHS) issued a State Pollutant Discharge Elimination System (SPDES) permit to NYTD in the mid-1960s. The permit was for treatment of cyanide bearing waste associated with wastewaters from nitride, alkaline wash and heat treatment wash tanks. In 1975, a proposal to modify and simplify the process was forwarded to SCDHS by NYTD. This proposal presented process design modifications intended to reduce the volume of process waste chemicals from the manufacturing process.

Several pieces of correspondence through the 1970's record instances of NYTD discharge violations above the allowable SPDES permit limits. Through the early 1980's the SCDHS issued several notices of violation against NYTD for unacceptable discharges of trichloroethene (TCE) at the SPDES discharge monitoring locations.

A former "discharge or diffusion well" was located near the north side of the entrance to the east loading dock. Reportedly, the use of the diffusion well was discontinued around 1981. The diffusion well was reportedly used for disposal of non-contact cooling water. A NYSDEC well completion report indicates that the well, S-28268D, was completed to a total depth of 116 feet with a screen interval from 108 to 116 ft bls. The well was installed in June 1966.

### 2.4 Hydrogeologic Setting

The following sections describe the regional and site-specific geology and hydrogeology. Information is based on several United States Geological Survey (USGS) reports, investigation work conducted by ARCADIS at a nearby site, and previous investigation work conducted by others at the Site.

#### 2.4.1 Regional Hydrogeology

The unconsolidated geologic deposits underlying Suffolk County consist of clay, silt, sand, and gravel that overlie southward-dipping consolidated bedrock. The crystalline bedrock consists mainly of Precambrian age granite, gneiss, and schist. The overlying unconsolidated sediments were deposited during the Cretaceous age and form, in ascending order, the Raritan and Magothy Formations. During the Pleistocene period, glacial meltwater deposited outwash material forming what is presently known as the Upper Glacial aquifer.

The Raritan Formation consists of the Lloyd Sand and the Raritan Clay. The Lloyd aquifer consists of fine to coarse sand, gravel, commonly with a clayey matrix, and lenses and layers of silty and solid clay. The Raritan confining unit consists of silty and solid clay, and lenses and layers of sand. Because of its low permeability, the Raritan Clay serves as a confining unit for the underlying Lloyd Sand.

The Magothy Formation is a deltaic deposit consisting of fine to medium sand, clayey in part, interbedded with lenses and layers of coarse sand, silt, and sandy and solid clay. Gravel is common in the basal zone of the Magothy Formation. McClymonds and Franke (1972) estimate the average horizontal hydraulic conductivity of the Magothy aquifer in the Melville area to be approximately 400 gallons per day per square foot (gpd/$ft^2$).

The Upper Glacial aquifer consists primarily of till and glacial outwash deposits. The till, composed of clay, sand, gravel, and boulders, forms the Harbor Hill and Ronkonkoma terminal moraines. These terminal moraines represent the farthest advance of late-Pleistocene glaciation on Long Island. South of the morainal deposits is a glacial outwash plain, which extends from the Harbor Hill and Ronkonkoma moraines to the Great South Bay, and consists of fine to very coarse sand and pebble to boulder sized gravel. Published data indicate that the horizontal hydraulic conductivity of the Upper Glacial aquifer in the Melville area is approximately 1,500 to 2,000 gpd/ft$^2$ (McClymonds and Franke, 1972).

### 2.4.2 Site Hydrogeology

Bedrock beneath the Site is found at an approximate elevation of 1,100 feet below mean sea level (msl). The Lloyd aquifer, which overlies bedrock, has a surface elevation of approximately 750 feet below msl. The Raritan Clay has an approximate surface elevation of 600 feet below msl. The Magothy aquifer is present from an approximate elevation of 50 feet above to 600 feet below msl. The contact between the Upper Glacial aquifer and the Magothy aquifer occurs at approximately 50 to 100 feet above msl at the Site (CDM, 2000). The Upper Glacial aquifer corresponds to the saturated upper part of the highly permeable Pleistocene deposits of sand and gravel.

The deposits encountered during subsurface investigations on-site have been predominantly characterized as tan to light brown/light red-brown/gray/white, fine to coarse sand and gravel. Thin lenses of reddish-brown clay and sandy silt have been encountered in boreholes MW-18D (60-64 ft below land surface [bls]), MW-19D (58-62 ft bls), MW-20D (60-64 ft bls), IW-14 (62-64 ft bls), IW-15 (56-58 ft bls and 62-64 ft bls), MW-30 (62-64 ft bls), and MW-33 (66-68 ft bls). In addition, a medium gray clay was encountered at 56.5 ft bls during the installation of MW-12 and a clay layer was encountered from 60-62 ft bls in MW-11 (see Figure 2).

Based upon water-level measurements collected on June 17, 2003, a water table contour map of the shallow aquifer zone was prepared (Figure 4). The direction of groundwater flow on-site is south-southeast (Figure 4). The horizontal hydraulic gradient in the shallow aquifer zone (45 to 60 ft bls) is approximately 0.001 ft/ft. Depth-to-water at the Site is approximately 50 ft bls. Site-specific hydraulic conductivity data are not available for the Site. Based on an examination of geologic logs for on-site wells, slug test and aquifer test data collected by ARCADIS at a nearby site in Melville, and regional hydrogeologic studies conducted by the USGS, ARCADIS estimates the hydraulic conductivity (K) in the area of the plume to be approximately 50 to 100 ft/day. Based on this range of hydraulic conductivities and an estimated effective porosity of 0.25, the estimated average horizontal groundwater velocity is approximately 0.3 ft/day. Due to the relatively homogeneous nature of the geology, the advective groundwater velocities in the shallow, intermediate (60 to 90 ft bls), and deep aquifer zones (130 to 185 ft bls) are expected to be similar.

# 3. Enhanced Reductive Dechlorination (ERD) Pilot Test Baseline Groundwater Monitoring Results and Non-Aqueous Phase Liquid (NAPL) Characteristics

## 3.1 VOC Plume Configuration

Groundwater samples were collected from most of the monitoring wells in June 2003 to establish baseline conditions prior to commencing the enhanced reductive dechlorination (ERD) pilot test and to determine the present-day VOC dissolved plume configuration. Table 1 provides the construction details for the entire well network. The monitoring well locations are shown on Figure 2. The present-day VOC plume configuration is discussed relative to the shallow (45 to 60 feet below land surface [ft bls]), intermediate (60 to 90 ft bls), and deep (130 to 185 ft bls) aquifer zones. The laboratory results from the VOC analyses are summarized in Appendix A (Table A1).

The constituents of concern (COCs) for the Site include tetrachloroethene (PCE), TCE, 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1-DCA), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride (VC).

Figure 5 shows the dissolved total VOC (TVOC) plume distribution in the shallow zone. TVOC concentrations in the shallow zone ranged from 7 µg/L (MW-1) to 52,225 µg/L (MW-13). The most significant concentrations were detected just east of the loading dock area. A second area of elevated concentrations exists in the vicinity of MW-7 (11,852 µg/L) and MW-11 (10,828 µg/L).

Figure 6 shows the dissolved TVOC plume distribution in the intermediate zone. TVOC concentrations in the intermediate zone ranged from 84 µg/L (IW-15) to 12,048 µg/L (MW-27D). Elevated concentrations were also detected just east of the loading dock area at MW-13D (5,970 µg/L) and IW-14 (6,421µg/L).

Figure 7 shows the dissolved TVOC plume distribution in the deep zone. TVOC concentrations in the deep zone ranged from 13 µg/L (MW-20D) to 202 µg/L (MW-18D). These wells are both located in the area just east of the loading dock area where elevated concentrations were reported in the shallow and intermediate zones. The third deep zone monitoring well (MW-19D) had a reported concentration of 40.8 µg/L.

The most significant TVOC concentration in the deep zone was reported in MW-18D (202 µg/L), which is screened from 133 to 143 ft bls. However, the PCE concentration in MW-18D was only 20 µg/L, with the remaining VOC mass comprised of transformation products TCE and cis-1,2-DCE. Based on the reported TVOC concentrations in the two other wells that comprise the deep zone monitoring network, MW-19D (40.8 µg/L), screened from 160 to 170 ft bls, and MW-20D (13 µg/L), screened from 175 to 185 ft bls, the vertical extent of contamination has been defined.

### 3.2 Biogeochemical Conditions

Groundwater samples were collected in June 2003 from selected monitoring wells for biogeochemical parameters to establish baseline biogeochemical conditions prior to commencing the ERD pilot test and to evaluate the occurrence and types of natural biodegradation processes responsible for observed trends in VOC concentrations. Background groundwater conditions, as exhibited at Well MW-15, are characterized as aerobic and oxidizing conditions. A dissolved oxygen concentration of 8.52 milligrams per liter (mg/L) and an oxidation-reduction potential (ORP) measurement of +336 millivolts (mV) was field measured in the flow through cell, which is representative of oxidizing conditions. The ORP of groundwater is a measure of electron activity and is an indicator of the relative tendency of a solution to accept or transfer electrons. The presence of nitrate (0.38 mg/L) also indicates that native groundwater is characterized as having oxidizing conditions. The laboratory results from the biogeochemical analyses are summarized in Appendix B (Tables B1 through B3).

The area of VOC-impacted groundwater located downgradient of the loading dock area is characterized by depressed dissolved oxygen concentrations, and elevated concentrations of reduced by-products (e.g., higher dissolved iron and manganese, sulfide, and methane concentrations relative to background). Concentrations of dissolved iron and manganese in background groundwater were measured at non-detect and 5.8 ug/L, respectively. Concentrations of dissolved iron and manganese within the core of the reducing environment show an increase in the range of 249 to 6,700 ug/L and 223 to 1,650 ug/L, respectively. The data also indicate the reduction of sulfate to sulfide by sulfate reducing microbes. The distribution of key biogeochemical indicator parameters in the shallow, intermediate, and deep zones is provided in Appendix B (Figures B1, B2, and B3, respectively). Collectively, these conditions indicate that in the absence of oxygen, other alternate electron acceptors are being utilized by bacteria to metabolize a carbon energy source and produce the enzymes and co-factors that fortuitously degrade VOCs.

The concentrations of select VOCs, ethene, and ethane in the shallow, intermediate, and deep zones are provided in Appendix B (Figures B4, B5, and B6, respectively). The data indicate that the indigenous microbial population is degrading the COCs, but that the natural reducing environment is too weak to provide a large reduction in VOC mass. Daughter products (i.e., TCE and cis-1,2-DCE) and end products (ethene and ethane) of PCE degradation are present in the plume; there is, however, an absence of VC in the plume. This distribution of VOCs indicates that the natural reductive dechlorination processes are slowly degrading VOCs to the end products ethene and ethane.

### 3.3 Presence of NAPL

Non-aqueous phase liquid (NAPL), consisting of a mixture of dense non-aqueous phase liquid (DNAPL) and light non-aqueous phase liquid (LNAPL), has been detected in monitoring wells IW-1, IW-3, IW-4, IW-9, MW-13, and MW-25D. For purposes of this RAWP, the term "NAPL" is defined as DNAPL and/or LNAPL, unless specified otherwise. Historically, DNAPL was detected in both IW-1 and IW-9 and LNAPL was detected in IW-9. Camp Dresser & McKee (CDM) began NAPL gauging/recovery efforts in wells IW-1 and IW-9 in March 1999 and continued these efforts through April 2001. The Site was transitioned from CDM to ARCADIS during the spring of 2001. MW-13 was added to the list of wells that are monitored for NAPL based on a review of the March 1999 groundwater sampling data, which indicated that NAPL might be present (PCE was detected at a concentration of 590,000 µg/L). In addition, monitoring wells IW-3, IW-4, and MW-25D were added to the list of wells that are monitored for NAPL during December 2001, when a comprehensive NAPL gauging event was conducted in the vicinity of wells known to contain NAPL. Appendix A (Table A2) provides fluid-level gauging measurements from July 2001 to the present. Currently, LNAPL is present in IW-9 and DNAPL is present in IW-1. NAPL has also been detected in IW-3, IW-4, MW-13, and MW-25D, but has not been present in IW-3 since December 2002, nor in IW-4, MW-13, and MW-25D since February 2002.

In March 2003, ARCADIS conducted a sub-floor investigation in the former NYTD production area, which was located in the currently unoccupied section of the building just north of the loading dock area. The purpose of the sub-floor investigation was to inspect the suspect location of the former diffusion well, which was believed to be one of the potential NAPL release mechanisms. The work involved excavating a 4-foot by 4-foot area through and to the base of the reinforced concrete floor slab in order to investigate a geophysical anomaly (i.e., the suspect location of the former diffusion well) that was identified during the November 2002 geophysical survey. The former diffusion well was successfully located during the sub-floor investigation effort. A photoionization detector (PID) was used to screen the soil that is located beneath the concrete floor and the wellhead. No VOCs were detected by the PID.

In April 2003, ARCADIS removed a number of well appurtenances that included a pitless adapter, seventy-three (73) feet of two-inch drop line, and a submersible pump from the former diffusion well. After these appurtenances were removed from the well, the well was sounded with a measuring tape and was determined to be open to a depth of approximately 103 feet below the top of the six-inch well casing. Based on the sounded depth of the well and the total depth indicated on the NYSDEC well completion report (116 ft bls), there is approximately 13 feet of material in the bottom of the well. The depth to water was measured using an interface probe. Although LNAPL was not detected in the well, it will be regauged for both LNAPL and DNAPL once well development has been completed. After the appurtenances were removed from the well, the wellhead was secured with a sanitary seal. Based on the observations from the sub-floor investigation and well appurtenances removal efforts (i.e., PID screening and visual and olfactory observations), the former diffusion well does not appear to be the conduit for the introduction of contaminants (e.g., oil and solvents) into the subsurface. However, based on the presence of a submersible pump in the well, it is possible that during active pumping VOCs may have been induced toward the well's screened zone.

Based on the distribution of solvent/oil in the subsurface, the most likely release mechanism is a leak from a former floor drain. Evaluation of a hand drawn sketch of a NYTD floor plan identified a floor drain and associated piping leading to a former underground waste oil tank that was removed in September 1991 (Article 12 Tank Registry [No. 4-0264, File Reference 4-2056). This former floor drain is located in the general vicinity of the former diffusion well. According to the NYSDEC, the former waste oil tank was removed under the oversight of the SCDHS, and there is no information suggesting that there was a release from the tank.

NAPL samples were collected on August 8, 2001 for visual inspection. Upon allowing the samples time to equilibrate in glass containers, DNAPL was present in IW-1, LNAPL was present in IW-9, and both DNAPL and LNAPL were present in MW-13.

In order to characterize the NAPL, samples were collected on September 6, 2001 from wells IW-1, IW-9, and MW-13 for submittal to the laboratory for chemical analysis and determination of physical properties. The samples were submitted for the following analyses: gas chromatography/flame ionization detection (GC/FID) gasoline range organics (GRO) and diesel range organics (DRO) via United States Environmental Protection Agency (USEPA) Method 8015B (IW-9 and MW-13 only), GC/FID fingerprinting via USEPA Method 8015B (IW-9 and MW-13 only), VOCs via USEPA Method 8260B, density via ASTM D 70, specific gravity via ASTM D 1298, and viscosity via ASTM D 445.

### 3.3.1 Chemical Characteristics

The laboratory results from the chemical analyses are summarized in Appendix A (Tables A3 and A4). The VOC data indicate that IW-9 and MW-13 contain petroleum-based constituents (i.e., ethylbenzene, xylene) as well as chlorinated hydrocarbons, whereas IW-1 contains only chlorinated hydrocarbons. Due to the presence of LNAPL in IW-9 and MW-13, the samples collected from these wells were submitted for GC/FID total petroleum hydrocarbons (i.e., GRO and DRO) and GC/FID fingerprinting analyses. The laboratory GC/FID fingerprint results indicate that the LNAPL in IW-9 and the DNAPL and LNAPL in MW-13 most closely resemble a mixed waste oil product in the range of mineral oil. PCE is also present.

### 3.3.2 Physical Characteristics

The laboratory results from the physical properties analyses are summarized in Appendix A (Table A5).

## 4. Remedial Action Objectives

Remedial action objectives (RAOs) form the basis of the remedy evaluation and are based on the contaminants, the affected environmental media, pathways of exposure to potential receptors, and standards or acceptable contaminant concentrations. Based on the analysis of these factors, cleanup objectives are determined.

Standards, Criteria, and Guidelines (SCGs) are to be considered when formulating, screening and evaluating remedial alternatives, and selecting a remedial alternative. The NYSDEC Division of Water Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values (SGVs) is the applicable document for the evaluation and selection of a remedial action for groundwater (NYSDEC TOGS 1.1.1, June 1998).

### 4.1 Pathways of Exposure

In accordance with Section XI (Deed Restriction) of the Voluntary Remediation Agreement, the Volunteer shall record an instrument with the Suffolk County Clerk, to run with the land, that:

- Prohibits the Site from ever being used for purposes other than the Contemplated Use; and,
- Prohibits the use of the groundwater underlying the Site without treatment rendering it safe for drinking water or industrial purposes.

Because the Volunteer, who is solely responsible for on-site contamination, is ensuring that contaminated groundwater will not be used on-site, the exposure pathway of ingestion can be eliminated.

Therefore, the potential route of exposure to COCs at the Site is as follows:

- Potential inhalation of COCs that may volatilize from groundwater and diffuse into indoor air.

All of the on-site contamination is at or below the water table (i.e., 50 to 90 feet or more beneath the ground surface). Although a potential pathway exists for an employee or on-site worker to be exposed to COCs in indoor air, a quarterly indoor air monitoring program conducted voluntarily by WHCS Melville between October 1999 and April 2001 showed that there is no health hazard to individuals within, or outside, of the building. Additional ambient air quality monitoring conducted by ARCADIS in July 2003, prior to commencing the ERD pilot test reagent injections, indicated that no site-related COCs were detected in ambient air. Therefore, the inhalation of COCs pathway is not a concern at the Site.

### 4.2 Development of Remedial Action Objectives

Based on the SGVs and the results of the comprehensive investigations that have been conducted at the Site between 1995 and 2001, the RAOs developed for the Site are as follows:

- Protect human health and the environment;

- Prevent or reduce the potential for NAPL to mobilize downward and prevent or reduce the potential for NAPL to contribute to the expansion of the areal extent of VOC contamination;

- Remediate the source area contamination, to the extent practicable, in order to control and/or reduce the off-site migration of VOCs in groundwater at levels that could result in unacceptable concentrations based on potential exposure pathways and the resulting risk to human health and the environment.

- Remediate the on-site groundwater in a manner consistent with the "Contemplated Use" of the Site, which is as an office building or other commercial facility.

### 4.3 Preliminary Remedial Action Goals

In order to meet the RAOs, SGVs will be used as the applicable groundwater standards at the point of compliance, which will be the downgradient property boundary. Based on the potential pathway of exposure, short-term and long-term remedial goals have been developed.

The short-term goal for the Site is as follows:

- To stabilize the VOC plume and mitigate the further deterioration of off-site groundwater by an on-site source.

The long-term goal for the Site is as follows:

- To remediate on-site VOC concentrations in groundwater to levels that meet groundwater standards at the downgradient property boundary.

Long-term groundwater monitoring data will be evaluated to determine acceptable VOC concentrations on-site that will sufficiently attenuate along the downgradient flowpath to maintain compliance with groundwater standards at the property boundary. Once active remediation is discontinued, compliance point monitoring will continue for two years to demonstrate that on-site VOC concentrations are not causing an exceedence of groundwater standards at the downgradient property boundary.

The progress of the remedial efforts on-site may, over time, indicate that alternate cleanup standards are warranted because it may not be possible to completely remove residual NAPL in a reasonable timeframe. Therefore, if after a minimum period of five years of operation of a groundwater remedial system, the remedy is not successfully achieving the remedial action objectives, other potential remedial options (or remedy enhancements) will be evaluated. If there are no other remedial alternatives that would more effectively achieve SGVs at the downgradient property boundary in a reasonable timeframe, then a petition for alternate cleanup standards will be submitted to the NYSDEC. A petition for alternate cleanup standards will include an evaluation demonstrating that there are no significant impacts to the public or environment, and will include a demonstration that reducing VOC concentrations to groundwater standards is technically impracticable.

### 4.4 Remedial Strategy

Based on the Site RAOs, the initial remedial goal will focus on recovering NAPL from the source area and controlling the downgradient migration of VOCs, thereby reducing concentrations at the downgradient property boundary. Achieving these initial remedial objectives are critical to the success of the overall remedial effort because:

(1) It will ensure that NAPL is not mobilized vertically downward where it can impact aquifer zones that are presently unimpacted or minimally impacted; and,

(2) Stabilizing the plume and controlling movement of the on-site groundwater plume will minimize potential further deterioration of off-site groundwater.

Following attainment of the initial remedial objectives, the long-term goal will be to continue to remediate on-site groundwater such that contaminant levels meet groundwater standards at the downgradient property boundary.

## 5. Identification and Evaluation of Remedial Action Technologies

The following section describes the technologies deemed appropriate for meeting the RAOs established in Section 4 of the RAWP. Included in this section are a brief review of each technology identified and the selection of remedial technologies to be included in the remedial action alternatives for the Site.

### 5.1 Technology Description of Identified Remedial Action Technologies

The following section provides a brief technology review of each technology deemed appropriate for meeting the RAOs. Included in the review is a list of advantages and disadvantages for the respective technology. Technologies reviewed include:

- NAPL hand bailing;
- Active/passive selective skimmers;
- In-situ reactive zones (IRZs);
- In-situ chemical oxidation;
- Nano-scale zero-valent iron (ZVI); and,
- Pump-and-treat.

A review of each technology is provided below.

#### 5.1.1 NAPL Hand Bailing

Hand bailing consists of using plastic or metal bailers to physically remove NAPL from a well. Bailers are typically sized to fit into 2-inch or 4-inch diameter wells and are physically lowered into the well to remove the NAPL. The NAPL is then containerized and disposed in accordance with local, state, and federal regulations. During a hand bailing event, hand bailing is typically conducted until no measurable NAPL is detected in the well or until recovery of the NAPL becomes impracticable. Hand bailing is currently being utilized at the Site as an interim corrective measure (ICM) to remove NAPL from the source area. The following is a list of advantages and disadvantages of hand bailing.

***Advantages***

- Highly reliable method with low probability of equipment malfunction; and,
- Technology is currently being utilized at the Site and has been proven effective in removing NAPL from existing monitoring wells.

*Disadvantages*

- NAPL recovery is limited to the rate at which NAPL naturally recovers into the well.

### 5.1.2 Active/Passive Selective Skimmers

Active/passive selective skimmers consist of a NAPL selective intake screen that floats at the NAPL interface, a collection reservoir, and interconnecting tubing. NAPL that passes through the NAPL selective screen is fed via gravity through the interconnecting tubing to the collection reservoir. Active selective oil skimmers also contain a pump (typically a bladder or diaphragm-type pump) to continuously pump NAPL from the collection reservoir to a container at land surface. Passive selective skimmers typically do not contain a pump and NAPL must be manually removed from the collection reservoir. Recovered NAPL is then disposed in an approved manner. The following is a list of advantages and disadvantages of active/passive selective skimmers.

*Advantages*

- Automated NAPL recovery.

*Disadvantages*

- Not cost effective for low NAPL recovery areas;
- Selective screens for DNAPL have not been field proven;
- Selective screens (DNAPL and LNAPL) may clog or pass water; and,
- NAPL recovery is limited to the rate at which NAPL naturally recovers into the well.

### 5.1.3 In-Situ Reactive Zone

Chlorinated volatile organic compounds (CVOCs) have long been perceived as recalcitrant and difficult to remediate in groundwater environments. In recent years, engineered bioremediation techniques have proven (through field application and laboratory study) to be effective for treating these types of compounds in groundwater.

ERD is an engineered bioremediation technique that falls into a class of remedial technologies known as IRZs. This technique is accepted by both federal and state regulatory agencies, and has been approved for use at several sites in New York and USEPA Region II. ERD employs an easily degradable carbohydrate solution (i.e., molasses) that is injected into the groundwater. The molasses injection provides excess organic carbon, which promotes microbial activity in the subsurface, subsequently enhancing the rates of reductive dechlorination of the CVOCs present.

When added to groundwater, naturally occurring bacteria begin to metabolize the molasses solution, consuming dissolved oxygen at a rate greater than it can be recharged naturally. Following depletion of oxygen, subsurface microbes begin the successive utilization of alternative electron acceptors to support respiration. The general sequence of alternate electron acceptor utilization and respiration by-product formation is as follows (from most thermodynamically favorable to least):

| | | |
|---|---|---|
| Nitrate ($NO_3$) | → | Nitrogen ($N_2$) |
| Manganic Manganese ($Mn^{4+}$) | → | Manganous Manganese ($Mn^{2+}$) |
| Ferric Iron ($Fe^{3+}$) | → | Ferrous Iron ($Fe^{2+}$) |
| Sulfate ($SO_4^{2-}$) | → | Sulfide ($S^{-2}$) |
| Carbon Dioxide ($CO_2$) | → | Methane ($CH_4$) |

By maintaining excess organic carbon in the groundwater environment, ERD technology stimulates microbial activity, driving the groundwater environment to anaerobic and strongly reducing conditions. The zone in which this environment is established serves as an IRZ. Within the IRZ, there are three primary processes by which microbes can degrade CVOCs dissolved in groundwater:

1. Cometabolism: In this process, CVOCs are fortuitously degraded by the enzymes and cofactors produced by microbes as they metabolize excess organic carbon.

2. Hydrogenolysis: In this process, chlorine atoms in CVOC molecules are directly replaced by excess hydrogen atoms created as a result of the reducing environment and through hydrolysis and fermentation of the excess organic carbon.

3. Dehalorespiration: In this process, microbes use the CVOC molecule itself to support respiration under the anaerobic and reducing environment maintained by the presence of excess organic carbon.

The degradation of VOCs by anaerobic bacteria occurs primarily through the process of dehalogenation (or reductive dechlorination), which is the successive removal of chlorine atoms from the VOC molecule via a biologically mediated pathway. For example, TCE is formed when a chlorine atom is removed from PCE. Under the proper reducing conditions, this process can continue, resulting in the successive formation of cis-1,2-DCE, VC, and finally ethene. Ethene is then degraded to ethane, and finally carbon dioxide and water are formed. A similar process of chlorine removal occurs for 1,1,1-TCA, in which 1,1-DCA, chloroethane, and ethane are formed.

In addition to biologically mediated pathways, direct mineralization of various CVOC transformation intermediates to water and carbon dioxide is possible in the presence of iron reduction. Where observed, this process prevents the buildup of compounds such as vinyl chloride. This process has been demonstrated and discussed in numerous literature accounts including: Bradley and Chappelle, 1996; Bradley and Chappelle, 1997; Wiedemeier and Chappelle, 1998; and Ferrey and Wilson, 2002.

The biological activity stimulated by the ERD process also results in a disruption of the natural dissolved phase-adsorbed phase equilibrium in the subsurface. This disruption transfers CVOC mass from the adsorbed phase to the dissolved phase (i.e., desorption), making it available for treatment. This same principle applies to NAPL resulting in increased NAPL dissolution rates and therefore increased NAPL degradation rates. The increased NAPL dissolution rate is caused by an increase in the aqueous phase to NAPL phase gradient (through destruction of dissolved phase constituents). This feature makes the ERD technology much more aggressive than some of the more traditional remediation technologies which rely on natural dissolution to access sorbed or separate-phase mass.

The following is a list of advantages and disadvantages for IRZs.

*Advantages*

- In-situ technique that enhances naturally occurring mechanisms for VOC mass destruction;

- Does not require above ground treatment equipment or produce a waste stream requiring discharge;

- Controls the migration of contaminated groundwater through the establishment of a subsurface reactive zone;

- Directly addresses adsorbed VOC mass on the soil matrix making it possible to remove VOC mass from the subsurface at a much greater rate than conventional treatment technologies;

- Increases NAPL degradation rates via enhanced NAPL dissolution rates;

- Creates an in-situ barrier to the plume migration, thus containing and treating the plume at the same time;

- Low capital and operating costs;

- Injection reagent will diffuse within areas of low permeability making it possible to remediate adsorbed VOC mass typically inaccessible to other in-situ remediation techniques (e.g., in-situ chemical oxidation); and,

- Baseline biogeochemical groundwater sampling results for wells within the contaminant plume indicate naturally occurring reducing conditions that can readily be enhanced.

***Disadvantages***

- Some site demonstrations have indicated that certain natural biogeochemical conditions may not be suitable for the implementation of an anaerobic IRZ.

- Some site demonstrations have indicated that certain hydrogeologic conditions may not be suitable for the implementation of an anaerobic IRZ.

### 5.1.4 In-Situ Chemical Oxidation

In-situ chemical oxidation is a developing remediation technology based on the introduction of an oxidant, such as hydrogen peroxide ($H_2O_2$), into the subsurface. Under the right conditions, the introduction of hydrogen peroxide will result in the production of hydroxyl radicals ($OH^•$), which is a strong chemical oxidizer that will create an environment to oxidize CVOCs such as PCE (and its degradation daughter products TCE, DCE, and vinyl chloride). The reaction is a nearly instantaneous oxidation of these compounds upon contact with hydroxyl radicals.

In-situ chemical oxidation of CVOCs can be accomplished using a reagent system patterned after a hydrogen peroxide – acid – ferrous iron oxidation method developed by H.J.H. Fenton, in the 1890's. Fenton's reagent oxidizes organic compounds by producing hydroxyl radicals, as follows:

$$H_2O_2 + Fe^{2+} \Rightarrow Fe^{3+} + OH^{\bullet} + OH^{-}$$

The hydroxyl radicals formed by the Fenton's reagent are one of the most powerful oxidizers known, more powerful than ozone, potassium permanganate, chlorine, and chlorine dioxide. The key to the Fenton's reagent system is a chain-reaction that recycles the soluble iron. This allows addition of iron at levels of catalytic, rather than stoichiometric, concentrations. The pH must remain below 5 to maintain iron solubility, and must remain above 3 to avoid quenching the hydroxyl radical.

A Fenton's-like oxidation method can be applied to oxidize CVOCs in aquifer systems. Typical systems pre-place ferrous iron and adjust formation pH to 5 or less. Hydrogen peroxide is then injected into the formation, reacting with the iron to generate hydroxyl radical. Alternatively, hydrogen peroxide and pH-adjusted ferrous sulfate are injected simultaneously. In aquifer formations that are naturally low in pH and high in soluble iron, it is possible to forego the pH-adjusted ferrous sulfate injection.

A summary of the Fenton's reaction process for CVOCs is as follows:

$$RHX + Fe^{2+} + H_2O_2 \Rightarrow Fe^{3+} + H_2O + CO_2 + H^{+} + X^{-}$$

In the above reaction, RHX represents a CVOC, where X is the halide (in this case, chloride). The complete destruction of the CVOC yields water, carbon dioxide, a hydrogen ion, and a halide anion. This reaction is rapid, non-selective (natural organic material in the treatment zone will also be oxidized), and generates heat and pressure in the subsurface.

In-situ chemical oxidation utilizing Fenton's reagent will also result in an increased rate of NAPL degradation through increased dissolution with oxidative destruction. This principle is similar to that described above for ERD; however, in-situ chemical oxidation utilizing Fenton's reagent will most likely result in less dissolution of NAPL than other technologies (e.g., ERD and ZVI) because of the relatively short reaction cycle of the hydroxyl radical.

The following is a general list of the advantages and disadvantages of chemical oxidation utilizing Fenton's reagent technology:

*Advantages*

- Does not require above ground treatment equipment or produce a waste stream requiring discharge;
- In-situ chemical oxidation utilizing Fenton's reagent has been proven effective in substantially reducing VOC concentrations in groundwater and soil;
- In-situ chemical oxidation eliminates sorption sites making adsorbed phase contaminant mass more readily available for treatment through oxidation or other means;
- Increases NAPL dissolution rates resulting in increased NAPL degradation rates;
- Aggressive remedial technology; and,
- Low operating cost.

*Disadvantages*

- May require substantial injection quantities to overcome the naturally occurring organic carbon sources, thus becomes more costly to implement;
- Potential to mobilize previously immobile metals;
- Potential for by-product formation;
- Oxidation takes place in the dissolved phase, therefore NAPL must first dissolve into groundwater before it can be oxidized;
- Increase in NAPL degradation rates may be comparatively lower then other available in-situ technologies such as ERD and ZVI.

- A substantial portion of the contamination may be bound within non-degradable organic carbon.

- The effective reactive period of Fenton's reagent is short-lived; therefore, VOCs adsorbed within areas of lower permeability may be inaccessible for remediation.

- Technology will be detrimental to existing microbial communities thereby reducing the effectiveness of an in-situ biological treatment alternative following injection of the in-situ chemical oxidation reagents, if necessary.

#### 5.1.5 Nano-Scale Zero-Valent Iron

The use of elemental metals for in-situ reductive dehalogenation has been developed over the past 8 years. Although several metals (such as zinc or tin) have been proven to be effective in this application, ZVI has been chosen due to its dehalogenation efficacy, cost and benign environmental impact. The dehalogenation process can be best described as anaerobic corrosion of the metal by the CVOC, which is adsorbed directly to the metal surface where the dehalogenation reactions occur. Recent research on ZVI systems indicates three mechanisms are at work in the reductive process:

1. The ZVI acts as a reductant by supplying electrons directly from the metal surface to the adsorbed CVOC;

2. Solubilized ferrous iron can also act as a reductant, albeit at a rate at least an order of magnitude slower; and,

3. ZVI may act as a catalyst for the reaction of hydrogen with the CVOC. In this process the hydrogen is produced on the surface of the iron metal as the result of anaerobic corrosion with water.

ZVI is typically emplaced within the subsurface as a reactive barrier perpendicular to the direction of groundwater flow to intercept the migration of a contaminant plume. The standard method of emplacing the reactive barrier has been trench and fill. However, when the groundwater table is located deep within the subsurface, this method is limited by technical feasibility and cost effectiveness.

New approaches have been recently developed (by ARCADIS) that include two significant improvements over previous common applications of the ZVI reductive dehalogenation technology:

1. Markedly improved reactivity due to greater surface area of nano-scale colloids; and,

2. The ability to emplace barriers through direct delivery by in-situ injection rather then trenching.

The volume of groundwater that can be treated by a given amount of metallic reagent is directly proportional to surface area of metallic agent to liquid volume ratio. Since the width of reaction zone required for any given site setting is inversely proportional to the surface area (Tratnyek et al., 1997), use of a nano-scale colloid with a surface area 1 to 2 orders of magnitude higher than conventional iron materials (e.g., granular iron filings, iron pellets, and iron powder), offers a significant advantage. In addition, enhancements using surfactants, shear-thinning fluids and/or pressure pulse technology (PPT) for the injection of iron colloids into soils are currently being evaluated.

Nano-scale ZVI will also result in an increased rate of NAPL degradation through direct contact between the iron and the NAPL, as well as through increased dissolution followed by reductive dechlorination of the dissolved phase constituents. Destruction of dissolved phase constituents leads to an increased dissolution of NAPL and therefore greater NAPL degradation.

The following is a general list of the advantages and disadvantages of the nano-scale iron injection technology:

*Advantages*

- *In-situ* technology is non-intrusive and can be implemented through typical groundwater monitoring and injection wells.

- Reductive dehalogenation utilizing nano-scale ZVI has been proven effective in substantially reducing VOC concentrations in groundwater.

- Greater surface area of nano-scale ZVI colloids creates increased reactivity and more efficient VOC destruction than conventional (e.g., granular iron filings) ZVIs.

- Direct reduction of NAPL results in increased NAPL degradation rates;

- Aggressive remedial technology.

- Minimal operating cost.

*Disadvantages*

- High capital cost.

- May be difficult to inject and stabilize the colloids in an effective fashion in permeable sediments.

- May be difficult to inject reagents within lower permeability areas; therefore, VOCs adsorbed within these areas may only be accessible for remediation after diffusing into the primary flow streams.

#### 5.1.6 Pump-and-Treat

Pump-and-treat consists of the extraction of contaminated groundwater through a series of recovery wells or trenches. Extracted groundwater is then conveyed via pipeline to a treatment facility and is treated using any one of a number of water treatment methods. Typical treatment methods include air stripping, carbon adsorption or physical-chemical methods such as chemical oxidation. Treated effluent water may then be discharged via a number of methods. Typical discharge options include discharge to a local storm sewer, discharge to surface water, or discharge to diffusion wells. The following is a list of advantages and disadvantages for pump-and-treat systems.

***Advantages***

- Provides hydraulic containment of the contaminated groundwater plume; and,

- Groundwater treatment technologies are technically sound and well proven.

***Disadvantages***

- Requires an aboveground treatment system and discharge of treated effluent. Discharge of the effluent produces the potential for cross contamination of the receiving body (e.g., stream, aquifer) in the event of treatment equipment failure;

- Treatment technologies typically produce waste by-products that require off-site disposal;

- The removal of adsorbed VOC mass on the soil matrix is limited by the rate of diffusive mass transfer into the dissolved phase;

- Pump-and-treat relies on physical flushing of VOC mass from the aquifer, which requires multiple pore volumes of the aquifer to be removed, often with only a small percent of the total mass removed; and,

- Relatively high capital and operation and maintenance costs.

## 5.2 Retained Remedial Action Technologies

The following section identifies the retained remedial action technologies to be utilized in the development of the remedial action alternatives for the Site. Remedial action technologies were retained based on their technical feasibility and applicability to meet the Site RAOs, implementability, and cost effectiveness.

### 5.2.1 NAPL Hand Bailing

Hand bailing was retained as the preferred remedial technology because of its low cost, minimal operation and maintenance requirements, and implementability. Although the use of active/passive selective skimmers may automate NAPL recovery, in general, these systems are not cost effective for low NAPL recovery areas and require frequent operation and maintenance site visits. In addition, selective screens for DNAPL have not been field proven and NAPL selective screens may clog or pass water, thereby producing excess fluids that require disposal. Finally, an automated NAPL recovery system provides no additional benefit over hand bailing because the volume of NAPL recovered at this Site is limited by the rate at which NAPL naturally recovers into the well. This limitation is due to the fact that NAPL is present below the water table rather than on the water table, and its movement is not governed by hydraulic gradients.

### 5.2.2 In-Situ Reactive Zone

The IRZ technique using ERD in groundwater was retained as a preferred remedial technology because of its ability to meet the established RAOs, minimal operation and maintenance requirements, implementability, and low cost. As discussed previously, the in-situ technique enhances naturally occurring mechanisms for VOC mass reduction and does not require above ground treatment equipment or produce a waste stream or waste product requiring discharge and/or disposal. In addition, the IRZ controls the migration of VOC-impacted groundwater through the establishment of the reactive zone and directly addresses adsorbed VOC mass on the soil matrix, thereby making it possible to remove VOC mass from the subsurface at a much greater rate than conventional treatment technologies such as pumping and treatment. Further, the injection reagent will diffuse within areas of low permeability making it possible to remediate adsorbed VOC mass typically inaccessible to other in-situ remediation techniques (e.g., in-situ chemical oxidation). Finally, establishment of an IRZ within areas containing NAPL will result in increased NAPL degradation rates.

### 5.2.3 In-Situ Chemical Oxidation

In-situ chemical oxidation utilizing Fenton's reagent was retained as a preferred remedial technology because of its ability to substantially lower source area contaminant mass, minimal operation and maintenance requirements, implementability, and proven effectiveness at the Site. As discussed previously, in-situ chemical oxidation using Fenton's reagent uses the creation of hydroxl radicals to directly oxidize contaminant mass and does not require above ground treatment equipment or produce a waste stream or waste product requiring discharge and/or disposal. Furthermore, in-situ chemical oxidation eliminates sorption sites making adsorbed phase contaminant mass more readily available for treatment and will also increase NAPL degradation rates, albeit at a slower rate then other retained technologies such as ERD and ZVI.

### 5.2.4 Nano-Scale Zero-Valent Iron

Nano-scale ZVI was retained as a preferred remedial technology because of its ability to substantially lower source area contaminant mass, minimal operation and maintenance requirements, and implementability. As discussed previously, nano-scale ZVI utilizes reductive dehalogenation to degrade contaminant mass and does not require above ground treatment equipment or produce a waste stream or product requiring discharge and/or disposal. Further, nano-scale ZVI will increase NAPL degradation rates through direct degradation of the NAPL and through enhanced dissolution due to degradation of dissolved phase constituents.

### 5.2.5 Pump-and-Treat

Pump-and-treat was retained as a preferred remedial technology for control of VOC migration because of its ability to meet the established RAOs, technical feasibility, and implementability. Although pump-and-treat contains many disadvantages to the IRZ technology, it is capable of hydraulically containing the contaminated groundwater plume.

# 6. Identification and Detailed Analysis of Remedial Action Alternatives

The following section identifies remedial action alternatives established to meet the RAOs for the Site. The remedial action alternatives are comprised of a combination of retained remedial technologies as described in Section 5.2 in order to stabilize the VOC plume and mitigate the further deterioration of off-site groundwater, and to remediate on-site VOC concentrations in groundwater to levels that meet groundwater standards at the downgradient property boundary. Although not explicit, each alternative contains a site-wide long-term groundwater monitoring program conducted for 30-years, institutional controls to ensure that future property use is limited (i.e., restricting the installation of commercial or residential groundwater supply wells), and an ambient air quality sampling program conducted to demonstrate worker health and safety in the adjacent commercial building.

A "No Further Action" alternative (Alternative 1) was evaluated to provide a baseline against which potential alternatives could be compared.

## 6.1 Identification and Description of Selected Remedial Action Alternatives

The following section identifies and provides a detailed description of the selected remedial action alternatives.

### 6.1.1 Alternative 1 – No Further Action

A "No Further Action" alternative was evaluated to provide a baseline against which potential alternatives could be compared. Under this alternative, a site-wide long-term groundwater monitoring program would be conducted for 30-years, an ambient air sampling program would be conducted to demonstrate worker health and safety, and institutional controls would be emplaced to ensure that future property use is limited (i.e., restricting the installation of commercial or residential groundwater supply wells). However, no additional remedial actions would be conducted at the Site; therefore, the established Site RAOs would not be met.

### 6.1.2 Alternative 2 – Continuation of NAPL Hand Bailing, In-Situ Reactive Zone for Source Area Remediation and In-Situ Reactive Zone for Control of VOC Migration

This alternative will address the removal of NAPL, source area remediation, and control of VOC migration as follows:

1. Removal of NAPL by hand bailing;
2. Installation of an IRZ system within the source area for the reduction of source area NAPL, adsorbed phase, and dissolved phase contaminant mass; and,
3. Installation of an IRZ system downgradient of the source area for control of VOC migration.

Under this alternative, NAPL hand bailing will continue on a routine basis from existing monitoring wells until no measurable NAPL exists or until further removal of NAPL is impracticable. The primary goal of NAPL hand bailing is to recover NAPL while reducing the potential for NAPL to be mobilized vertically downward. Preventing the downward migration of NAPL is essential to ensure that aquifer zones that are presently unimpacted or minimally impacted are not adversely affected, and to remove the source area contributing to the downgradient VOC plume. The most effective way to control the downward mobilization of NAPL is to remove or treat it while ensuring that any more aggressive remedial approach does not alter the natural conditions that have prevented any significant adverse impacts to deeper aquifer zones. NAPL recovery will continue in any well that contains measurable amounts of NAPL by hand bailing on a monthly schedule. For purposes of this RAWP it is assumed that NAPL hand bailing will be conducted for seven years. However, the actual timeframe will vary depending on site-specific conditions. During the remedial effort, the quantity, average NAPL recovery rates, and presence of NAPL will be continually monitored; therefore, the recovery schedule and recovery wells may be adjusted at any time during the remedial effort to account for changes in NAPL presence and recovery rates. Recovered NAPL will be containerized in a labeled, sealed 55-gallon drum and will be disposed in accordance with applicable local, state, and federal regulations.

Deep aquifer zone groundwater monitoring will be conducted on a quarterly basis during the period that only NAPL hand bailing is being implemented. The deep aquifer zone monitoring network will consist of monitoring wells MW-18D (screened from 133 to 143 ft bls) and MW-20D (screened from 175 to 185 ft bls). This monitoring effort is being implemented to confirm that VOC concentrations are stable and that VOCs are not migrating vertically downward during the period of NAPL bailing in the source area. Historic and more recent groundwater and NAPL analytical data indicate that the combination of hydrogeologic conditions and physical properties of the NAPL are responsible for the NAPL's very limited impact on groundwater quality at a depth greater than approximately 150 ft bls.

In addition to NAPL hand bailing, an IRZ will be established within the source area and immediately downgradient of the source area for the reduction of source area contaminant mass and for control of VOC migration. The primary goal of the source area IRZ will be to enhance NAPL degradation in order to eliminate NAPL as a continuing source, to reduce source area adsorbed VOC mass, and to reduce source area dissolved VOC mass to the extent practicable. The source area IRZ will be initiated within one year after the NYSDEC issues the ROD for the Site. The primary goal of the IRZ located immediately downgradient of the source area will be to reduce downgradient adsorbed and dissolved VOC mass to the extent practicable, to stabilize and control movement of the on-site groundwater plume, and to minimize potential further deterioration of off-site groundwater.

The two proposed IRZs will utilize existing and proposed monitoring and injection wells screened within the shallow and intermediate zones to inject the molasses reagent and to monitor biogeochemical parameters and VOC concentrations. Injection of reagent for establishment of the source area IRZ will be conducted through two proposed shallow zone injection wells and two proposed intermediate zone injection wells located immediately upgradient of the source area. Injection of reagent for establishment of the IRZ located immediately downgradient of the source area will be conducted through three existing IW-5, IW-6, and IW-16 shallow zone injection wells and five existing IW-10, IW-11, IW-13, IW-14, and IW-15 intermediate zone injection wells. It is anticipated that the injections will need to be completed every two-weeks during the first month of IRZ implementation. Following the first month, the molasses injections will be reduced to a less frequent schedule. However, data collected during the implementation of an IRZ may indicate the need to alter the molasses injection frequency at any time. A monitoring program will be established during the first year of IRZ implementation to provide data to evaluate whether changes in the injection volume, solution strength, or injection frequency are needed. One existing (MW-13) and one proposed shallow monitoring well and one existing (MW-13D) and one proposed intermediate monitoring well will be used to monitor the shallow and intermediate groundwater for the source area IRZ. Three existing (MW-7, MW-8, and MW-32) shallow zone monitoring wells and three existing (MW-23, MW-27D, and MW-33) intermediate zone monitoring wells will be used to monitor shallow and intermediate groundwater for the IRZ located immediately downgradient of the source area. Groundwater samples will be collected and analyzed for organic and inorganic parameters. These analyses will include field parameters, electron acceptors, biodegradation by-products, other biogeochemical indicators, and conventional analyses of VOCs.

#### 6.1.3 Alternative 3 - Continuation of NAPL Hand Bailing, In-Situ Chemical Oxidation for Source Area Remediation and In-Situ Reactive Zone for Control of VOC Migration

This alternative will address the removal of NAPL, source area remediation, and control of VOC migration as follows:

1. Removal of NAPL by hand bailing;

2. In-situ chemical oxidation utilizing Fenton's reagent within the source area for the reduction of source area NAPL, adsorbed and dissolved phase contaminant mass; and,

3. Installation of an IRZ system downgradient of the source area for control of VOC migration.

Under this alternative NAPL hand bailing and control of VOC migration will be addressed as outlined in Alternative 2. However, source area remediation will be completed through in-situ chemical oxidation utilizing Fenton's reagent as described below.

In addition to NAPL hand bailing and the installation of an IRZ downgradient of the source area for control of VOC migration, in-situ chemical oxidation utilizing Fenton's reagent will be implemented within the source area. The primary goal of in-situ chemical oxidation will be to enhance NAPL degradation in order to eliminate NAPL as a continuing source, to reduce source area adsorbed VOC mass, and to reduce source area dissolved VOC mass to the extent practicable.

In-situ chemical oxidation utilizing Fenton's reagent will be implemented and monitored through existing and proposed injection and monitoring wells. Specifically, reagents will be injected into seven shallow zone wells and nine intermediate zone wells. System performance monitoring will be conducted during and following the reagent injections utilizing two proposed shallow and two proposed intermediate groundwater monitoring wells located immediately downgradient of each injection well transect.

Based on existing groundwater analytical data, it is anticipated that shallow and intermediate zone groundwater within the source area will need to be adjusted for pH and amended with ferrous iron prior to injecting hydrogen peroxide. Assuming a natural oxidant demand (naturally occurring organic matter other then VOCs that will consume oxidant) of 1,500 milligrams per kilogram (mg/kg), and a total source area treatment volume of 57,300 cubic feet, approximately 204,000 gallons (gal) of five percent hydrogen peroxide would be required to overcome the natural oxidant demand within the source area. Assuming a 1 to 10 mass ratio of ferrous iron to hydrogen peroxide, approximately 14,000 gal of 35 percent ferrous sulfate heptahydrate would be required to provide sufficient ferrous iron to completely catalyze the hydrogen peroxide to hydroxyl radicals.

Because of the unknown contribution of natural oxidant demand, it was assumed that in-situ chemical oxidation would be applied incrementally in three annual injections. Under this methodology, each injection will be followed by a six-month post-injection monitoring period to assess the performance of the reagent injection, and to establish more precise design parameters for the follow up injections, if necessary.

#### 6.1.4 Alternative 4 - Continuation of NAPL Hand Bailing, Nano-Scale Zero-Valent Iron with the Establishment of a Limited In-Situ Reactive Zone for Source Area Remediation and In-Situ Reactive Zone for Control of VOC Migration

This alternative will address the removal of NAPL, source area remediation, and control of VOC migration as follows:

1. Removal of NAPL by hand bailing;

2. Nano-scale ZVI and the establishment of a limited IRZ within the source area for the reduction of source area NAPL, adsorbed phase, and dissolved phase contaminant mass; and,

3. Installation of an IRZ system downgradient of the source area for control of VOC migration.

Under this alternative NAPL hand bailing and control of VOC migration will be addressed as outlined in Alternative 2. However, source area remediation will be completed through the injection of nano-scale ZVI as described below. The primary goal of the nano-scale ZVI will be to enhance NAPL degradation in order to eliminate NAPL as a continuing source, to reduce source area adsorbed VOC mass, and to reduce source area dissolved VOC mass to the extent practicable.

Nano-scale ZVI will be implemented and monitored through existing and proposed injection and monitoring wells. It is anticipated that nano-scale ZVI will be delivered to the subsurface using PPT through one proposed shallow injection well and one proposed intermediate injection well located within the source area. PPT utilizes the creation of a porosity dilation wave by pulsing an injectate into the saturated zone resulting in significantly enhanced fluid flow characteristics through a permeable geologic matrix. PPT has been utilized for years within the oil field industry to enhance the recovery of oil into petroleum reservoirs and has recently been introduced into the environmental industry by Wavefront Environmental Technologies for enhancing NAPL recovery, and for enhancing the injection of reagents. Nano-scale ZVI System performance monitoring will be conducted following an injection event utilizing existing shallow Monitoring Well MW-13 and existing intermediate Monitoring Well MW-13D.

The required mass of nano-scale ZVI would initially be estimated during the detailed system design by retaining the highest mass required for the following three mechanisms: 1) reaction kinetics; 2) stoichiometrics; and, 3) iron surface area to water ratio (target of $1m^2$ of iron surface area to 1-milliter [ml] of water). In addition, a bench scale treatability test would be conducted to confirm that nano-scale ZVI would be capable of remediating the source area and to aid in determining the final nano-scale ZVI injection quantities and methodology. For cost estimating purposes only, it was assumed that 7,800 lbs of nano-scale ZVI will be required. Because of the variance in reactive surface area values listed in the literature and the variance in reactivity caused by site-specific conditions, it was assumed that the nano-scale ZVI will be injected over three separate injections at 2,600 lbs per injection. Under this methodology, each injection will be followed by a six-month post-injection monitoring period to assess the performance of the injection, and to establish more precise design parameters for the follow up injections, if necessary.

In addition to the injection of nano-scale ZVI, a limited IRZ would be established within the source area to enhance the performance of the nano-scale ZVI within the source area. It is anticipated that establishment of a limited IRZ will:

- Increase the active life of the nano-scale ZVI by eliminating oxidative scavengers (e.g., dissolved oxygen);

- Enhance VOC mass destruction through biotic ERD; and,

- Enhance VOC mass destruction through direct degradation of the NAPL and through enhanced dissolution due to degradation of dissolved phase constituents.

The limited IRZ would be implemented and monitored through existing and proposed injection and monitoring wells. Reagent injections would be completed through two proposed shallow and two proposed intermediate injection wells. IRZ performance monitoring would be limited to field parameter monitoring and would be conducted within the two proposed nano-scale ZVI injections wells (shallow and intermediate) and one existing shallow (MW-13) and one existing intermediate (MW-13D) monitoring well.

#### 6.1.5 Alternative 5 – Continuation of NAPL Hand Bailing and Pump-and-Treat for Control of VOC Migration and Source Area Remediation

This alternative will address the removal of NAPL, source area remediation, and control of VOC migration as follows:

1. Removal of NAPL by hand bailing;

2. Installation of a pump-and-treat system for control of VOC migration and source area remediation.

Under this alternative, NAPL hand bailing and residual VOCs within the source area will be addressed as outlined in Alternative 2. However, source area remediation and control of VOC migration will be conducted utilizing an on-site pump-and-treat system. The primary goal of the pump-and-treat system will be to control the movement of the on-site groundwater plume at the property boundary and to reduce VOC concentrations within the source area, thus minimizing potential further deterioration of off-site groundwater.

In this alternative the pump-and-treat system will consist of five newly installed shallow and intermediate groundwater recovery wells. One shallow and one intermediate recovery well will be installed within the source area to contain source area groundwater, one shallow and one intermediate recovery well will be installed at a central location downgradient of the source area recovery well to contain groundwater at the localized downgradient hot spot, and one shallow/intermediate (screened within both the shallow and intermediate zone) recovery well will be installed at the downgradient property boundary to contain groundwater at the property boundary, thereby preventing the VOC plume from further migrating off-site. For purposes of this RAWP, recovery rates were assumed for each location based on known hydrologic parameters from nearby sites, regional data, and engineering judgment. The assumed recovery rates are 60-gallons per minute (gpm) at the source area (30-gpm shallow and 30-gpm intermediate), 60-gpm at the localized downgradient hotspot (30-gpm shallow and 30-gpm intermediate), and 40-gpm at the downgradient property boundary. The exact location of recovery wells and groundwater recovery rates would be determined as part of the final engineering design.

For purposes of this RAWP, it was assumed that extracted groundwater would be conveyed via a below grade pipeline along the eastern property boundary to a treatment building located at the northeastern property boundary. Recovered groundwater would first be routed through a NAPL separator to remove NAPL that may be recovered, and would then be treated via low profile air strippers to remove dissolved phase CVOCs. Treated effluent would be discharged to two on-site diffusion wells located immediately adjacent to the proposed treatment building. If the air stripper off-gas needs to be treated, two 3000-pound (lb) vapor phase granular activated carbon (VPGAC) units would be used. However, the exact requirements for off-gas treatment would be evaluated for compliance with NYSDEC Air Guide 1 during the final engineering design.

### 6.2 Description of Evaluation Criteria

The following section provides a detailed evaluation of each remedial alternative with respect to the criteria of the National Contingency Plan (NCP) (per 40 CFR Part 300, as revised in 1990) and 6 NYCRR Part 375. A brief description of the individual evaluation criteria is provided below.

#### 6.2.1 Threshold Criteria

These first two criteria must be satisfied for a remedial alternative to be eligible for selection, and include:

- Protection of Human Health and the Environment:

  This criterion requires that an alternative be assessed to determine if it is protective of human health and the environment. This evaluation is based upon a composite of factors assessed under some of the other criteria, specifically short- and long-term effectiveness, and compliance with ARARs.

- Compliance with ARARs:

  Under this criterion, the issue of whether a remedial alternative meets ARARs under federal and state environmental laws and regulations is assessed. If one or more of these laws and regulations would not be met upon the implementation of a remedial alternative, then grounds for invoking a waiver must be provided.

#### 6.2.2 Primary Balancing Criteria

The next five criteria are used to compare and contrast the positive and negative aspects of the various remedial alternatives being evaluated, and include:

- Short-term Effectiveness:

  Under this criterion, the potential short-term impacts of a remedial action upon the community, the Site workers, and the environment are evaluated. The period of time required to implement the remedial measure is also estimated and compared against the other alternatives.

- Long-term Effectiveness and Permanence:

  The long-term effectiveness and permanence of a remedial alternative after implementation is evaluated. If wastes or residuals will remain at the Site after implementation, then the following items are evaluated: (1) the magnitude and nature of the residual risks posed by the remaining wastes; (2) the adequacy of the controls intended to limit the risks; and (3) the reliability of these controls.

- Reduction of Toxicity, Mobility and Volume through Treatment:

  Under this criterion, the ability of an alternative to permanently and significantly reduce toxicity, mobility or volume of the wastes is evaluated. Preference is given to remedial alternatives where this can be achieved.

- Implementability:

  Under this criterion, the technical and administrative feasibility of implementing a remedial alternative are evaluated. For technical feasibility, the difficulties associated with the construction and operation of the alternative and the ability to monitor the effectiveness of the remedy are evaluated. For administrative feasibility, the availability of the necessary personnel and material is evaluated, along with the potential difficulties in obtaining special permits, rights-of-way, etc.

- Cost:

  Capital costs and O&M costs are estimated for each remedial alternative and compared on a qualitative basis. Although cost is the last criterion evaluated, where two or more alternatives have met the requirements of the other criteria, cost effectiveness should be used as the basis for final remedy selection.

#### 6.2.3 Modifying Criteria

This final criterion is taken into account after evaluating those described above. This criterion is dependant on public comments on the PRAP NYSDEC comments. Therefore, this RAWP addresses only the above seven criteria.

### 6.3 Comparative Analysis of Alternatives

The following section provides a comparative analysis of the alternatives presented above. This comparison will be used to distinguish the relative benefits and drawbacks of each alternative based on the seven criteria detailed in Section 6.2. Table 2 summarizes the remedial alternative screening process. The criteria presented in Table 2 are screened as unfavorable, moderately favorable, favorable and highly favorable. Unfavorable is a medium specific term indicating the alternative does not address the goal adequately. Moderately favorable is a medium specific term indicating that some of the specific goals for a criterion have been met, but other alternatives may address the goal more effectively. Favorable is a medium specific term indicating an acceptable level of satisfaction of goals based on USEPA guidance. Highly favorable is a medium specific term indicating an acceptable level of satisfaction of goals based on USEPA guidance and that the alternative addresses the goal more effectively when compared to other favorable alternatives.

#### 6.3.1 Overall Protection of Human Health and the Environment

Alternatives 1, 2, 3, 4 and 5 provide for protection of human health on-site because all five alternatives include the implementation of a long-term groundwater monitoring and ambient air sampling program that would provide early warning of potential hazards in the event that on-site groundwater contaminant levels increase. As stated previously, historical indoor air quality monitoring within the on-site building has shown that there is no health hazard to individuals within, or outside, of the building. Therefore, if on-site groundwater contaminant levels do not increase, indoor air quality within the on-site building will not deteriorate to levels detrimental to human health. Alternatives 2, 3, 4 and 5 provide additional benefit by containing and treating the full on-site portion of the groundwater plume, thereby further reducing any potential future risk to on-site workers and/or off-site receptors.

Alternatives 2, 3 and 4 provide for equal protection of human health and the environment because these alternatives would contain and treat the full on-site portion of the groundwater plume, control degradation of off-site groundwater quality, and prevent downgradient migration to off-site receptors. Furthermore, these alternatives will remediate the contaminants in-situ, reducing the risk to Site workers and the adjacent environment. Alternative 5 will provide for protection of human health and the environment; however, pumping of contaminated water to above ground treatment equipment will provide a greater risk for worker and environmental exposure to contaminants. Alternative 1 provides a lesser degree of protection of human health because it provides no additional remedial actions and could potentially allow plume migration to off-site receptors.

#### 6.3.2 Compliance with ARARs

Alternatives 2, 3, 4 and 5 will achieve compliance with ARARs through the removal of NAPL at the source area and through treatment of on-site adsorbed phase and dissolved phase contaminants. Alternative 1 is not likely to achieve compliance with ARARs in a reasonable timeframe because no additional remedial activities will be conducted under this alternative.

As described previously, Alternative 2 will provide treatment of source area and residual downgradient adsorbed and dissolved phase contaminants through the implementation of two IRZs. NAPL will be remediated through source area hand bailing and through enhanced dissolution through establishment of a source area IRZ. Alternative 3 will provide treatment of source area and residual downgradient adsorbed and dissolved phase contaminants through the implementation in-situ chemical oxidation within the source area and the establishment of an IRZ downgradient of the source area. NAPL will be remediated through source area hand bailing and through enhanced dissolution through in-situ chemical oxidation. Alternative 4 will provide treatment of source area and residual downgradient adsorbed and dissolved phase contaminants through the implementation of nano-scale ZVI with limited IRZ within the source area and the establishment of an IRZ downgradient of the source area. NAPL will be remediated through source area hand bailing and through enhanced dissolution through nano-scale ZVI. Alternative 5 will provide treatment of source area and residual downgradient adsorbed and dissolved phase contaminants through the implementation of an on-site pump-and-treat system.

Although pump-and-treat systems have been proven effective in treating recovered groundwater to below ARARs, mass removal rates from the aquifer are typically limited by the slow rate of diffusive mass transfer of contaminants desorbing from the soil matrix into the dissolved phase. In addition, because the IRZ, in-situ chemical oxidation, and nano-scale ZVI technologies increase the rate of NAPL dissolution and directly address adsorbed phase mass, it is possible to remove VOC mass from the subsurface at a much greater rate than could be achieved through pump-and-treat. Therefore, Alternatives 2, 3 and 4 will have a higher likelihood of achieving compliance with ARARs within a shorter timeframe than Alternative 5. Of Alternatives 2, 3, and 4, Alternative 2 will have the highest likelihood of achieving compliance with ARARs within the shortest timeframe because the molasses reagent utilized with IRZ is capable of diffusing within areas of lower permeability. This provides a greater opportunity to remediate adsorbed phase VOCs within these zones as compared to Alternatives 3 and 4. As discussed in Section 2.4.2, lenses of lower permeability deposits have been encountered during the installation of on-site monitoring wells.

#### 6.3.3 Short-Term Effectiveness

As described below, the potential for Site worker and community exposure to contaminants, and the impacts to the environment varies between alternatives.

Of the five alternatives, Alternative 1 provides the least short-term negative impacts to the community, Site workers or the environment as a result of the remedial actions because there are limited opportunities for exposure (groundwater sampling only) and because current Site conditions indicate that there is currently no on-site or off-site exposure. Alternative 5 has the highest potential for short-term negative impacts to the community, Site workers or the environment due to the fact that Alternative 5 relies on the extraction of groundwater ex-situ in order to treat the environmental impacts. This allows the opportunity for exposure to COCs in the extracted groundwater and in the air stripper off-gas during operation. There is also the potential for equipment failure during startup activities and during operation of the pump-and-treat system, leading to more extensive exposure on- and off-site. However, adequate QA/QC and maintenance measures would be emplaced to prevent the potential for an uncontrolled release to the environment. Under Alternatives 2, 3, 4 and 5 there is also a short-term risk of exposure to Site workers directly responsible for NAPL hand bailing during the routine NAPL hand bailing events. In addition, under Alternative 3 there is a short-term risk of exposure to hazardous chemicals (hydrogen peroxide and ferrous sulfate) by Site workers directly responsible for the in-situ chemical oxidation injections. However, protective measures (personal protective equipment and implementation during non-working hours) would be used to minimize Site worker exposure.

Of the five alternatives, Alternative 1 provides the greatest short-term effectiveness with respect to the timing of the remedial action because little additional activity is required to implement it. Alternatives 2, 3 and 4 are also effective with respect to timing in the short-term because: 1) IRZs, nano-scale ZVI and in-situ chemical oxidation typically do not require extensive detailed construction drawings and the installation of invasive aboveground/belowground treatment structures, which can take one year or longer to complete for pump-and-treat systems; and 2) the IRZ, nano-scale ZVI and in-situ chemical oxidation approaches require less extensive permitting prior to active operation when compared to an extraction, treatment, and discharge activities associated with pump-and-treat.

#### 6.3.4 Long-Term Effectiveness and Permanence

As described below, the long-term effectiveness in achieving the RAOs, the O&M requirements, potential for Site worker and community exposure to contaminants, and the impacts to the environment vary between alternatives.

Of the five alternatives, Alternative 1 provides the least long-term effectiveness in achieving the Site RAOs because no additional remedial activities will be conducted. Alternatives 2, 3, 4 and 5 would be effective in the long-term in achieving the Site RAOs. However, Alternatives 2, 3 and 4 will be more effective in achieving the Site RAOs then Alternative 5 because the IRZ, in-situ chemical oxidation, and nano-scale ZVI technologies increase the rate of NAPL dissolution and directly address adsorbed phase mass, thereby making it possible to remove VOC mass from the subsurface at a much greater rate than could be achieved through pump-and-treat. Of Alternatives 2, 3, and 4, Alternative 2 will have the highest likelihood of achieving the Site RAOs within the shortest timeframe because the molasses reagent utilized with IRZ is capable of diffusing within areas of lower permeability. This provides a greater opportunity to remediate adsorbed phase VOCs within these zones as compared to Alternatives 3 and 4.

Of the five alternatives, Alternative 1 has the least O&M requirements and is the most versatile because there are no additional remedial actions. Alternatives 2, 3 and 4 are more versatile then Alternative 5 because they do not require permanent aboveground/belowground treatment structures or mechanical components, and can easily be enhanced to address additional areas of contamination, if necessary. Furthermore, because Alternatives 2, 3 and 4 do not require the installation of treatment structures or mechanical components there is less potential for equipment failure and system downtime. Therefore, Alternatives 2, 3 and 4 provide better protection of human health and the environment and have minimal O&M requirements.

Of the five alternatives, Alternative 1 provides the greatest potential for long-term negative impacts to the community and the environment. Although the likelihood of off-site contamination impacting a public supply well is low, the potential for site-related VOC contamination to impact commercial and public supply wells would remain with this alternative for a longer period of time than with the other alternatives. Alternatives 2, 3 and 4 provide the least long-term negative impacts to the community, Site workers or the environment as a result of the remedial actions. Alternatives 2, 3, and 4 will reduce source area contaminant mass to the extent practical through implementation of IRZ, in-situ chemical oxidation, and nano-scale ZVI technologies, respectively. In addition, each of these alternatives includes a downgradient IRZ to reduce downgradient contaminant mass to below applicable ARARs prior to off-site migration. As described previously, IRZ involves the injection of a carbon source to the subsurface to enhance the natural microbial population. The final degradation by-products include carbon dioxide, water, and chloride ions.

Alternative 5 has a higher potential for long-term negative impacts to the community, Site workers or the environment due to the fact that Alternative 5 relies on the extraction of groundwater ex-situ in order to treat the environmental impacts. This allows the opportunity for exposure to the COCs in the extracted groundwater and in the air stripper off-gas during operation. There is also the potential for equipment failure during operation of the pump-and-treat system leading to more extensive exposure on- and off-site. However, adequate QA/QC and maintenance measures would be emplaced to minimize the potential for an uncontrolled release to the environment.

#### 6.3.5 Reduction of Mobility, Toxicity, and Volume Through Treatment

Alternatives 2, 3, 4 and 5 will reduce the mobility, toxicity, and volume of waste through the implementation of the remedial actions. Under Alternative 1, no additional remedial activities will be conducted. Therefore, there will be minimal reduction in toxicity, mobility or volume of VOC mass.

Alternatives 2, 3 and 4 will provide for a greater reduction of toxicity and volume of waste as compared to Alternative 5. As stated previously, the IRZ, in-situ chemical oxidation, and nano-scale ZVI technologies increase the rate of NAPL dissolution and directly address adsorbed phase mass, thereby making it possible to remove VOC mass from the subsurface at a much greater rate than could be achieved through pump-and-treat. The total volume of waste reduction via pump-and-treat within the subsurface is limited by the rate of diffusive mass transfer from the adsorbed phase to the dissolved phase. Of Alternatives 2, 3, and 4, Alternative 2 will be the most effective in reducing the toxicity and volume of waste because the molasses reagent used with IRZ is capable of diffusing within areas of lower permeability. This provides a greater opportunity to remediate adsorbed phase VOCs within these zones as compared to Alternatives 3 and 4.

All of the remedial alternatives would reduce the mobility of wastes and prevent further off-site migration of contaminants through either the establishment of a downgradient IRZ (Alternatives 2, 3, and 4) or through pump-and-treat (Alternative 5).

#### 6.3.6 Implementability

As described below, each alternative evaluated in this RAWP is expected to be technically and administratively implementable. The ease of installation would vary based on the alternative evaluated.

Of the five alternatives, Alternative 1 is the most technically and administratively implementable because it involves no additional remedial actions. Alternative 2 is the most technically and administratively implementable of the alternatives involving active remediation. NAPL hand bailing and IRZs are both demonstrated and proven technologies for the COCs at the Site and require minimal O&M. In addition, this alternative requires minimal environmental permitting.

Alternative 3 is both technically and administratively implementable; however, this alternative will require a higher degree of technical planning and administrative work as compared to Alternatives 1 and 2. Because in-situ chemical oxidation using Fenton's chemistry contains a relatively short effective reactive period as compared to IRZs, substantial planning is required to ensure that the chemical reagents are properly introduced into the subsurface to provide adequate contact between reagent and contaminants. Additional administrative factors to be considered under Alternative 3 include the development of more detailed health and safety requirements and regulatory and community acceptance due to the injection of potentially hazardous reagents.

Alternative 4 is both technically and administratively implementable; however, this alternative will require a higher degree of technical planning as compared to Alternatives 1 and 2. Because nano-scale ZVI relies on the injection of a solution containing suspended colloidal particles, adequate planning is required to ensure that the nano-scale ZVI is emplaced effectively to provide sufficient contact between the nano-scale ZVI and contaminants.

Alternative 5 is technically and administratively implementable; however, this alternative will require a higher degree of administration as compared to Alternatives 1 and 2. Additional administrative factors to be considered under Alternative 5 include the development of a more detailed construction design, installation of the pump-and-treat system, and the application for air and water discharge permits.

#### 6.3.7 Cost

The estimated capital, O&M, and groundwater monitoring costs vary for each of the five alternatives. Alternative 1 is a low cost alternative, Alternatives 2, 3 and 4 are medium to low cost and Alternative 5 is a high cost alternative.

Alternative 2 is the lowest cost alternative capable of achieving the RAOs. Specifically, Alternative 2 is substantially less expensive to construct, operate, maintain, and monitor than Alternatives 3, 4, and 5. Alternative 2 does not require the installation of aboveground/belowground treatment structures, does not require electrical consumption for the operation of treatment equipment, and does not produce residual wastes (e.g., treated groundwater and VPGAC) requiring disposal. Further, raw material costs for Alternative 2 (e.g., injection reagents) are substantially lower then Alternatives 3 and 4. Alternatives 2, 3, and 4 will require an expanded groundwater monitoring parameter list to evaluate the effectiveness of the IRZ, however this monitoring program will run over a shorter period of time as compared to Alternative 5.

# 7. Selected Remedial Action Alternative

Based on the analyses conducted in this RAWP, ARCADIS has selected Alternative 2 as the preferred remedial alternative for the following reasons:

- Alternative 2 is protective of human health and the environment because it is the remedial technology most capable of maximizing VOC mass removal and meeting RAOs in a reasonable timeframe;

- Alternative 2 would effectively reduce the contaminant toxicity, volume, and mobility, thereby minimizing potential future exposures to off-site receptors;

- Alternative 2 is expected to be effective in the short-term, long-term, and as a permanent solution;

- Alternative 2 is the most technically and administratively feasible of the remedial alternatives;

- Alternative 2 has minimal short-term or long-term negative side effects to Site workers, the community, and the environment; and,

- Alternative 2 is the lowest cost alternative that meets the site-specific RAOs.

# 8. Detailed Description of Selected Remedial Action Alternative

The following section provides a detailed description of the selected remedial action alternative.

## 8.1 NAPL Recovery Methodology

The hand bailing of NAPL from any well that contains measurable amounts of NAPL will continue on a routine schedule until free-phase product is no longer present. Recovered NAPL will be containerized in a labeled, sealed 55-gallon drum. The 55-

gallon drum will be stored in a secure location and will be disposed of in accordance with applicable local, State, and Federal regulations. ARCADIS will evaluate NAPL recovery volumes, thickness data, and groundwater quality on an ongoing basis to determine if more effective methods can be used to address residual NAPL that may remain trapped in the aquifer matrix. NAPL recovery wells may be added or removed from the routine schedule based on the results of NAPL gauging during the routine monitoring visits.

### 8.2 IRZ Implementation Methodology

The following section describes the IRZ implementation methodology for the IRZ located immediately downgradient of the source area and for the source area IRZ.

#### 8.2.1 IRZ Located Downgradient of the Source Area Implementation Methodology

Implementation of the IRZ located downgradient of the source area will be conducted in accordance with the NYSDEC approved "Enhanced Reductive Dechlorination Pilot Test Workplan" (Appendix C) during the first 6 to 12 months of operation, and clarification provided in the December 11, 2002 Response to NYSDEC Comments on the Draft Remedial Action Plan (Appendix D).

After the first six months of implementation, ARCADIS will evaluate the results of the pilot test and a pilot test summary report will be prepared. Decisions regarding continuation of the IRZ located downgradient of the source area will be as follows:

1. If, after the first six to twelve months of implementation, the ERD pilot test has demonstrated that an anaerobic reducing IRZ can be established at the Site and that the natural rate of reductive dechlorination can be enhanced, ARCADIS will prepare an interim IRZ Workplan. If accepted by the NYSDEC, reagent injections and monitoring will be conducted in accordance with the interim IRZ Workplan until NYSDEC issuance of a ROD describing the selected remedial action alternative. Following NYSDEC approval, ARCADIS will prepare a Long-Term Groundwater Monitoring Plan as discussed in Section 9 of the RAWP.

2. If, following the six-month pilot test period, the ERD pilot test performance objectives listed in No. 1 above cannot be demonstrated; ARCADIS will reevaluate appropriate remedial technologies for control of VOC migration.

Technologies to be reevaluated may include in-situ chemical oxidation, nano-scale ZVI, and pump-and-treat.

### 8.2.2 Source Area IRZ Implementation Methodology

The source area IRZ can be implemented within one year of NYSDEC issuance of a ROD describing the selected remedial action alternative. However, if the IRZ downgradient of the source area achieves the pilot test objectives prior to issuance of the ROD, ARCADIS may propose to expedite implementation of the source area IRZ. ARCADIS will include the source area injections in the interim IRZ Workplan. If accepted by the NYSDEC, source area reagent injections and monitoring will be conducted as outlined in the interim IRZ Workplan until NYSDEC issuance of the ROD describing the selected remedial action alternative. Following NYSDEC approval, ARCADIS will prepare a Long-Term Groundwater Monitoring Plan as discussed in Section 9 of the RAWP.

If, following the six-month pilot test period for the IRZ located downgradient of the source area, the ERD pilot test performance does not justify expansion into the source area, ARCADIS will reevaluate appropriate remedial technologies for the source area. Technologies to be reevaluated may include IRZs, in-situ chemical oxidation, nano-scale ZVI, and pump-and-treat. In any case, the implementation of the source area remedy will be conducted within one year of startup and operation of an appropriate technology for control of VOC migration.

Source area IRZ implementation will be conducted in a similar manner to that of the IRZ located downgradient of the source area and will consist of reagent injections and subsequent system performance monitoring. Specifically, the reagent injection procedures will remain consistent with the methodology outlined in Section 5.5 of the "Enhanced Reductive Dechlorination Pilot Test Workplan" with the exception of the injection of a conservative tracer. A log will be kept during each injection event to record the solution strength (molasses and water volumes used), the total volume of solution injected into each injection well, the injection pressure at each injection well, and the injection flow rate. These measurements will be monitored to evaluate the condition of the well screens and whether well maintenance activities are needed. The wells will be redeveloped, as necessary. Copies of the molasses injection logs will be provided in the monthly Progress Reports. Hydrologic information obtained from injection of the conservative tracer and the required injection frequency, solution strength, and volume obtained during implementation of the ERD pilot test will be used in the development of the interim IRZ Workplan. The proposed injection well network and a brief discussion of the proposed groundwater-monitoring program is provided below.

#### *8.2.2.1 Injection Well Network*

The conceptual injection well network will consist of four injection wells located near and upgradient of the source area. The injection well locations will be selected based on the configuration of the on-site groundwater plume located at the source area and the anticipated extent of free-phase NAPL. Two injection wells will be installed within the shallow zone and will be screened from 50 to 70 ftbls. The remaining two injection wells will be installed within the intermediate zone and will be screened from 70 to 100 ftbls. It is anticipated that injection into these wells will be capable of treating the full on-site portion of the plume within the source area; however additional injection wells may be added based on the results of the ERD pilot test. Furthermore, following recovery of all available free-phase NAPL within the source area, additional injection wells may be added at a downgradient source area location depending on the results of the source area IRZ monitoring program, if necessary.

#### *8.2.2.2 IRZ Groundwater Monitoring*

As discussed previously, ARCADIS will prepare an interim source area IRZ monitoring plan. If accepted by the NYSDEC, source area reagent injections and monitoring will be conducted as outlined in the interim IRZ Workplan until NYSDEC issuance of a ROD describing the selected remedial action alternative. Following NYSDEC approval, ARCADIS will prepare a Long-Term Groundwater Monitoring Plan as discussed in Section 9 of the RAWP that will include a detailed description of the proposed source area IRZ monitoring. It is anticipated that source area IRZ monitoring will include a shallow zone and an intermediate zone monitoring well to monitor the performance of the source area IRZ using existing and/or proposed monitoring wells. The groundwater sampling procedures and list of analytes will be consistent with those outlined in the "Enhanced Reductive Dechlorination Pilot Test Workplan". The final number and locations of groundwater monitoring wells and the groundwater sampling frequency will be determined based on a review of the then current groundwater plume configuration, site-specific hydrogeologic data, and the results of the ERD pilot test.

## 9. Long-Term Groundwater Monitoring

Following NYSDEC approval of the selected remedial action alternative outlined in the RAWP, ARCADIS will prepare and submit to the NYSDEC a Long-Term Groundwater Monitoring Plan for the Site. The Long-Term Groundwater Monitoring Plan will detail a groundwater monitoring program and reporting schedule suitable for evaluation of the source area IRZ, the IRZ located downgradient of the source area, and for overall evaluation of the plume configuration. The long-term groundwater monitoring program will be implemented upon NYSDEC approval of the Long-Term Groundwater Monitoring Plan.

Two (2) compliance plane monitoring wells will be installed adjacent to shallow zone monitoring well MW-31 (screened from 60 to 70 ft bls) in order to monitor compliance with groundwater standards at the downgradient property boundary. These shallow zone monitoring wells will be installed at a later date to demonstrate compliance for site closure.

## 10. Ambient Air Quality Monitoring

Ambient air quality monitoring will be conducted at the Site to evaluate whether remedial activities are affecting the potential pathway of vapor intrusion. Although a potential pathway exists for an employee or on-site worker to be exposed to COCs in indoor air, a quarterly indoor air monitoring program conducted voluntarily by WHCS between October 1999 and April 2001 showed that there is no health hazard to individuals within, or outside, of the building. Therefore, the inhalation of COCs pathway is not expected to be a future concern at the Site. Historic air quality monitoring data collected by CDM from October 1999 to April 2001 indicated that the highest detected concentration of a site-related COC (PCE) was 9.65 micrograms per cubic meter ($\mu g/m^3$). This concentration is within background levels for PCE that were established by the New York State Department of Health, (NYSDOH) in a study conducted by the Bureau of Toxic Substance Assessment. The study was conducted between 1989 and 1996 and is entitled "Background Indoor/Outdoor Air Levels of Volatile Organic Compounds in Homes Sampled by the New York State Department of Health, 1989-1996" (NYSDOH, 2003). Furthermore, this concentration is well below the NYSDOH guideline of 100 $\mu g/m^3$ for PCE. NYSDOH recommends that the average air level for PCE in a residential community not exceed 100 $\mu g/m^3$, considering continuous lifetime exposure and sensitive people.

A baseline ambient air quality monitoring event was conducted by ARCADIS in July 2003 prior to commencing the ERD pilot test reagent injections in order to aid in the evaluation of indoor air quality data. Air quality sampling was conducted at two (2) locations in an area occupied by AT&T, and at one (1) outdoor location adjacent to the AT&T floor space along the east side of the office building. The laboratory analytical results show that no site-related COCs were detected in ambient air.

Air quality sampling will be conducted in accordance with procedures set forth in USEPA Compendium Method TO-14A, "Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography." Air quality sampling will be conducted at select locations within floor space currently occupied by AT&T, which is adjacent to the IRZ downgradient of the source area, and within the currently unoccupied portion of the building (i.e., in the former NYTD production area). Air samples will be collected over an 8-hour time period utilizing 6-liter Summa canisters. Each Summa canister will contain a calibrated flow controller regulated to collect samples at a continuous and constant flow rate over an 8-hour period. Summa canisters will be placed in locations representative of the breathing zone during sampling.

During each sampling event a log will be completed and signed by the sampler. Sampling parameters recorded in the log will include sample location and ID number, time of initiating and termination of sampling at each location, and initial and final Summa Canister vacuum.

Following collection of all samples, a chain-of-custody will be completed and packaged with the samples prior to shipment to the analytical laboratory. Samples will be shipped to the laboratory via overnight courier.

All sample analyses will be performed by Air Toxics Ltd. located in Folsom, California and will follow USEPA Method TO-14A. Samples will be analyzed for PCE, TCE, 1,1,1-TCA, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCA, 1,1-dichloroethene (1,1-DCE), and VC.

Following receipt of the laboratory analytical data for an individual monitoring round, the results of the monitoring round will be submitted to the NYSDEC, NYSDOH, and SCDHS as part of the monthly progress reports. Indoor air quality monitoring will be discontinued after 4 sampling events unless the data collected indicates the need to continue monitoring in order to demonstrate that remedial activities are not affecting the potential pathway of vapor intrusion.

The Community Air Monitoring Plan (CAMP) for the Site is provided in Appendix E. This CAMP has been prepared to ensure that the community is appropriately protected from potential airborne contaminants related to investigation and remedial work activities. The CAMP will be followed during all ground intrusive activities such as soil excavation and handling, and the installation of soil borings or monitoring wells. The CAMP will also be followed during the demolition of contaminated or potentially contaminated structures and during non-intrusive activities such as the collection of soil samples or the collection of groundwater samples and recovery of NAPL from existing monitoring wells.

## 11. Project Schedule

The proposed project schedule from initiation of the ERD Pilot Test is presented on Figure 8.

## 12. Reporting

ARCADIS will prepare and submit semi-annual progress letters to the NYSDEC during the first year of IRZ and NAPL hand bailing implementation. Progress letters will summarize the results of the groundwater remediation, any groundwater monitoring results, summarize conclusions, and propose modifications to the remedial program, if necessary. Reporting thereafter will be addressed in the Long-Term Groundwater Monitoring Plan as described in Section 9 of this RAWP. ARCADIS will continue to submit monthly Progress Reports as outlined in the Voluntary Cleanup Agreement. Copies of all project related data will also be provided in the monthly Progress Reports.

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Tables

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Table 1. Monitoring Well Construction Details, 25 Melville Park Road Site, Melville, New York.



| Well Designation | Well Diameter (inches) | Screened Interval (feet bls) | Total Depth (feet bls) | Vertical Zone Designation |
|---|---|---|---|---|
| IW-1 | 2 | 45 to 60 | 60 | Shallow Zone |
| IW-2 | 2 | 45 to 60 | 60 | Shallow Zone |
| IW-3 | 2 | 45 to 60 | 60 | Shallow Zone |
| IW-4 | 2 | 45 to 60 | 60 | Shallow Zone |
| IW-5 | 2 | 45 to 60 | 60 | Shallow Zone |
| IW-6 | 2 | 45 to 60 | 60 | Shallow Zone |
| IW-7 | 2 | 45 to 60 | 60 | Shallow Zone |
| IW-8 | 2 | 75 to 90 | 90 | Intermediate Zone |
| IW-9 | 2 | 75 to 90 | 90 | Intermediate Zone |
| IW-10 | 2 | 75 to 90 | 90 | Intermediate Zone |
| IW-11 | 2 | 75 to 90 | 90 | Intermediate Zone |
| IW-12 | 2 | 75 to 90 | 90 | Intermediate Zone |
| IW-13 | 2 | 75 to 90 | 90 | Intermediate Zone |
| IW-14 | 2 | 60 to 75 | 75 | Intermediate Zone |
| IW-15 | 2 | 60 to 75 | 75 | Intermediate Zone |
| IW-16 | 2 | 45 to 60 | 60 | Shallow Zone |
| MW-1 | 4 | 40 to 60 | 60 | Shallow Zone |
| MW-2 | 4 | 40 to 60 | 60 | Shallow Zone |
| MW-3 | 4 | 40 to 60 | 60 | Shallow Zone |
| MW-4 | 4 | 40 to 60 | 60 | Shallow Zone |
| MW-5 | 4 | 40 to 60 | 60 | Shallow Zone |
| MW-6 | 4 | 40 to 60 | 60 | Shallow Zone |
| MW-7 | 2 | 40 to 60 | 60 | Shallow Zone |
| MW-8 | 2 | 40 to 60 | 60 | Shallow Zone |
| MW-9 | 2 | 40 to 60 | 60 | Shallow Zone |
| MW-10 | 2 | 40 to 60 | 60 | Shallow Zone |
| MW-11 | 2 | 40 to 60 | 60 | Shallow Zone |
| MW-12 | 2 | 46.5 to 56.5 | 56.5 | Shallow Zone |
| MW-13 | 2 | 48 to 58 | 58 | Shallow Zone |
| MW-13D | 2 | 80 to 90 | 90 | Intermediate Zone |
| MW-14 | 2 | 46 to 56 | 56 | Shallow Zone |

Footnotes on last page.

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Table 1. Monitoring Well Construction Details, 25 Melville Park Road Site, Melville, New York.



| Well Designation | Well Diameter (inches) | Screened Interval (feet bls) | Total Depth (feet bls) | Vertical Zone Designation |
|---|---|---|---|---|
| MW-15 | 2 | 48.5 to 58.5 | 58.5 | Shallow Zone |
| MW-16D | 2 | 79.5 to 89.5 | 89.5 | Intermediate Zone |
| MW-17 | 2 | 50 to 60 | 60 | Shallow Zone |
| MW-18D | 4 | 133 to 143 | 143 | Deep Zone |
| MW-19D | 4 | 160 to 170 | 170 | Deep Zone |
| MW-20D | 4 | 175 to 185 | 185 | Deep Zone |
| MW-23 | 2 | 70 to 85 | 85 | Intermediate Zone |
| MW-24 | 2 | 45 to 60 | 60 | Shallow Zone |
| MW-25D | 4 | 40 to 55 | 90 | Shallow Zone |
| | 4 | 75 to 90 | 90 | Intermediate Zone |
| MW-26D | 4 | 35 to 50 | 85 | Shallow Zone |
| | 4 | 70 to 85 | 85 | Intermediate Zone |
| MW-27D | 4 | 40 to 55 | 90 | Shallow Zone |
| | 4 | 75 to 90 | 90 | Intermediate Zone |
| MW-28D | 4 | 40 to 55 | 90 | Shallow Zone |
| | 4 | 75 to 90 | 90 | Intermediate Zone |
| MW-29 | 2 | 45 to 60 | 60 | Shallow Zone |
| MW-30 | 4 | 75 to 90 | 90 | Intermediate Zone |
| MW-31 | 4 | 60 to 70 | 70 | Shallow Zone |
| MW-32 | 4 | 45 to 60 | 60 | Shallow Zone |
| MW-33 | 4 | 70 to 85 | 85 | Intermediate Zone |

bls Below land surface.

Table 2. Summary of Screening of Remedial Alternatives, 25 Melville Park Road Site, Melville, New York.

| Alternative | Description | Overall Protection of Human Health and Environment | Compliance with ARARs | Short Term Effectiveness | Long Term Effectiveness and Permanence | Reduction of Mobility, Toxicity and Volume through Treatment | Implementability | Cost |
|---|---|---|---|---|---|---|---|---|
| 1. | No further Action | Unfavorable | Unfavorable | Favorable | Moderately Favorable | Unfavorable | Most Favorable | Most Favorable |
| 2. | Continuation of NAPL Hand Bailing, In-Situ Reactive Zone for Source Area Remediation, and In-Situ Reactive Zone for Control of VOC Migration. | Most Favorable | Most Favorable | Favorable | Most Favorable | Most Favorable | Favorable | Favorable |
| 3. | Continuation of NAPL Hand Bailing, In-Situ Chemical Oxidation for Source Area Remediation, and In-Situ Reactive Zone for Control of VOC Migration. | Favorable | Favorable | Moderately Favorable | Favorable | Favorable | Moderately Favorable | Moderately Favorable |
| 4. | Continuation of NAPL Hand Bailing, Nano-Scale Zero-Valent Iron with the Establishment of a Limited In-Situ Reactive Zone for Source Area Remediation, and In-Situ Reactive Zone for Control of VOC Migration. | Favorable | Favorable | Favorable | Favorable | Favorable | Moderately Favorable | Moderately Favorable |
| 5. | Continuation of NAPL Hand Bailing and Pump-and-Treat for Control of VOC Migration. | Favorable | Favorable | Moderately Favorable | Moderately Favorable | Moderately Favorable | Moderately Favorable | Unfavorable |

**Legend**

| | |
|---|---|
| Most Favorable | Medium-specific term indicating an acceptable level of satisfaction of goals, based on U.S. Environmental Protection Agency (USEPA) guidance, and that the alternative addresses the goal more effectively when compared to other favorable alternatives. |
| Favorable | Medium-specific term indicating an acceptable level of satisfaction of goals based on USEPA guidance. |
| Moderately Favorable | Medium-specific term indicating that some of goals for a criterion based on USEPA guidance have been met, but other alternatives may address the goal more effectively. |
| Unfavorable | Medium-specific term indicating the alternative does not address the goal adequately. |
| ARARs | Applicable or relevant and appropriate requirements. |
| NAPL | Non-aqueous phase liquid. |
| VOC | Volatile Organic Compounds |

Figures

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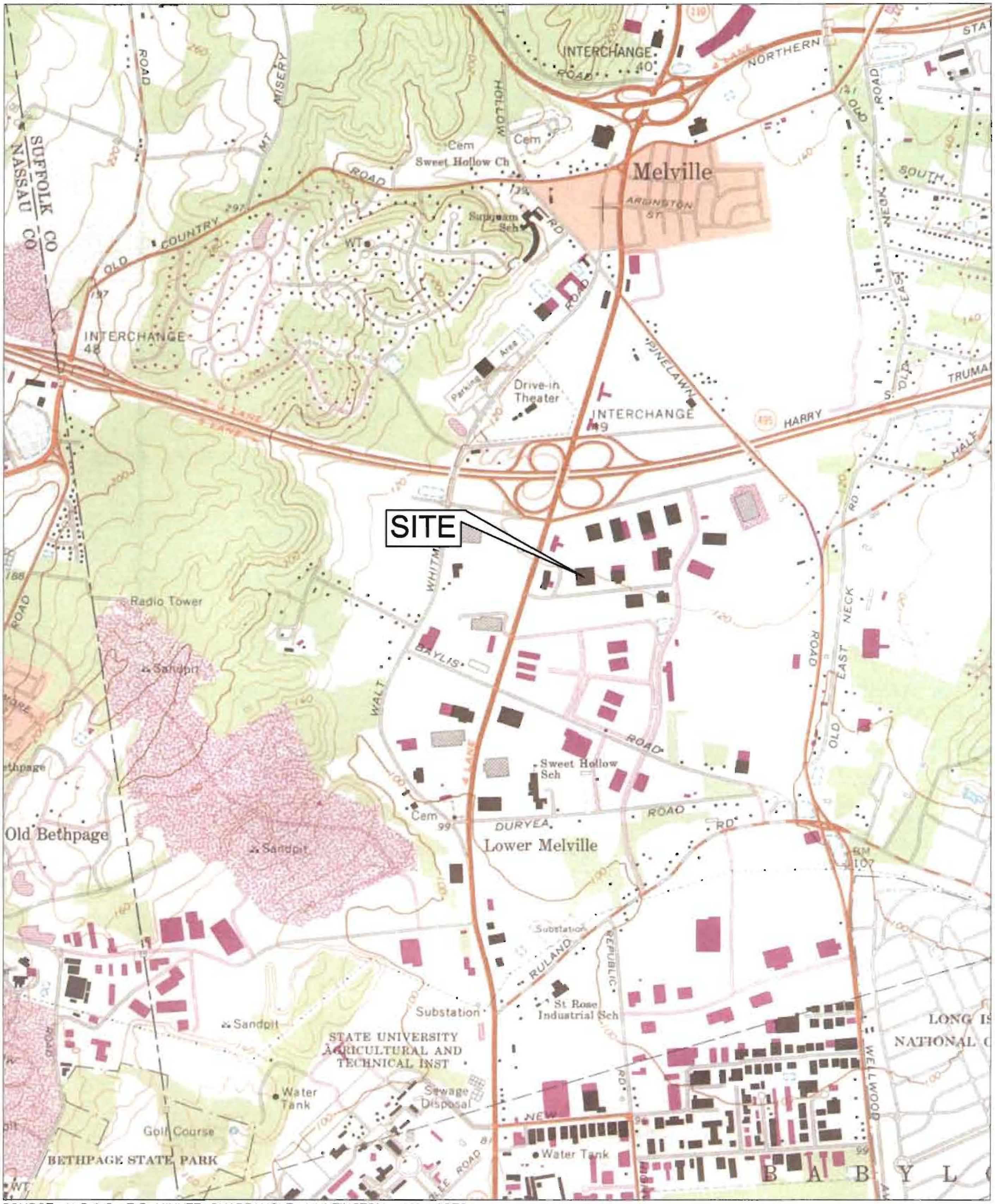


SOURCE: U.S.G.S. 7.5 MINUTE QUADRANGLE, HUNTINGTON, N.Y., 1979

| | | |
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| PROJECT MANAGER S. FELDMAN | DEPARTMENT MANAGER N. VALKENBURG | LEAD DESIGN PROF. | CHECKED BY C. KEEN |
| SITE LOCATION MAP | | TASK/PHASE NUMBER 00008 | DRAWN BY AG |
| 25 MELVILLE PARK ROAD, MELVILLE, NEW YORK 25 MPR, L.L.C. | | PROJECT NUMBER NY001332.0008 | DRAWING NUMBER 1 |

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SCALE IN FEET

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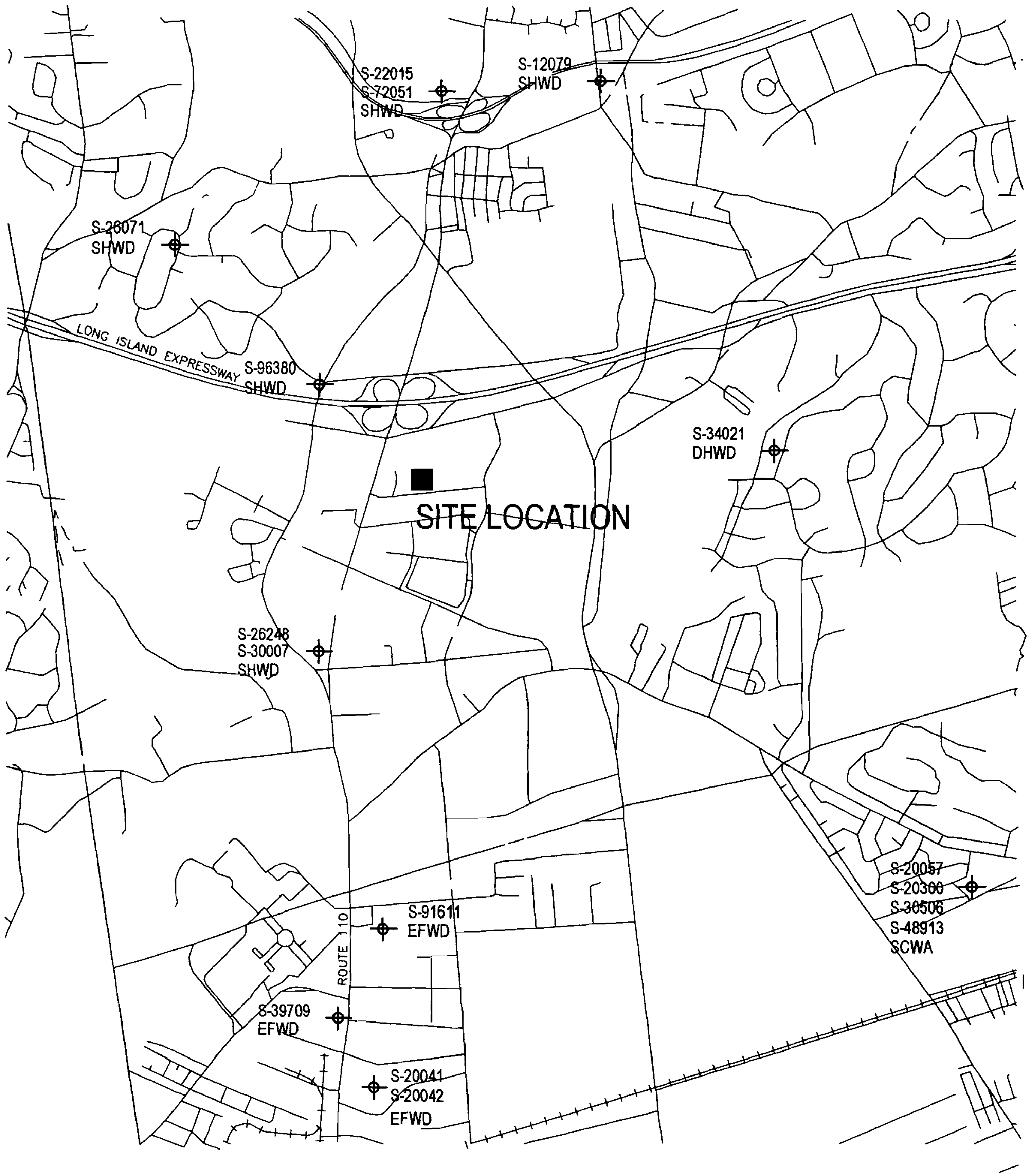
For Figure 2, see Project Manager.

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EXPLANATION

| | |
|---|---|
| S-96380 | LOCATION AND DESIGNATION OF PUBLIC WATER SUPPLY WELL |
| DHWD | DIX HILLS WATER DISTRICT |
| EFWD | EAST FARMINGDALE WATER DISTRICT |
| SHWD | SOUTH HUNTINGTON WATER DISTRICT |
| SCWA | SUFFOLK COUNTY WATER AUTHORITY |

NOTE: ALL LOCATIONS ARE APPROXIMATE

0 2500 FEET



REV. ISSUED DATE DESCRIPTION

ARCADIS

88 Duryea Road
Melville, NY 11747
Tel: 631-249-7600 Fax: 631-249-7610
www.arcadis-us.com

PROJECT TITLE

25 MELVILLE PARK ROAD
MELVILLE, NEW YORK

25 MPR, L.L.C.

SHEET TITLE

LOCATIONS OF PUBLIC WATER SUPPLY WELLS

| | |
|---|---|
| PROJECT MANAGER S. FELDMAN | DEPARTMENT MANAGER N. VALKENBURG |
| LEAD DESIGN PROF. | CHECKED BY C. KEEN |
| TASK/PHASE NUMBER 00008 | DRAWN BY LMC |
| PROJECT NUMBER NY001332.0008 | DRAWING NUMBER 3 |

For Figure 4, see Project Manager.

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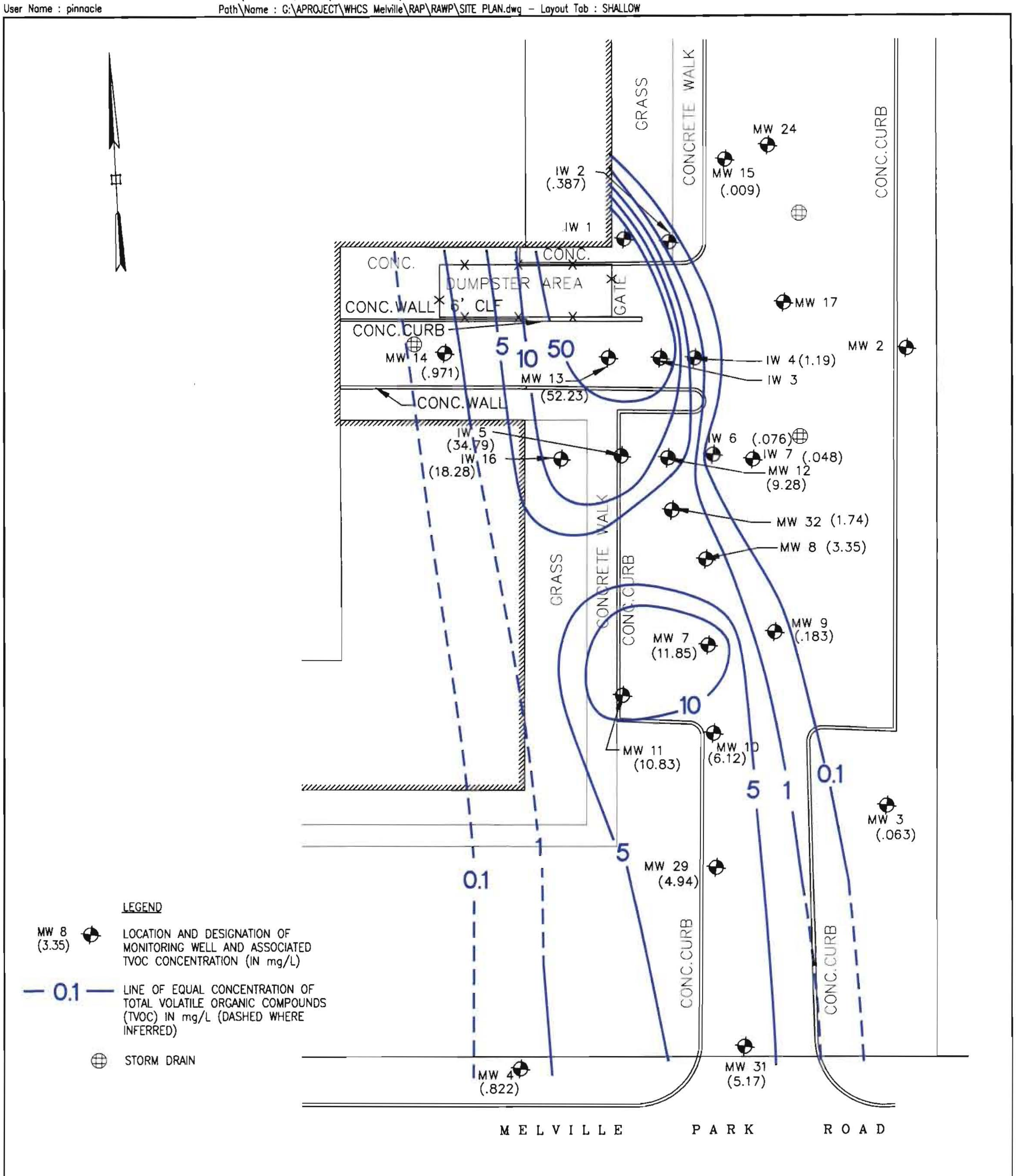


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0 30
SCALE IN FEET

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| PROJECT MANAGER<br>S. FELDMAN | DEPARTMENT MANAGER<br>N. VALKENBURG | LEAD DESIGN PROF. | CHECKED BY<br>C. KEEN |
|---|---|---|---|
| SHEET TITLE<br>TVOC CONCENTRATION DISTRIBUTION IN THE SHALLOW AQUIFER ZONE (45-60 FT BLS) DURING JUNE 2003<br>25 MELVILLE PARK ROAD, MELVILLE, NEW YORK<br>25 MPR, LLC. | | TASK/PHASE NUMBER<br>00008<br>PROJECT NUMBER<br>NY001332.0008 | DRAWN BY<br>LMC<br>DRAWING NUMBER<br>5 |

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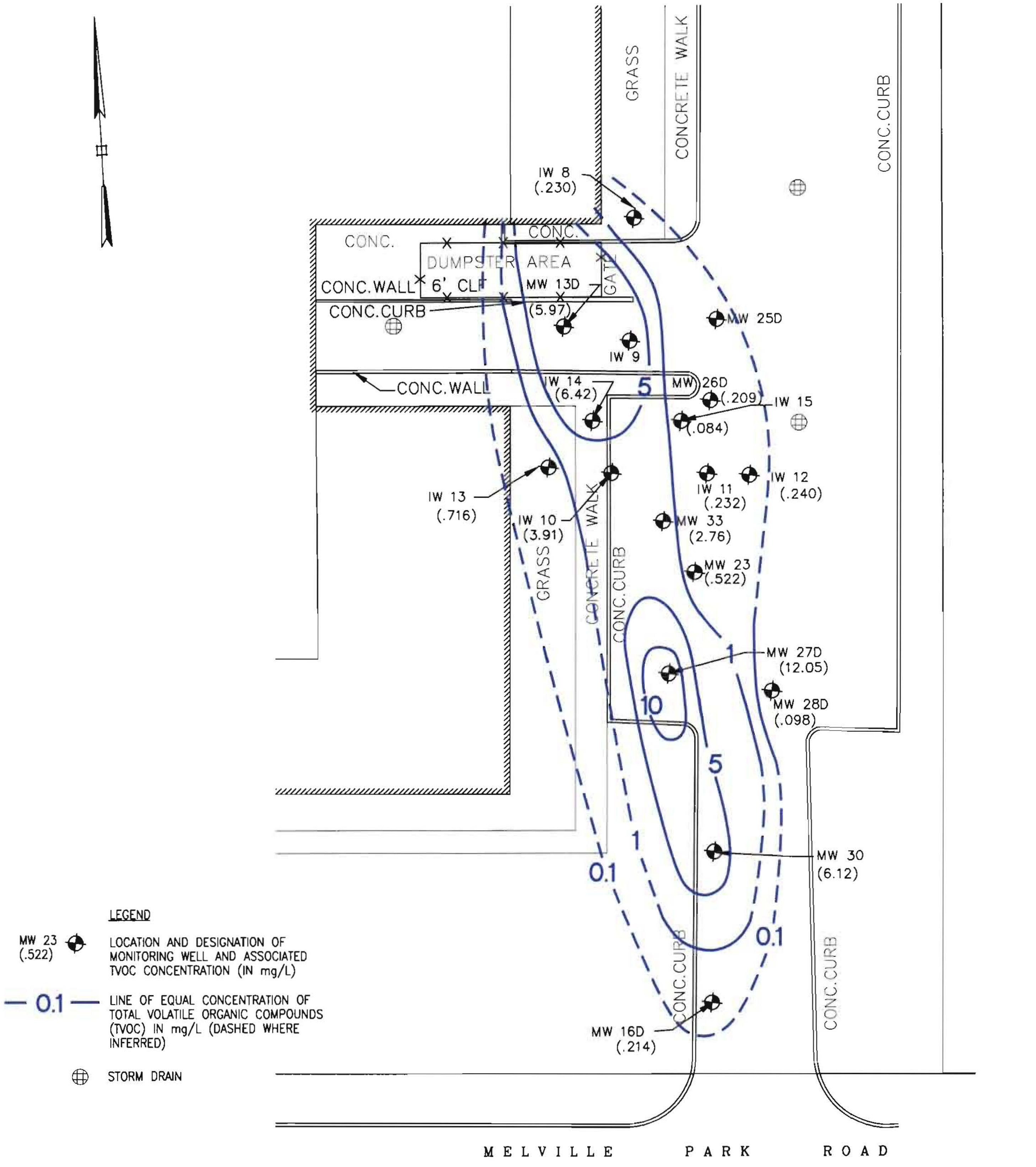




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| PROJECT MANAGER | DEPARTMENT MANAGER | LEAD DESIGN PROF. | CHECKED BY |
|---|---|---|---|
| S. FELDMAN | N. VALKENBURG | | C. KEEN |
| SHEET TITLE | | TASK/PHASE NUMBER | DRAWN BY |
| TVOC CONCENTRATION DISTRIBUTION IN THE INTERMEDIATE AQUIFER ZONE (60-90 FT BLS) DURING JUNE 2003<br>25 MELVILLE PARK ROAD, MELVILLE, NEW YORK<br>25 MPR, LLC. | | 00008 | LMC |
| | | PROJECT NUMBER | DRAWING NUMBER |
| | | NY001332.0008 | 6 |

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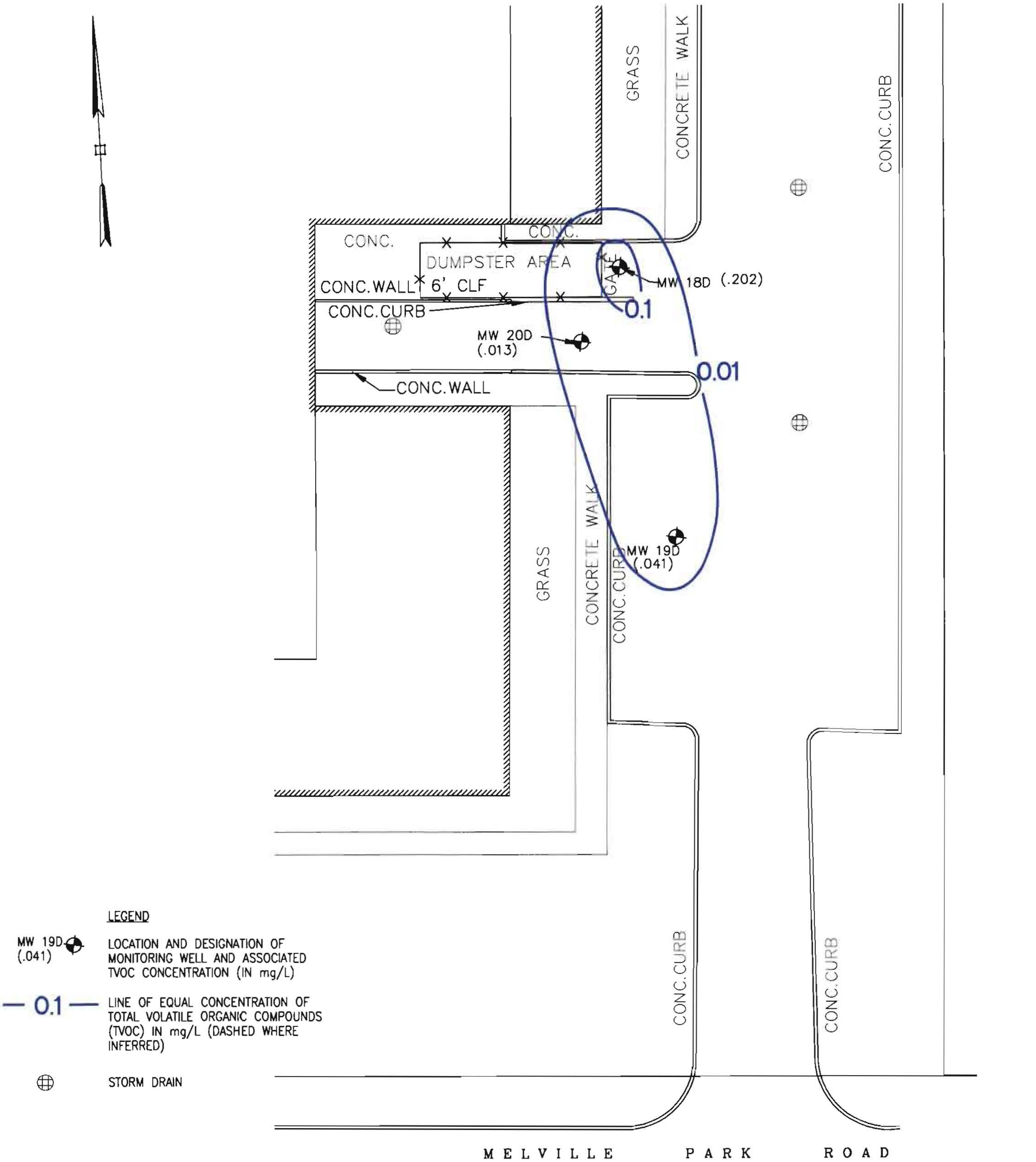




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SCALE IN FEET

ARCADIS
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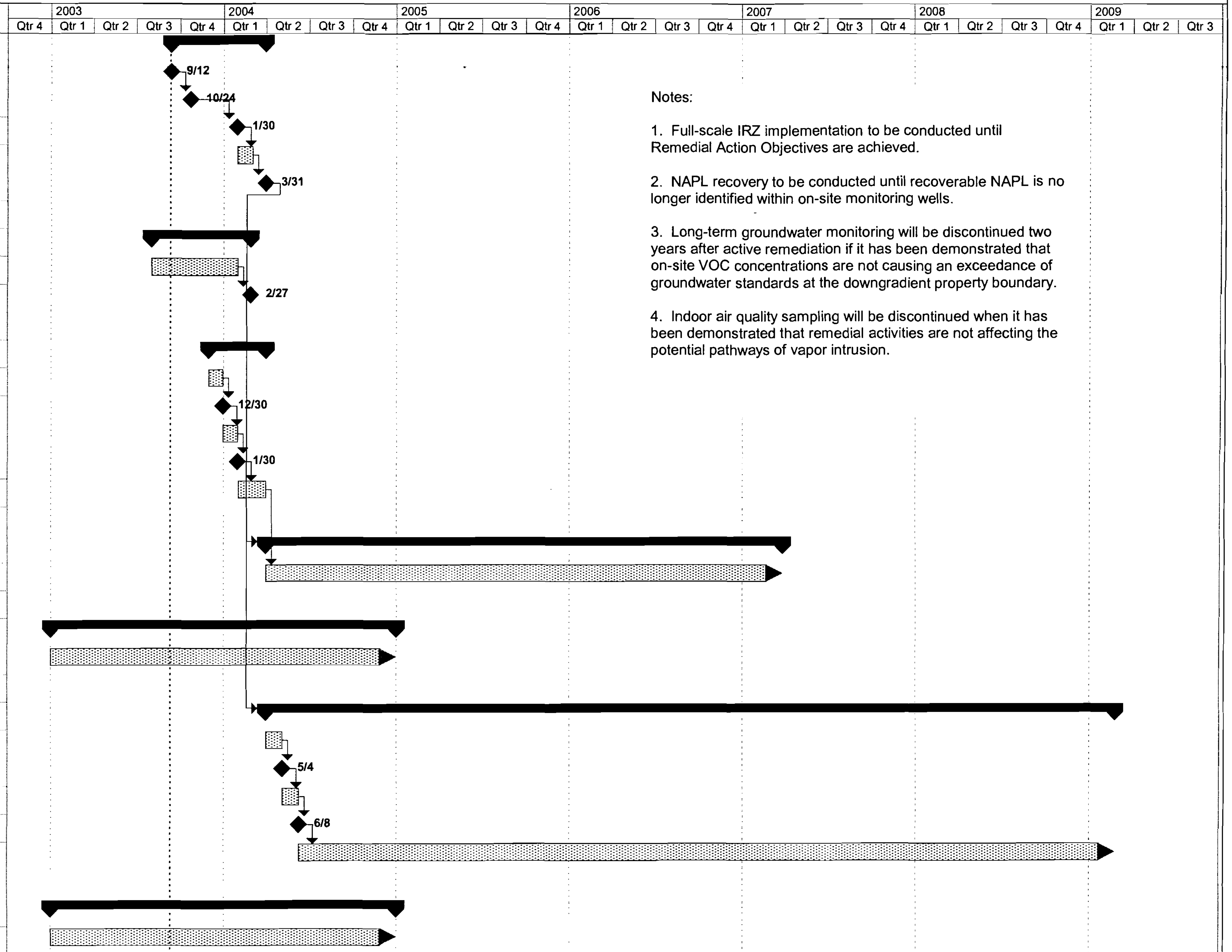
| PROJECT MANAGER | DEPARTMENT MANAGER | LEAD DESIGN PROF. | CHECKED BY |
|---|---|---|---|
| S. FELDMAN | N. VALKENBURG | | C. KEEN |
| SHEET TITLE | | TASK/PHASE NUMBER 00008 | DRAWN BY LMC |
| TVOC CONCENTRATION DISTRIBUTION IN THE DEEP AQUIFER ZONE (130-185 FT BLS) DURING JUNE 2003<br>25 MELVILLE PARK ROAD, MELVILLE, NEW YORK<br>25 MPR, LLC. | | PROJECT NUMBER<br>NY001332.0008 | DRAWING NUMBER<br>7 |

Figure 8. Project Implementation Schedule, 25 Melville Park Road Site, Melville, New York.

| ID | Task Name |
|---|---|
| 1 | **Remedial Action Work Plan (RAWP)** |
| 2 | Submission of RAWP to Regulatory Agencies |
| 3 | Regulatory Agency Approval of RAWP |
| 4 | NYSDEC Issuance of PRAP |
| 5 | Public Comment Period |
| 6 | NYSDEC Issuance of ROD |
| 7 | |
| 8 | **Downgradient IRZ Pilot Test Implementation** |
| 9 | Pilot Test Implementation |
| 10 | Submission of Pilot Test Letter Report |
| 11 | |
| 12 | **Interim IRZ Implementation** |
| 13 | Preparation of Interim IRZ Work Plan |
| 14 | Submission of Interim IRZ Work Plan to Regulatory Agencies |
| 15 | Regulatory Agency Review of Interim IRZ Work Plan |
| 16 | Regulatory Agency Approval of Interim IRZ Work Plan |
| 17 | Implementation of Interim Downgradient and Source Area IRZs |
| 18 | |
| 19 | **Full-Scale IRZ Implementation** |
| 20 | Implementation of Full-Scale Downgradient and Source Area IRZs |
| 21 | |
| 22 | **NAPL Recovery** |
| 23 | NAPL Recovery and Data Evaluation |
| 24 | |
| 25 | **Long-Term Groundwater Monitoring** |
| 26 | Preparation of Long-Term Monitoring Plan |
| 27 | Submission of Long-Term Monitoring Plan to Regulatory Agencies |
| 28 | Regulatory Agency Review of Long-Term Monitoring Plan |
| 29 | Regulatory Agency Approval of Long-Term Monitoring Plan |
| 30 | Long-Term Groundwater Monitoring |
| 31 | |
| 32 | **Air Monitoring** |
| 33 | Indoor Air Quality Sampling |




Notes:

1. Full-scale IRZ implementation to be conducted until Remedial Action Objectives are achieved.

2. NAPL recovery to be conducted until recoverable NAPL is no longer identified within on-site monitoring wells.

3. Long-term groundwater monitoring will be discontinued two years after active remediation if it has been demonstrated that on-site VOC concentrations are not causing an exceedance of groundwater standards at the downgradient property boundary.

4. Indoor air quality sampling will be discontinued when it has been demonstrated that remedial activities are not affecting the potential pathways of vapor intrusion.

Project: 25 Melville Park Road GRiP®
Date: Tue 9/9/03

Task | Milestone | Task End Date To Be Determined
Split | Summary

ARCADIS

## Appendix A

ERD Pilot Test Baseline Groundwater Quality Results, June 2003, Fluid-Level Gauging Measurements, and Non-Aqueous Phase Liquid Chemical and Physical Properties Results

## Tables

A1 Concentrations of Volatile Organic Compounds in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

A2 Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

A3 Concentrations of Volatile Organic Compounds in Non-Aqueous Phase Liquid Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

A4 Concentrations of Gasoline Range Organics (GRO) and Diesel Range Organics (DRO) in Non-Aqueous Phase Liquid Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

A5 Physical Properties of Non-Aqueous Phase Liquid Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

Table A1. Concentrations of Volatile Organic Compounds in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Compound: (Units in ug/L) | Sample ID: Date: | IW-2 06/19/03 | IW-4 06/20/03 | IW-5 06/17/03 | IW-6 06/17/03 | IW-7 06/18/03 | IW-8 06/19/03 | IW-10 06/18/03 |
|---|---|---|---|---|---|---|---|---|
| Chloromethane | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| Bromomethane | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| Vinyl Chloride | | <1 | <2 | <1 | <1 | <1 | <2 | <2 |
| Chloroethane | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| Methylene Chloride | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| Acetone | | <10 | <20 | <16 | <10 | <10 | <20 | <20 |
| Carbon Disulfide | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| 1,1-Dichloroethene | | <5 | <10 | 3 J | <5 | <5 | <10 | <10 |
| 1,1-Dichloroethane | | <5 | <10 | 9 | <5 | <5 | <10 | <10 |
| cis-1 2-Dichloroethene | | 26 J | 250 | 3300 D | 7 | <5 | <10 | 66 |
| trans-1 2-Dichloroethene | | <5 | <10 | 45 | <5 | <5 | <10 | <10 |
| Chloroform | | <5 | <10 | 2 J | <5 | <5 | <10 | <10 |
| 1,2-Dichloroethane | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| 2-Butanone | | <10 | <20 | <10 | <10 | <10 | <20 | <20 |
| 1,1,1-Trichloroethane | | 9 J | <10 | 110 | <5 | <5 | 6 J | 8 J |
| Carbon Tetrachloride | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| Bromodichloromethane | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| 1,2-Dichloropropane | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| cis-1,3-Dichloropropene | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| Trichloroethene | | 82 J | 340 | 9200 D | 16 | 9 | 4 J | 39 |
| Dibromochloromethane | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| 1,1,2-Trichloroethane | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| Benzene | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| trans-1,3-Dichloropropene | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| Bromoform | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| 4-Methyl-2-Pentanone | | <10 | <20 | <10 | <10 | <10 | <20 | <20 |
| 2-Hexanone | | <10 | <20 | <10 | <10 | <10 | <20 | <20 |
| Tetrachloroethene | | 270 AJ | 600 D | 22000 D | 53 | 39 | 220 | 3800 D |
| 1,1,2,2-Tetrachloroethane | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| Toluene | | <5 | <10 | 5 J | <5 | <5 | <10 | <10 |
| Chlorobenzene | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| Ethylbenzene | | <5 | <10 | 13 | <5 | <5 | <10 | <10 |
| Styrene | | <5 | <10 | <5 | <5 | <5 | <10 | <10 |
| Xylene (total) | | <5 | <10 | 98 | <5 | <5 | <10 | <10 |
| **Total VOCs** | | **387** | **1190** | **34785** | **76** | **48** | **230** | **3913** |

| | |
|---|---|
| ug/L | Micrograms per liter. |
| A | Exceeded calibration range. |
| B | Detected in associated blank. |
| D | Detected at secondary dilution. |
| J | Estimated value. |
| REP | Replicate. |
| FB | Field Blank. |
| TB | Trip Blank. |
| VOCs | Volatile Organic Compounds. |

Table A1. Concentrations of Volatile Organic Compounds in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Compound: (Units in ug/L) | Sample ID: Date: | IW-11 06/18/03 | IW-12 06/18/03 | IW-13 06/27/03 | IW-14 06/27/03 | IW-15 06/27/03 | IW-16 06/27/03 | MW-1 06/16/03 |
|---|---|---|---|---|---|---|---|---|
| Chloromethane | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Bromomethane | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Vinyl Chloride | | <1 | <1 | <2 | <2 | <1 | <2 | <1 |
| Chloroethane | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Methylene Chloride | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Acetone | | <10 | <10 | <20 | <20 | <10 | <20 | <10 |
| Carbon Disulfide | | 3 J | <5 | <10 | <10 | <5 | <10 | <5 |
| 1,1-Dichloroethene | | <5 | <5 | <10 | <10 | <5 | 6 J | <5 |
| 1,1-Dichloroethane | | 1 J | <5 | <10 | <10 | 1 J | 11 | <5 |
| cis-1 2-Dichloroethene | | 16 | 47 | 18 | 310 | 5 | 5500 D | <5 |
| trans-1 2-Dichloroethene | | <5 | 0.8 J | <10 | 2 J | <5 | 80 | <5 |
| Chloroform | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| 1,2-Dichloroethane | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| 2-Butanone | | <10 | <10 | <20 | <20 | <10 | <20 | <10 |
| 1,1,1-Trichloroethane | | <5 | <5 | <10 | 29 | 3 J | 170 | 2 J |
| Carbon Tetrachloride | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Bromodichloromethane | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| 1,2-Dichloropropane | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| cis-1,3-Dichloropropene | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Trichloroethene | | 31 | 72 | 8 J | 580 D | 18 | 5800 D | <5 |
| Dibromochloromethane | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| 1,1,2-Trichloroethane | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Benzene | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| trans-1,3-Dichloropropene | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Bromoform | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| 4-Methyl-2-Pentanone | | <10 | <10 | <20 | <20 | <10 | <20 | <10 |
| 2-Hexanone | | <10 | <10 | <20 | <20 | <10 | <20 | <10 |
| Tetrachloroethene | | 180 | 120 | 690 D | 5500 D | 57 | 6700 D | 5 J |
| 1,1,2,2-Tetrachloroethane | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Toluene | | 0.7 J | <5 | <10 | <10 | <5 | 1 J | <5 |
| Chlorobenzene | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Ethylbenzene | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Styrene | | <5 | <5 | <10 | <10 | <5 | <10 | <5 |
| Xylene (total) | | <5 | <5 | <10 | <10 | <5 | 14 | <5 |
| **Total VOCs** | | **231.7** | **239.8** | **716** | **6421** | **84** | **18282** | **7** |

ug/L Micrograms per liter.
A Exceeded calibration range.
B Detected in associated blank.
D Detected at secondary dilution.
J Estimated value.
REP Replicate.
FB Field Blank.
TB Trip Blank.
VOCs Volatile Organic Compounds.

Table A1. Concentrations of Volatile Organic Compounds in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Compound: (Units in ug/L) | Sample ID: Date: | MW-3 06/16/03 | MW-4 06/17/03 | MW-7 06/26/03 | MW-8 06/26/03 | MW-8 REP REP062603 06/26/03 | MW-9 06/20/03 | MW-10 06/23/03 |
|---|---|---|---|---|---|---|---|---|
| Chloromethane | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Bromomethane | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Vinyl Chloride | | <1 | <1 | <2 | <2 | <2 | <1 | <2 |
| Chloroethane | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Methylene Chloride | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Acetone | | <10 | <10 | <20 | <20 | <20 | <10 | <20 |
| Carbon Disulfide | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| 1,1-Dichloroethene | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| 1,1-Dichloroethane | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| cis-1 2-Dichloroethene | | 0.6 J | 24 | 360 | 25 | 22 | 6 | 300 |
| trans-1 2-Dichloroethene | | <5 | <5 | 5 J | <10 | <10 | <5 | 4 J |
| Chloroform | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| 1,2-Dichloroethane | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| 2-Butanone | | <10 | <10 | <20 | <20 | <20 | <10 | <20 |
| 1,1,1-Trichloroethane | | 0.8 J | 10 | 77 | <10 | <10 | <5 | 18 |
| Carbon Tetrachloride | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Bromodichloromethane | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| 1,2-Dichloropropane | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| cis-1,3-Dichloropropene | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Trichloroethene | | 15 | 88 | 1400 D | 220 | 160 | 47 | 1600 D |
| Dibromochloromethane | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| 1,1,2-Trichloroethane | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Benzene | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| trans-1,3-Dichloropropene | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Bromoform | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| 4-Methyl-2-Pentanone | | <10 | <10 | <20 | <20 | <20 | <10 | <20 |
| 2-Hexanone | | <10 | <10 | <20 | <20 | <20 | <10 | <20 |
| Tetrachloroethene | | 47 | 700 D | 10000 D | 3100 D | 3900 D | 130 | 4200 D |
| 1,1,2,2-Tetrachloroethane | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Toluene | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Chlorobenzene | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Ethylbenzene | | <5 | <5 | 0.8 J | <10 | <10 | <5 | <10 |
| Styrene | | <5 | <5 | <10 | <10 | <10 | <5 | <10 |
| Xylene (total) | | <5 | <5 | 9 J | <10 | <10 | <5 | <10 |
| **Total VOCs** | | **63.4** | **822** | **11851.8** | **3345** | **4082** | **183** | **6122** |

ug/L Micrograms per liter.
A Exceeded calibration range.
B Detected in associated blank.
D Detected at secondary dilution.
J Estimated value.
REP Replicate.
FB Field Blank.
TB Trip Blank.
VOCs Volatile Organic Compounds.

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Table A1. Concentrations of Volatile Organic Compounds in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Compound: (Units in ug/L) | Sample ID: Date: | MW-11 06/23/03 | MW-12 06/17/03 | MW-13 06/19/03 | MW-13D 06/19/03 | MW-14 06/20/03 | MW-15 06/24/03 | MW-16D 06/23/03 |
|---|---|---|---|---|---|---|---|---|
| Chloromethane | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| Bromomethane | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| Vinyl Chloride | | <2 | <2 | <2 | <2 | <1 | <1 | <2 |
| Chloroethane | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| Methylene Chloride | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| Acetone | | <20 | <20 | 18 J | <20 | <10 | <10 | <20 |
| Carbon Disulfide | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| 1,1-Dichloroethene | | 3 J | <10 | 6 J | <10 | <5 | <5 | <10 |
| 1,1-Dichloroethane | | <10 | <10 | <10 | <10 | 2 J | <5 | <10 |
| cis-1 2-Dichloroethene | | 2600 D | 170 | 3400 D | 41 | 94 | <5 | 4 J |
| trans-1 2-Dichloroethene | | 28 | 3 J | 37 | <10 | 1 J | <5 | <10 |
| Chloroform | | <10 | <10 | 1 J | <10 | <5 | <5 | <10 |
| 1,2-Dichloroethane | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| 2-Butanone | | <20 | <20 | <20 | <20 | <10 | <10 | <20 |
| 1,1,1-Trichloroethane | | 97 | 13 | 520 AJ | 29 | 14 | 3 J | <10 |
| Carbon Tetrachloride | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| Bromodichloromethane | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| 1,2-Dichloropropane | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| cis-1,3-Dichloropropene | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| Trichloroethene | | 2500 D | 980 D | 10000 D | 100 | 280 D | <5 | <10 |
| Dibromochloromethane | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| 1,1,2-Trichloroethane | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| Benzene | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| trans-1,3-Dichloropropene | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| Bromoform | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| 4-Methyl-2-Pentanone | | <20 | <20 | <20 | <20 | <10 | <10 | <20 |
| 2-Hexanone | | <20 | <20 | <20 | <20 | <10 | <10 | <20 |
| Tetrachloroethene | | 5600D | 8100 D | 38000 D | 5800 D | 580 D | 6 | 210 |
| 1,1,2,2-Tetrachloroethane | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| Toluene | | <10 | <10 | 19 | <10 | <5 | <5 | <10 |
| Chlorobenzene | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| Ethylbenzene | | <10 | 0.8 J | 14 | <10 | <5 | <5 | <10 |
| Styrene | | <10 | <10 | <10 | <10 | <5 | <5 | <10 |
| Xylene (total) | | <10 | 9 J | 210 | <10 | <5 | <5 | <10 |
| **Total VOCs** | | **10828** | **9275.8** | **52225** | **5970** | **971** | **9** | **214** |

ug/L Micrograms per liter.
A Exceeded calibration range.
B Detected in associated blank.
D Detected at secondary dilution.
J Estimated value.
REP Replicate.
FB Field Blank.
TB Trip Blank.
VOCs Volatile Organic Compounds.

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Table A1. Concentrations of Volatile Organic Compounds in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

| Compound: (Units in ug/L) | Sample ID: Date: | MW-18D 06/19/03 | MW-19D 06/20/03 | MW-20D 06/20/03 | MW-23 06/26/03 | MW-26D 06/18/03 | MW-27D 06/24/03 | MW-28D 06/24/03 |
|---|---|---|---|---|---|---|---|---|
| Chloromethane | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Bromomethane | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Vinyl Chloride | | <2 | <1 | <1 | <2 | <2 | <2 | <1 |
| Chloroethane | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Methylene Chloride | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Acetone | | <20 | <10 | <10 | <20 | <20 | <20 | <10 |
| Carbon Disulfide | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| 1,1-Dichloroethene | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| 1,1-Dichloroethane | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| cis-1 2-Dichloroethene | | 180 | 3 J | 2 J | 32 | 12 | 1200 D | 1 J |
| trans-1 2-Dichloroethene | | <10 | <5 | <5 | <10 | <10 | 16 | <5 |
| Chloroform | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| 1,2-Dichloroethane | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| 2-Butanone | | <20 | <10 | <10 | <20 | <20 | <20 | <10 |
| 1,1,1-Trichloroethane | | <10 | <5 | <5 | <10 | <10 | 32 | 0.9 J |
| Carbon Tetrachloride | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Bromodichloromethane | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| 1,2-Dichloropropane | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| cis-1,3-Dichloropropene | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Trichloroethene | | 2 J | 0.8 J | <5 | 150 | 37 | 4100 D | 19 |
| Dibromochloromethane | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| 1,1,2-Trichloroethane | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Benzene | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| trans-1,3-Dichloropropene | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Bromoform | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| 4-Methyl-2-Pentanone | | <20 | <10 | <10 | <20 | <20 | <20 | <10 |
| 2-Hexanone | | <20 | <10 | <10 | <20 | <20 | <20 | <10 |
| Tetrachloroethene | | 20 | 37 | 11 | 340 | 160 | 6700D | 77 |
| 1,1,2,2-Tetrachloroethane | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Toluene | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Chlorobenzene | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Ethylbenzene | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Styrene | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| Xylene (total) | | <10 | <5 | <5 | <10 | <10 | <10 | <5 |
| **Total VOCs** | | **202** | **40.8** | **13** | **522** | **209** | **12048** | **97.9** |

| | |
|---|---|
| ug/L | Micrograms per liter. |
| A | Exceeded calibration range. |
| B | Detected in associated blank. |
| D | Detected at secondary dilution. |
| J | Estimated value. |
| REP | Replicate. |
| FB | Field Blank. |
| TB | Trip Blank. |
| VOCs | Volatile Organic Compounds. |

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Table A1. Concentrations of Volatile Organic Compounds in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Compound: (Units in ug/L) | Sample ID: Date: | MW-29 06/23/03 | MW-30 06/24/03 | MW-31 06/24/03 | MW-32 06/26/03 | MW-33 06/26/03 | TB061603 06/16/03 | TB061803 06/18/03 |
|---|---|---|---|---|---|---|---|---|
| Chloromethane | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| Bromomethane | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| Vinyl Chloride | | <2 | <1 | <1 | <2 | <2 | <1 | <1 |
| Chloroethane | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| Methylene Chloride | | <10 | <5 | <5 | <10 | <10 | 1JB | 1JB |
| Acetone | | <20 | <10 | <10 | <20 | <20 | <10 | <10 |
| Carbon Disulfide | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| 1,1-Dichloroethene | | <10 | <5 | 1 J | <10 | <10 | <5 | <5 |
| 1,1-Dichloroethane | | <10 | <5 | 3 J | <10 | <10 | <5 | <5 |
| cis-1 2-Dichloroethene | | 400 | 330 D | 420 D | 170 | 41 | <5 | <5 |
| trans-1 2-Dichloroethene | | 5 J | 4 J | 9 | <10 | <10 | <5 | <5 |
| Chloroform | | <10 | 2 J | <5 | <10 | <10 | <5 | <5 |
| 1,2-Dichloroethane | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| 2-Butanone | | <20 | <10 | <10 | <20 | <20 | <10 | <10 |
| 1,1,1-Trichloroethane | | 40 | 13 | 37 | <10 | <10 | <5 | <5 |
| Carbon Tetrachloride | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| Bromodichloromethane | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| 1,2-Dichloropropane | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| cis-1,3-Dichloropropene | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| Trichloroethene | | 990 D | 470 D | 1100 D | 470 D | 120 | <5 | <5 |
| Dibromochloromethane | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| 1,1,2-Trichloroethane | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| Benzene | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| trans-1,3-Dichloropropene | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| Bromoform | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| 4-Methyl-2-Pentanone | | <20 | <10 | <10 | <20 | <20 | <10 | <10 |
| 2-Hexanone | | <20 | <10 | <10 | <20 | <20 | <10 | <10 |
| Tetrachloroethene | | 3500 D | 5300D | 3600D | 1100 D | 2600 D | <5 | <5 |
| 1,1,2,2-Tetrachloroethane | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| Toluene | | <10 | <5 | 0.8 J | <10 | <10 | <5 | <5 |
| Chlorobenzene | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| Ethylbenzene | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| Styrene | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| Xylene (total) | | <10 | <5 | <5 | <10 | <10 | <5 | <5 |
| **Total VOCs** | | **4935** | **6119** | **5170.8** | **1740** | **2761** | **1** | **1** |

ug/L Micrograms per liter.
A Exceeded calibration range.
B Detected in associated blank.
D Detected at secondary dilution.
J Estimated value.
REP Replicate.
FB Field Blank.
TB Trip Blank.
VOCs Volatile Organic Compounds.

# ARCADIS



Table A1. Concentrations of Volatile Organic Compounds in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

| Compound: (Units in ug/L) | Sample ID: Date: | TB061903 06/19/03 | TB062003 06/20/03 | TB062303 06/23/03 | TB062403 06/24/03 | TB062603 06/26/03 | TB062703 06/27/03 | FB062603 06/26/03 |
|---|---|---|---|---|---|---|---|---|
| Chloromethane | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Bromomethane | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Vinyl Chloride | | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Chloroethane | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Methylene Chloride | | 1JB | 1JB | 1JB | 1JB | 1JB | 1JB | 1JB |
| Acetone | | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Carbon Disulfide | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| 1,1-Dichloroethene | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| 1,1-Dichloroethane | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| cis-1 2-Dichloroethene | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| trans-1 2-Dichloroethene | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Chloroform | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| 1,2-Dichloroethane | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| 2-Butanone | | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| 1,1,1-Trichloroethane | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Carbon Tetrachloride | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Bromodichloromethane | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| 1,2-Dichloropropane | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| cis-1,3-Dichloropropene | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Trichloroethene | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Dibromochloromethane | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| 1,1,2-Trichloroethane | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Benzene | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| trans-1,3-Dichloropropene | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Bromoform | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| 4-Methyl-2-Pentanone | | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| 2-Hexanone | | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Tetrachloroethene | | 0.6 J | <5 | <5 | <5 | <5 | <5 | <5 |
| 1,1,2,2-Tetrachloroethane | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Toluene | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Chlorobenzene | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Ethylbenzene | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Styrene | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Xylene (total) | | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| **Total VOCs** | | **1.6** | **1** | **1** | **1** | **1** | **1** | **1** |

| | |
|---|---|
| ug/L | Micrograms per liter. |
| A | Exceeded calibration range. |
| B | Detected in associated blank. |
| D | Detected at secondary dilution. |
| J | Estimated value. |
| REP | Replicate. |
| FB | Field Blank. |
| TB | Trip Blank. |
| VOCs | Volatile Organic Compounds. |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: | IW-1 | | | | | | IW-9 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) |
| 7/30/01 | | 50.23 | ND | 58.20 | 58.60 | 0.00 | 0.40 | 49.50 | 48.18 | ND | 89.32 | 1.32 | 0.00 |
| 8/6/01 | | 50.26 | ND | 58.20 | 58.60 | 0.00 | 0.40 | 50.20 | 48.21 | ND | 89.32 | 1.99 | 0.00 |
| 10/9/01 | | 51.28 | ND | 58.45 | 58.60 | 0.00 | 0.15 | 50.34 | 49.18 | ND | 89.32 | 1.16 | 0.00 |
| 10/25/01 | | 51.63 | ND | 58.15 | 58.60 | 0.00 | 0.45 | 50.45 | 49.58 | ND | 89.32 | 0.87 | 0.00 |
| 11/9/01 | | 51.77 | ND | 57.85 | 58.60 | 0.00 | 0.75 | 50.91 | 49.70 | ND | 89.32 | 1.21 | 0.00 |
| 11/19/01 | | 51.91 | ND | 58.38 | 58.60 | 0.00 | 0.22 | 50.41 | 49.88 | ND | 89.32 | 0.53 | 0.00 |
| 12/3/01 | | 52.17 | ND | 58.35 | 58.60 | 0.00 | 0.25 | 50.56 | 50.12 | ND | 89.32 | 0.44 | 0.00 |
| 12/19/01 | | 52.26 | ND | 58.40 | 58.60 | 0.00 | 0.20 | 51.80 | 51.19 | ND | 89.32 | 0.61 | 0.00 |
| 1/8/02 | | 52.46 | ND | 58.44 | 58.60 | 0.00 | 0.16 | 51.18 | 50.42 | ND | 89.32 | 0.76 | 0.00 |
| 1/24/02 | | 52.65 | ND | 58.42 | 58.60 | 0.00 | 0.18 | 51.35 | 50.60 | ND | 89.32 | 0.75 | 0.00 |
| 2/6/02 | | 52.81 | ND | * | 58.60 | 0.00 | <0.01 | 50.90 | 50.77 | ND | 89.32 | 0.13 | 0.00 |
| 2/20/02 | | 53.08 | ND | 58.53 | 58.60 | 0.00 | 0.07 | 51.53 | 51.04 | ND | 89.32 | 0.49 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: | IW-1 | | | | | | IW-9 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) |
| 3/7/02 | | 53.27 | ND | 58.50 | 58.60 | 0.00 | 0.10 | 51.79 | 51.23 | ND | 89.32 | 0.56 | 0.00 |
| 3/21/02 | | 53.37 | ND | 58.55 | 58.60 | 0.00 | 0.05 | 51.60 | 51.33 | ND | 89.32 | 0.27 | 0.00 |
| 4/11/02 | | 53.56 | ND | 58.53 | 58.60 | 0.00 | 0.07 | 52.20 | 51.53 | ND | 89.32 | 0.67 | 0.00 |
| 4/26/02 | | 53.85 | Trace | 58.55 | 58.60 | Trace | 0.05 | 52.24 | 51.80 | ND | 89.32 | 0.44 | 0.00 |
| 5/15/02 | | 53.88 | ND | 58.52 | 58.60 | 0.00 | 0.08 | 52.55 | 51.79 | ND | 89.32 | 0.76 | 0.00 |
| 5/31/02 | | 54.00 | ND | 58.53 | 58.60 | 0.00 | 0.07 | 52.31 | 52.00 | ND | 89.32 | 0.31 | 0.00 |
| 6/14/02 | | 54.16 | ND | 58.55 | 58.60 | 0.00 | 0.05 | 52.75 | 52.12 | ND | 89.32 | 0.63 | 0.00 |
| 6/28/02 | | 54.42 | ND | 58.45 | 58.60 | 0.00 | 0.15 | 52.70 | 52.40 | ND | 89.32 | 0.30 | 0.00 |
| 7/12/02 | | 54.78 | Trace | 58.52 | 58.60 | Trace | 0.08 | 53.20 | 52.77 | ND | 89.32 | 0.43 | 0.00 |
| 7/30/02 | | 55.22 | ND | 58.53 | 58.60 | 0.00 | 0.07 | 53.98 | 53.19 | ND | 89.32 | 0.79 | 0.00 |
| 8/2/02 | | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| 8/6/02 | | 55.37 | ND | ND | 58.60 | 0.00 | 0.00 | 53.62 | 53.38 | ND | 89.32 | 0.24 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: IW-1 Depth to Water (ft btoc) | IW-1 Depth to LNAPL (ft btoc) | IW-1 Depth to DNAPL (ft btoc) | IW-1 Total Depth (ft btoc) | IW-1 LNAPL Thickness (feet) | IW-1 DNAPL Thickness (feet) | IW-9 Depth to Water (ft btoc) | IW-9 Depth to LNAPL (ft btoc) | IW-9 Depth to DNAPL (ft btoc) | IW-9 Total Depth (ft btoc) | IW-9 LNAPL Thickness (feet) | IW-9 DNAPL Thickness (feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/7/02 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| 8/9/02 | 55.46 | ND | ND | 58.60 | 0.00 | 0.00 | 53.71 | 53.44 | ND | 89.32 | 0.27 | 0.00 |
| 8/16/02 | 55.66 | 55.61 | ND | 58.60 | 0.05 | 0.00 | 53.88 | 53.62 | ND | 89.32 | 0.26 | 0.00 |
| 8/22/02 | 55.86 | 55.76 | ND | 58.60 | 0.10 | 0.00 | 54.18 | 53.79 | ND | 89.32 | 0.39 | 0.00 |
| 9/4/02 | 54.77 | ND | 58.20 | 58.60 | 0.00 | 0.40 | 53.48 | 52.76 | ND | 89.32 | 0.72 | 0.00 |
| 9/20/02 | 55.47 | 55.13 | 58.50 | 58.60 | 0.34 | 0.10 | 53.65 | 53.12 | ND | 89.32 | 0.53 | 0.00 |
| 10/3/02 | 55.11 | 55.00 | 55.40 | 58.60 | 0.11 | 3.20 | 53.35 | 53.02 | 88.30 | 89.32 | 0.33 | 1.02 |
| 10/17/02 | 54.52 | 54.50 | 57.25 | 58.60 | 0.02 | 1.35 | 52.58 | 52.46 | ND | 89.32 | 0.12 | 0.00 |
| 10/25/02 | 54.61 | ND | 57.85 | 58.60 | 0.00 | 0.75 | 52.74 | 52.51 | ND | 89.32 | 0.23 | 0.00 |
| 11/8/02 | 54.65 | ND | 58.25 | 58.60 | 0.00 | 0.35 | 52.86 | 52.57 | ND | 89.32 | 0.29 | 0.00 |
| 11/25/02 | 54.36 | ND | 58.15 | 58.60 | 0.00 | 0.45 | 52.83 | 52.30 | ND | 89.32 | 0.53 | 0.00 |
| 12/9/02 | 54.64 | ND | 58.31 | 58.60 | 0.00 | 0.29 | 53.31 | 52.59 | ND | 89.32 | 0.72 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: IW-1 Depth to Water (ft btoc) | IW-1 Depth to LNAPL (ft btoc) | IW-1 Depth to DNAPL (ft btoc) | IW-1 Total Depth (ft btoc) | IW-1 LNAPL Thickness (feet) | IW-1 DNAPL Thickness (feet) | IW-9 Depth to Water (ft btoc) | IW-9 Depth to LNAPL (ft btoc) | IW-9 Depth to DNAPL (ft btoc) | IW-9 Total Depth (ft btoc) | IW-9 LNAPL Thickness (feet) | IW-9 DNAPL Thickness (feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12/24/02 | 54.21 | ND | 58.34 | 58.60 | 0.00 | 0.26 | 52.85 | 52.17 | ND | 89.32 | 0.68 | 0.00 |
| 1/9/03 | 53.85 | ND | 58.42 | 58.60 | 0.00 | 0.18 | 52.41 | 51.80 | ND | 89.32 | 0.61 | 0.00 |
| 1/28/03 | 53.75 | ND | 58.19 | 58.60 | 0.00 | 0.41 | 52.35 | 51.70 | ND | 89.32 | 0.35 | 0.00 |
| 2/12/03 | 53.83 | 53.79 | 58.48 | 58.60 | 0.04 | 0.12 | 52.24 | 51.74 | ND | 89.32 | 0.50 | 0.00 |
| 2/26/03 | 53.28 | ND | 58.35 | 58.60 | 0.00 | 0.25 | 51.52 | 51.25 | ND | 89.32 | 0.27 | 0.00 |
| 3/12/03 | 52.92 | 52.90 | ND | 58.60 | 0.02 | 0.00 | 51.10 | 50.86 | ND | 89.32 | 0.24 | 0.00 |
| 3/26/03 | 52.81 | 52.80 | ND | 58.60 | 0.01 | 0.00 | 51.06 | 50.77 | ND | 89.32 | 0.29 | 0.00 |
| 4/10/03 | 52.81 | ND | 58.55 | 58.60 | 0.00 | 0.05 | 50.93 | 50.73 | ND | 89.32 | 0.20 | 0.00 |
| 4/24/03 | 52.77 | 52.76 | 58.55 | 58.60 | 0.01 | 0.05 | 51.04 | 50.72 | ND | 89.32 | 0.32 | 0.00 |
| 5/21/03 | 53.02 | ND | 58.45 | 58.60 | 0.00 | 0.15 | 51.50 | 51.00 | ND | 89.32 | 0.50 | 0.00 |
| 6/26/03 | 50.97 | ND | ND | 58.60 | 0.00 | 0.00 | 49.32 | 48.94 | ND | 89.32 | 0.38 | 0.00 |
| 7/30/03 | 50.82 | ND | 58.42 | 58.60 | 0.00 | 0.18 | 49.37 | 48.75 | ND | 89.32 | 0.62 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: MW-13 Depth to Water (ft btoc) | MW-13 Depth to LNAPL (ft btoc) | MW-13 Depth to DNAPL (ft btoc) | MW-13 Total Depth (ft btoc) | MW-13 LNAPL Thickness (feet) | MW-13 DNAPL Thickness (feet) | IW-3 Depth to Water (ft btoc) | IW-3 Depth to LNAPL (ft btoc) | IW-3 Depth to DNAPL (ft btoc) | IW-3 Total Depth (ft btoc) | IW-3 LNAPL Thickness (feet) | IW-3 DNAPL Thickness (feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/30/01 | 48.43 | ND | * | 58.20 | 0.00 | <0.01 | 48.08 | NM | NM | NM | NM | NM |
| 8/6/01 | 48.47 | ND | * | 58.20 | 0.00 | <0.01 | NM | NM | NM | NM | NM | NM |
| 10/9/01 | 49.48 | ND | ND | 58.20 | 0.00 | 0.00 | NM | NM | NM | NM | NM | NM |
| 10/25/01 | 49.85 | 49.81 | ND | 58.20 | 0.04 | 0.00 | NM | NM | NM | NM | NM | NM |
| 11/9/01 | 50.14 | 49.95 | ND | 58.20 | 0.19 | 0.00 | NM | NM | NM | NM | NM | NM |
| 11/19/01 | 50.24 | 50.10 | ND | 58.20 | 0.14 | 0.00 | NM | NM | NM | NM | NM | NM |
| 12/3/01 | 50.52 | 50.38 | ND | 58.20 | 0.14 | 0.00 | NM | NM | NM | NM | NM | NM |
| 12/19/01 | 50.52 | 50.45 | ND | 58.20 | 0.07 | 0.00 | 50.10 | ND | ND | 59.80 | 0.00 | 0.00 |
| 1/8/02 | 50.70 | 50.66 | ND | 58.20 | 0.04 | 0.00 | 50.41 | 50.30 | ND | 59.80 | 0.11 | 0.00 |
| 1/24/02 | 50.87 | 50.85 | ND | 58.20 | 0.02 | 0.00 | 50.55 | 50.50 | ND | 59.80 | 0.05 | 0.00 |
| 2/6/02 | 51.03 | 51.02 | ND | 58.20 | 0.01 | 0.00 | 51.04 | 50.66 | ND | 59.80 | 0.38 | 0.00 |
| 2/20/02 | 51.29 | ND | ND | 58.20 | 0.00 | 0.00 | 51.30 | 50.91 | ND | 59.80 | 0.39 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: MW-13 Depth to Water (ft btoc) | MW-13 Depth to LNAPL (ft btoc) | MW-13 Depth to DNAPL (ft btoc) | MW-13 Total Depth (ft btoc) | MW-13 LNAPL Thickness (feet) | MW-13 DNAPL Thickness (feet) | IW-3 Depth to Water (ft btoc) | IW-3 Depth to LNAPL (ft btoc) | IW-3 Depth to DNAPL (ft btoc) | IW-3 Total Depth (ft btoc) | IW-3 LNAPL Thickness (feet) | IW-3 DNAPL Thickness (feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/7/02 | 51.49 | ND | ND | 58.20 | 0.00 | 0.00 | 51.56 | 51.10 | ND | 59.80 | 0.46 | 0.00 |
| 3/21/02 | 51.58 | ND | ND | 58.20 | 0.00 | 0.00 | 51.41 | 51.20 | ND | 59.80 | 0.21 | 0.00 |
| 4/11/02 | 51.78 | ND | ND | 58.20 | 0.00 | 0.00 | 51.82 | 51.40 | ND | 59.80 | 0.42 | 0.00 |
| 4/26/02 | 52.08 | Trace | ND | 58.20 | <0.01 | 0.00 | 51.98 | 51.69 | ND | 59.80 | 0.29 | 0.00 |
| 5/15/02 | 52.11 | ND | ND | 58.20 | 0.00 | 0.00 | 52.05 | 51.70 | ND | 59.80 | 0.35 | 0.00 |
| 5/31/02 | 52.22 | ND | ND | 58.20 | 0.00 | 0.00 | 52.33 | 51.84 | ND | 59.80 | 0.49 | 0.00 |
| 6/14/02 | 52.35 | ND | ND | 58.20 | 0.00 | 0.00 | 52.55 | 52.00 | ND | 59.80 | 0.55 | 0.00 |
| 6/28/02 | 52.64 | ND | ND | 58.20 | 0.00 | 0.00 | 52.79 | 52.25 | ND | 59.80 | 0.54 | 0.00 |
| 7/12/02 | 53.00 | ND | ND | 58.20 | 0.00 | 0.00 | 53.42 | 52.63 | ND | 59.80 | 0.79 | 0.00 |
| 7/30/02 | 53.43 | ND | ND | 58.20 | 0.00 | 0.00 | 59.59 | 53.04 | NA | 59.80 | 6.55 | NA |
| 8/2/02 | NM | NM | NM | NM | NM | NM | 57.32 | 53.12 | ND | 59.80 | 4.20 | 0.00 |
| 8/6/02 | NM | NM | NM | NM | NM | NM | 59.60 | 53.21 | NA | 59.80 | 6.39 | NA |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: | MW-13 | | | | | | IW-3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) |
| 8/7/02 | | NM | NM | NM | NM | NM | NM | 55.91 | 53.25 | 58.70 | 59.80 | 2.66 | 1.10 |
| 8/9/02 | | 53.70 | ND | ND | 58.20 | 0.00 | 0.00 | 59.59 | 53.29 | NA | 59.80 | 6.30 | NA |
| 8/16/02 | | 53.84 | ND | ND | 58.20 | 0.00 | 0.00 | 59.40 | 53.44 | NA | 59.80 | 5.96 | NA |
| 8/22/02 | | 54.01 | 54.00 | 0.00 | 58.20 | 0.01 | 0.00 | 59.50 | 53.60 | NA | 59.80 | 5.90 | NA |
| 9/4/02 | | 52.98 | ND | ND | 58.20 | 0.00 | 0.00 | 54.68 | 52.59 | Trace | 59.80 | 2.09 | Trace |
| 9/20/02 | | 53.39 | ND | Trace | 58.20 | 0.00 | Trace | 56.80 | 52.99 | ND | 59.80 | 3.81 | 0.00 |
| 10/3/02 | | 53.24 | ND | ND | 58.20 | 0.00 | 0.00 | 55.30 | 52.90 | ND | 59.80 | 2.40 | 0.00 |
| 10/17/02 | | 52.73 | ND | ND | 58.20 | 0.00 | 0.00 | 54.20 | 52.35 | ND | 59.80 | 1.85 | 0.00 |
| 10/25/02 | | 52.80 | ND | ND | 58.20 | 0.00 | 0.00 | 53.81 | 52.39 | ND | 59.80 | 1.42 | 0.00 |
| 11/8/02 | | 52.81 | ND | ND | 58.20 | 0.00 | 0.00 | 53.41 | 52.45 | ND | 59.80 | 0.96 | 0.00 |
| 11/25/02 | | 52.55 | ND | ND | 58.20 | 0.00 | 0.00 | 52.90 | 52.17 | ND | 59.80 | 0.73 | 0.00 |
| 12/9/02 | | 52.84 | ND | ND | 58.20 | 0.00 | 0.00 | 53.38 | 52.47 | ND | 59.80 | 0.91 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: | MW-13 | | | | | | IW-3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) |
| 12/24/02 | | 52.44 | ND | ND | 58.20 | 0.00 | 0.00 | 52.25 | 52.05 | ND | 59.80 | 0.20 | 0.00 |
| 1/9/03 | | 52.10 | ND | ND | 58.20 | 0.00 | 0.00 | 51.72 | ND | ND | 59.80 | 0.00 | 0.00 |
| 1/28/03 | | 51.98 | ND | ND | 58.20 | 0.00 | 0.00 | 51.63 | ND | ND | 59.80 | 0.00 | 0.00 |
| 2/12/03 | | 52.02 | ND | ND | 58.20 | 0.00 | 0.00 | 51.66 | ND | ND | 59.80 | 0.00 | 0.00 |
| 2/26/03 | | 51.51 | ND | ND | 58.20 | 0.00 | 0.00 | 51.14 | ND | ND | 59.80 | 0.00 | 0.00 |
| 3/12/03 | | 51.14 | ND | ND | 58.20 | 0.00 | 0.00 | 50.76 | ND | ND | 59.80 | 0.00 | 0.00 |
| 3/26/03 | | 51.03 | ND | ND | 58.20 | 0.00 | 0.00 | 50.67 | ND | ND | 59.80 | 0.00 | 0.00 |
| 4/10/03 | | 51.01 | ND | ND | 58.20 | 0.00 | 0.00 | 50.65 | ND | ND | 59.80 | 0.00 | 0.00 |
| 4/24/03 | | 51.00 | ND | ND | 58.20 | 0.00 | 0.00 | 50.68 | ND | ND | 59.80 | 0.00 | 0.00 |
| 5/21/03 | | 51.24 | ND | ND | 58.20 | 0.00 | 0.00 | 50.87 | ND | ND | 59.80 | 0.00 | 0.00 |
| 6/26/03 | | 49.18 | ND | ND | 58.20 | 0.00 | 0.00 | 48.81 | ND | ND | 59.80 | 0.00 | 0.00 |
| 7/30/03 | | 49.02 | ND | ND | 58.20 | 0.00 | 0.00 | 48.65 | ND | ND | 59.80 | 0.00 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: | IW-4 | | | | | | MW-25D | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) |
| 7/30/01 | | 47.99 | NM | NM | NM | NM | NM | 48.00 | NM | NM | NM | NM | NM |
| 8/6/01 | | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| 10/9/01 | | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| 10/25/01 | | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| 11/9/01 | | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| 11/19/01 | | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| 12/3/01 | | 50.10 | 49.96 | ND | 59.71 | 0.14 | 0.00 | 50.10 | 50.00 | ND | 88.80 | 0.10 | 0.00 |
| 12/19/01 | | 50.03 | 50.02 | ND | 59.71 | 0.01 | 0.00 | 50.17 | 50.05 | ND | 88.80 | 0.12 | 0.00 |
| 1/8/02 | | 50.29 | ND | ND | 59.71 | 0.00 | 0.00 | 50.41 | 50.28 | ND | 88.80 | 0.13 | 0.00 |
| 1/24/02 | | 50.45 | ND | ND | 59.71 | 0.00 | 0.00 | 50.58 | 50.48 | ND | 88.80 | 0.10 | 0.00 |
| 2/6/02 | | 50.64 | ND | ND | 59.71 | 0.00 | 0.00 | 50.66 | 50.64 | ND | 88.80 | 0.02 | 0.00 |
| 2/20/02 | | 50.89 | ND | ND | 59.71 | 0.00 | 0.00 | 50.92 | ND | ND | 88.80 | 0.00 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: | IW-4 | | | | | | MW-25D | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) |
| 3/7/02 | | 51.08 | ND | ND | 59.71 | 0.00 | 0.00 | 51.12 | ND | ND | 88.80 | 0.00 | 0.00 |
| 3/21/02 | | 51.14 | ND | ND | 59.71 | 0.00 | 0.00 | 51.18 | ND | ND | 88.80 | 0.00 | 0.00 |
| 4/11/02 | | 51.37 | ND | ND | 59.71 | 0.00 | 0.00 | 51.42 | ND | ND | 88.80 | 0.00 | 0.00 |
| 4/26/02 | | 51.67 | ND | ND | 59.71 | 0.00 | 0.00 | 51.70 | ND | ND | 88.80 | 0.00 | 0.00 |
| 5/15/02 | | 51.66 | ND | ND | 59.71 | 0.00 | 0.00 | 51.70 | ND | ND | 88.80 | 0.00 | 0.00 |
| 5/31/02 | | 51.83 | ND | ND | 59.71 | 0.00 | 0.00 | 51.86 | ND | ND | 88.80 | 0.00 | 0.00 |
| 6/14/02 | | 51.95 | ND | ND | 59.71 | 0.00 | 0.00 | 52.00 | ND | ND | 88.80 | 0.00 | 0.00 |
| 6/28/02 | | 52.22 | ND | ND | 59.71 | 0.00 | 0.00 | 52.27 | ND | ND | 88.80 | 0.00 | 0.00 |
| 7/12/02 | | 52.59 | ND | ND | 59.71 | 0.00 | 0.00 | 52.64 | ND | ND | 88.80 | 0.00 | 0.00 |
| 7/30/02 | | 53.04 | ND | ND | 59.71 | 0.00 | 0.00 | 53.05 | ND | ND | 88.80 | 0.00 | 0.00 |
| 8/2/02 | | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| 8/6/02 | | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: IW-4 Depth to Water (ft btoc) | IW-4 Depth to LNAPL (ft btoc) | IW-4 Depth to DNAPL (ft btoc) | IW-4 Total Depth (ft btoc) | IW-4 LNAPL Thickness (feet) | IW-4 DNAPL Thickness (feet) | MW-25D Depth to Water (ft btoc) | MW-25D Depth to LNAPL (ft btoc) | MW-25D Depth to DNAPL (ft btoc) | MW-25D Total Depth (ft btoc) | MW-25D LNAPL Thickness (feet) | MW-25D DNAPL Thickness (feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/7/02 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| 8/9/02 | 53.27 | ND | ND | 59.71 | 0.00 | 0.00 | 53.33 | ND | ND | 88.80 | 0.00 | 0.00 |
| 8/16/02 | 53.43 | ND | ND | 59.71 | 0.00 | 0.00 | 53.50 | ND | ND | 88.80 | 0.00 | 0.00 |
| 8/22/02 | 53.60 | ND | ND | 59.71 | 0.00 | 0.00 | 53.65 | ND | ND | 88.80 | 0.00 | 0.00 |
| 9/4/02 | 52.55 | ND | ND | 59.71 | 0.00 | 0.00 | 52.59 | ND | ND | 88.80 | 0.00 | 0.00 |
| 9/20/02 | 52.96 | ND | ND | 59.71 | 0.00 | 0.00 | 53.02 | ND | ND | 88.80 | 0.00 | 0.00 |
| 10/3/02 | 52.83 | ND | ND | 59.71 | 0.00 | 0.00 | 52.89 | ND | ND | 88.80 | 0.00 | 0.00 |
| 10/17/02 | 52.29 | ND | ND | 59.71 | 0.00 | 0.00 | 52.36 | ND | ND | 88.80 | 0.00 | 0.00 |
| 10/25/02 | 52.35 | ND | ND | 59.71 | 0.00 | 0.00 | 52.40 | ND | ND | 88.80 | 0.00 | 0.00 |
| 11/8/02 | 52.42 | ND | ND | 59.71 | 0.00 | 0.00 | 52.43 | ND | ND | 88.80 | 0.00 | 0.00 |
| 11/25/02 | 52.13 | ND | ND | 59.71 | 0.00 | 0.00 | 52.16 | ND | ND | 88.80 | 0.00 | 0.00 |
| 12/9/02 | 52.44 | ND | ND | 59.71 | 0.00 | 0.00 | 52.49 | ND | ND | 88.80 | 0.00 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: | IW-4 | | | | | | MW-25D | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Depth to DNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) | DNAPL Thickness (feet) |
| 12/24/02 | | 52.04 | ND | ND | 59.71 | 0.00 | 0.00 | 52.03 | ND | ND | 88.80 | 0.00 | 0.00 |
| 1/9/03 | | 51.65 | ND | ND | 59.71 | 0.00 | 0.00 | 51.68 | ND | ND | 88.80 | 0.00 | 0.00 |
| 1/28/03 | | 51.57 | ND | ND | 59.71 | 0.00 | 0.00 | 51.60 | ND | ND | 88.80 | 0.00 | 0.00 |
| 2/12/03 | | 51.61 | ND | ND | 59.71 | 0.00 | 0.00 | 51.63 | ND | ND | 88.80 | 0.00 | 0.00 |
| 2/26/03 | | 51.07 | ND | ND | 59.71 | 0.00 | 0.00 | 51.11 | ND | ND | 88.80 | 0.00 | 0.00 |
| 3/12/03 | | 50.69 | ND | ND | 59.71 | 0.00 | 0.00 | 50.73 | ND | ND | 88.80 | 0.00 | 0.00 |
| 3/26/03 | | 50.61 | ND | ND | 59.71 | 0.00 | 0.00 | 50.64 | ND | ND | 88.80 | 0.00 | 0.00 |
| 4/10/03 | | 50.58 | ND | ND | 59.71 | 0.00 | 0.00 | 50.62 | ND | ND | 88.80 | 0.00 | 0.00 |
| 4/24/03 | | 50.57 | ND | ND | 59.71 | 0.00 | 0.00 | 50.60 | ND | ND | 88.80 | 0.00 | 0.00 |
| 5/21/03 | | 50.82 | ND | ND | 59.71 | 0.00 | 0.00 | 50.86 | ND | ND | 88.80 | 0.00 | 0.00 |
| 6/26/03 | | 48.75 | ND | ND | 59.71 | 0.00 | 0.00 | 48.79 | ND | ND | 88.80 | 0.00 | 0.00 |
| 7/30/03 | | 48.62 | ND | ND | 59.71 | 0.00 | 0.00 | 48.64 | ND | ND | 88.80 | 0.00 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

| Date: | Well ID: MW-15 Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) |
|---|---|---|---|---|
| 7/30/01 | 47.82 | NM | NM | NM |
| 8/6/01 | NM | NM | NM | NM |
| 10/9/01 | NM | NM | NM | NM |
| 10/25/01 | NM | NM | NM | NM |
| 11/9/01 | NM | NM | NM | NM |
| 11/19/01 | NM | NM | NM | NM |
| 12/3/01 | 49.76 | ND | 57.84 | 0.00 |
| 12/19/01 | 49.80 | ND | 57.84 | 0.00 |
| 1/8/02 | 50.06 | ND | 57.84 | 0.00 |
| 1/24/02 | 50.23 | ND | 57.84 | 0.00 |
| 2/6/02 | 50.52 | ND | 57.84 | 0.00 |
| 2/20/02 | 50.74 | ND | 57.84 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: | MW-15 | | | |
|---|---|---|---|---|---|
| | | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) |
| 3/7/02 | | 50.92 | ND | 57.84 | 0.00 |
| 3/21/02 | | 51.02 | ND | 57.84 | 0.00 |
| 4/11/02 | | 51.13 | ND | 57.84 | 0.00 |
| 4/26/02 | | 51.51 | ND | 57.84 | 0.00 |
| 5/15/02 | | 51.50 | ND | 57.84 | 0.00 |
| 5/31/02 | | 52.42 | ND | 57.84 | 0.00 |
| 6/14/02 | | 52.78 | ND | 57.84 | 0.00 |
| 6/28/02 | | 52.06 | ND | 57.84 | 0.00 |
| 7/12/02 | | 52.43 | ND | 57.84 | 0.00 |
| 7/30/02 | | 52.85 | ND | 57.84 | 0.00 |
| 8/2/02 | | NM | NM | NM | NM |
| 8/6/02 | | NM | NM | NM | NM |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Date: | Well ID: | MW-15 | | | |
|---|---|---|---|---|---|
| | | Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) |
| 8/7/02 | | NM | ND | 57.84 | 0.00 |
| 8/9/02 | | 53.12 | ND | 57.84 | 0.00 |
| 8/16/02 | | 53.29 | ND | 57.84 | 0.00 |
| 8/22/02 | | 53.46 | ND | 57.84 | 0.00 |
| 9/4/02 | | 52.24 | ND | 57.84 | 0.00 |
| 9/20/02 | | 52.75 | ND | 57.84 | 0.00 |
| 10/3/02 | | 52.63 | ND | 57.84 | 0.00 |
| 10/17/02 | | 52.07 | ND | 57.84 | 0.00 |
| 10/25/02 | | 52.17 | ND | 57.84 | 0.00 |
| 11/8/02 | | 52.24 | ND | 57.84 | 0.00 |
| 11/25/02 | | 51.90 | ND | 57.84 | 0.00 |
| 12/9/02 | | 52.28 | ND | 57.84 | 0.00 |

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Table A2. Fluid-Level Gauging Measurements in Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

| Date: | Well ID: MW-15 Depth to Water (ft btoc) | Depth to LNAPL (ft btoc) | Total Depth (ft btoc) | LNAPL Thickness (feet) |
|---|---|---|---|---|
| 12/24/02 | 51.82 | ND | 57.84 | 0.00 |
| 1/9/03 | 51.42 | ND | 57.84 | 0.00 |
| 1/28/03 | 51.25 | ND | 57.84 | 0.00 |
| 2/12/03 | 51.45 | ND | 57.84 | 0.00 |
| 2/26/03 | 50.89 | ND | 57.84 | 0.00 |
| 3/12/03 | 50.48 | ND | 57.84 | 0.00 |
| 3/26/03 | 50.45 | ND | 57.84 | 0.00 |
| 4/10/03 | 50.43 | ND | 57.84 | 0.00 |
| 4/24/03 | 50.44 | ND | 57.84 | 0.00 |
| 5/21/03 | 50.70 | ND | 57.84 | 0.00 |
| 6/26/03 | 48.62 | ND | 57.84 | 0.00 |
| 7/30/03 | 48.50 | ND | 57.84 | 0.00 |

DNAPL Dense Non-Aqueous Phase Liquid.
LNAPL Light Non-Aqueous Phase Liquid.
ft btoc Feet below top of casing.
NA Not applicable due to fluid column being almost exclusively comprised of NAPL.
ND Not Detected.
NM Not Measured.
* DNAPL was detected. However, the amount of product in the well was less than 0.01-feet thick. Upon withdrawing a bailer from the well, DNAPL was visually apparent.
Note: During each gauging event, the wells are gauged for the presence of both DNAPL and LNAPL.

Table A3. Concentrations of Volatile Organic Compounds in Non-Aqueous Phase Liquid Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

| Constituent (Concentrations in ug/L) | Sample ID: / Sample Date: / NAPL Type: | IW-1 (OLD) 8/8/01 DNAPL | IW-1 9/6/01 DNAPL | IW-9L 9/6/01 LNAPL | MW-13 9/6/01 DNAPL |
|---|---|---|---|---|---|
| **VOCs** | MDL (ug/L) | | | | |
| Chloromethane | 10 | < 25,000,000 | < 20,000 | < 25,000,000 | < 50,000 |
| Bromomethane | 10 | < 25,000,000 | < 20,000 | < 25,000,000 | < 50,000 |
| Vinyl Chloride | 10 | < 25,000,000 | < 20,000 | < 25,000,000 | < 50,000 |
| Chloroethane | 10 | < 25,000,000 | < 20,000 | < 25,000,000 | < 50,000 |
| Methylene Chloride | 5 | < 125,000,000 | < 10,000 | < 125,000,000 | < 25,000 |
| Acetone | 10 | < 25,000,000 | < 20,000 | < 25,000,000 | < 50,000 |
| Carbon Disulfide | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| Vinyl Acetate | 10 | < 25,000,000 | < 20,000 | < 25,000,000 | < 50,000 |
| 1,1-Dichloroethene | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| 1,1-Dichloroethane | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| cis-1,2-Dichloroethene | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| trans-1,2-Dichloroethene | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| Chloroform | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| 1,2-Dichloroethane | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| 2-Butanone | 10 | < 25,000,000 | < 20,000 | < 25,000,000 | < 50,000 |
| 1,1,1-Trichloroethane | 5 | 1,400,000 J | 2,400 J | < 12,000,000 | < 25,000 |
| Carbon Tetrachloride | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| Bromodichloromethane | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| 1,2-Dichloropropane | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| cis-1,3-Dichloropropene | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| Trichloroethene | 5 | 3,900,000 J | 5,500 J | 2,400,000 J | 10,000 J |
| Dibromochloromethane | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| 1,1,2-Trichloroethane | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| Benzene | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| trans-1,3-Dichloropropene | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| Bromoform | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| 4-Methyl-2-Pentanone | 10 | < 25,000,000 | < 20,000 | < 25,000,000 | < 50,000 |
| 2-Hexanone | 10 | < 25,000,000 | < 20,000 | < 25,000,000 | < 50,000 |
| Tetrachloroethene | 5 | 410,000,000 | 240,000 | 310,000,000 | 590,000 |
| Toluene | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| 1,1,2,2-Trachloroethane | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| Chlorobenzene | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| Ethylbenzene | 5 | < 12,000,000 | < 10,000 | 640,000 J | < 25,000 |
| Styrene | 5 | < 12,000,000 | < 10,000 | < 12,000,000 | < 25,000 |
| Xylene (total) | 5 | < 12,000,000 | < 10,000 | 2,700,000 J | 6,200 J |

MDL Method detection limit, which varies with instrument used.
ug/L Micrograms per liter.
J Estimated value.

Table A4. Concentrations of Gasoline Range Organics (GRO) and Diesel Range Organics (DRO) in Non-Aqueous Phase Liquid Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

| Parameter | Sample ID: / Sample Date: | IW-1 (OLD) 8/8/01 | IW-1 9/6/01 | IW-9L 9/6/01 | MW-13 9/6/01 |
|---|---|---|---|---|---|
| GRO | | -- | -- | 180,000,000 ug/kg | 24,000 ug/L J |
| DRO | | -- | -- | 858,000 mg/kg | -- (a) |

mg/kg Milligrams per kilogram.
ug/kg Micrograms per kilogram.
ug/L Micrograms per liter.
J Estimated value.
-- Not analyzed.
(a) Insufficient product volume.

Table A5. Physical Properties of Non-Aqueous Phase Liquid Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

| Parameter | Sample ID: Sample Date: | IW-1 (OLD) 8/8/01 | IW-1 9/6/01 | IW-9L 9/6/01 | MW-13 9/6/01 |
|---|---|---|---|---|---|
| **Density (g/cc)** | | -- | 0.9966 | 0.9807 | 1.0322 |
| **Specific Gravity** | | -- | 0.9972 | 0.9813 | 1.0329 |
| **Viscosity Kinematics (cSt)** | | -- | 29.65 | 25.25 | 56.30 |

-- Not analyzed.
cSt Centistokes.
g/cc Grams per cubic centimeter.

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## Appendix B

Biogeochemical Conditions, June 2003

## Tables

B1 Concentrations of Dissolved Metals in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

B2 Concentrations of Classical Chemistry Analytes in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

B3 Concentrations of Light Hydrocarbons in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.

## Figures

B1 Field Parameters and Concentrations of Classical Chemistry Analytes, Methane, and Dissolved Metals (Shallow Zone).

B2 Field Parameters and Concentrations of Classical Chemistry Analytes, Methane, and Dissolved Metals (Intermediate Zone).

B3 Field Parameters and Concentrations of Classical Chemistry Analytes, Methane, and Dissolved Metals (Deep Zone).

B4 Concentrations of Select Volatile Organic Compounds, Ethene, and Ethane (Shallow Zone).

B5 Concentrations of Select Volatile Organic Compounds, Ethene, and Ethane (Intermediate Zone).

B6 Concentrations of Select Volatile Organic Compounds, Ethene, and Ethane (Deep Zone).

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Table B1. Concentrations of Dissolved Metals in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Analyte: (Units in ug/L) | Sample ID: Date: | MW-7 06/26/03 | MW-8 06/26/03 | MW-8 REP REP062603 06/26/03 | MW-10 06/23/03 | MW-11 06/23/03 | MW-15 06/24/03 | MW-16D 06/23/03 | MW-23 06/26/03 | MW-27D 06/24/03 | MW-28D 06/24/03 | MW-29 06/23/03 | MW-30 06/24/03 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Iron (dissolved) | | 59 B | 249 | 240 | 1040 | <52 | <52 | <52 | <52 | <52 | <52 | <52 | 2060 |
| Manganese (dissolved) | | 737 | 223 | 227 | 494 | 40.8 | 5.8 B | 5 B | 16.3 | 152 | 62.9 | 44.8 | 1650 |

ug/L Micrograms per liter.
B Detected between IDL and CRDL.
IDL Instrument detection limit.
CRDL Contract required detection limit.
REP Replicate.

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Table B1. Concentrations of Dissolved Metals in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Analyte: (Units in ug/L) | Sample ID: Date: | MW-31 06/24/03 | MW-32 06/26/03 | MW-33 06/26/03 |
|---|---|---|---|---|
| Iron (dissolved) | | <52 | 6700 | <52 |
| Manganese (dissolved) | | 32.1 | 1120 | 61.3 |

ug/L Micrograms per liter.
B Detected between IDL and CRDL.
IDL Instrument detection limit.
CRDL Contract required detection limit.
REP Replicate.

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Table B2. Concentrations of Classical Chemistry Analytes in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Analyte: (Units in mg/L) | Sample ID: Date: | IW-5 06/17/03 | IW-6 06/17/03 | IW-10 06/18/03 | IW-11 06/18/03 | IW-13 06/27/03 | IW-14 06/27/03 | IW-15 06/27/03 | IW-16 06/27/03 | MW-7 06/26/03 | MW-8 06/26/03 | MW-8 REP REP062603 06/26/03 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alkalinity | | -- | -- | -- | -- | -- | -- | -- | -- | 2.34 | 10.1 | 10.1 |
| Bromide | | -- | -- | -- | -- | -- | -- | -- | -- | <0.10 | <0.10 | <0.10 |
| Chloride | | -- | -- | -- | -- | -- | -- | -- | -- | 77 | 210 | 210 |
| Nitrate | | -- | -- | -- | -- | -- | -- | -- | -- | 0.43 | 0.72 | 0.72 |
| Nitrite | | -- | -- | -- | -- | -- | -- | -- | -- | <0.10 | <0.10 | <0.10 |
| Sulfate | | -- | -- | -- | -- | -- | -- | -- | -- | 57 | 15 | 15 |
| TOC | | 20 | 13 | 0.56 B | 4.4 | 0.57 B | 2.1 | 2.2 | 4 | 4.7 | 3.9 | 4.2 |

mg/L Milligrams per liter.
-- Not analyzed
B Detected between IDL and CRDL.
IDL Instrument detection limit.
CRDL Contract required detection limit.
REP Replicate.
TOC Total Organic Carbon.

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Table B2. Concentrations of Classical Chemistry Analytes in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Analyte: (Units in mg/L) | Sample ID: Date: | MW-10 06/23/03 | MW-11 06/23/03 | MW-15 06/24/03 | MW-16D 06/23/03 | MW-23 06/26/03 | MW-27D 06/24/03 | MW-28D 06/24/03 | MW-29 06/23/03 | MW-30 06/24/03 | MW-31 06/24/03 | MW-32 06/26/03 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alkalinity | | 21.1 | 61.4 | 15.6 | 8.09 | 17.7 | 28 | 13.8 | 44.2 | 25.2 | 42.9 | 30.6 |
| Bromide | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.051 B | <0.10 | <0.10 |
| Chloride | | 120 | 52 | 5.6 | 24 | 28 | 130 | 52 | 48 | 27 | 31 | 190 |
| Nitrate | | 0.82 | 0.62 | 0.38 | 1.8 | 3 | 2.1 | 3.3 | 0.98 | 0.96 | 0.8 | 0.46 |
| Nitrite | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Sulfate | | 32 | 41 | 4 | 19 | 23 | 110 | 15 | 25 | 67 | 24 | 59 |
| TOC | | 4.9 | 3.2 | 0.33 B | 0.26 B | 1.3 | 6.7 | 2.3 | 2 | 2.1 | 1.7 | 6.8 |

mg/L Milligrams per liter.
-- Not analyzed
B Detected between IDL and CRDL.
IDL Instrument detection limit.
CRDL Contract required detection limit.
REP Replicate.
TOC Total Organic Carbon.

Table B2. Concentrations of Classical Chemistry Analytes in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Analyte: (Units in mg/L) | Sample ID: Date: | MW-33 06/26/03 |
|---|---|---|
| Alkalinity | | 72 |
| Bromide | | 0.058 B |
| Chloride | | 44 |
| Nitrate | | 1.2 |
| Nitrite | | <0.10 |
| Sulfate | | 52 |
| TOC | | 5.6 |

mg/L Milligrams per liter.
-- Not analyzed
B Detected between IDL and CRDL.
IDL Instrument detection limit.
CRDL Contract required detection limit.
REP Replicate.
TOC Total Organic Carbon.

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Table B3. Concentrations of Light Hydrocarbons in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Analyte: Sample ID: / Date: | MW-7 06/26/03 | MW-8 06/26/03 | MW-10 06/23/03 | MW-11 06/23/03 | MW-15 06/24/03 | MW-16D 06/23/03 | MW-23 06/26/03 | MW-27D 06/24/03 | MW-28D 06/24/03 |
|---|---|---|---|---|---|---|---|---|---|
| Ethane (ng/L) | 18 | 34 | 15 | 24 | 9.6 | <5.0 | 16 | <5.0 | <5.0 |
| Ethene (ng/L) | 63 | 120 | 56 | 33 | 16 | <5.0 | 29 | <5.0 | 22 |
| Methane (ug/L) | 0.38 | 0.34 | 1.6 | 0.40 | 0.28 | 0.18 | 0.26 | 0.20 | 5.9 |

ug/L Micrograms per liter.
REP Replicate.

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Table B3. Concentrations of Light Hydrocarbons in Groundwater Samples Collected from Monitoring Wells, 25 Melville Park Road Site, Melville, New York.



| Analyte: | Sample ID:<br>Date: | MW-29<br>06/23/03 | MW-30<br>06/24/03 | MW-31<br>06/24/03 | MW-32<br>06/26/03 | MW-33<br>06/26/03 |
|---|---|---|---|---|---|---|
| Ethane (ng/L) | | 14 | 71 | 11 | 26 | 67 |
| Ethene (ng/L) | | 27 | 220 | 40 | 73 | 240 |
| Methane (ug/L) | | 0.23 | 0.51 | 0.48 | 0.30 | 0.35 |

ug/L Micrograms per liter.
REP Replicate.

For Drawing B1, see Project Manager.

| Analyte/Parameter | IW-14 6/27/03 |
|---|---|
| ORP (mV)* | 331 |
| pH (SU)* | 5.21 |
| Dissolved Oxygen (mg/L)* | 2.74 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | 2.1 |
| Sulfide (mg/L)^ | NA |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |

| Analyte/Parameter | MW-13D 6/19/03 |
|---|---|
| ORP (mV)* | 289 |
| pH (SU)* | 5.55 |
| Dissolved Oxygen (mg/L)* | 7.77 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | NA |
| Sulfide (mg/L)^ | NA |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |

| Analyte/Parameter | IW-8 6/19/03 |
|---|---|
| ORP (mV)* | 332 |
| pH (SU)* | 5.41 |
| Dissolved Oxygen (mg/L)* | 3.71 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | NA |
| Sulfide (mg/L)^ | NA |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |

| Analyte/Parameter | IW-15 6/27/03 |
|---|---|
| ORP (mV)* | 308 |
| pH (SU)* | 5.04 |
| Dissolved Oxygen (mg/L)* | 2.72 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | 2.2 |
| Sulfide (mg/L)^ | NA |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |

| Analyte/Parameter | MW-26D 6/18/03 |
|---|---|
| ORP (mV)* | 344 |
| pH (SU)* | 5.22 |
| Dissolved Oxygen (mg/L)* | 3.23 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | NA |
| Sulfide (mg/L)^ | NA |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |

| Analyte/Parameter | IW-13 6/27/03 |
|---|---|
| ORP (mV)* | 406 |
| pH (SU)* | 5.37 |
| Dissolved Oxygen (mg/L)* | 6.75 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | 0.57 B |
| Sulfide (mg/L)^ | NA |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |

| Analyte/Parameter | IW-10 6/18/03 |
|---|---|
| ORP (mV)* | 266 |
| pH (SU)* | 5.37 |
| Dissolved Oxygen (mg/L)* | 7.53 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | NA |
| Sulfide (mg/L)^ | 0.56 B |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |

| Analyte/Parameter | IW-12 6/18/03 |
|---|---|
| ORP (mV)* | 343 |
| pH (SU)* | 5.25 |
| Dissolved Oxygen (mg/L)* | 6.79 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | NA |
| Sulfide (mg/L)^ | NA |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |

| Analyte/Parameter | MW-33 6/26/03 |
|---|---|
| ORP (mV)* | 424 |
| pH (SU)* | 6.33 |
| Dissolved Oxygen (mg/L)* | 2.09 |
| Nitrate (mg/L) | 1.2 |
| Nitrite (mg/L) | ND |
| Sulfate (mg/L) | 52 |
| TOC (mg/L) | 5.6 |
| Sulfide (mg/L)^ | 0.028 |
| Methane (ug/L) | 0.35 |
| Dissolved Iron (ug/L) | ND |
| Dissolved Manganese (ug/L) | 61.3 |

| Analyte/Parameter | IW-11 6/18/03 |
|---|---|
| ORP (mV)* | 331 |
| pH (SU)* | 5.39 |
| Dissolved Oxygen (mg/L)* | 5.88 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | 4.4 |
| Sulfide (mg/L)^ | NA |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |

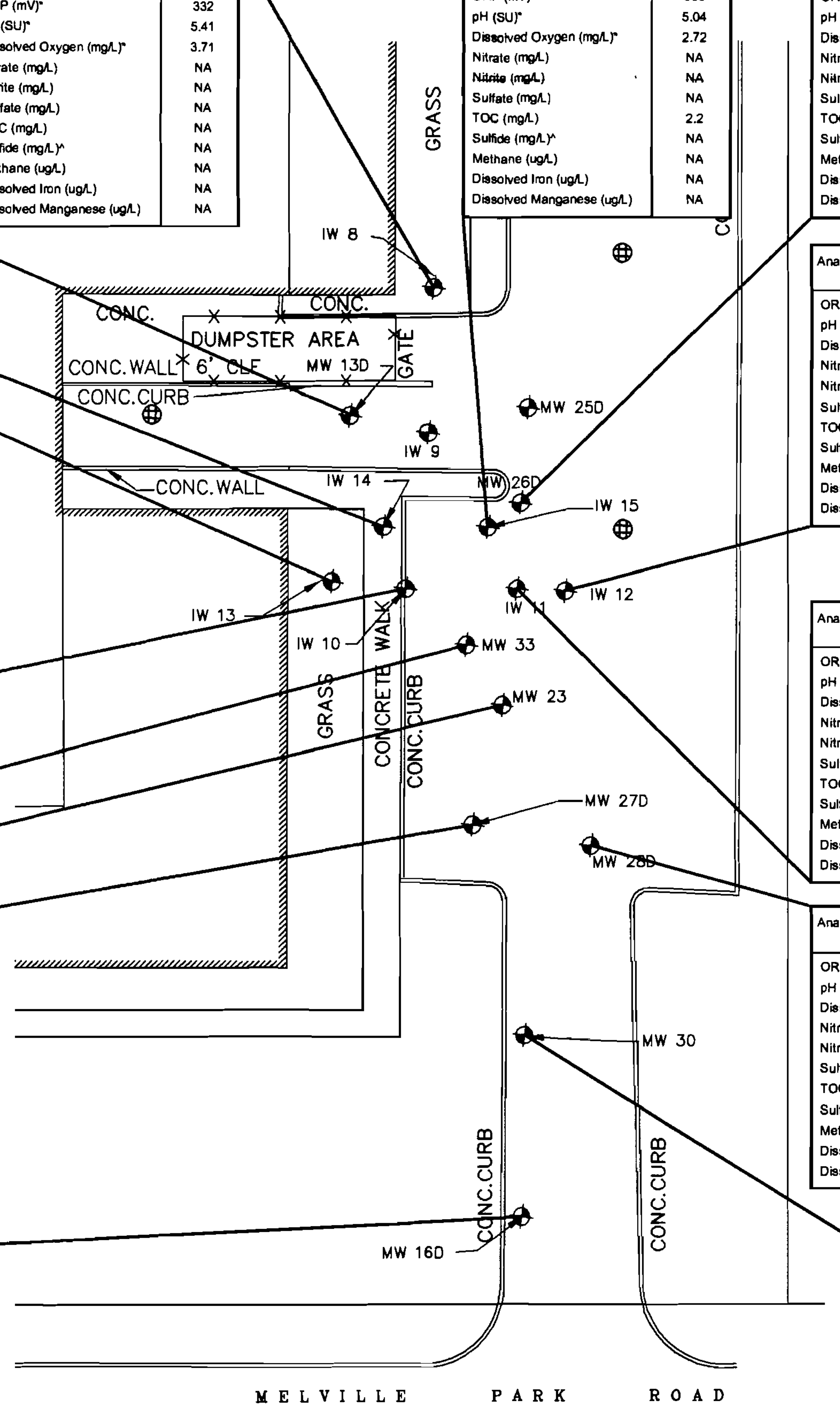
| Analyte/Parameter | MW-23 6/26/03 |
|---|---|
| ORP (mV)* | 384 |
| pH (SU)* | 5.40 |
| Dissolved Oxygen (mg/L)* | 2.72 |
| Nitrate (mg/L) | 3 |
| Nitrite (mg/L) | ND |
| Sulfate (mg/L) | 23 |
| TOC (mg/L) | 1.3 |
| Sulfide (mg/L)^ | 0.013 |
| Methane (ug/L) | 0.26 |
| Dissolved Iron (ug/L) | ND |
| Dissolved Manganese (ug/L) | 16.3 |

| Analyte/Parameter | MW-27D 6/24/03 |
|---|---|
| ORP (mV)* | 450 |
| pH (SU)* | 5.38 |
| Dissolved Oxygen (mg/L)* | 5.99 |
| Nitrate (mg/L) | 2.1 |
| Nitrite (mg/L) | ND |
| Sulfate (mg/L) | 110 |
| TOC (mg/L) | 6.7 |
| Sulfide (mg/L)^ | 0.078 |
| Methane (ug/L) | 0.20 |
| Dissolved Iron (ug/L) | ND |
| Dissolved Manganese (ug/L) | 152 |

| Analyte/Parameter | MW-28D 6/24/03 |
|---|---|
| ORP (mV)* | 300 |
| pH (SU)* | 5.26 |
| Dissolved Oxygen (mg/L)* | 1.76 |
| Nitrate (mg/L) | 3.3 |
| Nitrite (mg/L) | ND |
| Sulfate (mg/L) | 15 |
| TOC (mg/L) | 2.3 |
| Sulfide (mg/L)^ | 0.016 |
| Methane (ug/L) | 5.9 |
| Dissolved Iron (ug/L) | ND |
| Dissolved Manganese (ug/L) | 62.9 |

| Analyte/Parameter | MW-16D 6/23/03 |
|---|---|
| ORP (mV)* | 306 |
| pH (SU)* | 5.23 |
| Dissolved Oxygen (mg/L)* | 9.22 |
| Nitrate (mg/L) | 1.8 |
| Nitrite (mg/L) | ND |
| Sulfate (mg/L) | 19 |
| TOC (mg/L) | 0.26 B |
| Sulfide (mg/L)^ | 0.068 |
| Methane (ug/L) | 0.18 |
| Dissolved Iron (ug/L) | ND |
| Dissolved Manganese (ug/L) | 5 B |

| Analyte/Parameter | MW-30 6/24/03 |
|---|---|
| ORP (mV)* | 163 |
| pH (SU)* | 5.72 |
| Dissolved Oxygen (mg/L)* | 1.15 |
| Nitrate (mg/L) | 0.96 |
| Nitrite (mg/L) | ND |
| Sulfate (mg/L) | 67 |
| TOC (mg/L) | 2.1 |
| Sulfide (mg/L)^ | 0.018 |
| Methane (ug/L) | 0.51 |
| Dissolved Iron (ug/L) | 2060 |
| Dissolved Manganese (ug/L) | 1650 |






LEGEND

| | |
|---|---|
| MW 23 | LOCATION AND DESIGNATION OF MONITORING WELL |
| mV | MILLIVOLTS |
| SU | STANDARD UNITS |
| mg/L | MILLIGRAMS PER LITER |
| ug/L | MICROGRAMS PER LITER |
| NA | NOT ANALYZED |
| ND | NOT DETECTED |
| * | PARAMETER MEASURED IN THE FIELD |
| ^ | FIELD ANALYSIS USING A SPECTROPHOTOMETER |
| B | DETECTED BETWEEN INSTRUMENT DETECTION LIMIT AND CONTRACT REQUIRED DETECTION LIMIT |
| | STORM DRAIN |

0 30
SCALE IN FEET

REV. ISSUED DATE DESCRIPTION

ARCADIS

88 Duryea Road
Melville, NY 11747
Tel: 631-249-7600 Fax: 631-249-7610
www.arcadis-us.com

PROJECT TITLE

25 MELVILLE PARK ROAD
MELVILLE, NEW YORK

25 MPR, L.L.C.

SHEET TITLE

FIELD PARAMETERS AND CONCENTRATIONS OF CLASSICAL CHEMISTRY ANALYTES, METHANE, AND DISSOLVED METALS (INTERMEDIATE ZONE)

| | |
|---|---|
| PROJECT MANAGER S. FELDMAN | DEPARTMENT MANAGER N. VALKENBURG |
| LEAD DESIGN PROF. | CHECKED BY C. KEEN |
| TASK/PHASE NUMBER 00008 | DRAWN BY LMC |
| PROJECT NUMBER NY001332.0008 | DRAWING NUMBER B2 |

Date\Time : Tue, 09 Sep 2003 - 5:08pm
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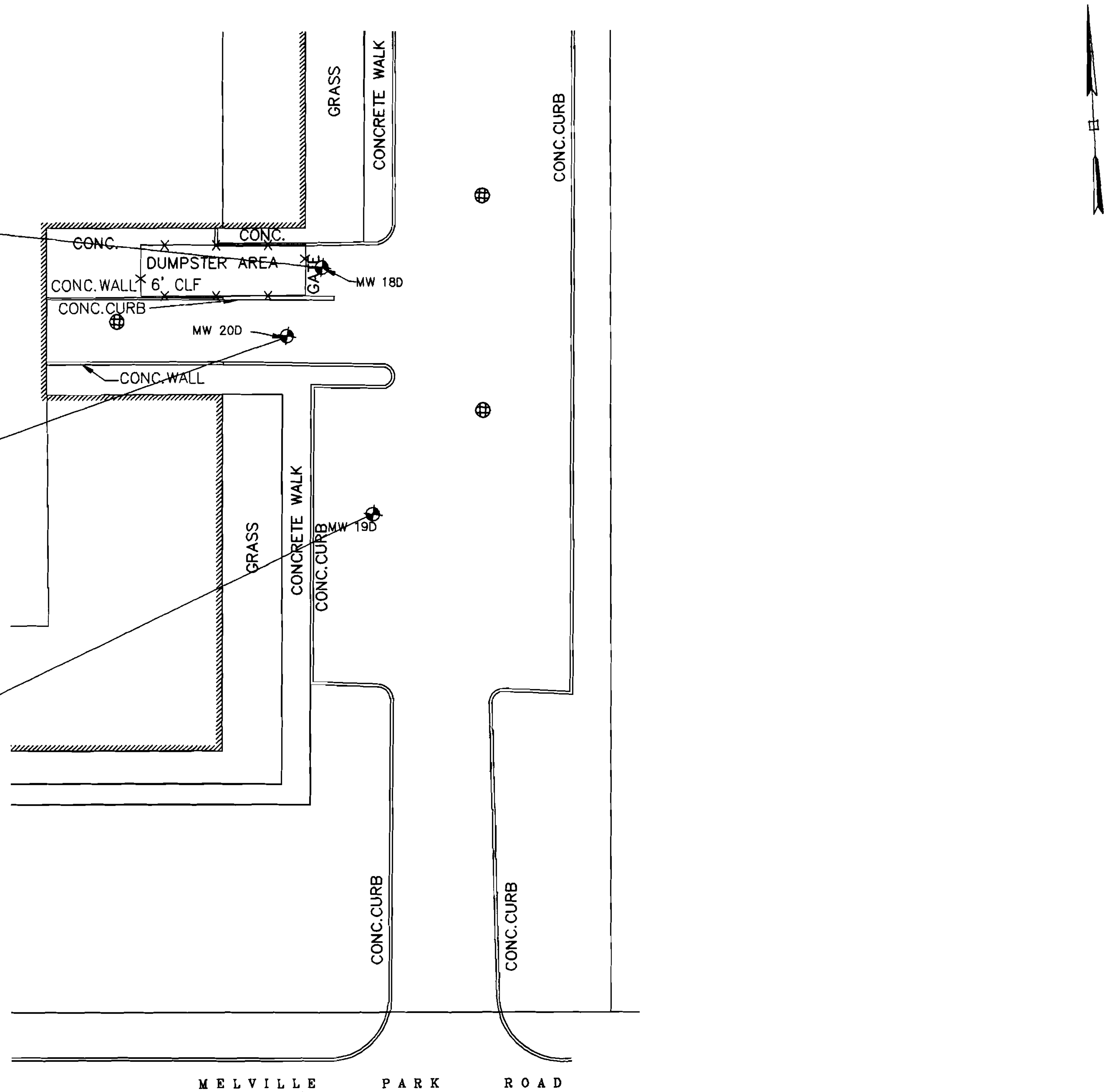
User Name : pinnacle

| Analyte/Parameter | MW-18D 6/19/03 |
|---|---|
| ORP (mV)* | 222 |
| pH (SU)* | 6.91 |
| Dissolved Oxygen (mg/L)* | 0.97 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | NA |
| Sulfide (mg/L)^ | NA |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |

| Analyte/Parameter | MW-20D 6/20/03 |
|---|---|
| ORP (mV)* | 267 |
| pH (SU)* | 5.76 |
| Dissolved Oxygen (mg/L)* | 0.83 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | NA |
| Sulfide (mg/L)^ | NA |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |

| Analyte/Parameter | MW-19D 6/20/03 |
|---|---|
| ORP (mV)* | 279 |
| pH (SU)* | 5.41 |
| Dissolved Oxygen (mg/L)* | 4.96 |
| Nitrate (mg/L) | NA |
| Nitrite (mg/L) | NA |
| Sulfate (mg/L) | NA |
| TOC (mg/L) | NA |
| Sulfide (mg/L)^ | NA |
| Methane (ug/L) | NA |
| Dissolved Iron (ug/L) | NA |
| Dissolved Manganese (ug/L) | NA |






LEGEND

| | |
|---|---|
| MW 18D | LOCATION AND DESIGNATION OF MONITORING WELL |
| mV | MILLIVOLTS |
| SU | STANDARD UNITS |
| mg/L | MILLIGRAMS PER LITER |
| ug/L | MICROGRAMS PER LITER |
| NA | NOT ANALYZED |
| * | PARAMETER MEASURED IN THE FIELD |
| ^ | FIELD ANALYSIS USING A SPECTROPHOTOMETER |
| | STORM DRAIN |

0 30
SCALE IN FEET

REV. ISSUED DATE DESCRIPTION

ARCADIS
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www.arcadis-us.com

PROJECT TITLE

25 MELVILLE PARK ROAD
MELVILLE, NEW YORK

25 MPR, L.L.C.

SHEET TITLE

FIELD PARAMETERS AND CONCENTRATIONS OF CLASSICAL CHEMISTRY ANALYTES, METHANE, AND DISSOLVED METALS (DEEP ZONE)

| | |
|---|---|
| PROJECT MANAGER S. FELDMAN | DEPARTMENT MANAGER N. VALKENBURG |
| LEAD DESIGN PROF. | CHECKED BY C. KEEN |
| TASK/PHASE NUMBER 00008 | DRAWN BY LMC |
| PROJECT NUMBER NY001332.0008 | DRAWING NUMBER B3 |

Date\Time : Tue, 09 Sep 2003 - 5:08pm
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Acad Version : R16.0
User Name : pinnacle

For Drawing B4, see Project Manager.

| Constituent (Units in ug/L) | MW-13D 6/19/03 |
|---|---|
| Tetrachloroethene | 5800 D |
| Trichloroethene | 100 |
| cis-1,2-Dichloroethene | 41 |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |

| Constituent (Units in ug/L) | IW-8 6/19/03 |
|---|---|
| Tetrachloroethene | 220 |
| ~~Trichloroethene~~ | 4 J |
| cis-1,2-Dichloroethene | ND |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |

| Constituent (Units in ug/L) | IW-15 6/27/03 |
|---|---|
| Tetrachloroethene | 57 |
| Trichloroethene | 18 |
| cis-1,2-Dichloroethene | 5 |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |

| Constituent (Units in ug/L) | MW-26D 6/18/03 |
|---|---|
| Tetrachloroethene | 160 |
| Trichloroethene | 37 |
| cis-1,2-Dichloroethene | 12 |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |

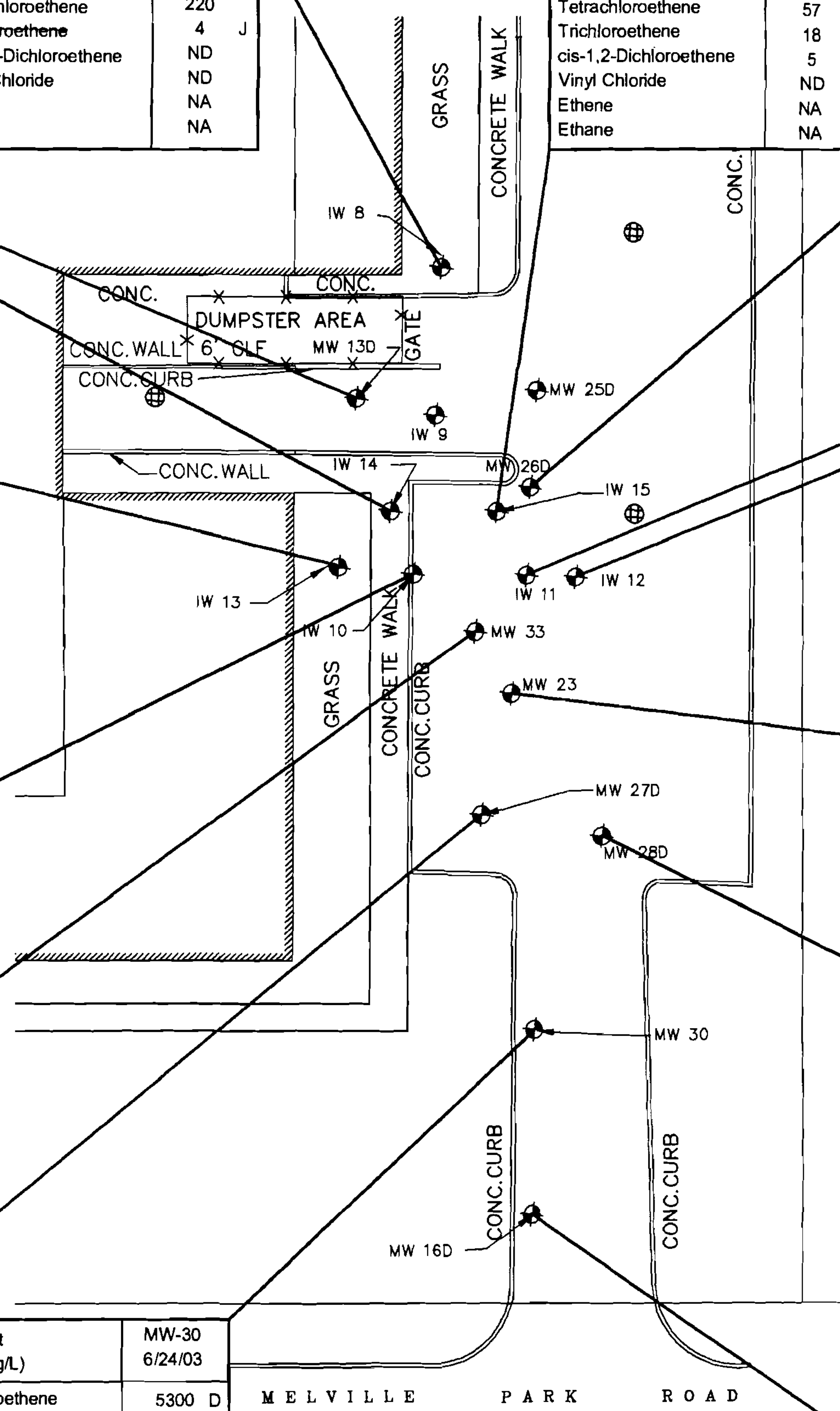
| Constituent (Units in ug/L) | IW-14 6/27/03 |
|---|---|
| Tetrachloroethene | 5500 D |
| Trichloroethene | 580 D |
| cis-1,2-Dichloroethene | 310 |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |

| Constituent (Units in ug/L) | IW-11 6/18/03 |
|---|---|
| Tetrachloroethene | 180 |
| Trichloroethene | 31 |
| cis-1,2-Dichloroethene | 16 |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |

| Constituent (Units in ug/L) | IW-13 6/27/03 |
|---|---|
| Tetrachloroethene | 690 D |
| Trichloroethene | 8 J |
| cis-1,2-Dichloroethene | 18 |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |

| Constituent (Units in ug/L) | IW-12 6/18/03 |
|---|---|
| Tetrachloroethene | 120 |
| Trichloroethene | 72 |
| cis-1,2-Dichloroethene | 47 |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |

| Constituent (Units in ug/L) | IW-10 6/18/03 |
|---|---|
| Tetrachloroethene | 3800 D |
| Trichloroethene | 39 |
| cis-1,2-Dichloroethene | 66 |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |




| Constituent (Units in ug/L) | MW-23 6/26/03 |
|---|---|
| Tetrachloroethene | 340 |
| Trichloroethene | 150 |
| cis-1,2-Dichloroethene | 32 |
| Vinyl Chloride | ND |
| Ethene | 0.029 |
| Ethane | 0.016 |

| Constituent (Units in ug/L) | MW-33 6/26/03 |
|---|---|
| Tetrachloroethene | 2600 D |
| Trichloroethene | 120 |
| cis-1,2-Dichloroethene | 41 |
| Vinyl Chloride | ND |
| Ethene | 0.240 |
| Ethane | 0.067 |

| Constituent (Units in ug/L) | MW-28D 6/24/03 |
|---|---|
| Tetrachloroethene | 77 |
| Trichloroethene | 19 |
| cis-1,2-Dichloroethene | 1 J |
| Vinyl Chloride | ND |
| Ethene | 0.022 |
| Ethane | ND |

| Constituent (Units in ug/L) | MW-27D 6/24/03 |
|---|---|
| Tetrachloroethene | 6700 D |
| Trichloroethene | 4100 D |
| cis-1,2-Dichloroethene | 1200 D |
| Vinyl Chloride | ND |
| Ethene | ND |
| Ethane | ND |

| Constituent (Units in ug/L) | MW-30 6/24/03 |
|---|---|
| Tetrachloroethene | 5300 D |
| Trichloroethene | 470 D |
| cis-1,2-Dichloroethene | 330 D |
| Vinyl Chloride | ND |
| Ethene | 0.220 |
| Ethane | 0.071 |

| Constituent (Units in ug/L) | MW-16D 6/23/03 |
|---|---|
| Tetrachloroethene | 210 |
| Trichloroethene | ND |
| cis-1,2-Dichloroethene | 4 J |
| Vinyl Chloride | ND |
| Ethene | ND |
| Ethane | ND |



LEGEND

| | |
|---|---|
| MW 23 | LOCATION AND DESIGNATION OF MONITORING WELL |
| ug/L | MICROGRAMS PER LITER |
| D | DETECTED AT SECONDARY DILUTION |
| J | ESTIMATED VALUE |
| ND | NOT DETECTED |
| NA | NOT ANALYZED |
| | STORM DRAIN |

0 30
SCALE IN FEET

REV. ISSUED DATE DESCRIPTION

ARCADIS

88 Duryea Road
Melville, NY 11747
Tel 631-249-7600 Fax 631-249-7610
www.arcadis-us.com

PROJECT TITLE

25 MELVILLE PARK ROAD
MELVILLE, NEW YORK

25 MPR, L.L.C.

SHEET TITLE

CONCENTRATIONS OF SELECT VOLATILE ORGANIC COMPOUNDS, ETHENE, AND ETHANE (INTERMEDIATE ZONE)

| | |
|---|---|
| PROJECT MANAGER S. FELDMAN | DEPARTMENT MANAGER N. VALKENBURG |
| LEAD DESIGN PROF. | CHECKED BY C. KEEN |
| TASK/PHASE NUMBER 00008 | DRAWN BY LMC |
| PROJECT NUMBER NY001332.0008 | DRAWING NUMBER B5 |

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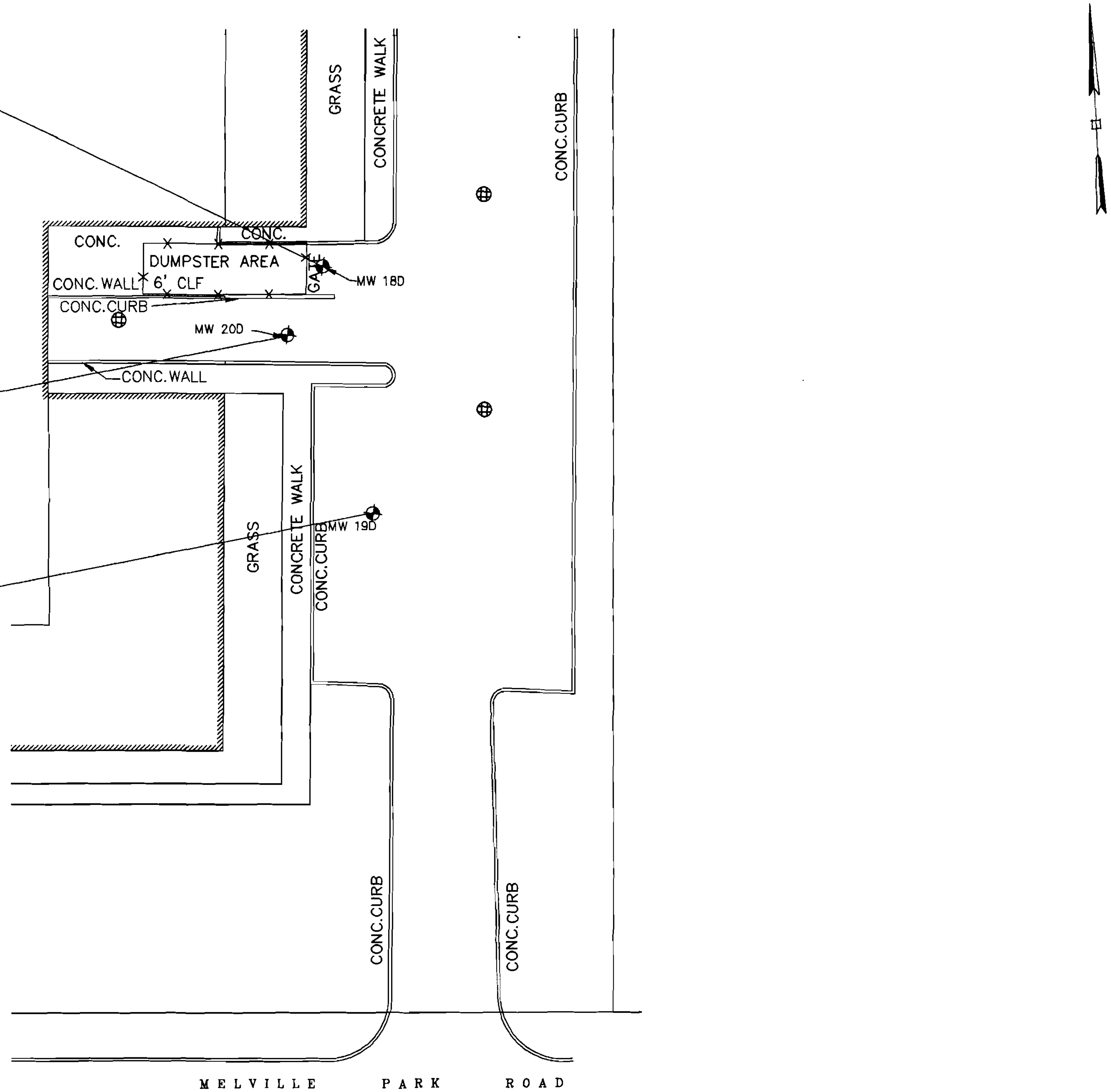
User Name : pinnacle

| Constituent (Units in ug/L) | MW-18D 6/19/03 |
|---|---|
| Tetrachloroethene | 20 |
| Trichloroethene | 2 J |
| cis-1,2-Dichloroethene | 180 |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |

| Constituent (Units in ug/L) | MW-20D 6/20/03 |
|---|---|
| Tetrachloroethene | 11 |
| Trichloroethene | ND |
| cis-1,2-Dichloroethene | 2 J |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |

| Constituent (Units in ug/L) | MW-19D 6/20/03 |
|---|---|
| Tetrachloroethene | 37 |
| Trichloroethene | 0.8 J |
| cis-1,2-Dichloroethene | 3 J |
| Vinyl Chloride | ND |
| Ethene | NA |
| Ethane | NA |






LEGEND

| | |
|---|---|
| MW 18D | LOCATION AND DESIGNATION OF MONITORING WELL |
| ug/L | MICROGRAMS PER LITER |
| D | DETECTED AT SECONDARY DILUTION |
| J | ESTIMATED VALUE |
| ND | NOT DETECTED |
| NA | NOT ANALYZED |
| | STORM DRAIN |

0 30
SCALE IN FEET

REV. ISSUED DATE DESCRIPTION

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www.arcadis-us.com

PROJECT TITLE

25 MELVILLE PARK ROAD
MELVILLE, NEW YORK

25 MPR, L.L.C.

SHEET TITLE

CONCENTRATIONS OF SELECT VOLATILE ORGANIC COMPOUNDS, ETHENE, AND ETHANE (DEEP ZONE)

| | |
|---|---|
| PROJECT MANAGER S. FELDMAN | DEPARTMENT MANAGER N. VALKENBURG |
| LEAD DESIGN PROF. | CHECKED BY C. KEEN |
| TASK/PHASE NUMBER 00008 | DRAWN BY LMC |
| PROJECT NUMBER NY001332.0008 | DRAWING NUMBER B6 |

Date\Time : Tue, 09 Sep 2003 - 5:09pm
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User Name : pinnacle

ARCADIS

## Appendix C

Enhanced Reductive Dechlorination Pilot Test Workplan; and NYSDEC Letter of May 13, 2003

# New York State Department of Environmental Conservation
**Division of Environmental Remediation, Region One**
Building 40 - SUNY, Stony Brook, New York 11790-2356
**Phone:** (631) 444-0240 • **FAX:** (631) 444-0248
**Website:** www.dec.state.ny.us


Erin M. Crotty
Commissioner

May 13, 2003

Steven Feldman
Arcadis G&M, Inc.
88 Duryea Road
Melville, NY 11747

Re: ERD Pilot Test Work Plan, April 1, 2003
25 Melville Park Road, #V00128-1

Dear Mr. Feldman:

As we discussed previously, the subject work plan is acceptable under the following conditions:

1) Table 2, page 1 of 4, baseline shallow monitoring wells - Add MW-9

2) Table 2, page 3 of 4, Field Parameter Monitoring

Add a laboratory TOC analysis for the following:

- MW-29 (5th month)
- MW-31 (5th month
- MW-11 (3rd and 5th month)
- MW-30 (5th month)
- MW-16D (5th month)
- MW-9 (3rd and 5th month)

Add IW-7 and IW-12 to the field parameter monitoring for months 1, 3, and 5. This monitoring will include a laboratory sample for TOC and the field parameters (pH, ORP, DO, temperature, and specific conductivity).

3) If the TOC is elevated in the following TOC analyses (field parameter monitoring), these wells will be included in the following months performance monitoring:

- MW-10 (3rd and 5th month)
- MW-29 (5th month)
- MW-31 (5th month
- MW-11 (3rd and 5th month)
- MW-30 (5th month)
- MW-16D (5th month)
- MW-9 (3rd and 5th month)

These wells (except for MW-9) are identified as supplemental monitoring wells in the last paragraph of Section 5.3. Elevated TOC concentrations will be the trigger for these wells to be added to the following months performance monitoring.

4) Any modification of the monitoring schedule needs NYSDEC approval.

5) Indoor Air Sampling, Section 5.5.5:

- As part of the baseline data, an outdoor air sample is needed, in addition to the two proposed sampling events.
- The laboratory analyzing the air samples must be NYSDOH ELAP certified to perform the selected analyses.
- The air samples must be analyzed by methods that can achieve minimum detection limits of one part per billion (ppb) for the compounds of interest. This is equivalent to one to seven micrograms per cubic meter, depending on the molecular weight for each compound.
- The attached NYSDOH guidance for indoor air sampling will be followed.
- The NYSDOH project manager for this site will be provided further details prior to the air sampling to ensure that these samples will be collected in accordance with applicable guidance.

Since the work plan is being conditionally approved, please attach a copy of this letter to the front of the work plan. As so amended, the work plan is hereby approved.

If you have any questions, please do not hesitate to call me at (631) 444-0244. If you have any questions regarding the air sampling requirements, please call Mr. Ian Ushe at (518) 402-7880.

Sincerely,

Robert R. Stewart

Robert R. Stewart
Environmental Engineer I

Enclosure

cc: W. Parish
E. Obrecht
K. Carpenter
J. Haas
W. O'Brien
I. Ushe, NYSDOH
R. Seyfarth, SCDHS
G. Rosser, SCDHS
L. Levine, Melville Industrial Associates
S. Hardy, Achon Group

ARCADIS

*Infrastructure, buildings, environment, communications*

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www.arcadis-us.com

Mr. Robert R. Stewart, Environmental Engineer
New York State Department of Environmental Conservation
Division of Environmental Remediation, Region One
Building 40 - SUNY
Stony Brook, New York 11790-2356

ENVIRONMENTAL

Subject:
Enhanced Reductive Dechlorination (ERD) Pilot Test Workplan
25 Melville Park Road Site
Melville, New York

Date:
1 April 2003

Contact:
Steven M. Feldman

Phone:
(631) 391-5244

Email:
sfeldman@arcadis-us.com

Our ref:
NY001332.0003.00003

Dear Mr. Stewart:

Enclosed is a copy of the revised workplan entitled, "Enhanced Reductive Dechlorination (ERD) Pilot Test Workplan, 25 Melville Park Road Site, Melville, New York." This revised workplan supersedes the ERD Pilot Test Workplan that was submitted by ARCADIS on January 22, 2003. The revisions are based on discussions from the February 27, 2003 meeting between the New York State Department of Environmental Conservation (NYSDEC), Suffolk County Department of Health Services (SCDHS), and ARCADIS and the NYSDEC letter dated March 4, 2003, which provided comments on the January 22, 2003 ERD Pilot Test Workplan.

ARCADIS would like to begin well installation activities as soon as possible. Prior to initiating these activities, ARCADIS is requesting written approval of the ERD Pilot Test Workplan from the NYSDEC.

Please do not hesitate to contact us if you have any questions.

Sincerely,

ARCADIS G&M, Inc.

Steven M. Feldman
Project Manager

Nicholas Valkenburg
Project Director

Copies:
Lawrence Levine, 25 MPR LLC
Shawn Hardy, ARCHON Group
Kevin Carpenter, NYSDEC
Joseph Haas, NYSDEC
Eric Obrecht, NYSDEC
William O'Brien, NYSDEC
Steven Scharf, NYSDEC
Ian Ushe, NYSDOH
Geralyn Rosser, SCDHS
Robert Seyfarth, SCDHS

# Enhanced Reductive Dechlorination (ERD) Pilot Test Workplan

25 MELVILLE PARK ROAD SITE
MELVILLE, NEW YORK

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# Enhanced Reductive Dechlorination (ERD) Pilot Test Workplan

25 Melville Park Road Site
Melville, New York

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## Disclosure Statement

The laws of New York State require that the corporations which render engineering services in New York be owned by individuals licensed to practice engineering in the State. ARCADIS cannot meet that requirement. Therefore, all engineering services rendered to 25 MPR, LLC in New York are being performed by ARCADIS Engineers and Architects of New York, P.C., a New York Professional corporation qualified to render professional engineering in New York. There is no surcharge or extra expense associated with the rendering of professional services by ARCADIS Engineers and Architects of New York, P.C.

ARCADIS is performing all those services that do not constitute professional engineering, and is providing administrative and personnel support to ARCADIS Engineers and Architects of New York, P.C. All matters relating to the administration of the contract with 25 MPR, LLC are being performed by ARCADIS pursuant to its Amended and Restated Services Agreement with ARCADIS Engineers and Architects of New York, P.C.

## 1. Introduction

This Enhanced Reductive Dechlorination (ERD) Pilot Test Workplan (Workplan) was prepared by ARCADIS and ARCADIS Engineers and Architects of New York, P.C., on behalf of 25 MPR, LLC, for the 25 Melville Park Road Site (hereinafter referred to as the "Site") in Melville, New York. Under the provisions of the New York State Voluntary Cleanup Program, WHCS Melville, L.L.C. (WHCS) and the New York State Department of Environmental Conservation (NYSDEC) entered into a Voluntary Remediation Agreement (Agreement) on January 13, 1998 to remediate the on-site portion of the groundwater plume that is impacted with chlorinated volatile organic compounds (CVOCs).

In the Draft Remedial Action Plan (RAP) issued on January 24, 2002, enhanced reductive dechlorination (ERD) is identified as the preferred technology for remediation of groundwater. This Workplan has been prepared in response to an August 19, 2002 letter from the NYSDEC indicating their receptiveness to a pilot demonstration of the ERD technology prior to conditional approval of the Remedial Action Work Plan (RAWP). The ERD technique was selected based on an evaluation of the most appropriate remedial technologies. In addition to addressing dissolved-phase CVOC mass, the ERD technique will also treat sorbed-phase CVOC mass, and has the potential to be used in the source area to remediate residual non-aqueous phase liquid (NAPL).

This workplan describes a six to twelve-month pilot test of ERD technology. The data collected during the pilot test will be used to evaluate whether ERD can be successfully applied at the Site. If the pilot test proves the technology is successful, it will be retained for use in the remedial action for groundwater.

## 2. Objectives

The primary CVOCs present in site groundwater include: tetrachloroethene (PCE), trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), cis-1,2-dichloroethene (cis-1,2-DCE), 1,1-dichloroethane (1,1-DCA).

The main goal of implementing the ERD technology at the Site will be to reduce the concentrations of these CVOCs. This will be accomplished through the injection of an easily degradable carbohydrate solution, creation of an anaerobic and strongly reducing in-situ reactive zone (IRZ), and transformation of the CVOCs to progressively less chlorinated intermediates until they are completely degraded to carbon dioxide and water. Consequently, the objectives of this pilot test will be to:

- Demonstrate that an anaerobic and reducing IRZ can be established at the Site;
- Determine how much the natural rate of reductive dechlorination can be enhanced;
- Determine the carbohydrate loading necessary to create and maintain the IRZ; and
- Confirm the optimal delivery parameters.

Performance data collected during operation of the pilot test will be periodically compared to the baseline data and evaluated against the above performance objectives. Ultimately, the determination as to whether the pilot test was a success will be based on the ability to demonstrate that the technology is capable of satisfying the short-term and long-term preliminary remedial action goals presented in the Draft RAP. Specifically, this involves short-term stabilization of the CVOC plume to prevent further off-site migration and long-term reduction of on-site CVOC mass such that cleanup goals are achieved at the downgradient property boundary.

## 3. Review of ERD Technology

CVOCs have long been perceived as recalcitrant and difficult to remediate in groundwater environments. In recent years, engineered bioremediation techniques have proven (through field application and laboratory study) to be effective for treating these types of compounds in groundwater.

ERD is an engineered bioremediation technique that falls into a class of remedial technologies known as In-situ Reactive Zones (IRZ). This technique is accepted by both federal and state regulatory agencies, and has been approved for use at several sites in New York and USEPA Region II. ERD employs an easily degradable carbohydrate solution (i.e., molasses), which is injected into the groundwater. The molasses injection provides excess organic carbon, which promotes microbial activity in the subsurface, subsequently enhancing the rates of reductive dechlorination of the CVOCs present.

When added to groundwater, naturally occurring bacteria begin to metabolize the molasses solution, consuming dissolved oxygen at a rate greater than it can be recharged naturally. Following depletion of oxygen, subsurface microbes begin the successive utilization of alternative electron acceptors to support respiration. The general sequence of alternate electron acceptor utilization and respiration byproduct formation is as follows (from most thermodynamically favorable to least):

| | | |
|---|---|---|
| Nitrate ($NO_3$) | → | Nitrogen ($N_2$) |
| Mangenic Manganese ($Mn^{4+}$) | → | Mangenous Manganese ($Mn^{2+}$) |
| Ferric Iron ($Fe^{3+}$) | → | Ferrous Iron ($Fe^{2+}$) |
| Sulfate ($SO_4^{2-}$) | → | Sulfide ($S^{-2}$) |
| Carbon Dioxide ($CO_2$) | → | Methane ($CH_4$) |

By maintaining excess organic carbon in the groundwater environment, ERD technology stimulates microbial activity, driving the groundwater environment to anaerobic and strongly reducing conditions. The zone in which this environment is established serves as an IRZ. Within the IRZ, there are three primary processes by which microbes can degrade CVOCs dissolved in groundwater:

1. Cometabolism: In this process, CVOCs are fortuitously degraded by the enzymes and cofactors produced by microbes as they metabolize excess organic carbon.

2. Hydrogenolysis: In this process, chlorine atoms in CVOC molecules are directly replaced by excess hydrogen atoms created as a result of the reducing environment and through hydrolysis and fermentation of the excess organic carbon.

3. Dehalorespiration: In this process, microbes use the CVOC molecule itself to support respiration under the anaerobic and reducing environment maintained by the presence of excess organic carbon.

The degradation of VOCs by anaerobic bacteria occurs primarily through the process of dehalogenation (or reductive dechlorination), which is the successive removal of chlorine atoms from the VOC molecule via a biologically mediated pathway. For example, TCE is formed when a chlorine atom is removed from PCE. Under the proper reducing conditions, this process can continue, resulting in the successive formation of cis-1,2-DCE, vinyl chloride (VC), and finally ethene. Ethene is then degraded to ethane, and finally carbon dioxide and water are formed. A similar process of chlorine removal occurs for 1,1,1-TCA, in which 1,1-DCA, chloroethane, and ethane are formed.

In addition to the above, direct mineralization of various CVOC transformation intermediates to water and carbon dioxide is possible in the presence of iron reduction. Where observed, this process prevents the buildup of compounds such as vinyl chloride. This process has been demonstrated and discussed in numerous literature accounts including: Bradley and Chappelle, 1996; Bradley and Chappelle, 1997; Wiedemeier and Chappelle, 1998; and Ferrey and Wilson, 2002.

The biological activity stimulated by the ERD process also results in a disruption of the natural dissolved phase-adsorbed phase equilibrium in the subsurface. This disruption transfers CVOC mass from the adsorbed phase to the dissolved phase (i.e., desorption), making it available for treatment. This same principle applies to NAPL. This feature makes the ERD technology much more aggressive than some of the more traditional remediation technologies which rely on natural dissolution to access sorbed or separate-phase mass.

## 4. Existing Site Conditions

This section of the workplan contains a brief overview of existing conditions at the Site. Included in this section are a brief description of the geology and hydrogeology, and a summary of recent groundwater quality data.

### 4.1 Geology/Hydrogeology

The deposits encountered during subsurface investigations on-site have been predominantly characterized as tan to light brown/light red-brown/gray/white, fine to coarse sand and gravel. Thin lenses of reddish-brown clay and sandy silt have been encountered in boreholes MW-18D [60-64 feet below land surface (ft bls)], MW-19D (58-62 ft bls), and MW-20D (60-64 ft bls). In addition, a medium gray clay was encountered at 56.5 ft bls during the installation of MW-12 and a clay layer was encountered from 60-62 ft bls in MW-11.

The direction of groundwater flow on-site is south-southeast. The horizontal hydraulic gradient in the shallow aquifer zone (45 to 60 ft bls) is approximately 0.001 ft/ft. Depth-to-water at the site is approximately 50 ft bls. Site-specific hydraulic conductivity data is not available for the site. Based on an examination of geologic logs for on-site wells, slug test and aquifer test data collected by ARCADIS at a nearby site in Melville, and regional hydrogeologic studies conducted by the U.S. Geological Survey, ARCADIS estimates the hydraulic conductivity (K) in the area of the plume to be approximately 50 to 100 ft/day. Based on this range of hydraulic conductivities and an estimated effective porosity of 0.25, the estimated average horizontal groundwater velocity is approximately 0.3 ft/day. Due to the relatively homogeneous nature of the geology, the advective groundwater velocities in the shallow, intermediate (75 to 90 ft bls), and deep aquifer zones (100 to 185 ft bls) are expected to be similar.

### 4.2 Existing Groundwater Conditions

In order to gain a better understanding of current groundwater conditions, ARCADIS collected groundwater samples from most of the site monitoring wells between July and August 2001. Figure 1 shows the existing well network at the site with the exception of MW-6, which is located in the northwest corner of the site. The apparent configurations of the CVOC plumes in the shallow, intermediate, and deep aquifer zones are depicted on Figures 2, 3, and 4, respectively. Key observations are as follows:

- Total CVOC concentrations in the shallow zone (Figure 2) ranged from 3.4 micrograms per liter (μg/L) (MW-4) to 32,000 μg/L (IW-3). The highest concentrations were detected just east of the loading dock area. A second area of high concentrations exists in the vicinity of MW-8 (15,083 μg/L) and MW-7 (11,900 μg/L).

- Total CVOC concentrations in the intermediate zone (Figure 3) ranged from 52.3 μg/L (MW-16D) to 13,130 μg/L (MW-13D). The highest concentration was detected just east of the loading dock area. A high concentration was also detected at MW-27D (8,835 μg/L).

- Total CVOC concentrations in the deep zone (Figure 4) ranged from 2 μg/L (MW-20D) to 275 μg/L (MW-18D). These wells are both located in the area just east of the loading dock area where the highest concentrations were reported in the shallow and intermediate zones. The third deep zone monitoring well (MW-19D) had a reported concentration of 2.5 μg/L.

The significant decrease in concentrations with depth between the shallow and deep zones indicates that the dissolved CVOC plume has been vertically delineated. Furthermore, the most significant CVOC concentration in the deep zone was reported in MW-18D (275 µg/L), which is screened from 133 to 143 ft bls. Based on the reported concentrations in the two other wells that comprise the deep zone monitoring network, MW-19D (2.5 µg/L), screened from 160 to 170 ft bls, and MW-20D (2 µg/L), screened from 175 to 185 ft bls, the vertical extent of contamination does not appear to extend below 150 ft bls.

#### 4.3 Biogeochemical Conditions

As part of the July/August 2001 monitoring event, groundwater samples from select monitoring wells were also analyzed for a suite of biogeochemical parameters. The data provide insight into the occurrence and types of natural biodegradation processes ongoing at the site. The results indicate that natural degradation of the CVOCs in groundwater is occurring (most likely as a result of the presence of petroleum hydrocarbons in the source area), but at a rate that is insufficient to achieve remedial goals.

The ambient groundwater environment, as exhibited at Well MW-15, is aerobic and oxidizing. This is generally characterized by dissolved oxygen (DO) concentrations above 1 milligram per liter (mg/L) and an oxidation-reduction potential (ORP) greater than +100 millivolts (mV). The dissolved oxygen concentration observed at MW-15 was 6.87 and 3.21 mg/L, as measured in the field and in the laboratory, respectively. In addition to abundant dissolved oxygen concentrations, the next most preferred electron acceptor (nitrate) was also detected at a concentration of 1.3 mg/L. Finally, the field-measured oxidation-reduction potential (ORP) at MW-15 was +208 millivolts (mV).

By comparison, the groundwater environment in the area of CVOC impacts exhibits a lack of DO, negative ORP, and the presence of the reduced forms of various alternate electron acceptors (e.g., dissolved iron, dissolved manganese, sulfide, and methane). Background concentrations of dissolved iron and dissolved manganese were below the limits of detection and 14.5 µg/L, respectively. Concentrations of dissolved iron and dissolved manganese within the core of the CVOC plume range from 8,700 to 13,100 µg/L (iron) and 168 to 651 µg/L (manganese), respectively. The presence of sulfide and methane indicate that strongly reducing conditions are present in at least a portion of the CVOC plume. The reducing conditions are further confirmed by the presence of PCE transformation intermediates (TCE and DCE) and end products (ethene and ethane). It is also worth noting that there is an absence of VC in a plume where ethene and ethane are present, indicating that reducing conditions can be created that will achieve complete reductive dechlorination without VC build-up. Collectively, the data provide strong lines of evidence to support the suitability of the ERD technique for application at the site.

# 5. ERD Pilot Test Program

ARCADIS proposes to implement a six- to twelve-month pilot test program to demonstrate the ERD technology downgradient of the source area. The following sections present an overview of the rationale, objectives, and scope of work for the ERD Pilot Test Program.

## 5.1 Pilot Test Location

In order to properly evaluate ERD technology in a pilot test, molasses-solution injection wells and groundwater observation wells will be required. The test must be conducted in an area of the site where sufficient impacts are present, and the well network should be designed to both evaluate the performance of the ERD process and determine the extent of the IRZ.

Based on the short-term remedial goals for the site and current groundwater conditions, ARCADIS proposes to conduct the pilot test in a location just south of the primary area of high CVOC concentrations. As depicted on Figures 5 and 6, two transects of injection wells will be used to target the shallow and intermediate aquifer zones in this area. The selection of this area for the pilot test is based on the following:

- The recent groundwater sampling data indicate the presence of dissolved CVOC concentrations ranging up to 1,000 µg/L;

- A successful pilot system in this area can be maintained after the test has concluded, providing a barrier to mitigate further migration of impacted groundwater from the source area. This would satisfy the short-term remedial goals for the site; and

- There is an existing network of wells in and downgradient of this area that can be used for the pilot test.

A summary of the completion details for the pilot test injection and monitoring wells associated with each aquifer zone is presented in Table 1. Specific details regarding the positioning, installation, completion, and development of the pilot test well network are presented in the following two sections.

### 5.2 Injection Well Network

A network of eight injection wells (three shallow zone and five intermediate zone) will be used to deliver the molasses solution to the subsurface. This network will make use of both new and existing wells, and will be arranged in a transect oriented perpendicular to the direction of groundwater flow. Specifically, the shallow zone injection network will consist of existing injection wells IW-5 and IW-6, plus proposed injection well IW-16 (Figure 5). The intermediate zone injection network will consist of existing injection wells IW-10 and IW-11, plus proposed injection wells IW-13, IW-14, and IW-15 (Figure 6).

Each of the existing injection wells are constructed of 2-inch diameter, schedule 40 polyvinyl chloride (PVC) well casing and screen. Existing shallow zone injection wells IW-5 and IW-6 are screened from 45 to 60 ft bls and existing intermediate zone injection wells IW-10 and IW-11 are screened from 75 to 90 ft bls.

The four new injection wells (IW-13, IW-14, IW-15, and IW-16) will also be constructed of 2-inch diameter, schedule 40 PVC well casing and 2-inch diameter, 0.020-inch (20 slot) PVC well screen. Intermediate zone injection well IW-13 will be completed to a total depth of 90 ft bls with a screened interval from 75 to 90 ft bls. Both IW-14 and IW-15 will be completed to a total depth of 75 ft bls with a screened interval from 60 to 75 ft bls. Shallow zone injection well IW-16 will be completed to a total depth of 60 ft bls with a screened interval from 45 to 60 ft bls.

### 5.3 Monitoring Well Network

A network of six monitoring wells (three shallow zone and three intermediate zone) will be used to track the progress of the pilot test. This network will make use of both new and existing wells, and will be arranged to allow confirmation of the length and width of the resulting IRZ.

The shallow zone monitoring network will consist of existing monitoring wells MW-7 and MW-8, and proposed monitoring well MW-32. The intermediate zone monitoring network will consist of existing monitoring wells MW-23 and MW-27D, and proposed monitoring well MW-33. As proposed, these monitoring points are positioned approximately 12, 25, and 50 feet downgradient of the injection wells. Based on an average groundwater seepage velocity of 0.3 feet per day (Section 4.1), these positions correspond to advective transport times of approximately 40, 80, and 165 days.

With the exception of MW-27D, each of the existing monitoring wells are constructed of 2-inch diameter, schedule 40 polyvinyl chloride (PVC) well casing and screen. Existing shallow zone monitoring wells MW-7 and MW-8 are screened from 40 to 60 ft bls. Existing intermediate zone monitoring well MW-23 is screened from 70 to 85 ft bls. Existing intermediate zone monitoring well MW-27D is constructed of 4-inch diameter, schedule 40 PVC and is screened over two intervals: 40 to 55 ft bls (upper) and 75 to 90 ft bls (lower). The two new monitoring wells (MW-32 and MW-33) will be constructed of 4-inch diameter, schedule 40 PVC well casing and 4-inch diameter, 0.020-inch (20 slot) PVC well screen. Monitoring well MW-32 will be completed to a total depth of 60 ft bls with a screened interval from 45 to 60 ft bls. Monitoring well MW-33 will be completed to a total depth of 85 ft bls with a screened interval from 70 to 85 ft bls.

In the event that monitoring data indicate advective transport times are faster than anticipated (see discussion in Section 6.2), the network described above will be supplemented by additional wells. Specifically, this will include existing shallow-zone monitoring wells MW-10, MW-11, and MW-29; existing intermediate zone monitoring wells MW-16D and MW-28D; and proposed monitoring wells MW-30 (intermediate) and MW-31 (shallow). Construction details for these wells are provided in Table 1.

### 5.4 Well Installation Methodology

Monitoring wells MW-30, MW-31, MW-32, and MW-33 and injection wells IW-13, IW-14, IW-15, and IW-16 will be installed with a drill rig using 6.25-inch (monitoring wells) and 4.25-inch (injection wells) inside diameter hollow-stem augers. Once the well casing and screen are inserted into the borehole, the annular space between the well screen and the borehole will be backfilled with Morie #2 filter pack, or equivalent. The filter pack will be followed by a 2-foot thick bentonite seal and then backfilled with grout. In addition, a locking cap will be placed on the well and a flush-mount protective surface casing will be installed. Lithologic samples will be collected every five feet between the interval of 50 and 90 ft bls in the MW-30 and MW-33 boreholes.

Following installation of the new injection and monitoring wells, each well will be developed to remove fine-grained material and ensure hydraulic communication with the surrounding formation. Drill cuttings and development water will be containerized for proper disposal.

### 5.5 Injection Procedures

Following installation of the well network, the pilot test program will begin. The pilot test will consist of two components, molasses solution injections and performance monitoring. Details regarding the molasses injection procedures are outlined below. Pilot test performance monitoring is addressed in Section 6.

#### 5.5.1 Feed Solution

As previously discussed, the ERD pilot will involve adding molasses to the subsurface in the form of a dilute solution. The molasses contains sucrose, reducing sugars, organic non-sugars, and water, all of which are fully soluble in water. The total consumable carbohydrate concentration in the molasses is approximately 60% by weight.

In some hydrogeologic settings, the organic acids produced during the enhanced microbial activity results in a groundwater pH drop. Based on the ambient groundwater alkalinity and the type of underlying geology, the need for a buffer against pH fluctuations is not anticipated. However, if field data indicate that additional buffering capacity is required, sodium bicarbonate (baking soda) will be added to the injection solution.

#### 5.5.2 Injection Loading and Frequency

In order for the ERD technology to be successful, a sufficient amount of carbohydrate must be added to the subsurface to stimulate microbial activity, provide excess organic carbon, create the zone of anaerobic and reducing conditions, and propagate the IRZ in the target zone. Our experience indicates that a target carbohydrate concentration of 1,000 mg/L in the groundwater is optimum.

Given this target carbohydrate concentration, and the anticipated hydraulic conditions in the test area, the total volume of molasses feed solution injected into each well during each injection event will be between 100 and 500 gallons. These volumes represent between one and six percent of the total volume of groundwater in the effective pore space around each injection well. Consequently, water-table mounding or other hydraulic effects are unlikely. At the beginning of the pilot test, the prescribed volume of dilute molasses feed solution will be injected every two weeks. Following the fourth injection event, it is anticipated that injection events will be reduced to a monthly frequency. However, the injection volume, solution concentration, and/or the frequency of injection may be altered during the test depending on field measurements made in the observation wells and the analytical results obtained during groundwater monitoring conducted to track pilot test performance. Adjustments will be reported in the Monthly Progress Reports (see Section 7.0).

#### 5.5.3 Molasses Solution Injection Procedure

During each injection event, the dilute molasses solution will be prepared in batches. Each batch will be prepared in a portable polyethylene tank on the back of a field truck or trailer by thoroughly mixing the molasses and the potable water (along with the bromide tracer and bicarbonate, if warranted) in the proper ratio. The molasses feed solution will then be pumped into the injection wells using a gas-powered centrifugal transfer pump. The tank will be graduated, allowing the total volume injected into each well to be monitored over time.

A log will be kept during each injection event to record the solution strength (molasses and water volumes used), the total volume of solution injected into each injection well, the injection pressure at each injection well, and the injection flow rate. These measurements will be monitored to evaluate the condition of the well screens (i.e., biofouling) and whether well maintenance activities are needed. The wells will be redeveloped, as necessary. A copy of the injection log is presented in Appendix A.

#### 5.5.4 Conservative Tracer Injection Procedure

ARCADIS will add potassium bromide (KBr) to the molasses reagent mixture as a conservative tracer to estimate advective transport times and confirm and document the lateral extent of ambient hydraulic mixing in the test area. A predetermined quantity of KBr will be uniformly dissolved in the reagent solution added to injection wells IW-6 (shallow zone) and IW-11 (intermediate zone) to generate a target concentration of 10 mg/L of bromide in the treatment area. This concentration should be readily detected above background Br concentrations at the downgradient monitoring wells.

#### 5.5.5 Ambient Air Quality Monitoring

ARCADIS will conduct indoor ambient air quality monitoring as part of the ERD pilot test to evaluate whether remedial activities are affecting the potential pathway of vapor intrusion. Historic air quality monitoring data collected by Camp Dresser & McKee (CDM) from October 1999 to April 2001 indicated that the highest detected concentration of a site-related constituent of concern (COC) was 1.4 ppbv (PCE). This concentration is within background levels for PCE that were established by the New York State Department of Health (NYSDOH) in a study conducted by the Bureau of Toxic Substance Assessment. The study was conducted between 1989 and 1996 and is entitled "Background Indoor/Outdoor Air Levels of Volatile Organic Compounds in Homes Sampled by the New York State Department of Health, 1989-1996" (NYSDOH, 2003). A baseline monitoring event will be conducted prior to commencing the ERD technology in order to aid in the evaluation of indoor air quality data. In addition, a second indoor ambient air quality monitoring event will be conducted at a period three months from the time the injections begin. If site-related COC concentrations in indoor air are consistent with background levels and groundwater concentrations decline (or remain relatively stable) over time, then additional indoor ambient air quality monitoring will not be conducted.

Air quality sampling will be conducted in accordance with procedures set forth in USEPA Compendium Method TO-14A, "Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography." Air quality sampling will be conducted at two (2) locations within floor space currently occupied by AT&T, which is located adjacent to the area where the IRZ will be established. Air samples will be collected over an 8-hour time period utilizing 6-liter Summa Canisters. Each Summa Canister will contain a calibrated flow controller regulated to collect samples at a continuous and constant flow rate over an 8-hour period. Summa canisters will be placed on the existing floor surface (in the AT&T facility along the eastern wall of the building) during sampling.

During each sampling event a log will be completed and signed by the sampler. Sampling parameters recorded in the log will include sample location and ID number, time of initiating and termination of sampling at each location, and initial and final Summa Canister vacuum.

In addition to the two ambient air samples to be collected, a field (trip) blank will be submitted for laboratory analysis. The field blank will be a Summa Canister carried into the field, but never opened. The results from the field blank will identify if there is any interference during sample collection that could influence the sample results. In addition, the laboratory will analyze a method blank in accordance with TO-14A procedures to determine if there are any sample interferences from the laboratory environment.

Following collection of all samples, a chain-of-custody will be completed and packaged with the samples prior to shipment to the analytical laboratory. Samples will be shipped to the laboratory via overnight courier.

All sample analyses will be performed by Air Toxics Ltd. located in Folsom, California and will follow USEPA Method TO-14A. Samples will be analyzed for PCE, TCE, 1,1,1-TCA, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCA, 1,1-DCE, and VC.

Following receipt of the laboratory analytical data for an individual monitoring round, the results of the monitoring round will be tabulated and submitted to the NYSDEC, NYSDOH, and Suffolk County Department of Health Services (SCDHS) as part of the monthly progress reports. In addition, a figure will be prepared showing the sampling locations and copies of the air quality sampling logs and original analytical data packages will be included.

## 6.0 Groundwater Monitoring

A critical portion of the ERD pilot test will be the groundwater monitoring used to demonstrate performance. Performance monitoring will include a baseline event, followed by a series performance monitoring events. The data collected from these performance monitoring activities will be evaluated against the proposed performance objectives. This comparison will be used to determine whether the pilot test is successful. Details regarding performance monitoring are presented in the following sections. A summary of the proposed sampling and analysis schedule for the ERD pilot test performance monitoring is presented in Table 2.

### 6.1 Baseline Data Collection

To establish baseline conditions (i.e., groundwater conditions prior to the start of the molasses injections), an initial round of groundwater elevation measurements and groundwater quality samples will be collected. Baseline data for the pilot test will be collected from the injection wells, upgradient (background) monitoring well MW-15, and Pilot Test monitoring wells MW-7, MW-8, MW-23, MW-27D, MW-32, and MW-

33. In addition, to establish baseline conditions for longer-term performance monitoring beyond the six-month data collection period, groundwater quality samples will be collected from shallow zone monitoring wells MW-10, MW-11, MW-29, and MW-31; and intermediate zone monitoring wells MW-16D, MW-28D, and MW-30. Furthermore, to determine the present-day CVOC dissolved-phase plume configuration, groundwater quality samples will be collected from the following monitoring wells and will be analyzed for VOCs (plus tentatively identified compounds [TICs]) only: shallow zone monitoring wells MW-1, MW-3, MW-4, MW-12, MW-13, MW-14, IW-2, IW-4, and IW-7; intermediate zone monitoring wells MW-13D, MW-26D, IW-8, and IW-12; and deep zone monitoring wells MW-18D, MW-19D, and MW-20D.

Because the injection activities disturb equilibrium conditions that affect dissolved-phase CVOC concentrations, the injection wells are unsuitable for monitoring or demonstration of technology performance. Consequently, the baseline groundwater samples collected from the eight injection wells will be analyzed for VOCs (plus TICs) and total organic carbon (TOC) only. Groundwater samples collected from the observation wells during the baseline event will be analyzed for the following:

- <u>CVOCs</u> - The relative concentrations of individual CVOCs provide the strongest evidence of enhanced reductive dechlorination.

- <u>Electron Acceptors</u> - The presence or lack of electron acceptors provides an indication of the primary microbial respiration processes controlling the groundwater environment. Specifically, the baseline sampling event will include analysis for nitrate and sulfate.

- <u>Reduced Electron Acceptors and Degradation End Products</u> - The presence of reduced electron acceptors provides another measure of the primary microbial respiration processes controlling the groundwater environment. The presence and relative concentrations of CVOC degradation end products provides confirmation that the ERD process is being driven to completion. Specifically, the baseline sampling event will include analysis for nitrite, dissolved (ferrous) iron, dissolved (manganous) manganese, sulfide, chloride, ethene, ethane, and methane.

- <u>Other Indicator Parameters</u> - Total organic carbon (TOC) will be analyzed to evaluate the performance of the injection program and provide the basis for adjustments. Alkalinity will be analyzed as an indicator of the formations ability to buffer against swings in pH, and as an additional indicator of enhanced microbial activity. Bromide will be analyzed to evaluate advective transport times and lateral dispersion of the molasses solution from the injection wells.

- Field Parameters - These parameters are measured in the field using a water quality meter, to demonstrate adequate well development and to confirm the prevailing groundwater environment (aerobic and oxidizing vs. anaerobic and reducing). The field parameters that will be measured as part of the baseline sampling event include DO, ORP, pH, temperature, and specific conductance.

### 6.2 Performance Monitoring Data Collection

Following completion of the baseline sampling event and initiation of molasses solution injections, groundwater monitoring will be conducted to evaluate the extent of the IRZ and the effectiveness of the ERD process. Over the first six-months of the pilot test, two types of performance monitoring will be completed, as follows:

- "Standard" performance monitoring will be completed at two, four, and six months following the initiation of injections, as outlined in Table 2. This data will be used to evaluate the progress and performance of the pilot test.

- "Interim" performance monitoring will be completed between each standard performance monitoring event. These events will be limited to the collection of down-hole field parameter measurements and grab samples for TOC analysis. TOC samples will be collected from the injection wells and selected monitoring wells using disposable bailers (no purging). Similarly, down-hole field parameter measurements will be collected from select injection wells and select monitoring wells using a water quality probe. The measurements will be collected at the center of the screened interval for each well. This data will allow real-time evaluation of the injection program performance and provide the basis for timely adjustments. A tentative schedule for these events is outlined in Table 2. Modifications to the schedule (frequency, wells included) may be made as warranted by the data collected.

- Together, the "interim" and "standard" performance monitoring data will be used to refine estimates of advective transport times and evaluate whether additional downgradient wells need to be included for monitoring of VOC concentrations and biogeochemical parameters.

Due to its reactivity, sulfide analysis will be completed in the field using a HACH™ spectrophotometer (Table 2). The groundwater samples collected for off-site laboratory analysis will be placed in the appropriate sampling containers and shipped to a NYSDOH certified laboratory for analysis. Tables 3 and 4 provide the groundwater sample collection and analytical protocols for the parameters associated with the performance monitoring events. A NYSDEC Analytical Services Protocol (ASP) Category A sample data package will be provided for the groundwater samples. Quality assurance/quality control (QA/QC) sampling will include collection of one field duplicate sample per sampling event. The field duplicate sample will be analyzed for all specified parameters from that sampling event with the exception of the dissolved gases.

### 6.3 Groundwater Sampling Procedures

Prior to sample collection, water-level measurements will be collected from each of the molasses solution injection and groundwater monitoring wells. The water level in the well will be measured to the hundredth of a foot with an electronic water-level indicator and the total depth of the well will be sounded.

Due to the highly sensitive nature of the biogeochemical sampling parameters to be collected, both purging and sampling will be performed via low-flow (or micropurge) techniques using a low-flow submersible pump (Grundfos Redi-Flo II or equivalent). These methods are well documented and are preferred for obtaining representative groundwater samples for biogeochemical and VOC analysis (Puls and Barcelona, 1996; Wiedemeier, et al., 1998; Piontek, 1995).

The submersible pump and dedicated polyethylene discharge tubing will be lowered to the center of the screened interval of each well for the purging process, or the midpoint of the saturated portion of the screen if the well bridges the water table. Groundwater will then be extracted from each well using micropurge techniques and will be directed into a flow-through chamber, or cell. This cell will contain the DO, ORP, pH, specific conductance, and temperature probes and will be designed and constructed in such a manner as to preclude groundwater contact with atmospheric air. The wells will be purged at rates that do not exceed 500 milliliters per minute (ml/min). Ideally, the purge rate of each well should equal the recharge rate of that well.

During purging, field parameters will be collected at 5-minute intervals. Groundwater will continue to be purged from each well until the field parameters stabilize (i.e., within 10%). Following stabilization of field parameters, the flow rate will be decreased to 100 mL/min to allow groundwater sampling to take place. Subsequent to lowering the flow rate to 100 mL/min, the groundwater samples will be collected from the discharge of the submersible pump. For the analyses that require field filtering of groundwater samples, dedicated, single-use, 0.45 micron filters will be affixed to the discharge of the submersible pump.

All non-dedicated equipment used during groundwater sampling will be decontaminated between monitoring well locations using the following methods. The submersible pump will be immersed in a 5-gallon pail containing a potable water/detergent (Micro™) solution. The pump will be scrubbed using a brush and approximately 5 gallons of solution will be run through the pump and containerized in a 55-gallon drum. Following this, approximately 5 gallons of potable water will be run through the pump and containerized in a 55-gallon drum. A low-flow groundwater sampling log and downhole probe parameter form designed for the documentation of field observations and parameters during monitoring events are included as Appendix B.

## 7.0 Data Evaluation and Reporting

During the course of the pilot test, status updates will be provided to the NYSDEC in the Monthly Progress Reports. These updates will include a summary of the activities completed to date and groundwater quality data collected during the previous month. The groundwater quality data summaries presented in each update will include the data from previous updates for comparison.

After six months of implementation, ARCADIS will evaluate the results of the pilot test to determine whether the pilot test has met the performance objectives. A pilot test report will then be prepared. The report will include an evaluation of the extent of the IRZ developed; the primary biodegradation processes occurring within the IRZ; the extent to which the ERD process made sorbed mass available for treatment within the IRZ; and if possible, the degree to which natural rates of degradation were enhanced. In addition, a discussion regarding the feasibility of applying the technology at the site will be included.

## 8.0 References

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Table 1. Well Construction Details for Existing and Proposed Injection and Monitoring Wells, ERD Pilot Test Workplan, 25 Melville Park Road Site, Melville, New York.

Injection Wells

| Well ID | Screened Interval (feet bls) | Total Well Depth (feet bls) | Zone | Notes |
|---|---|---|---|---|
| IW-5 | 45-60 | 60 | Shallow | Existing well |
| IW-6 | 45-60 | 60 | Shallow | Existing well |
| IW-16 | 45-60 | 60 | Shallow | Proposed well |
| IW-10 | 75-90 | 90 | Intermediate | Existing well |
| IW-11 | 75-90 | 90 | Intermediate | Existing well |
| IW-13 | 75-90 | 90 | Intermediate | Proposed well |
| IW-14 | 60-75 | 75 | Intermediate | Proposed well |
| IW-15 | 60-75 | 75 | Intermediate | Proposed well |

Monitoring Wells

| Well ID | Screened Interval (feet bls) | Total Well Depth (feet bls) | Zone | Notes |
|---|---|---|---|---|
| MW-7 | 40-60 | 60 | Shallow | Existing well |
| MW-8 | 40-60 | 60 | Shallow | Existing well |
| MW-10 | 45-60 | 60 | Shallow | Existing well |
| MW-11 | 45-60 | 60 | Shallow | Existing well |
| MW-15 | 48.5-58.5 | 58.5 | Shallow | Existing well |
| MW-29 | 45-60 | 60 | Shallow | Existing well |
| MW-31 | 60-70 | 70 | Shallow | Proposed well |
| MW-32 | 45-60 | 60 | Shallow | Proposed well |
| MW-16D | 79.5-89.5 | 89.5 | Intermediate | Existing well |
| MW-23 | 70-85 | 85 | Intermediate | Existing well |
| MW-27D | 40-55 (Upper)<br>75-90 (Lower) | 90 | Intermediate | Existing well |
| MW-28D | 40-55 (Upper)<br>75-90 (Lower) | 90 | Intermediate | Existing well |
| MW-30 | 75-90 | 90 | Intermediate | Proposed well |
| MW-33 | 70-85 | 85 | Intermediate | Proposed well |

Notcs
bls - Below Land Surface

Table 2. Summary of Proposed Performance Monitoring, ERD Pilot Test Workplan, 25 Melville Park Road Site, Melville, New York.



| Sampling Event | | Well | VOCs plus TICs | Dissolved (ferrous) Iron | Dissolved (manganous) Manganese | Nitrate | Nitrite | Sulfate | Sulfide | Ethene | Ethane | Methane | TOC | Alkalinity* | Chloride | Bromide | pH | ORP | DO | Temperature | Specific Conductance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Analysis/Parameter | | | | | | | | | | | | | | | | | | |
| Baseline | *Injection Wells* | | | | | | | | | | | | | | | | | | | | |
| | Shallow | IW-5 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-6 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-16 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | Intermediate | IW-10 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-11 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-13 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-14 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-15 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | *Monitoring Wells* | | | | | | | | | | | | | | | | | | | | |
| | Shallow | MW-1 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-3 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-4 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-7 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-8 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-10 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-11 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-12 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-13 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-14 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-15 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-29 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-31 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-32 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | IW-2 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | IW-4 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | IW-7 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | Intermediate | MW-13D | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-16D | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-23 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-26D | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-27D | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-28D | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-30 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-33 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | IW-8 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | IW-12 | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | Deep | MW-18D | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-19D | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-20D | L | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |

See notes on last page.

Table 2. Summary of Proposed Performance Monitoring, ERD Pilot Test Workplan, 25 Melville Park Road Site, Melville, New York.



| Sampling Event | | Well | VOCs plus TICs | Dissolved (ferrous) Iron | Dissolved (manganous) Manganese | Nitrate | Nitrite | Sulfate | Sulfide | Ethene | Ethane | Methane | TOC | Alkalinity* | Chloride | Bromide | pH | ORP | DO | Temperature | Specific Conductance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Performance Monitoring Month 2 | *Injection Wells* | | | | | | | | | | | | | | | | | | | | |
| | Shallow | IW-5 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-6 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-16 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | Intermediate | IW-10 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-11 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-13 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-14 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-15 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | *Monitoring Wells* | | | | | | | | | | | | | | | | | | | | |
| | Shallow | MW-7 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | MW-8* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | MW-32 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | Interm. | MW-23* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | MW-27D | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | MW-33 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| Performance Monitoring Month 4 | *Injection Wells* | | | | | | | | | | | | | | | | | | | | |
| | Shallow | IW-5 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-6 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-16 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | Intermediate | IW-10 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-11 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-13 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-14 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-15 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | *Monitoring Wells* | | | | | | | | | | | | | | | | | | | | |
| | Shallow | MW-7* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | MW-8 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-32 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | Interm. | MW-23 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-27D* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | MW-33 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |

See notes on last page.

Table 2. Summary of Proposed Performance Monitoring, ERD Pilot Test Workplan, 25 Melville Park Road Site, Melville, New York.



| Sampling Event | | Well | VOCs plus TICs | Dissolved (ferrous) Iron | Dissolved (manganous) Manganese | Nitrate | Nitrite | Sulfate | Sulfide | Ethene | Ethane | Methane | TOC | Alkalinity* | Chloride | Bromide | pH | ORP | DO | Temperature | Specific Conductance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Analysis/Parameter | | | | | | | | | | | | | | | | | | |
| Performance Monitoring Month 6 | *Injection Wells* | | | | | | | | | | | | | | | | | | | | |
| | Shallow | IW-5 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-6 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-16 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | Intermediate | IW-10 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-11 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-13 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-14 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-15 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | *Monitoring Wells* | | | | | | | | | | | | | | | | | | | | |
| | Shallow | MW-7 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-8 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-15 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-32 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | Interm. | MW-23 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-27D | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| | | MW-33 | L | L | L | L | L | L | H | L | L | L | L | L | L | L | F | F | F | F | F |
| Field Parameter Monitoring Months 1, 3, and 5 | *Injection Wells* | | | | | | | | | | | | | | | | | | | | |
| | Shallow | IW-5 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | IW-6 (1, 3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-16 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Intermediate | IW-10 (1, 3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | IW-11 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | IW-13 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | IW-14 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | IW-15 (1, 3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | *Monitoring Wells* | | | | | | | | | | | | | | | | | | | | |
| | Shallow | MW-7 (3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | MW-8 (1, 3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | MW-10 (3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | MW-11 (3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-15 (1, 3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-29 (5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-31 (5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-32 (1, 3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | Intermediate | MW-16D (5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-23 (1, 3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | MW-27D (3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |
| | | MW-28D (3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-30 (5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | F | F | F | F | F |
| | | MW-33 (1, 3, 5)* | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | L | --- | --- | --- | F | F | F | F | F |

See notes on last page.

Notes

The baseline event includes additional wells for the purposes of establish baseline conditions for longer-term performance monitoring (beyond the six-month data collection period)

The subset of monitoring wells and frequency of the field parameter monitoring may be modified, as warranted, based on ongoing data collection and evaluation.

* - Groundwater sample will be collected with a bailer and and field measurements will be collected down-hole (no purging)

VOCs - Volatile Organic Compounds
ORP - Oxidation Reduction Potential
DO - Dissolved Oxygen
TOC - Total Organic Carbon
--- Indicates no sample to be collected
(1, 3, 5) - Data Collection During Months 1, 3, and 5
(3, 5) - Data Collection During Months 3 and 5
(5) - Data Collection During Month 5

TICs - Tentatively Identified Compounds
L - Laboratory analysis
H - Field Analysis using a Hach™ Spectrophotometer
F - Field Measurement using a water quality meter
* - Alkalinity will be analyzed only if the pH fluctuates significantly

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Table 3. Sample Collection and Analyses Protocols, Sample Containers, Volume, Preservation, and Holding Time Techniques, ERD Pilot Test Workplan, 25 Melville Park Road Site, Melville, New York.

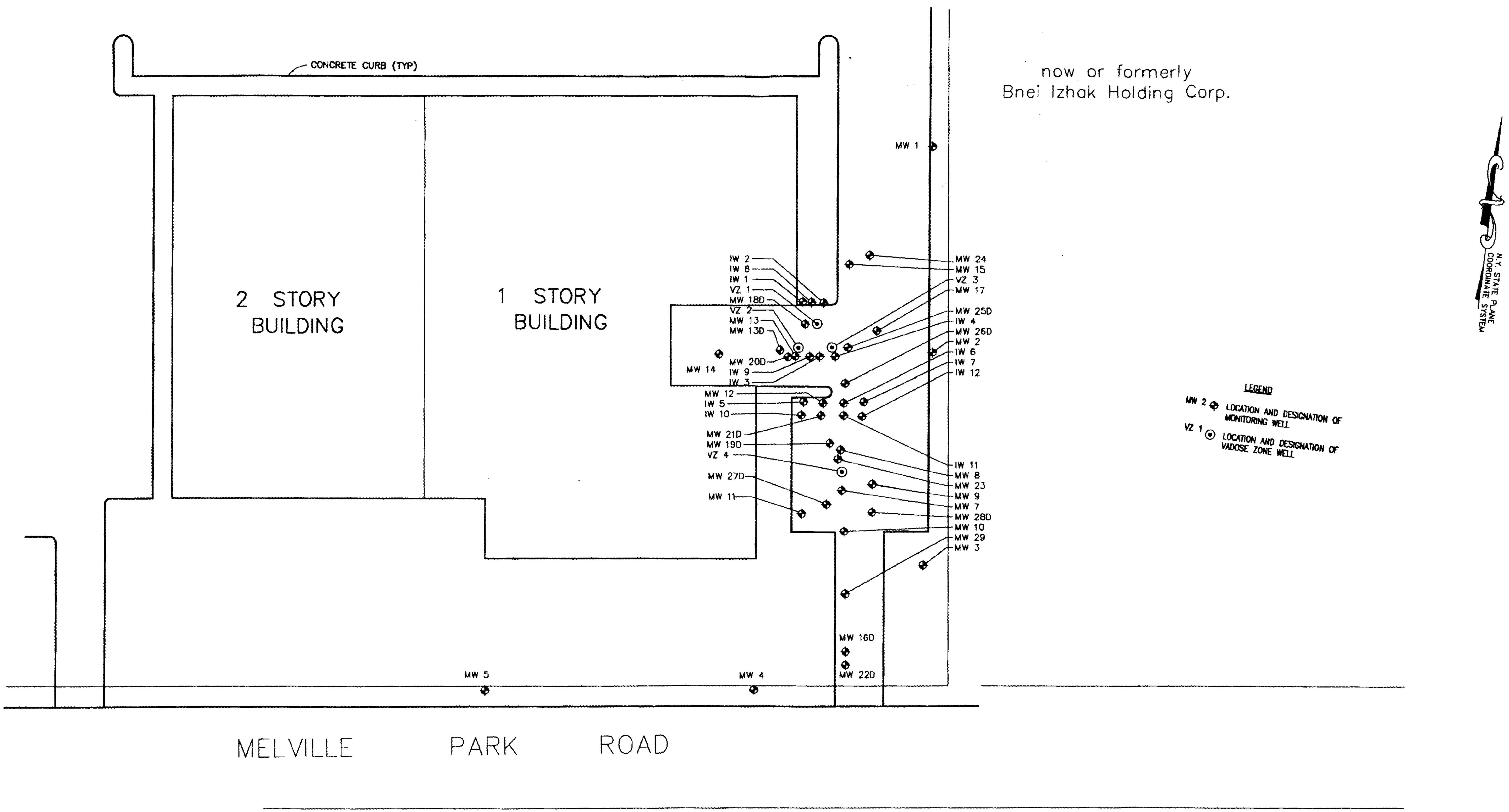
| Parameter | Method | Method Detection Limit | Sample Container(s) (a) | Chemical Preservative (b) | Holding Time |
|---|---|---|---|---|---|
| VOCs plus TICs | 8260 | see Table 4 | (2) 40 mL, glass voa vials | None<br>HCl | 7 days to analysis<br>14 days to analysis |
| Ethane and Ethene | AM20 | 5 ng/L* | (2) 40 mL, glass voa vials | None | 14 days |
| Methane ($CH_4$) | AM20 | 15 ng/L* | (2) 40 mL, glass voa vials | None | 14 days |
| Alkalinity | 310.1 | 0.594 mg/L | (1) 1,000 mL, plastic | None | 14 days |
| Nitrate ($NO_3$) | 300.0 | 0.002 mg/L | (1) 1,000 mL, plastic | None | 48 hours |
| Nitrite ($NO_2$) | 300.0 | 0.003 mg/L | (1) 1,000 mL, plastic | None | 48 hours |
| Sulfate ($SO_4$) | 300.0 | 0.012 mg/L | (1) 1,000 mL, plastic | None | 28 days |
| Chloride (Cl) | 300.0 | 0.147 mg/L | (1) 1,000 mL, plastic | None | 28 days |
| Bromide (Br) | 300.0 | 0.006 mg/L | (1) 1,000 mL, plastic | None | 28 days |
| Sulfide | Hach™ | 0.005 mg/L | NA | NA | NA |
| Dissolved Iron | 6010 | 0.1 mg/L | (1) 500 mL, plastic | $HNO_3$ | 6 months |
| Dissolved Manganese | 6010 | 0.1 mg/L | (1) 500 mL, plastic | $HNO_3$ | 6 months |
| TOC | 415.1 | 1 mg/L | (2) 40 mL, glass voa vials | $H_2SO_4$ | 28 days |

(a) The number of containers required is in parentheses.
(b) Samples will be cooled to approximately 4 degrees Celcius.
VOCs Volatile Organic Compounds.
TICs Tentatively Identified Compounds.
mL Milliliter.
mg/L Milligrams per liter.
ng/L Nanograms per liter.
HCl Hydrochloric Acid.
Hach™ Field Analysis using a Hach™ Spectrophotometer.
TOC Total Organic Carbon.
NA Not applicable.
Method detection limits reported by Severn Trent Laboratories, Inc., Shelton, CT.
* Method quantitation limits reported by Microseeps, Inc., Pittsburgh, PA.

Table 4. Volatile Organic Compounds Method Detection Limits, Laboratory Reporting Limits, and NYSDEC Groundwater Criteria, 25 Melville Park Road Site, Melville, New York.

| Compound | Method Detection Limit (ug/L) | Reporting Limit (ug/L) | NYSDEC TOGS (1.1.1) SGV (ug/L) |
|---|---|---|---|
| Chloromethane | 1.0 | 5 | - |
| Vinyl chloride | 1.0 | 5 | 2 |
| Bromomethane | 3.1 | 5 | 5 |
| Chloroethane | 0.8 | 5 | 5 |
| 1,1-Dichloroethene | 0.8 | 5 | 5 |
| Carbon disulfide | 0.6 | 5 | - |
| Acetone | 1.9 | 10 | 50 |
| Methylene chloride | 0.4 | 5 | 5 |
| trans-1,2-Dichloroethene | 0.6 | 5 | 5 |
| 1,1-Dichloroethane | 0.6 | 5 | 5 |
| cis-1,2-Dichloroethene | 0.6 | 5 | 5 |
| 2-Butanone (MEK) | 1.1 | 10 | 50 |
| Chloroform | 0.4 | 5 | 7 |
| 1,1,1-Trichloroethane | 0.4 | 5 | 5 |
| Carbon tetrachloride | 0.3 | 5 | 5 |
| Benzene | 0.4 | 5 | 1 |
| 1,2-Dichloroethane | 0.3 | 5 | 0.6 |
| Trichloroethene | 0.7 | 5 | 5 |
| 1,2-Dichloropropane | 0.6 | 5 | 1 |
| Bromodichloromethane | 0.4 | 5 | 50 |
| cis-1,3-Dichloropropene | 0.6 | 5 | 0.4 |
| 4-Methyl-2-pentanone (MIBK) | 0.5 | 10 | - |
| Toluene | 0.3 | 5 | 5 |
| trans-1,3-Dichloropropene | 0.4 | 5 | 0.4 |
| 1,1,2-Trichloroethane | 0.8 | 5 | 1 |
| Tetrachloroethene | 0.4 | 5 | 5 |
| 2-Hexanone | 1.3 | 10 | 50 |
| Dibromochloromethane | 0.2 | 5 | 50 |
| Chlorobenzene | 0.2 | 5 | 5 |
| Ethylbenzene | 0.3 | 5 | 5 |
| Styrene | 0.4 | 5 | 5 |
| Bromoform | 0.4 | 5 | 50 |
| 1,1,2,2-Tetrachloroethane | 0.7 | 5 | 5 |
| Xylenes (total) | 1.0 | 5 | 5 |

ug/L Micrograms per Liter.
NYSDEC New York State Department of Environmental Conservation.
TOGS Technical and Operational Guidance Series.
SGV Ambient Water Quality Standards and Guidance Values.

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| NO. | DATE | REVISION DESCRIPTION | BY | CKD |
|---|---|---|---|---|

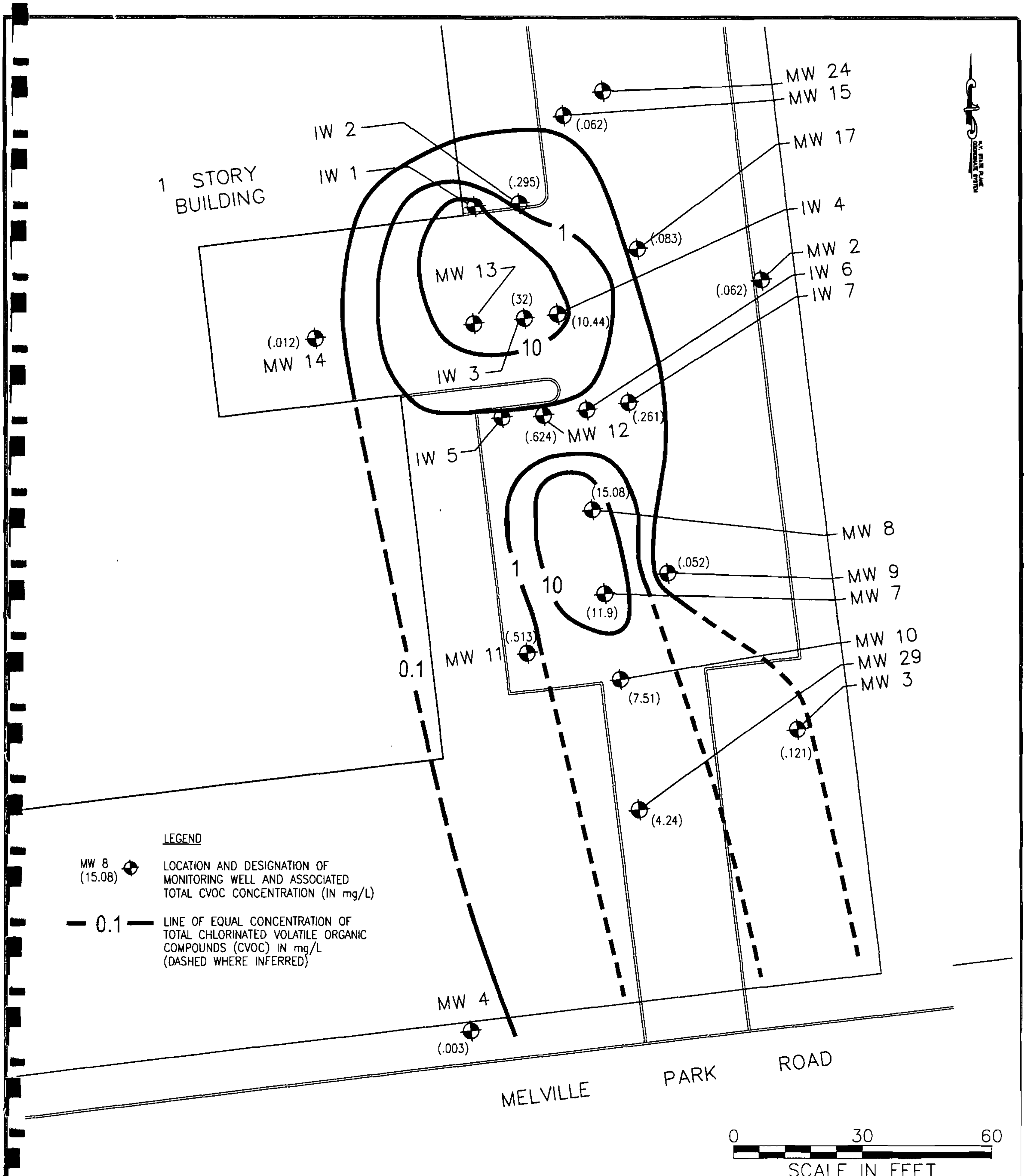
ARCADIS G&M
88 Duryea Road
Melville, NY 11747
Tel: (631) 249-7600 Fax: (631) 249-7610

25 MELVILLE PARK ROAD
MELVILLE, NEW YORK

25 MPR, LLC

DRAWN A.G.
DATE 1/08/02
PROJECT MANAGER S. FELDMAN
DEPARTMENT MANAGER N. VALKENBURG
LEAD DESIGN PROF.
CHECKED

SITE PLAN




| | | | | |
|---|---|---|---|---|
| ARCADIS G&M | DRAWN A.G. | DATE 1/14/03 | PROJECT MANAGER S. FELDMAN | DEPARTMENT MANAGER N. VALKENBURG |
| | TOTAL CVOC CONCENTRATION DISTRIBUTION IN THE SHALLOW AQUIFER ZONE (45–60 FT BLS) AUGUST 2001<br>25 MELVILLE PARK ROAD<br>MELVILLE, NEW YORK<br>25 MPR, L.L.C. | | LEAD DESIGN PROF. | CHECKED C. KEEN |
| | | | PROJECT NUMBER NY01332.03.03 | DRAWING NUMBER 2 |

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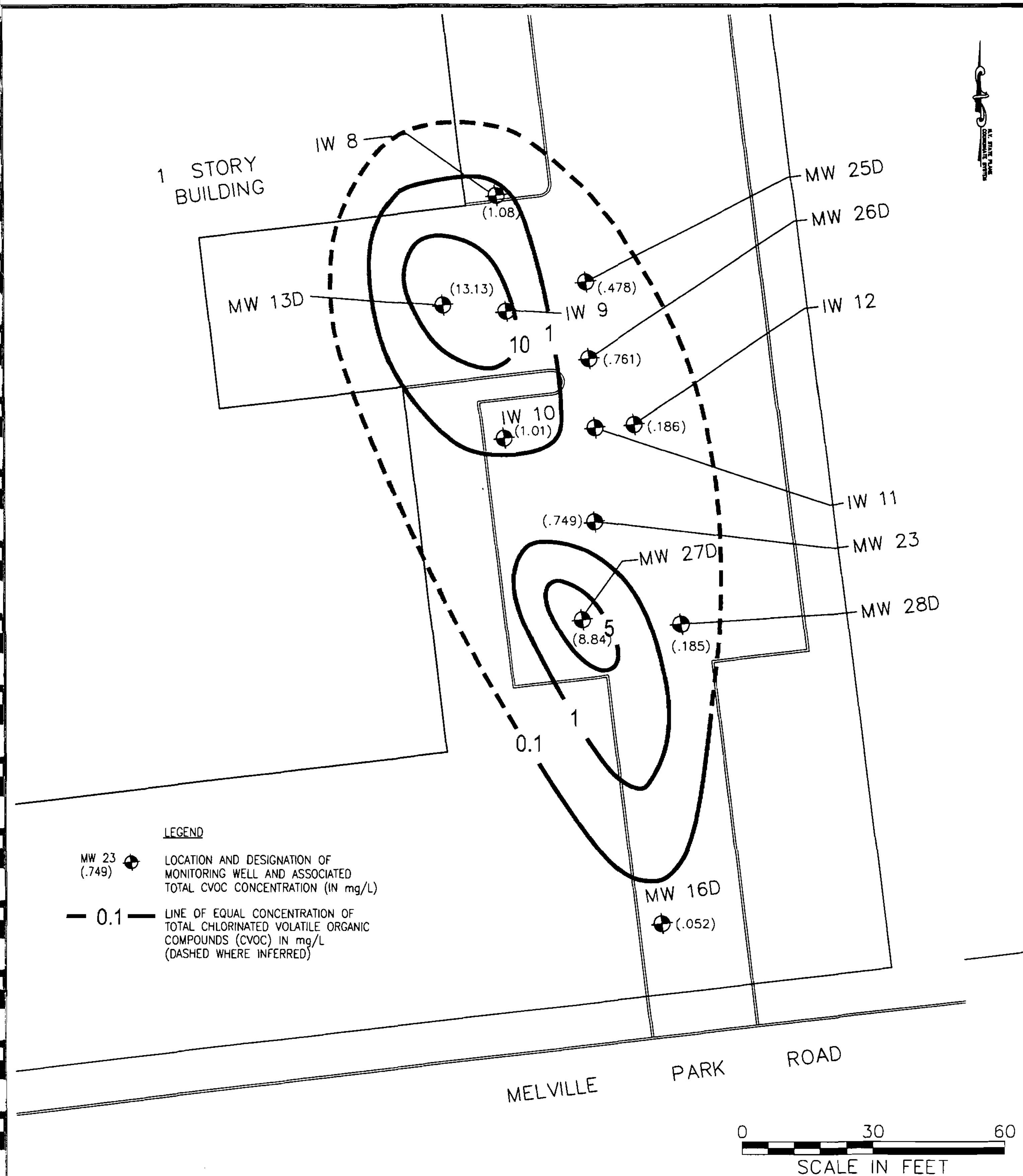




ARCADIS G&M

| DRAWN | DATE | PROJECT MANAGER | DEPARTMENT MANAGER |
|---|---|---|---|
| A.G. | 1/14/03 | S. FELDMAN | N. VALKENBURG |
| TOTAL CVOC CONCENTRATION DISTRIBUTION IN THE INTERMEDIATE AQUIFER (75-90 FT BLS) AUGUST 2001<br>25 MELVILLE PARK ROAD<br>MELVILLE, NEW YORK<br>25 MPR, L.L.C. | | LEAD DESIGN PROF. | CHECKED C. KEEN |
| | | PROJECT NUMBER NY01332.03.03 | DRAWING NUMBER 3 |

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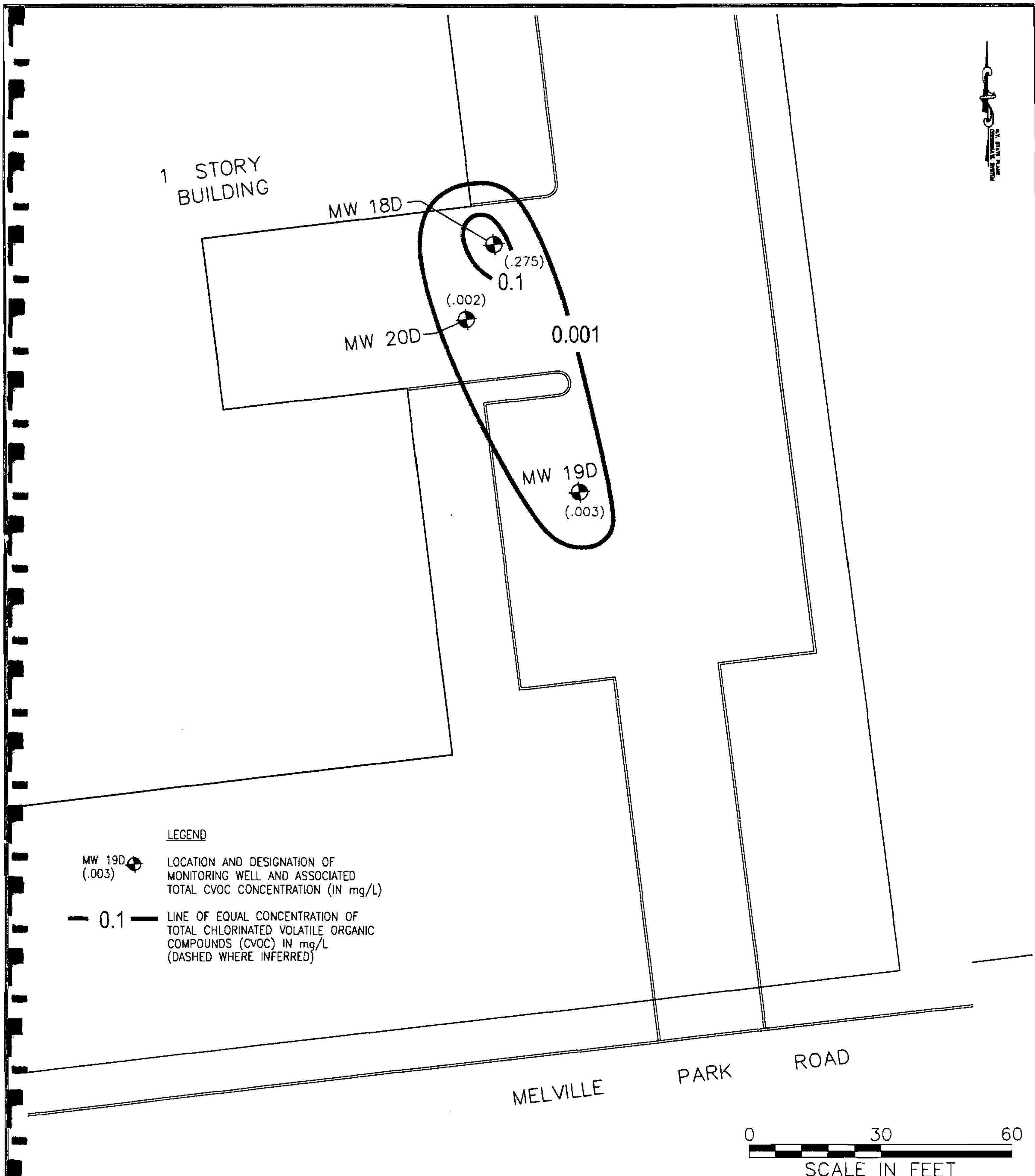


ARCADIS G&M

| | | | |
|---|---|---|---|
| DRAWN A.G. | DATE 1/14/03 | PROJECT MANAGER S. FELDMAN | DEPARTMENT MANAGER N. VALKENBURG |
| TOTAL CVOC CONCENTRATION DISTRIBUTION IN THE DEEP AQUIFER ZONE (100–185 FT BLS) AUGUST 2001<br>25 MELVILLE PARK ROAD<br>MELVILLE, NEW YORK<br>25 MPR, L.L.C. | | LEAD DESIGN PROF. | CHECKED C. KEEN |
| | | PROJECT NUMBER NY01332.03.03 | DRAWING NUMBER 4 |

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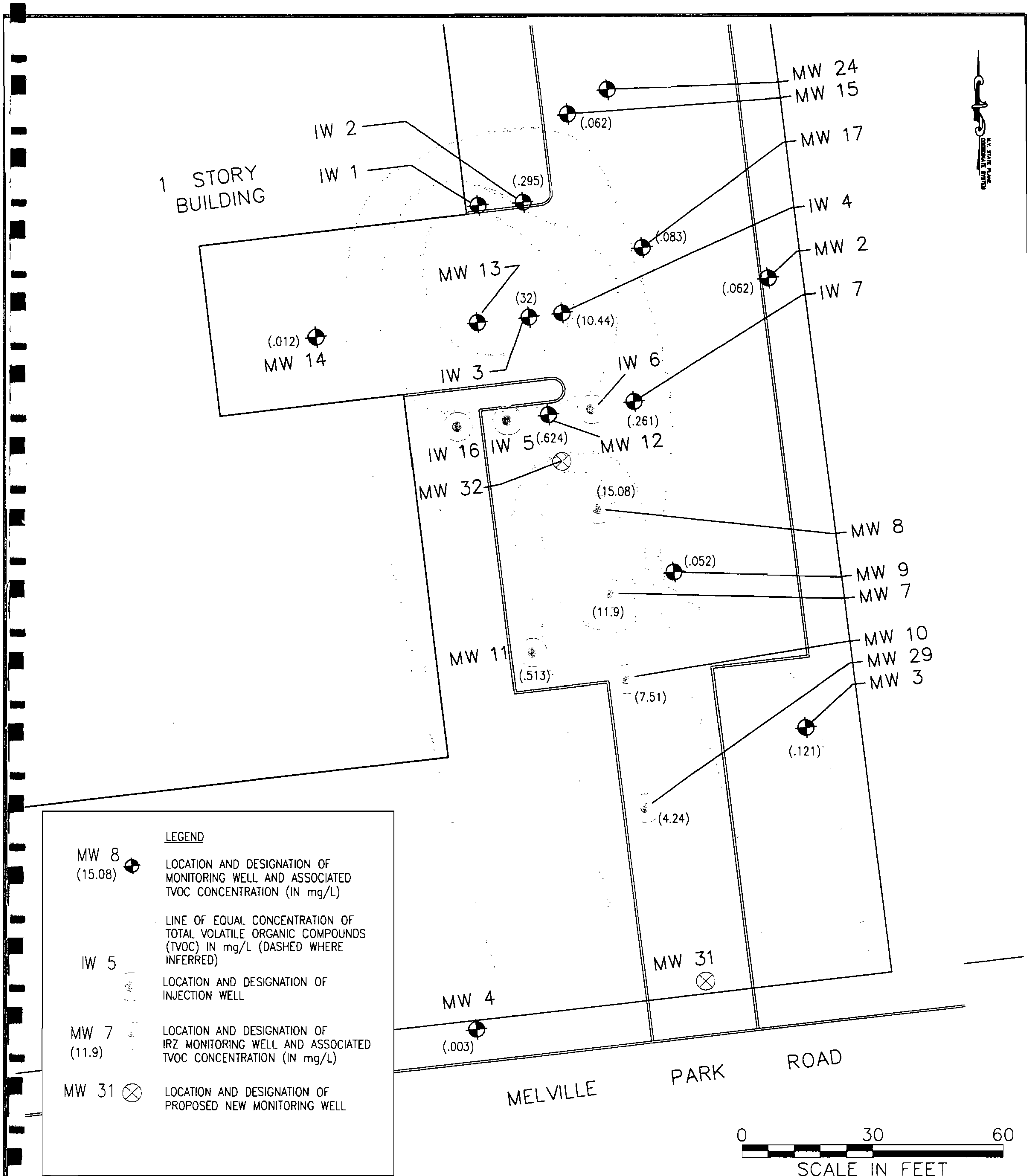


ARCADIS G&M

| DRAWN | DATE | PROJECT MANAGER | DEPARTMENT MANAGER |
|---|---|---|---|
| A.G. | 4/1/03 | S. FELDMAN | N. VALKENBURG |
| PROPOSED IRZ WELL NETWORK IN THE SHALLOW AQUIFER ZONE (45-60 FT BLS) 25 MELVILLE PARK ROAD MELVILLE, NEW YORK 25 MPR, L.L.C. | | LEAD DESIGN PROF. | CHECKED C. KEEN |
| | | PROJECT NUMBER NY01332.03.03 | DRAWING NUMBER 5 |

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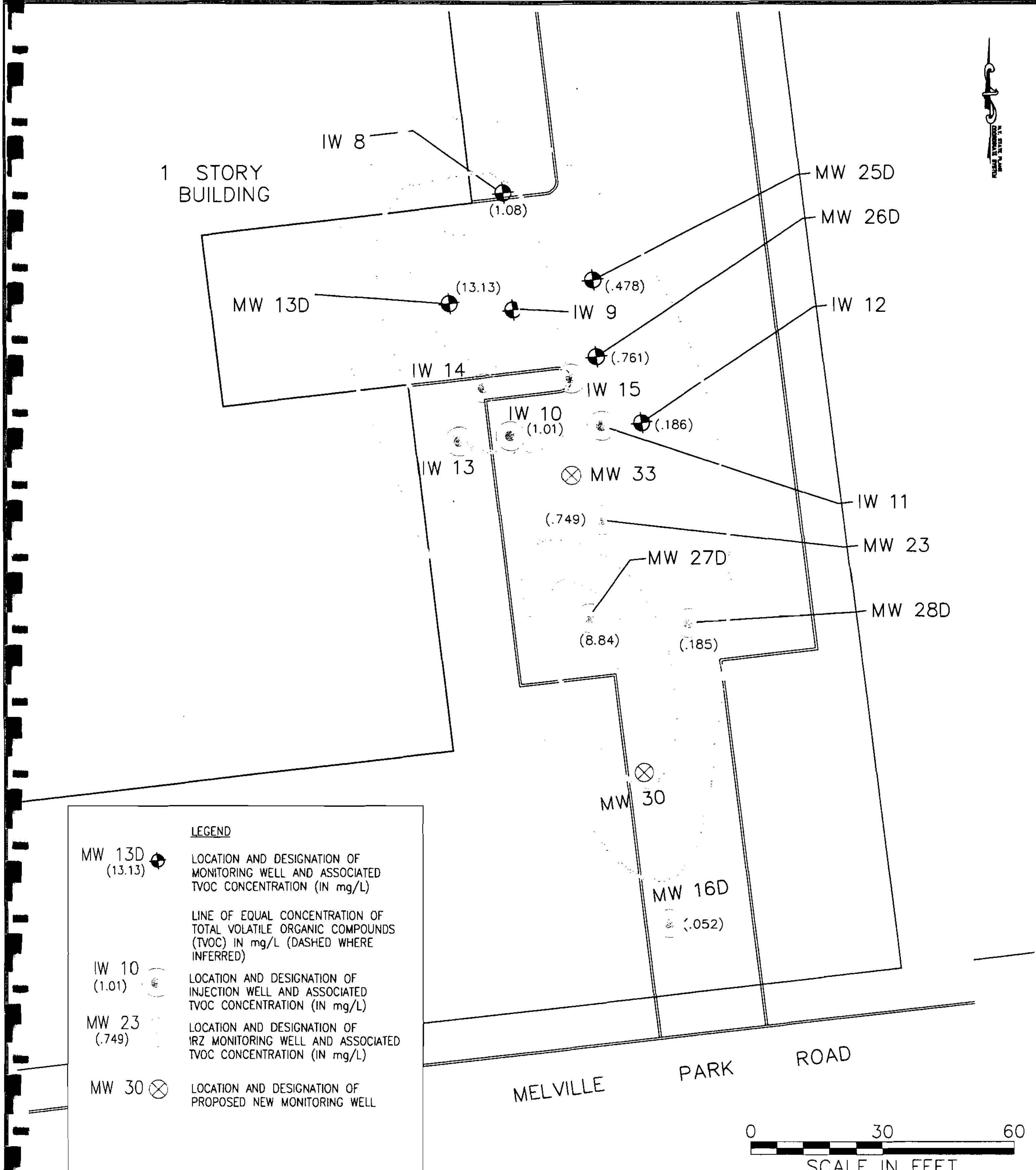


LEGEND

| | |
|---|---|
| MW 13D (13.13) | LOCATION AND DESIGNATION OF MONITORING WELL AND ASSOCIATED TVOC CONCENTRATION (IN mg/L) |
| | LINE OF EQUAL CONCENTRATION OF TOTAL VOLATILE ORGANIC COMPOUNDS (TVOC) IN mg/L (DASHED WHERE INFERRED) |
| IW 10 (1.01) | LOCATION AND DESIGNATION OF INJECTION WELL AND ASSOCIATED TVOC CONCENTRATION (IN mg/L) |
| MW 23 (.749) | LOCATION AND DESIGNATION OF IRZ MONITORING WELL AND ASSOCIATED TVOC CONCENTRATION (IN mg/L) |
| MW 30 | LOCATION AND DESIGNATION OF PROPOSED NEW MONITORING WELL |

| | | | | |
|---|---|---|---|---|
| ARCADIS G&M | DRAWN A.G. | DATE 4/1/03 | PROJECT MANAGER S. FELDMAN | DEPARTMENT MANAGER N. VALKENBURG |
| | PROPOSED IRZ WELL NETWORK IN THE INTERMEDIATE AQUIFER ZONE (75–90 FT BLS) 25 MELVILLE PARK ROAD MELVILLE, NEW YORK 25 MPR, L.L.C. | | LEAD DESIGN PROF. | CHECKED C. KEEN |
| | | | PROJECT NUMBER NY01332.03.03 | DRAWING NUMBER 6 |

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## Appendix A

Molasses Injection Daily Log Form

MOLASSES INJECTION LOG

ERD Pilot Test
25 Melville Park Road Site
Melville, New York

Injection Well # ______________________________

| Date | Injection No. | Raw Molasses Volume (gallons) | Water Volume (gallons) | Solution Strength (Ratio) | Volume Injected (gallons) | Notes/ Observations |
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## Appendix B

Groundwater Sampling/Downhole Probe Parameter Log Forms

ARCADIS G&M, Inc.

# Low-Flow Groundwater Sampling Log

Project Number: ____________ Task: ____________ Well ID: ____________
Date: ____________ Sampled By: ____________
Sampling Time: ____________ Recorded By: ____________
Weather: ____________ Coded Replicate No.: ____________

**Instrument Identification**
Water Quality Meter(s): ____________ Serial #: ____________

**Purging Information**
Casing Material: ____________ Purge Method: ____________
Casing Diameter: ____________ Screen Interval (ft bmp): Top ____________ Bottom ____________
Sounded Depth (ft bmp): ____________ Pump Intake Depth (ft bmp): ____________
Depth to Water (ft bmp): ____________ Purge time Start: ____________ Finish: ____________

**Field Parameter Measurements Taken During Purging**

| Time | Minutes Elapsed | Rate (mL/min) | Volume Purged | Temp (°C) | pH (SI Units) | Spec. Cond. (mS/cm) | ORP (mV) | DO (mg/L) | Turbidity (NTU) | Depth to Water (ft bmp) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
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**Sample Condition** Color: ____________ Odor: ____________ Appearance: ____________
**Sample Collection**
Parameter: Container: No. Preservative:

PID Reading ____________

Comments ____________

ARCADIS G&M, Inc.

# Downhole Field Parameter Form

Project Number: ____________ Task: ____________ Well ID: ____________
Date: ____________ Recorded By: ____________
Weather: ____________

**Instrument Identification**

Water Quality Meter(s): ____________ Serial #: ____________

**Well Information**

Casing Material: ____________ Depth to Water (ft bmp): ____________ Time: ____________
Casing Diameter: ____________ Screen Interval (ft bmp): Top ____________ Bottom ____________
Sounded Depth (ft bmp): ____________ Downhole Readings Start: ____________ Finish: ____________

**Downhole Field Parameter Measurements**

| Time | Depth (ft bmp) | Temp (°C) | pH (SI Units) | Spec. Cond. (mS/cm) | ORP (mV) | DO (mg/L) | Comments |
|---|---|---|---|---|---|---|---|
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## Appendix D

December 11, 2002 Response to NYSDEC Comments, Draft Remedial Action Plan, 25 Melville Park Road Site, Melville, New York; and NYSDEC letter of March 4, 2003, Response to Comments

**New York State Department of Environmental Conservation**
**Division of Environmental Remediation, Region One**
Building 40 - SUNY, Stony Brook, New York 11790-2356
**Phone:** (631) 444-0240 • **FAX:** (631) 444-0248
**Website:** www.dec.state.ny.us

Erin M. Crotty
Commissioner

March 4, 2003

Steven Feldman
Arcadis Geraghty & Miller
88 Duryea Road
Melville, NY 11747

Re: Response to Comments, December 11, 2002
25 Melville Park Road, Melville, #V00128-1

Dear Mr. Feldman:

This letter responds to your Response to NYSDEC Comments document dated December 11, 2002. Please see the attached input that I received from the New York State Department of Health and the Suffolk County Department of Health Services. I have also included a copy of an earlier e-mail message that I sent to you to clarify SCDHS's comments. Please note that some of SCDHS comments were further modified by the discussions in our 2/27/03 meeting.

Some other issues that came up in our 2/27/03 meeting should also be considered when you prepare the revised remedial action work plan, as follows:

1) Regarding the additional wells needed on the downgradient border to establish a "compliance plane" as requested by SCDHS, it was suggested in our recent meeting that one well east and one well west of proposed well MW-31 would satisfy this comment. These two wells should be screened in the vertical center of the plume and be located near the downgradient property border. The screen zone should be either 60'-70' or 65'-75'. The actual screen zone for these wells would be selected based on the results of the baseline round of sampling proposed in the pilot test.

2) Please adjust the injections well locations so that they are in accordance with our discussions in the 2/27/03 meeting. You agreed that the injections wells for the dissolved plume will be expanded westward of IW-5 to treat more of the plume.

Please submit a revised remedial action work plan that attempts to address the Department's comments within 30 days of your receipt of this letter. Please do not hesitate to call me at (631) 444-0244 if you have any questions.

Comments on the draft pilot test work plan are being submitted under separate cover. Please also see this comment letter since some of those comments also affect the revised remedial action work plan.

Sincerely,

Robert R. Stewart

Robert R. Stewart
Environmental Engineer I

Enclosures

cc: W. Parish
E. Obrecht
K. Carpenter
S, Scharf
J. Haas
W. O'Brien
I. Ushe, NYSDOH
R. Seyfarth, SCDHS
G. Rosser, SCDHS

**From:** "Zwelonke I. Ushe" <ziu01@health.state.ny.us>
**To:** <rrstewar@gw.dec.state.ny.us>
**Date:** 12/24/02 10:05AM
**Subject:** Re: Response to Comments, 12/11/02, 25 Melville Park Road, V00128-1

Bob,

I have reviewed the response to agency comments in the document. Melville Park for the most part has addressed DOH comments on the draft RAWP. It is possible that the proposed remedial action using the molasses injection (In-situ Reactive Zone (IRZ) ) will release VOC vapors, which might be different from previous known indoor air contaminates at the site. Therefore it will be necessary for Melville to develop a baseline indoor air database, before and after they start the IRZ. The last indoor air monitoring was conducted in April 2001. A work Plan for monitoring indoor air should also be included in the final RAWP document.

Ian Ushe

**From:** "Fitzpatrick, Geralyn" <Geralyn.Fitzpatrick@CO.SUFFOLK.NY.US>
**To:** 'Robert Stewart' <rrstewar@gw.dec.state.ny.us>
**Date:** 1/7/03 10:26AM
**Subject:** RE: Response to Comments, 12/11/02, 25 Melville Park Road, V00128-1

Bob:

My comments are as follows:

- NYSDEC, Comment 1 - Anaerobic reductive dechlorination of the more chlorinated CAHs, such as PCE and TCE, occurs more readily than the dechlorination of CAHs that have already been reduced, i.e. DCE and VC; so, although VC will degrade under anaerobic conditions the presence of PCE in groundwater may inhibit the anaerobic reductive dechorination of VC (Tandol and Other 1994).

- NYSDEC, Comment 7 - Monitoring wells MW-18D and MW-20D should be monitored quarterly. The term 'stable' is ambiguous. Any increase in the concentrations of the COC should trigger the implementation of a more aggressive source area remediation program.

- SCDHS, Comment 4 - Source area sampling, in the vicinity of MW-13, is not addressed in NYSDEC Comment No. 9.

Other concerns:

- The three wells designated as shallow injection wells do not transect the entire 1000 ppb TVOC plume, the same goes for the intermediate zone but to a lesser degree.

- A compliance plane needs to be established at the southern property boundary which necessitates the installation of additional wells. The additional wells proposed are inadequate. Also, there needs to be at least one well outside the reactive zone/groundwater plume.

- There should be a well biofouling/clogging contingency plan.

- Sampling should be performed biweekly initially.

- Nutrients must be analyzed, i.e. baron, calcium, magnesium, manganese, nitrogen, potassium, and phosphorus. Also measured: presence and concentration of specific microbes and microbial activity.

If you have any questions please don't hesitate to call me at 853-2387.
Thanks,
Geri Rosser

-----Original Message-----
From: Robert Stewart [mailto:rrstewar@gw.dec.state.ny.us]
Sent: Monday, December 16, 2002 10:51 AM
To: Geralyn.Fitzpatrick@CO.SUFFOLK.NY.US; Robert.Seyfarth@CO.SUFFOLK.NY.US; Eric Obrecht; Joe Haas; Kevin Carpenter; Steven Scharf; William O'Brien; ziu01@health.state.ny.us
Cc: SFeldman@arcadis-us.com; Walter Parish

**From:** Robert Stewart
**To:** Steve, Feldman,
**Subject:** Fwd: RE: Response to Comments, 12/11/02, 25 Melville Park Road, V00128-1

Steve,

Please see the attached comments from SCDHS. I have discussed them with Geri and here's some further input:

NYSDEC, comment 1: The pilot test should resolve whether the technology works.

SCDHS, comment 4: Geri and I agreed that while there is NAPL in the source area being recovered, sampling of the source area wells will not be necessary. Of course, we still need to monitor the deep zone under the source area as indicated in Geri's previous comment.

Other concerns #1: We expect that the pilot test will determine whether the injection wells will cover the entire width of the plume. If they don't, you would have to expand the IRZ later, as necessary. I understand that a tracer will be put in the injected medium to better define the width of the IRZ.

Other concerns #2: We would like you to add MW-3 and MW-4 to the monitoring network.

Other concerns #3: Please put something in the work plan which indicates that the wells will be cleaned as necessary in case of biofouling/clogging.

Other concerns #4: We know that it will take a while for the IRZ to set up. However, we would like you to sample MW-8 every two weeks to better monitor the progress of the injections in addition to the other proposed monitoring.

Other concerns #5: "baron" should be "boron".

If Geri has any further input on her comments, I encourage her to forward it to us.

Geri and I are willing to discuss these comments in a conference call, if you'd like. Also, you can call Geri or I individually if you have questions.

Please note that I am still waiting for comments on the comment response document from the other reviewers. These additional comments will be forwarded under separate cover.

Thanks,
Bob Stewart
Phone: (631) 444-0244

**CC:** geralyn.fitzpatrick@co.suffolk.ny.us

# ARCADIS

*Infrastructure, buildings, environment, communications*

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Mr. Robert R. Stewart, Environmental Engineer
New York State Department of Environmental Conservation
Region 1 Office
SUNY at Stony Brook
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Stony Brook, New York 11790-2356

ENVIRONMENTAL

Subject:
Response to NYSDEC Comments
Draft Remedial Action Plan, January 24, 2002
25 Melville Park Road, Melville, #V00128-1

Date:
11 December 2002

Contact:
Steven M. Feldman

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631-391-5244

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Our ref:
NY001332.0006.00001

Dear Mr. Stewart:

ARCADIS is providing responses to comments on the Draft Remedial Action Plan (RAP) for the 25 Melville Park Road Site in Melville, New York. The responses provided below correspond specifically to the comments provided in an August 19, 2002 letter containing the joint comments compiled from the New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health (NYSDOH), and Suffolk County Department of Health Services (SCDHS).

<u>NYSDEC</u>

**Comment**

1) **The Department's primary concern is that the anaerobic biodegradation in the IRZ may result in the generation of considerable concentrations of vinyl chloride (VC). VC degrades slowly under anaerobic conditions. If even a small percentage of the high concentrations of tetrachloroethene, trichloroethene, and/or 1,2-dichloroethene (as high as 15 ppm of total chlorinated solvents in MW-8) in the IRZ are converted to VC, VC generation could become a significant problem.**

**Based on your experiences at other sites, you indicate that any residual vinyl chloride which escapes the IRZ will be degraded aerobically. Our concern in this regard is that, in Long Island's Upper Glacial Aquifer, plumes are very narrow, swift moving and undergo little hydrodynamic dispersion.**

**Consequently, there is very little mixing with the surrounding oxygenated waters. The oxygen which enters into an anoxic plume is diffusion limited. Therefore, it is suspected that insufficient oxygen will diffuse into the plume after it leaves the IRZ to allow aerobic breakdown of the vinyl chloride before it leaves the downgradient property border. For this reason, the Department recommends the implementation of an oxygen delivery treatment technology (such as biosparging) after the IRZ to ensure that sufficient oxygen is available for complete aerobic degradation of the vinyl chloride before it leaves the property.**

**If you insist, the Department would consider allowing you to perform a pilot test (not to exceed 6 months time) to evaluate whether sufficient oxygen will naturally diffuse into the plume after the IRZ. Ample monitoring for dissolved oxygen (DO) would be necessary after the IRZ. If VC is generated, low DO readings after the IRZ would be considered as advance warning that there is insufficient oxygen for aerobic biodegradation. These low DO readings would have to immediately trigger the construction of an oxygen injection system, such as biosparging. Approval of this approach would be contingent upon ample monitoring after the IRZ and the ability to put in place an oxygen injection system, if necessary, before any vinyl chloride generated in the IRZ can leave the site. Additionally, there would have to be an adequate aerobic "buffer zone" (where aerobic degradation could occur) between the end of the IRZ and the property border. Your statements on the top of page 34 suggest that there may not be an adequate buffer zone after none months of injections.**

Response

ARCADIS recognizes that the NYSDEC is concerned that vinyl chloride (VC) could be generated within the reactive zone and subsequently move beyond the property boundary. We must reiterate that much has been learned regarding the anaerobic degradation of PCE and its daughter products in recent years. One of the chief observations is that VC is degraded in an anaerobic environment at reasonable and acceptable rates. In many cases where the environment is enhanced, VC does not even appear. Historically, the literature has reported on natural degradation of TCE, in which the natural system is carbon limited. In these situations the process can stall at cis-1,2-DCE or be insufficiently reducing to bring about the complete reductive dechlorination to ethene.

Based on the site-specific conditions we believe that this site is highly amenable to reductive enhancements to achieve the complete reductive dechlorination of volatile organic compounds (VOCs). In fact, data collected during the July/August 2001 groundwater sampling event indicated that, under current conditions, daughter products (i.e., trichloroethene [TCE] and cis-1,2-dichloroethene [DCE]) and end products (ethene and ethane) of PCE degradation are already present in the plume. What these data demonstrate is that the reducing environment in the source area at this site – created because of the presence of degradable petroleum hydrocarbons coincident with the VOC plume – has already achieved complete degradation (to ethene) without the formation of significant VC. The data coincide with data ARCADIS has collected at other sites and suggests that, contrary to your general observation that VC persists under anaerobic conditions, generation of VC will not be a problem at the site.

The VOC plume at the site is not swift moving (on average only 0.25 ft/d) because the horizontal hydraulic gradient is relatively flat due to the site's close proximity to the regional groundwater divide. This groundwater flow condition, along with the fact that plumes in the upper glacial aquifer undergo little hydrodynamic dispersion, create conditions that are very conducive to establishing an in-situ reactive zone (IRZ) with sufficient residence time for the complete VOC degradation process to occur. As stated above, VC will degrade under anaerobic conditions. The benefit that was highlighted in previous discussions with the NYSDEC is that the VC degrades under aerobic conditions as well and therefore can degrade even if it leaves the strongly reducing environment – this is not the case for PCE, TCE and cis-1,2-DCE.

ARCADIS is in the process of preparing a Pilot Test Workplan for a test program that will need to run between six and twelve months. The objectives of the pilot test are to:

- Demonstrate that an engineered enhanced anaerobic environment can be established at the site;

- Determine the rate of carbon substrate addition necessary to create and maintain the reducing environment;

- Determine how much the natural rate of reductive dechlorination can be enhanced; and

- Optimize the injection methodology.

When enhancing a natural environment, there is some uncertainty related to the precise rates and timeframes needed to achieve specific remedial milestones. This uncertainty is related to our inability to define the amount of mass present in the subsurface and the variability of natural systems. This uncertainty is accounted for in the monitoring program that will be applied during the pilot test and the proposed ongoing data evaluation effort that will be undertaken. Modifications to the injection program (i.e., frequency, solution strength, solution volume) will be implemented, as warranted, based on the specific site data. Electron acceptor utilization, by-product formation, source material degradation, and daughter-product and end-product formation will be monitored along the axis of the reactive zone. Using this information, the rate of degradation can be defined and the success of the process demonstrated. Our goal in the reactive zone will be to create an environment devoid of oxygen and nitrates, where sulfanogenic and methanogenic conditions dominate. The presence of DO in the reactive zone indicates an inadequate carbon supply and the need to add carbon in order to enhance anaerobic and reducing conditions.

With respect to VC formation, it is important to understand that the mere presence of VC does not warrant actions (such as the implementation of a biosparging system) that will directly disrupt the anaerobic reactive zone. The presence of VC in this process is transient in a properly maintained enhanced anaerobic environment. As stated previously, the rate of degradation of TCE to ethene is rapid enough (half lives of 15 days or less have been measured by ARCADIS) that VC does not represent an unreasonable risk at this site. There is no need for an aerobic "buffer zone" between the IRZ and property boundary if VC concentrations are not persistent near the property boundary.

However, if warranted based on the pilot test, a biosparging system can be designed in a short time frame, and can be constructed at the downgradient property.

**Comment**

2) **The first months of operation (up to 6 months) will be considered as a pilot test. After the pilot test period (which you must specify in the revised work plan), a pilot test report will have to be prepared which evaluates the performance of this treatment alternative. If this proposed remedy does not**

**look promising, another remedial alternative will have to be proposed. You will be strictly limited to a maximum of 6 months for the pilot test. No extensions for the pilot test will be granted.**

**Response**

As previously stated, the objectives of the six- to twelve-month pilot test are to demonstrate that enhancement of the biodegradation processes is being established and to optimize the injection methodology. In order to satisfy the DEC's request, a pilot test report will be prepared upon receipt of data from the sampling event at the end of the six-month period, although up to 12 months may be required to achieve the pilot test objectives. The report will document the pilot test methodology and results to date, and evaluate biogeochemical conditions and degradation processes in the subsurface. As discussed during our meeting of October 15, 2002, ARCADIS would continue the injections beyond the six-month period if the technology has successfully established a reduced environment, if source material concentrations have generally declined and daughter product formation has been achieved within the reactive zone. ARCADIS recognizes that another remedial alternative will need to be proposed if the pilot test results indicate that the IRZ technology is inappropriate for the site. ARCADIS would like to meet with the NYSDEC to discuss the status of the pilot test after approximately three to four months of injections have occurred.

**Comment**

**3) You have chosen to call the work plan a "Remedial Action Plan". Due to potential confusion on the public's part with the Department prepared "Proposed Remedial Action Plan". The Department would prefer if you would entitle the subject work plan as a Remedial Action Work Plan.**

**Response**

The revised work plan will be entitled "Remedial Action Work Plan".

**Comment**

**4) Proposed NAPL Recovery – The bi-weekly NAPL recovery (pages 20 and 30) should include IW-3 besides IW-1, IW-9 and MW-13.**

**Response**

NAPL has been gauged and recovered from IW-3 since December 19, 2001. The RAWP will be revised to indicate that IW-3 is included in the NAPL recovery effort.

**Comment**

**5) This site is listed as a class 2 inactive hazardous waste disposal site. This listing requires that the Department must select the remedy for this site in accordance with 6 NYCRR Part 375. This involves the preparation of a Proposed Remedial Action Plan (PRAP) by the Department. The PRAP must be presented to the public in order to receive public input on the proposed remedy. Until public input has been considered and the final remedy is specified in a Department prepared Record of Decision (ROD), final approval of any remedial action work plan cannot be granted.**

**Response**

ARCADIS recognizes that Voluntary Cleanup Sites listed on the Registry of Inactive Hazardous Waste Disposal Sites as Class 2 require that the Citizen Participation requirements in 6 NYCRR Part 375 be followed. It is our understanding that the NYSDEC will prepare a PRAP and ROD to fulfill the Part 375 requirements although the site will remain under the Voluntary Cleanup Program. On behalf of 25 MPR, ARCADIS will continue to perform the work necessary to satisfy the requirements of the January 13, 1998 Voluntary Remediation Agreement and support the NYSDEC's effort in meeting the Part 375 requirements. To that end, ARCADIS will provide information in the RAWP, and other technical support and citizen participation assistance to support NYSDEC's remedy selection process.

**Comment**

**6) Source Remediation – On pages 14 and 20, it is stated that remedial actions will be evaluated to address adsorbed and dissolved phase VOCs in the source area following recovery of NAPL. The timing of this evaluation is not acceptable. It is the responsibility of the Department to present the entire remedy to the public for a particular operable unit and to receive public input on the remedy. It is the Department's conclusion that the on-site groundwater remediation should be considered as one operable unit and should not be divided up. Therefore, it will be necessary that you also evaluate the source**

**area remedial options in the subject work plan. You may pick your preferred remedy. A detailed evaluation of the preferred source area remedy should be included in the work plan. After review of the remedial alternatives for the source area which are presented in the work plan, the Department will select the preferred source area remedy to present to the public in the PRAP. Our selection may not coincide with the remedy that you select. Consequently, I recommend that you have some preliminary discussion with the Department about source area remedial alternatives. Initial screening should include the following alternatives: 1) pump and treat, 2) molasses injection, 3) chemical oxidation, 4) any other alternative that you consider appropriate such as zero valence iron, and 5) NAPL bailing only.**

**Please note that the "NAPL bailing only" alternative for the source area will not be acceptable regardless of whether the groundwater cleanup goals will be met at the downgradient property border. The bulk of the contamination in the source area must be removed. NAPL bailing is only the first step. At some point, the NAPL bailing will have to be abandoned or supplemented with a more aggressive technology to treat the source area.**

**Response**

As discussed during the October 15, 2002 meeting with the NYSDEC, ARCADIS will evaluate source area remedial options in the RAWP, select a preferred remedy, and provide a detailed evaluation of the preferred remedy. The source area remedial technologies that will be evaluated are: NAPL removal; IRZ using molasses injections; chemical oxidation; nano-scale zero-valent iron; and pump-and-treat. The RAWP will propose that implementation of a source area remedy - beyond NAPL bailing - be initiated approximately one year after implementation of a NYSDEC-approved downgradient treatment system. In case there was a misunderstanding regarding our intent to aggressively remediate source area contamination, we would like to clarify our position relative to the source area. First, the presence of NAPL represents a contaminant source that needs to be removed to the greatest extent practicable. In order to minimize the impacts to groundwater and remove readily accessible mass, we believe that it is necessary to remove recoverable NAPL prior to implementing a more aggressive source area remedy. This was the overriding rationale for phasing in a more aggressive source area remedy only after NAPL bailing was essentially completed. A secondary reason for not recommending a preferred source area remedy in the draft RAP was based on the premise that additional monitoring data would enable us to more effectively evaluate an appropriate remedial technology. Nevertheless, ARCADIS will evaluate remedial options and recommend a preferred remedial technology in the RAWP.

**Comment**

**7) There must be a time limit specified in the work plan for the hand bailing before the more aggressive source remediation is implemented. During the limited period of NAPL bailing, monitoring of the groundwater beneath the source area will be necessary to identify any movement of the contaminants towards the deeper aquifer. MW-18D screened at 133'-143' and MW-20D screened at 175'-185' are in a good location to identify an increase in contaminant levels in the deep aquifer. These wells should be periodically sampled for VOCs while only NAPL bailing, by itself, is being performed in the source area. The 260 ug/l PCE detected on 8/6/01 in MW-18D already indicates that some of the contaminants have migrated to the deep aquifer. If there is evidence that a significant amount of contaminants are sinking in the source area, the more aggressive remedial alternatives for the source area must be implemented in a timely manner to prevent further migration. It is questionable whether hand bailing will be effective in preventing migration to the deeper aquifer, as stated on page 20 of the work plan.**

**Response**

As discussed during our meeting on October 15, 2002, the RAWP will propose that implementation of a source area remedy that goes beyond NAPL bailing be initiated approximately one year after DEC final approval of the downgradient remedy. Monitoring Wells MW-18D and MW-20D will be sampled semi-annually during the period of NAPL bailing to confirm that VOC concentrations are stable and VOCs are not migrating vertically downward. Historic and more recent groundwater monitoring data indicate that the combination of hydrogeologic conditions and physical properties of the NAPL are responsible for the NAPL's very limited impact on groundwater quality greater than approximately 150 ft bls. The text on page 20 will be revised to indicate that the best way to control the downward mobilization of NAPL is to remove or treat it while ensuring that any more aggressive remedial approach does not alter the natural conditions that have prevented any significant adverse impacts to deeper aquifer zones.

**Comment**

8) **Preliminary Remedial Action Goals, section 4.3 pages 11 & 12 – At the end of section 4.3, it states that you may seek alternate cleanup standards if it is not possible to completely remove residual NAPL in a reasonable time frame. At that juncture, it would be necessary to evaluate other potential remedial alternatives if the chosen remedial alternative has not successfully addressed the contamination. However, the Department would consider your request, after 5 years of operation, for an alternate cleanup objective if there are no significant impacts to the public or environment and there are not other available remedial alternatives which would achieve better results.**

**Response**

ARCADIS will revise the text in Section 4.3 to reflect that, if after 5-years of operation, the remedy is not successfully achieving the remedial action objectives, other potential remedial options (or remedy enhancements) will be evaluated. If there are no other remedial alternatives that would more effectively achieve MCLs at the downgradient property boundary in a reasonable timeframe, then a petition for alternate cleanup standards will be submitted to the NYSDEC. A petition for alternate cleanup standards will include an evaluation demonstrating that there are no significant impacts to the public or environment.

**Comment**

9) **Monitoring of the Injections, page 21, page 32, Table 1, and Table 2**

- **Please add MW-28D screened at the 75'-90' to the initial injection monitoring network. This well is in the plume (185 ppb TVOCs in summer 2001). Additionally, please also add water table well MW-11 (513 ppb TVOCs in summer 2001) to the injection monitoring network. These wells will help indicate the width of the treatment zone and potential VC generation towards the east and west sides of the plume where the IRZ may be weaker.**

- **A shallow monitoring well at the downgradient border is needed to determine what concentrations are leaving the site. MW-16D screened at 79.5'-89.5' is the only monitoring well on the downgradient border which is in the plume. A new monitoring well** should be constructed with a 10' screen zone located at approximately 60'-70' below grade. These two wells will also be used to determine whether the groundwater cleanup objectives are being achieved at the downgradient property border. (This issue is discussed in the middle of page 21. However, the proposed shallow well is needed now due to the potential for generating VC).

- If the IRZ extends past MW-27D, as suggested on the top of page 34, an intermediate monitoring well screened between 75'-90' should be constructed midway between MW-27D and MW-16D to monitor the 'buffer zone' where you contend that VC will be biodegraded aerobically. Please note that water table well MW-29 has limited uses for monitoring the buffer zone since, based on historical profile sampling on the downgradient border, a good portion of the plume passes beneath this well.

- If a biosparge system is constructed as recommended in comment #1, there should be sufficient monitoring wells in place downgradient of the injections to determine if this treatment is having the desired effect on the DO readings and whether the VC, if present, is being biodegraded by the improved aerobic conditions.

- If in the future you wish to make a significant change to the monitoring schedule, as suggested on the bottom of page 32 and towards the top of page 34, you would have to notify the Department of the proposed changes. Minor modifications should be noted in the monthly reports.

- The round of sampling at the conclusion of the pilot test must include all sampling parameters necessary to evaluate the performance of he molasses injections.

- The results of the monitoring should be included in the monthly reports. Please send NYSDOH's copy of the monthly reports directly to Ian Ushe, the new NYSDOH project manager.

Response

Monitoring Wells MW-28D and MW-11 will be included in the pilot test monitoring program. Documentation of the monitoring program will be part of the Pilot Test Work Plan.

A new shallow zone monitoring well (screened from approximately 60 to 70 ft bls) will be installed in the vicinity of MW-16D prior to initiation of the pilot test. The plan for installation of this monitoring well and a figure showing the proposed location will be included in the Pilot Test Work Plan.

A new intermediate monitoring well (screened from approximately 75 to 90 ft bls) will be installed midway between MW-27D and MW-16D. The plan for installation of this monitoring well and a figure showing the proposed location will be included in the Pilot Test Work Plan.

If the results of the IRZ pilot test indicate that a biosparge system is necessary at the downgradient property boundary, the biosparge system will be designed and installed, and a monitoring plan will be developed to evaluate DO and VC concentrations in close proximity to the downgradient boundary of the site.

Any significant change to the monitoring schedule during the pilot test or Long-Term Monitoring Program would be proposed to the NYSDEC in writing for approval prior to implementation. As noted in your comment, any minor change would be documented in the monthly progress report.

The round of sampling to occur six months after initiation of the pilot test will include all sampling parameters necessary to evaluate the effectiveness of the IRZ remediation. The Pilot Test will provide detailed information on the wells to be sampled and the analytical parameters.

Once tabulated and evaluated, results of the monitoring data will be provided to the NYSDEC in the Consent Order monthly progress reports, and a copy will be sent directly to Ian Ushe of the NYSDOH.

**Comment**

**10) Molasses Injection Logs, page 31 – Copies of the molasses injections logs should be included in the monthly reports.**

**Response**

Agreed.

**Comment**

**11) Section 11, Reporting – Copies of all project related data should be included in the monthly reports, as has been suggested earlier.**

**Response**

Agreed.

**Comment**

**12) Given all the monitoring wells installed at this site, a table should be prepared that lists each well, the depth of the well, and the screened interval. This table should be included in future submittals where this information is needed to properly evaluate the data.**

**Response**

A well construction table will be provided in the RAWP.

**Comment**

**13) One associated general site figure showing the location of all the wells should be included. Possibly, the table noted under comment #12 can be added to this figure.**

**Response**

Figure 2 of the RAP, which shows all wells at the site other than MW-6 (located in the northwest corner of the site), will be replaced with a larger size figure in the RAWP that shows the entire site and all monitoring wells.

**Comment**

**14) Page 4: the document should refer to the "Suffolk County Department of Health Services (SCDHS)" and not the "Suffolk County Department of Environmental Conservation (SCDEC)".**

**Response**

The text will be revised to reflect the fact that the Suffolk County Department of Environmental Conservation issued a SPDES permit to NYTD in the mid-1950's, and that the agency is now referred to as the Suffolk County Department of Health Services (SCDHS).

**Comment**

**15) Page 12 & 13, Section 4.4 & Section 5.1: It is not clear whether the NAPL recovery screening of technologies distinguishes between LNAPL and DNAPL.**

**Response**

The screening of NAPL recovery technologies in the RAP did not distinguish between LNAPL and DNAPL. The overall NAPL recovery technology is the same, although the type of selective screen and how the skimmer is positioned at the NAPL/water interface would be specific to whether LNAPL or DNAPL were present in a particular well.

**Comment**

**16) Citizen Participation (CP) Activities: CP activities will be performed in accordance with 6NYCRR Part 375-1.5. When the remedial action work plan has been found to be acceptable to the reviewing agencies, you will receive conditional approval of the work plan. After the work plan has been conditionally approved, the Department will prepare the PRAP. A public meeting will be held to present the proposed remedy to the public. To announce the public meeting, the Department will prepare a meeting invitation fact sheet. The Department will prepare a public contact list for this site and establish public document repositories. An ENB notice will also be prepared to notify the public of the meeting and the associated 30 day public comment period on the**

**proposed remedy. The Department will prepare the ROD after considering public input. If significant, relevant public comments are received, the Department may change the selected remedy. Under these conditions, the Department may change the selected remedy. Under these conditions, the Department would require you to revise the remedial action work plan accordingly. Your role in this process will be to present your proposal to the public in the PRAP meting. If significant public interest develops in this site, the planned citizen participation activities for this site may have to be increased.**

**Response**

ARCADIS is prepared to support the NYSDEC effort to inform and involve interested parties in the remedial decision-making process, and we request that you to seek our involvement in all key communications with the public.

**Comment**

**17) There is no Health and Safety Plan (HASP) and no Community Air Monitoring Plan (CAMP) associated with the RAWP. The most recent version of a generic CAMP prepared by the New York State Department of Health is attached as guidance.**

**Response**

A HASP was prepared by ARCADIS in July 2001 for our field activities prior to initiation of NAPL bailing and groundwater sampling. A copy of the HASP is being provided as Attachment A. ARCADIS has been conducting air monitoring with an organic vapor meter equipped with a photoionization detector (PID) during NAPL bailing and groundwater sampling. A CAMP will be prepared and submitted to the NYSDEC for approval, and followed by field personnel during all drilling, sampling and product recovery activities.

**Comment**

**18) An OM&M Plan must be submitted. Some of section 8 in the document would qualify as a conceptual OM&M plan, however there is still missing information about how the field and laboratory data will be used to make decisions such as optimization of the injection frequency, dose, volume, location,**

**etc. A final OM&M plan must be submitted subsequent to construction of the remedy.**

**Response**

The Pilot Test Work Plan for in-situ reactive zone remedy will provide detailed information regarding the injection feed rate, solution strength, frequency, and locations of injection wells. The Work Plan will also document the monitoring of VOCs and biogeochemical parameters, and how the information will be used to confirm that the reactive zone has been established and is treating the groundwater. The monitoring data will enable ARCADIS to optimize the injection methodology and the injection well network for a full-scale application.

**Comment**

**19) Additional details about how the initial dosing was determined is needed, unless this is entirely based upon experience and then adjusted base upon the change in the geochemistry and organic data. (See related comment #25.)**

**Response**

Please refer to the previous Response No. 18.

**Comment**

**20) Page 11, Section 4.2, Source remediation must be a remedial action objective. Bullet 3 could be interpreted to mean that the concentrations leaving the site would be acceptable. The remedy has to eliminate off-site impacts from on-site sources.**

**Response**

Development of remedial action objectives (RAOs) for this site are based on the nature of the contaminants, potential pathways of exposure, and cleanup goals or acceptable contaminant concentrations.

Within this context, the third bullet will be revised in the RAWP, as follows:

"Remediate the source area contamination, to the extent practicable, in order to control and/or reduce the off-site migration of VOCs in groundwater at levels that could result in unacceptable levels based on potential exposure pathways and the resulting risk to human health and the environment.

**Comment**

**21) Page 11, Section 4.3, The long-term goal should include a reference to meeting groundwater standards at the downgradient border.**
**Last Paragraph, Section 4.3, This approach is not acceptable. It is not technical impracticability if the selected remedy doesn't work. There are other technologies that could be applied to this problem. (See related comment #8.)**

**Response**

The cleanup goal at the downgradient property boundary is the applicable groundwater standard, which is the Division of Water Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values. The statement will be revised so that the term "cleanup goals" is replaced with "groundwater standards".

Please refer to Response No. 8 regarding the remedial approach if residual NAPL cannot be fully remediated in a reasonable timeframe. ARCADIS will be applying a remedial technology that can remediate adsorbed VOC mass and aggressively treat, rather than contain, the source area impacts. Planning for the potential contingency that alternate cleanup standards (that are protective of human health and the environment) may be needed is a recognition and acceptance of the limitations of the current status of remedial technologies, and not an unwillingness to utilize whatever remedial technology is most warranted to address the source area contamination.

**Comment**

**22) Page 15, Section5.2.1, Second Paragraph, Last Sentence, This sentence indicates that the IRZ affects the saturated adsorbed VOCs. Elsewhere in the document it was indicated that the biological processes resulting from this technology can produce a mild surfactant affect through lipids and alcohols. If you decide to evaluate this technology as a potential remedy for the source area, this affect may be useful in the source area.**

**Response**

ARCADIS concurs with your observation regarding the ability of the IRZ to treat adsorbed VOC mass, and its potential usefulness as a source area remedy to be used in conjunction with NAPL bailing.

**Comment**

**23) Page 21, There is no plan for deep injection and monitoring. If this technology can produce a surfactant effect, NAPL may be mobilized downward. Deep injections might counteract this. Section 6.1.2, Downgradient shallow and deep monitoring wells are contemplated for installation prior to "site closure". While the meaning of site closure is unclear here, it is reasonable to expect that these wells may need to be installed earlier. (See also the second bullet under comment #9.)**

**Response**

Section 6.1.2 should actually be referring to the two proposed additional monitoring (one shallow and one deep) as one in the shallow zone and one in the intermediate zone. These proposed wells would coincide with the zones where downgradient VOC impacts have been observed. The text will be revised to indicate that these wells would be installed prior to initiation of the pilot test, rather than prior to site closure.

Existing deep zone wells will be used to evaluate whether the deep zone is being impacted by source area contamination. One or more deep zone monitoring wells downgradient of MW-19D may be necessary at a later date if the future distribution of VOCs in the intermediate or deep zones warrant additional monitoring points.

It is important to note that the surfactant effect will not mobilize NAPL as stated in the agency comment. The surfactants dissolve adsorbed organics at a greater rate than water alone, thus making them available to be degraded.

**Comment**

**24) Page 25, Section 6.3.2, None of the alternatives address the residual NAPL that will be a continuing source to the groundwater.**

**Response**

As presented in Response No. 6, the RAWP will more explicitly evaluate remedial options that will be used in conjunction with NAPL bailing to aggressively remediate the source area so that, to the extent practicable, NAPL will not be a continuing source of VOCs to the groundwater.

**Comment**

**25) Page 31, Section 8.2.1.1, The basis for the initial dose should be explained and the criteria for subsequent optimization of doses must be part of an OM&M plan.**

**Response**

The reagent feed characteristics of rate, strength, and frequency are tied to the need to deliver adequate organic carbon to maintain strongly reducing conditions within the reactive zone. The basis for the initial dose is to satisfy two criteria that must be met to create an effective reactive zone. First, there must be enough substrate to drive the entire zone into highly reducing conditions. Typically the goal is to maintain between 100 and 1000 mg/L total organic carbon (TOC) in the reactive zone. Based on ARCADIS experience, this translates to one or two orders of magnitude higher target TOC concentration in the injection wells. The reason higher concentrations must be fed in the injection wells relates to the fact that the organic carbon will be metabolized as it flows with groundwater, therefore, it is necessary to establish a TOC gradient between the injection points and the rest of the reactive zone.

Second, enough organic substrate must be added to the subsurface to ensure that the electron acceptors in the groundwater are utilized. An organic carbon feed rate capable of maintaining the TOC target range above should be adequate to account for the electron acceptor (primarily DO, nitrate, and sulfate) flux - the product of the electron acceptor concentration and the groundwater flow rate. The reactive zone will be designed to supply enough substrate to overcome the electron acceptor flux and maintain the target TOC.

Calculations that go through the process of determining the initial feed rate, solution strength, and injection frequency based on establishing the necessary TOC gradient will be provided in the Pilot Test Work Plan. Monitoring data during the pilot test will be used to adjust and optimize the reagent feed characteristics.

**Comment**

**26) Page 31, Section 8.2.1.3, Please indicate when the referenced feed rate will be established. A monitoring plan must be prepared and submitted subsequent to construction.**

**Response**

The initial injection feed rate calculations will be presented in an Appendix to the Pilot Test Work Plan. The Work Plan will present detailed monitoring requirements for the pilot test program. A long-term monitoring plan for evaluating the performance of a full-scale remedy will be prepared and submitted to the NYSDEC prior to startup of the final remedy.

**Comment**

**27) Page 32, Section 8.2.1.5, it would appear that we need some off-site, downgradient monitoring wells to effectively monitor the performance of the remedy. VC must be considered to be among the constituents of concern for monitoring purposes. There should be monitoring of the deep zone. (See comments 7 and 9 which also cover this issue.)**

**Response**

One component of evaluating the performance of the remedy will be the monitoring of groundwater quality at the downgradient property boundary. The purpose of this monitoring will be to document and evaluate concentrations of VOCs to ensure that site-related contamination is being treated within the property boundary. Because 25 MPR LLC is only responsible for remediation of the on-site contamination, we are planning to conduct performance monitoring solely with on-site wells.

**Comment**

**28) Page 35, Section 11, Semi-annual reporting is not nearly frequent enough. (See comments 9,10, and 11 which also cover this issue).**

**Response**

ARCADIS apologizes for any misunderstanding. The semi-annual reporting referred to additional, more detailed technical status letters during the first year of IRZ and NAPL-recovery implementation. We have always planned to continue submitting monthly progress reports as outlined in the Voluntary Cleanup Agreement. These monthly progress reports will include the requested project-related data requested in the NYSDEC letter of August 19, 2002. Following the first year of remediation, reporting of data will be provided as outlined in a Long-Term Groundwater Monitoring Plan to be prepared for the site.

The semi-annual reporting during the first year of IRZ implementation, referred to in Section 11 of the RAP, will provide a more detailed evaluation of the status of the IRZ and results of the performance monitoring.

**Comment**

**29) It is expected that there will be some time before this work plan is conditionally approved, the NYSDEC prepared PRAP is presented to the public, and the final remedy is specified in the ROD. During this time, the Department would not object to the performance of a pilot test, limited to a maximum duration of 6 months, for the molasses injections. However, a pilot test work plan would have to be developed and approved by the Department if you decide to perform the pilot test before conditional approval has been granted on the remedial action work plan. Comment in this letter should be used as an aid in preparing the pilot test work plan. Please note that official approval of the proposed molasses injections remedial alternative for the dissolved on-site plume cannot be granted until public comments on the remedy have been considered. Consequently, a pilot test performed prior to the ROD would be done at your own risk.**

**Response**

ARCADIS is aware that the IRZ pilot test will be conducted at our own risk, and is in the process of preparing and submitting a Pilot Test Work Plan.

NYSDOH's Comments

**Comment**

**1) Quarterly monitoring of indoor air quality (IAQ) should be conducted to demonstrate that subsurface vapors from remediation and/or contamination are not adversely impacting IAQ.**

**Response**

Quarterly monitoring of indoor air quality (IAQ) was conducted by CDM from October 1999 to April 2001. The monitoring data indicate that the January 2001 sampling event was the only event in which a site-related constituent of concern (COC) was detected (PCE concentration of 1.4 ppb).

Low-level concentrations of a number of other VOCs that are not site-related COCs were also detected during the numerous monitoring events. All reported concentrations of these non-site-related VOCs, with the exception of benzene, were below both Occupational Limits and Ambient Air Guide Criteria. Benzene was detected during two monitoring events, December 1999 and January 2001. The reported concentrations for these two monitoring events were well below Occupational Limits but above Ambient Air Guide Criteria (non-detect). Nevertheless, benzene is not a COC for the site, since it has only been detected at low ug/L concentrations (estimated values at less than 10 ug/L) in historical groundwater samples. In summary, the quarterly monitoring of IAQ conducted by CDM showed that there is no health hazard to individuals within, or outside, of the building. ARCADIS concludes from available data that the on-site VOC plume present at or below the water table, which is located 50 ft bls, is not adversely impacting IAQ.

Conditions that could potentially influence IAQ have not changed since completion of this monitoring effort. Therefore, monitoring of IAQ is not necessary at this time. However, monitoring of IAQ will be conducted when remedial activities beneath the building slab are performed. The purpose of this IAQ monitoring will be to determine if remedial activities are adversely affecting IAQ, and whether measures need to be taken to mitigate potential impacts. A Plan for IAQ monitoring will be provided as an attachment to the CAMP.

**Comment**

**2) On page 33, the list of constituents of concern include PCE, TCE, 1,1,1-TCA, 1,1-DCA AND 1,2-DCE. Vinyl Chloride and 1,1-DCE should also be included as a constituent of concern.**

**Response**

Only vinyl chloride should be included in the list of COCs since it can be formed by the successive reductive dechlorination of the source compound PCE. While 1,1-DCE can be formed by the abiotic transformation of 1,1,1-TCA, the fact that only trace concentrations (4 ug/L) were detected in one well during the July/August sampling round is a good indicator that it will not form to any appreciable extent. In either case, VC and 1,1-DCE are included in all VOC analyses performed on groundwater samples collected at the site.

**Comment**

**3) In order to expedite NAPL removal, consideration should be given to characterizing or finding the source of NAPL on the site.**

**Response**

ARCADIS has contracted a subsurface geophysical survey firm to make another attempt to locate the former on-site diffusion well. We will provide NYSDEC with the results of the geophysical investigation in the December 2002 Progress Report.

**Comment**

**With respect to the In-Situ Reactive Zone (IRZ – Chosen alternative)**

**4) Under Section 6.1, Alternative#1 includes placing institutional controls to ensure that future property use is limited (i.e., restricting the installation of commercial or residential groundwater supply wells). Consideration should be made to include institutional controls on Alternatives 2&3 as well, especially if the groundwater cleanup objectives are not going to be met.**

**Response**

Institutional controls to ensure that future property use is limited will be included in Alternatives 2 and 3 of the RAWP.

**Comment**

**5) It would be helpful, if ARCADIS provided us with remedial targets or expectations of groundwater contaminate removal, using IRZ overtime at the site.**

**Response**

Because of the numerous and diverse biodegradation mechanisms occurring in IRZs, it is difficult, if not impossible, to project site-specific groundwater contaminant removal rates until such time that sufficient site-specific data have been generated following implementation of the IRZ technology. A Case History describing the apparent degradation rate constants for an IRZ application at a site with similar COCs and groundwater velocities is provided as Attachment B.

**Comment**

**6) If the In-Situ Reactive Zone appears to be occurring at unacceptable rate, or if the extent of the anaerobic reactive zone appears to be limited, consideration should be given to pursue other remedies. It is not clear from the draft what would be done, if such were the case.**

**Response**

If the IRZ Pilot Test does not appear to be enhancing the biodegradation of VOCs at an acceptable rate, consideration would be given to pursue an alternate remedy identified in the RAWP.

**Comment**

**7) The statements on page 30 about Alternative 2 need to be qualified. The statements assume optimum biogeochemical conditions, resulting in short and long-term effectiveness against the contaminants on site. However it is possible, even after injecting molasses solution into groundwater to enhance the**

**anaerobic and reducing environment, that the rate of cleanup might be unacceptable.**

**Response**

While all remedial technologies have their strengths and weaknesses, the detailed analysis of remedial action alternatives is based on the premise that they will be designed to meet the performance criteria. It is also possible that more conventional remedial technologies will not perform to their design criteria due to certain site-specific factors. However, for an equitable comparison of remedial action alternatives, it is assumed that each technology will accomplish the performance criteria that the scientific and regulatory communities have accepted that they are capable of achieving. This acceptance is based on their documented use at other sites across the country undergoing environmental cleanups.

**Comment**

**8) In Section 11, it is stated that ARCADIS will prepare and submit semi-annual progress report to NYSDEC. I suggest that reporting be changed to monthly, in order to provide early warning of potential problems.**

**Response**

Please refer to the response to NYSDEC Comment No. 28.

**Comment**

**9) In reviewing the literature and examples of IRZ bio-remediation provided by ARCADIS G&M, I find very little quantitative data showing how effective it has been. It would be helpful if such data could be provided.**

**Response**

Please refer to the response to the NYSDOH Comment No. 5.

**Comment**

**Data Presentation**

**10) In addition to the information provided in section 6.2, a table should be provided listing the three alternatives, the criteria under which they are being evaluated and how each alternative measures up to the criteria.**

**Response**

A table will be provided that lists the alternatives, the criteria under which they are being evaluated, and a qualitative comparison of how the alternatives measure up to the criteria.

**Comment**

**11) Drawings showing where the IRZ wells will be located and monitored would be helpful to have.**

**Response**

The IRZ Pilot Test Work Plan will include a figure showing the injection well network and monitoring well network, and a table providing the list of analytes and sampling schedule.

**Comment**

**12) Consideration should be given to graphing LNAPL, NAPL and DNAPL results.**

**Response**

Charts showing trends in LNAPL and DNAPL thickness are being developed and will be provided in a progress report.

**Comment**

**13) A comprehensive flow diagram showing exactly how the remedy will be implemented and what happens when one remedy does not meet the cleanup goals would be helpful in understanding the flow events.**

**Response**

A flow chart depicting the decision-making process during implementation of the remedy will be provided in the RAWP.

**SCDHS's Comments**

**Comment**

**1) Pathways of Exposure, page 10 – Ingestion of contaminated groundwater is not discussed.**

**Response**

In accordance with Section XI (Deed Restriction) of the Voluntary Remediation Agreement, the Volunteer shall record an instrument with the Suffolk County Clerk, to run with the land, that:

- Prohibits the Site from ever being used for purposes other than the Contemplated Use; and,
- Prohibits the use of the groundwater underlying the Site without treatment rendering it safe for drinking water or industrial purposes.

Because the Volunteer, who is solely responsible for on-site contamination, is ensuring that contaminated groundwater will not be used on-site, the exposure pathway of ingestion can be eliminated.

This discussion will be provided in the RAWP.

**Comment**

**2) What is the suspected area of influence of the molasses injections?**

**Response**

The proposed line of injection wells in both the shallow and intermediate zones cover a width of approximately 20 feet transverse to the groundwater flow direction. The minimum expected area of influence of the reactive zone that is established downgradient of the injection wells is estimated to be 30 feet. The lateral spreading of TOC in the immediate vicinity of the injection wells is due to the volume and rate of injection, as well as, the hydrodynamic characteristics of the formation and groundwater flow regime. As the reagent migrates downgradient from the injection wells, the same transport mechanisms that influence contaminant migration at the site will affect the lateral spreading of TOC, including but not limited to adsorption, dilution, dispersion and diffusion.

Ongoing collection of field data will be used to determine the actual area of influence of the molasses injections, and the reagent feed characteristics will be optimized based upon that data.

**Comment**

3) **One of the negative points for the molasses injections will be that much of the dissolved on-site groundwater contamination which has already passed the proposed injection wells will be allowed to migrate off-site without treatment. One of the advantages for the pump and treat option is that the entire on-site plume would be treated.**

**Response**

Once the IRZ is established it will control the off-site migration of VOCs. The IRZ pilot test can be initiated within four weeks of NYSDEC approval of the Pilot Test Work Plan; thus treatment will begin almost immediately. Other remedial alternatives will take significantly more time to design and construct, and would not be implemented "at risk" due to the much higher capital cost of the remedy. Therefore, an IRZ remedy represents the most expeditious way to control off-site migration of VOCs. In addition, it is important to remember that for a compound like TCE, the dissolved plume only represents 15 to 30% of the mass present in the formation, the remainder is adsorbed to the soil matrix. Pump and treat technologies control groundwater flow, but only remove dissolved phase contamination, thus a pump and treat remedy will operate for 30 to 50 years. An IRZ attacks the dissolved and adsorbed phase simultaneously, thus removing the long-term source of contamination to groundwater, while at the same time controlling migration of the plume. In this way an IRZ can achieve 50 years of pump and treat clean up in 5 years or less.

**Comment**

**4) The last time the groundwater in the source area was sampled was last summer. There is no proposed sampling for VOCs in the source area in Tables 1 and 2. This means that the source area would not be sampled for approximately two years until the long term monitoring plan is implemented. This is unacceptable.**

**Response**

Please refer to the response to NYSDEC Comment No. 9.

**Comment**

**5) In Tables 1 and 2, there is inadequate sampling for VOCs. Each sampling event should include sampling for VOCs with the reporting of TICs. Without adequate VOC sampling, the generation of potential byproducts such as VC, 1,2-dichloroethene, or alcohols would go undetected.**

**Response**

The groundwater monitoring during the pilot test has been revised to include adequate monitoring for VOCs. However, each sampling event will not necessarily include sampling for VOCs at each well because some wells will be too far downgradient of the injection wells to be affected in the initial stage of the pilot test. The Pilot Test Work Plan will provide a detailed monitoring schedule and list of analytes.

We trust that these responses adequately address the joint agency comments. Please contact us if you have any questions or need additional information.

Sincerely,

ARCADIS G&M, Inc.

Steven Feldman

Steven M. Feldman
Project Manager

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ARCADIS

## Attachment A

Health and Safety Plan
Groundwater Investigation at
the 25 Melville Park Road Site,
Melville, New York

ARCADIS

Health and Safety Plan

Groundwater Investigation at the 25 Melville Park Road Site, Melville, New York

PREPARED FOR

WHCS Melville, LLC

ARCADIS GERAGHTY&MILLER

# Health and Safety Plan

## Groundwater Investigation at the 25 Melville Park Road Site, Melville, New York


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**Date:**
27 July 2001

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C Utilities and Structures Checklist

D Accident Reporting Form, OSHA 101

## 1. Introduction

ARCADIS G&M, Inc. has been retained by WHCS Melville, LLC to conduct the groundwater investigation and remediation at the 25 Melville Park Road Site, located in Melville, New York. This Health and Safety Plan (HASP) has been developed to address the potential physical and chemical hazards that our workers may face while performing the planned field activities. This HASP establishes procedures to minimize worker's exposures through personal protective equipment and safe work practices. This HASP has been developed to meet the requirements of the Occupational Safety and Health Administration (OSHA) regulations, Title 29, Code of Federal Regulations, Part 1910.120 (29 CFR 1910.120), "Hazardous Waste Operations and Emergency Response." It is intended for the protection of our workers. Anyone else, such as subcontractors, client, and visitors may review our HASP and follow its procedures if they wish.

## 2. Responsibilities

ARCADIS G&M's on-site geologist will be designated as the Site Safety Officer (SSO). The SSO will be responsible for implementing the procedures and safe work practices established in this HASP. In the event that the SSO must leave the site while the work is in progress, an alternate SSO will be designated to ensure that the HASP will continue to be followed. The SSO will report all health and safety matters to the project manager, Steve Feldman, who has responsibility for overseeing the planned activities. Tom Eng, health and safety officer, will be available on an as needed basis.

## 3. Site Description

The Site was a former manufacturing facility, occupied by the New York Twist Drill Company, of high-speed carbon and carbide drills. The site is presently occupied by a two-story office building and parking facilities. The site is subject to the requirements of the New York State Department of Environmental Conservation (NYSDEC) Voluntary Cleanup Agreement, Index Number: W1-0778-96-11, entered into between WHCS Melville, LLC and the NYSDEC on January 13, 1998. The 25 Melville Park Road property is located south and east of the intersection of Broadhollow Road (Route 110) and the Long Island Expressway (Route 495) in the Village of Melville, Town of Huntington, Suffolk County, New York. Surrounding properties are classified as industrial and commercial. The mailing address of the facility is 25 Melville Park Road Road, Melville, New York 11747. A site location map is presented on Figure 1.

## 4. Planned Field Activities

The planned field activities associated with this groundwater investigation consist of the installation of vertical profile borings/monitoring wells, the collection of groundwater samples to determine groundwater quality, and the recovery of non-aqueous phase liquid (NAPL) from monitoring wells.

## 5. Hazard Evaluation

The potential hazards, physical and chemical, associated with the planned field activities for this site have been evaluated and are identified in Table 1. Existing site information was used in this evaluation process.

The physical hazards associated with the planned field activities include the potential for being struck by/against equipment; being splashed with potentially contaminated fluids; slipping/falling due to wet or uneven surfaces; and, exposure to noise during the installation of the vertical profile borings/monitoring wells.

The chemical hazards associated with the planned field activities include the potential exposure to volatile organic compounds (VOCs) such as ethylbenzene, toluene, xylene, tetrachloroethylene (PCE), trichloroethylene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), 1,2-dichloroethylene (1,2 DCE), 1,1-dichloroethene (1,1-DCE), and 1,1-dichloroethane (1,1-DCA). Free NAPL, believed to be a mixture of cutting oil and chlorinated solvent, is also present at the site. Based upon this information, the following exposure pathways have been identified to minimize potential worker's exposure:

- Inhalation of vapors and gases.
- Direct skin and eye contact.
- Skin absorption of chemicals.
- Accidental ingestion.

## 6. Air Monitoring

Air monitoring will be conducted at this site during all planned field activities to ensure that the workers are appropriately protected from the potential physical and chemical hazards. An intrinsically safe photoionization detector (PID) instrument will be used.

This instrument is designed to measure trace quantities of VOCs in air and has a parts per million (ppm) sensitivity range. This instrument will be calibrated each morning, before field use, and calibration records will be kept.

## 7. Action Levels

The following action level procedure (see Table 2) has been established for all planned field activities to evaluate whether actual field conditions will require an upgrade in the level of personal protection. Prior to the start of each day's activities, background readings in the immediate work area will be taken using the PID instrument. Should background readings be less than the action level of 25 ppm for a sustained period of 10 minutes the planned field activities will start with workers in Level D protective equipment. During all field activities, air monitoring using the PID instrument will be conducted. An action level of 25 ppm for a sustained period of 10 minutes in the worker's breathing zone has been established based on the potential presence of tetrachloroethylene. Table 3, Current Occupational Airborne Contaminant Standards and Guidelines, provides a listing of the compounds found at this site and their current occupational exposure limits If the action level is exceeded work will be discontinued, the work area will be permitted to vent and the workers moved to an area up wind. Work will not resume until the concentrations fall below the action level. If the PID readings do not fall below the action level after 15 minutes, the work will resume with the level of protection upgraded to Level C using a full-face air-purifying respirator equipped with an organic vapor cartridge. When the PID readings are below the action level, then downgrading to Level D is possible. Should PID instrument readings meet or exceed 1,000 ppm for a sustained period of 10 minutes, work will be discontinued, workers will be moved upwind, and the work area will be permitted to vent. Work will not resume until PID readings fall below the action level for tetrachloroethene in the work zone.

## 8. Levels Of Protection

Based upon the hazard evaluation results, all tasks will initially be performed in Level D protection. In the event that the established action levels are exceeded, the level of protection may be upgraded to Level C. The following is a description of the personal protective equipment required for each level:

Level D

- Hard hat

- Disposable coveralls
- Safety glasses, goggles, or faceshield
- Steel-toe and shank, chemical-resistant boots
- Chemical-resistant gloves
- Hearing protection, Noise Reduction Rating (NRR) of 35 decibels

Level C

- Hard hat
- Disposable coveralls
- Safety glasses, goggles, or faceshield
- Steel-toe and shank, chemical-resistant boots
- Chemical-resistant gloves
- Hearing protection, NRR of 35 decibels
- Full-face air-purifying respirator equipped with organic vapor cartridges

## 9. Safe Work Practices

All ARCADIS G&M site personnel will be participants of the company's health and safety program. This includes 40 hours of initial training and three days of supervised field work, annual 8-hour refresher training and 8-hour manager and supervisor training.

- All ARCADIS G&M site personnel are participants of the company's medical surveillance program.
- A copy of the HASP will be available for reference at the site during the planned field activities. Site visitors will be required to sign the Site Visitors Log (Appendix A).

- Dust suppression, using a water spray, will be used when needed to reduce airborne particulates during the field activities.
- A pre-entry, tailgate safety meeting will be conducted and recorded on the form in Appendix B prior to the start of each day's activities to discuss the associated hazards.
- All underground utilities and structures will be marked out and cleared before any ground intrusive work begins. This will be recorded on the form provided in Appendix C.
- The SSO will inform all subcontractors of the potential hazards associated with the site and the planned field activities. A copy of the HASP will be made available for their review.
- No eating, drinking, and smoking will be permitted in the work and support zones.
- No sources of ignition, such as matches or lighters will be permitted in the work and support zones.
- The buddy system will be used in all work areas.
- During hazardous weather conditions, such as lightning and thunderstorms, work will cease immediately.

## 10. Site Control

Entrance to the work site is limited to authorized personnel only. The SSO will determine and identify the following areas of the work site. These areas will be divided into three zones, designated as the exclusion zone, the contamination reduction zone (CRZ), and the support zone. The SSO will also specify the equipment, operations, and personnel to occupy these controlled areas.

1. Exclusion Zone (Zone 1)

The exclusion zone is the zone where contamination exists or could occur. All personnel working in an exclusion zone will wear the prescribed level of protection. An entry and exit check point will be visually defined at the periphery of the exclusion zone to regulate the flow of personnel and equipment into and out of the zone. Personnel who have not met the medical monitoring and training criteria set forth in this HASP are not permitted to enter the exclusion and contamination reduction zones.

An exclusion zone will be established around the work areas in which encountering hazardous substances are probable. When established, this zone will be of sufficient size to contain all work activities and resultant waste production. The exclusion zone perimeter will be defined with cones, barricades, or barricade tape.

2. Contamination Reduction Zone (Zone 2)

The area between the exclusion zone and the support zone is the CRZ. This zone provides a transition between a contaminated area (exclusion zone) and a support zone. The CRZ serves as a buffer to further reduce the possibility of the clean support zone from becoming contaminated. It provides additional assurance that the physical transfer of contaminating substances on personnel, on equipment, or in the air is limited through a combination of decontamination, distance between exclusion and support zones, air dilution, zone restrictions, and work functions. Decontamination of personnel and sampling equipment will be performed in the contamination reduction corridor (CRC), which will be situated within the CRZ. The CRC will be established as the entry and exit points to the defined work areas.

3. Support Zone (Zone 3)

This space is outside the zone of contamination or potential contamination. The support zone must be marked and protected against contamination from the work area. This zone serves the following functions:

- An entry for personnel, material, and equipment.
- An exit for decontaminated personnel, materials, and equipment.
- An area for rest breaks.

Waste materials resulting from work activities (such as contaminated protective clothing) will be containerized within the exclusion zone and properly disposed of. Only authorized visitors and investigative team members will be allowed within work areas during the field work. Site security will be performed by the SSO or his designee.

## 11. Decontamination

All personnel performing work tasks in the work areas must pass through the CRZ decontamination procedure, regardless of the work task or level of protection used. All equipment and tools used within the work area will also undergo decontamination.

In Level D protection, personnel decontamination will consist of removing the disposable coveralls, if one was worn, followed by washing the outer boots and gloves with a decontamination solution, consisting of detergent and water. Gloves and boots will then be rinsed with clean water. This activity will occur in the CRZ.

In Level C protection, the disposable coveralls, boots and gloves will be washed and rinsed in the same manner as previously described prior to removal. The respirator face piece will then be removed and the respirator will be placed in a plastic-lined container for decontamination. This activity will occur in the CRZ.

Equipment used in the work area (tools, monitoring equipment, radios, clipboards, etc.) will be deposited on plastic drop cloths or in different containers with plastic liners. Tools and devices will be washed/wiped in a detergent solution and rinsed with clean water, then stored or serviced for reuse.

## 12. Emergency Plan

Verbal communications may be difficult at times due to personal protective equipment and noise. A universal set of hand signals will then be used. They are as follows:

| | |
|---|---|
| Hand gripping throat: | Can't breath |
| Grip partner's wrist or place hands around waist: | Leave work area immediately |
| Hand on top of head: | Need assistance |
| Thumbs up: | Okay, I'm all right |
| Thumbs down: | No, Negative |

## 13. Injury Reporting

All job-related injuries and illnesses will be reported to the SSO. If medical attention is needed, the injured worker will be decontaminated, if possible, prior to leaving the site.

The SSO will investigate the cause of the accident and corrective measures will be taken before the work can resume. It will be the responsibility of the SSO to complete the accident reporting form, OSHA 101, included as Appendix D for all injuries. The completed OSHA 101 should be forwarded to the office health and safety manager within six days for recording into the OSHA 200 log. In the event of a fatality or 3 or more workers hospitalized as a result of a single incident, the SSO will contact the office health and safety manager immediately for OSHA reporting purposes.

## 14. Emergency Telephone Numbers

| | | |
|---|---|---|
| Police | - | 911 |
| Melville Fire Department | - | (631) 423-2635 |
| Ambulance | - | Dial Local Operator |
| North Shore University Hospital at Plainview | - | (516) 719-3000 |

## 15. Directions To The Hospital

North Shore University Hospital at Plainview is located approximately four miles from the site. All medical emergencies should be directed to the hospital for treatment. The hospital is located at 888 Old Country Road, Plainview, New York. The hospital can be reached, by vehicle from the site, by taking Melville Park Road west to Broadhollow Road (Route 110). Turn left on Broadhollow Road and proceed to Bethpage-Spagnoli Road. Turn right on Bethpage-Spagnoli Road and proceed west to Old Bethpage Road. Heading northwest (on Old Bethpage Road), proceed to Old Country Road and turn left. Proceed west on Old Country Road to the hospital, which is located on the north side of Old Country Road (east of NY135 [Seaford-Oyster Bay Expressway]).

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Table 1. Potential Physical and Chemical Hazards Associated with the Planned Field Activities, 25 Melville Park Road Site, Melville, New York.

| | Physical Hazards | | | | Chemical Hazards | | | |
|---|---|---|---|---|---|---|---|---|
| | Struck By/Against Equipment | Splash | Slips and Falls | Noise | Inhalation | Skin and Eye Contact | Skin Absorption | Accidental Ingestion |
| Installation of Vertical Profile Borings/Monitoring Wells, Groundwater Sampling, and Recovery of NAPL. | X | X | X | X | X | X | X | X |

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Table 2. Summary of Action Levels, 25 Melville Park Road Site, Melville, New York.

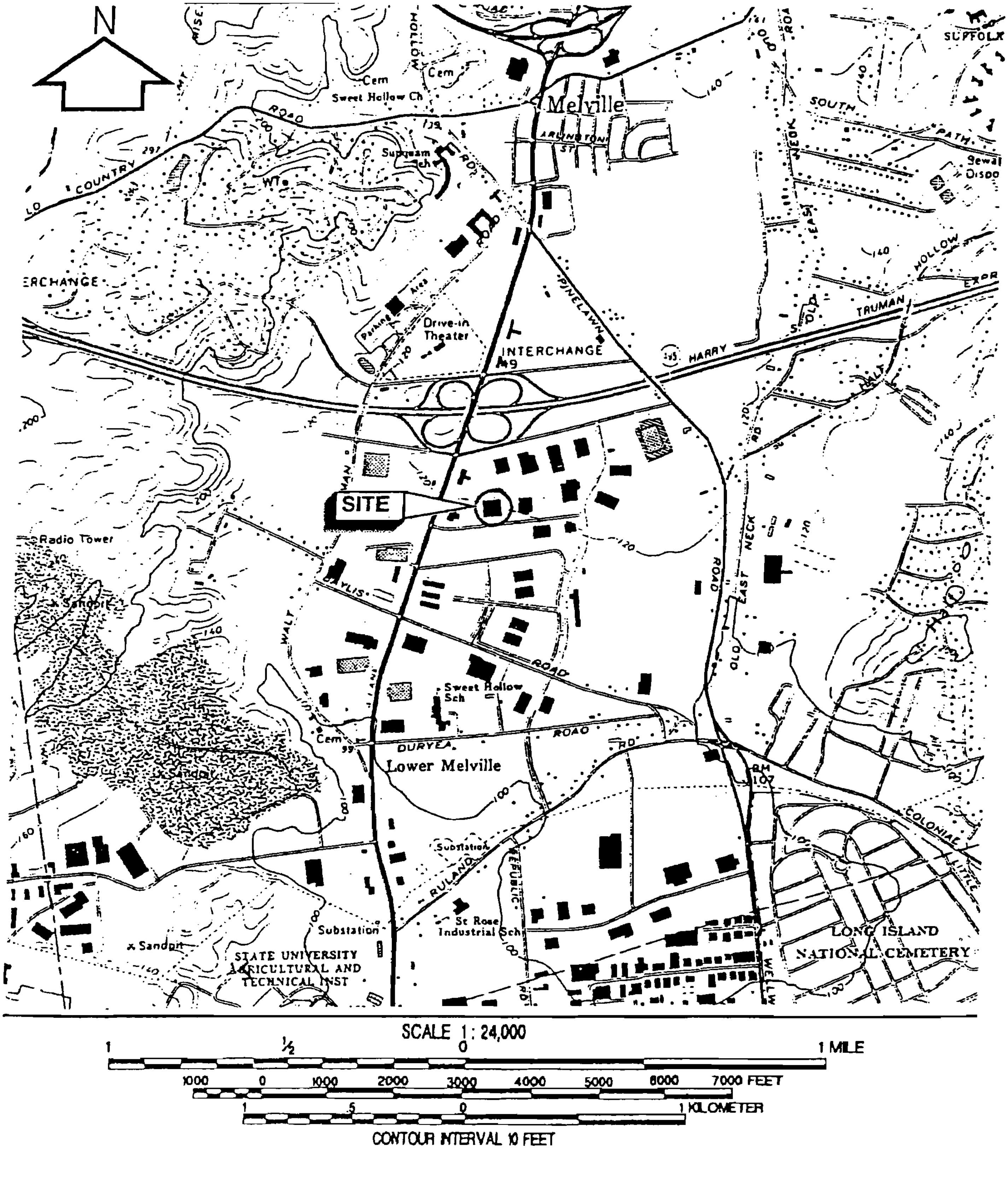
| Air Monitoring | Action Levels | Actions To Take |
|---|---|---|
| PID Reading | <25 ppm | Start in Level D protection. |
| PID Reading | >25 ppm[1] | Let work area vent or upgrade to Level C protection. |
| PID Reading | > 1,000 ppm[1] | Let work area vent. |

PID Photoionization detector.
ppm Parts per million.
1 For 10 minutes.

Table 3. Current Occupational Airborne Contaminants Standards and Guidelines, 25 Melville Park Road Site, Melville, New York.

| Compound | ACGIH-TLV (ppm) TWA | ACGIH-TLV (ppm) STEL | OHSA-PEL (ppm)[1] TWA |
|---|---|---|---|
| 1,1-Dichloroethane | 100 | -- | 100 |
| 1,2-Dichloroethene | 200 | -- | 200 |
| Ethylbenzene | 100 | 125 | 100 |
| Tetrachloroethene | 25 | 100 | 100 |
| Toluene | 50 | -- | 200 |
| 1,1,1-Trichloroethane | 350 | 450 | 350 |
| Trichloroethene | 50 | 100 | 100 |
| Xylene | 100 | 150 | 100 |

ACGIH American Conference of Governmental Industrial Hygienists (2001).
OSHA Occupational Safety and Health Administration.
TLV Threshold limit value.
PEL Permissible exposure limit.
TWA 8-Hour time weighted average.
STEL 15-Minute short term exposure limit.
ppm Parts per million.
-- Not established.
1 29 CFR 1910.1000 Tables Z-1 and Z-2.




SOURCE: Fugro.

**Figure 1-1**
**Site Location**
**25 Melville Park Road, Melville, New York**

ARCADIS GERAGHTY & MILLER

# Appendix A

Site Visitors Log

## SITE VISITORS LOG

THE UNDERSIGNED VISITORS REQUIRE ENTRANCE TO THE WORK ZONES AND HAVE THOROUGHLY READ THE HEALTH AND SAFETY PLAN, UNDERSTAND THE POTENTIAL HAZARDS AT THE SITE, AND THE PROCEDURES TO MINIMIZE EXPOSURE TO THESE HAZARDS.

| NAME (print) | COMPANY | DATE | SIGNATURE |
|---|---|---|---|
| | | | |
| | | | |
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# Appendix B

Tailgate Safety Meeting Form

# TAILGATE SAFETY MEETING

Prepared by ______________________

Client ______________________ Project ______________________

Date ______________________ Project Number ______________________

Work Location ______________________________________________

Type of Work to be Done ______________________________________

## SAFETY TOPICS PRESENTED

Chemical Hazards ______________________________________________

______________________________________________________________

Physical Hazards/Underground Utilities ___________________________

______________________________________________________________

Protective Clothing/Equipment ___________________________________

______________________________________________________________

Special Equipment ______________________________________________

Emergency Procedures ___________________________________________

______________________________________________________________

Hospital/Clinic ______________________ Phone ( )______________

Paramedic Phone ( )______________________

Hospital Address _______________________________________________

Other _________________________________________________________

## ATTENDEES

| NAME PRINTED | SIGNATURE |
|---|---|
| ______________________ | ______________________ |
| ______________________ | ______________________ |
| ______________________ | ______________________ |
| ______________________ | ______________________ |
| ______________________ | ______________________ |

Meeting Conducted by ______________________ ______________________

Name Printed Signature

## Appendix C

Utilities and Structures Checklist

| | DRILL RIG SAFETY | |
|---|---|---|
| Policy No. | Page | Revision Date: |
| Approval: | | Approval Date: |

## UTILITIES AND STRUCTURES CHECKLIST

**Project:** ______________________ **Prepared by:** ______________

**Location:** ______________________ **Date:** ______________

**Instructions.** This checklist has to be completed by a G&M staff member as a safety measure to insure that all underground utility lines, other underground structures as well as above-ground power lines are clearly marked out in the area selected for boring or excavation. **DRILLING OR EXCAVATION WORK MAY NOT PROCEED UNTIL LINES ARE MARKED AND THIS CHECKLIST HAS BEEN COMPLETED.** Arrangements for underground utility markouts are best made at the time of the preliminary site visit to allow client and/or utility company sufficient time. Keep completed checklist and maps on site; send copy to Project Manager.

**Assignment of Responsibility.** Client is responsible for having underground utilities and structures located and marked. Preferably, the utilities themselves should mark out the lines.

**Drilling or Excavation Sites.** Attach a map of the property showing the proposed drilling or excavation site (or if sites are widely separated, several maps) clearly indicating the area(s) checked for underground utilities or underground structures and the location of above-ground power lines.

**Utilities and Structures**

| Type | Not Present | Present | How Marked[1] |
|---|---|---|---|
| Petroleum products line | | | |
| Natural gas line | | | |
| Steam line | | | |
| Water line | | | |
| Sewer line | | | |
| Storm drain | | | |
| Telephone cable | | | |
| Electric power line | | | |
| Product tank | | | |
| Septic tank/drain field | | | |
| Overhead power line | | | |

1) Flags, paint on pavement, wooden stakes, etc.

| | DRILL RIG SAFETY | |
|---|---|---|
| Policy No. | Page | Revision Date: |
| Approval: | | Approval Date: |

**UTILITIES AND STRUCTURES CHECKLIST**
**(Continued)**

**Name and affiliation of person who marked out underground lines or structures**

| Name | Organization | Phone |
|---|---|---|
| | | |

**Emergency Procedures**

Persons at site or facility to contact in case of emergency
1. ______________________ Phone ______________
2. ______________________ Phone ______________
Fire Dept: Phone ______________ Ambulance: Phone ______________
Utility: Phone ______________ Utility: Phone ______________
Directions to nearest hospital (describe or attach map).

G:\user\laurao\manual\checklist.doc

ARCADIS GERAGHTY&MILLER

## Appendix D

Accident Reporting Form, OSHA 101

# OSHA FORM 101

## SUPPLEMENTARY RECORD OF OCCUPATIONAL INJURIES AND ILLNESSES

EMPLOYER

1. Name ______________________________

2. Mail Address ______________________________
(No. and street) (City or town) (State)

3. Location, if different from mail address ______________________________

INJURED OR ILL EMPLOYEE

4. Name ______________________________ Social Security No. ______________
(First name) (Middle name) (Last name)

5. Home Address ______________________________
(No. and street) (City or town) (State)

6. Age __________ 7. Sex: Male__________ Female__________ (Check one)

8. Occupation ______________________________
(Enter regular job title, not the specific activity he was performing at time of injury.)

9. Department ______________________________
(Enter name of department or division in which the injured person is regularly employed, even though he may have been temporarily working in another department at the time of injury.)

THE ACCIDENT OR EXPOSURE TO OCCUPATIONAL ILLNESS

10. Place of accident or exposure ______________________________
(No. and street) (City or town) (State)

If accident or exposure occurred on employer's premises, give address of plant or establishment in which it occurred. Do not indicate department or division within the plant or establishment. If accident occurred outside employer's premises at an identifiable address, give that address. If it occurred on a public highway or at any other place which cannot be identified by number and street, please provide place references locating the place of injury as accurately as possible.

11. Was place of accident or exposure on employer's premises? ______________ (Yes or No)

12. What was the employee doing when injured? ______________________________
(Be specific. If he was using tools or equipment or handling material,
______________________________
name them and tell what he was doing with them.)
______________________________

13. How did the accident occur? ______________________________
(Describe fully the events which resulted in the injury or occupational illness. Tell what happened and how it happened.
______________________________
Name any objects or substances involved and tell how they were involved. Give full details on all factors which led or contributed to the accident.
______________________________
Use separate sheet for additional space.)

OCCUPATIONAL INJURY OR OCCUPATIONAL ILLNESS

14. Describe the injury or illness in detail and indicate the part of body affected ______________
(e.g: amputation of right index finger at second joint;
______________________________
fracture of ribs; lead poisoning; dermatitis of left hand, etc.)

15. Name the object or substance which directly injured the employee. (For example, the machine or thing he struck against or which struck him; the vapor or poison he inhaled or swallowed; the chemical or radiation which irritated his skin; or in cases of strains, hernias, etc., the thing he was lifting, pulling, etc.)
______________________________
______________________________

16. Date of injury or initial diagnosis of occupational illness ______________________________
(Date)

17. Did employee die? ____________ (Yes or No)

OTHER

18. Name and address of physician ______________________________

19. If hospitalized, name and address of hospital ______________________________
______________________________

Date of report ____________________ Prepared by ______________________________

Official position ________________________

2A:OSHA101.FRM

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Attachment B

Mobilization of Sorbed-Phase Chlorinated Alkenes in Enhanced Reductive Dechlorination Case Study Results and Discussion

## MOBILIZATION OF SORBED-PHASE CHLORINATED ALKENES IN ENHANCED REDUCTIVE DECHLORINATION CASE STUDY RESULTS AND DISCUSSION

**High-Carbonate Porous Aquifer.** A reactive zone was established in a porous, high-carbonate aquifer in the Midwestern U.S., that was contaminated by perchloroethene and trichloroethene releases prior to 1980. Darcian groundwater velocities at the site were approximately 30 cm per day. The organic carbon fraction in the aquifer ranged from 0.001 to 0.006, while aqueous-phase perchloroethene and trichloroethene concentrations were 3 and 5 umol/L (500 and 700 ug/L), respectively, prior to treatment. At a median organic carbon fraction of 0.003, 80 percent of the PCE and 58 percent of the TCE were expected to reside in sorbed phase prior to the start of carbon injections.

Enhanced reductive dechlorination was induced through injections of 5 or 10 percent molasses solution every 2 weeks over a six-month period. Chlorinated alkene concentrations were observed at a groundwater monitoring well located approximately 30 meters downgradient from the reactive zone. The results of enhanced reductive dechlorination are shown on Figure 1,. Which shows molar concentrations to clearly display the stoichiometry of the degradation processes.

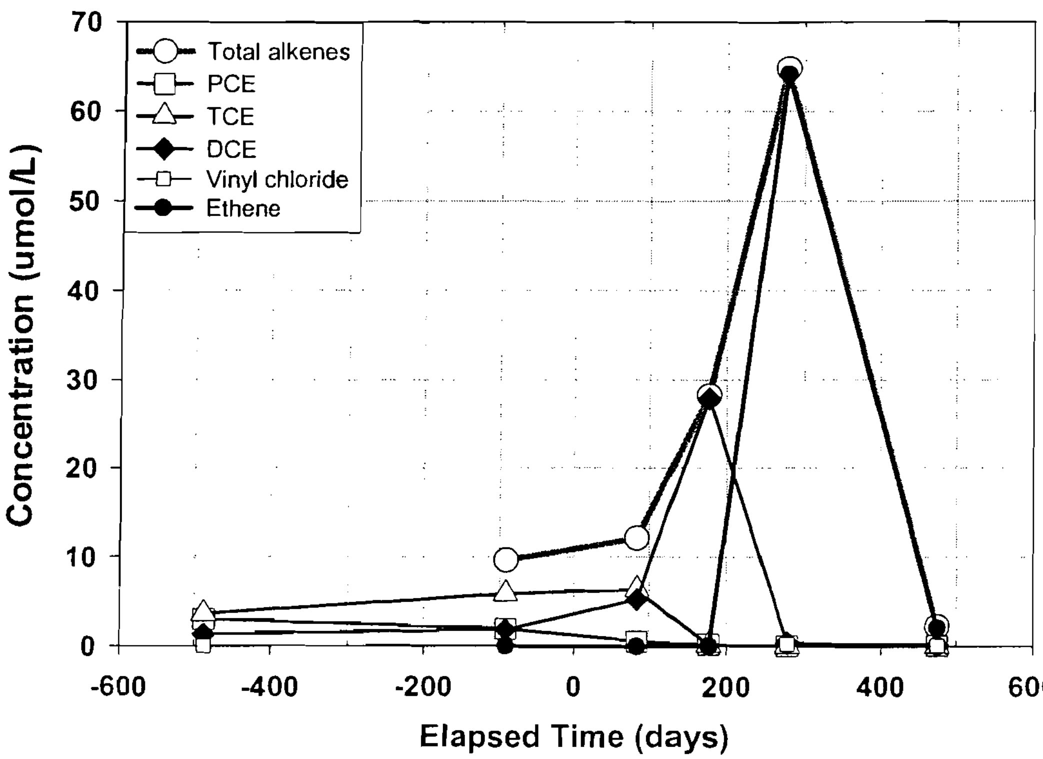


Figure 1. Results of enhanced reductive dechlorination in a high-carbonate aquifer. Carbon injections began at 0 days elapsed time. Ethene monitoring began with the baseline sampling event which occurred at –91 days.

As reductive dechlorination proceeded, a 6-fold increase in total dissolved alkenes was observed. This was consistent with the initial estimate of sorbed phase contamination based on a soil organic carbon fraction, $f_{oc}$, in the range of 0.006.

The observed contaminant decreases represented the combined effects of desorption and degradation. As a result, field observations could not be used to determine true degradation rate constants. Instead, "apparent" degradation rate constants were estimated from the aqueous-phase data assuming simple first-order decay. The resulting values were 0.015 $day^{-1}$ for perchloroethene and 0.042 $day^{-1}$ for trichloroethene and cis-1,2-dichloroethene. Because the apparent degradation was the net of both desorption releases of contaminant and reductive dechlorination reactions, the actual rate constants for perchloroethene and trichloroethene were likely 0.05 $day^{-1}$ or greater, corresponding to a half life shorter than 14 days. It is important to note that vinyl chloride did not accumulate during the study period. The pre-treatment vinyl chloride concentrations was 0.05 umol/L (3 ug/L), and the peak observed was only 0.2 umol/L (12 ug/L) – occurring after 27 umol/L (2,700 ug/L) of cis-1,2-dichloroethene was degraded.

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# Appendix E

Community Air Monitoring Plan

# Community Air Monitoring Plan
# 25 Melville Park Road Site
# Melville, New York

Real-time air monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) will be conducted at the Site during field activities to ensure that the community is appropriately protected from potential airborne contaminants related to investigation and remedial work activities. The principal VOCs that have been detected in groundwater at the Site are tetrachloroethylene (PCE), trichloroethylene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), 1,2-dichloroethylene (1,2 DCE), and 1,1-dichloroethane (1,1-DCA). Non-aqueous phase liquid (NAPL), which has been determined to be a mixture of oil and PCE, is also present at the Site. Continuous monitoring will be conducted during all ground intrusive activities such as soil excavation and handling, the installation of soil borings or monitoring wells, and during the demolition of contaminated or potentially contaminated structures. Periodic monitoring will be conducted during non-intrusive activities such as the collection of soil samples or the collection of groundwater samples and recovery of NAPL from existing monitoring wells.

## VOC Monitoring, Response Levels, and Actions

### Outdoor Monitoring

VOCs will be monitored using an intrinsically safe photoionization detector (PID). The PID is designed to measure trace quantities of VOCs in air and has a parts per million (ppm) sensitivity range. The PID will be calibrated each morning, before field use, and calibration records will be kept.

VOCs will be monitored at the upwind perimeter of the immediate work area (i.e., the exclusion zone) at the start of each workday and periodically thereafter to establish background conditions. VOCs will be monitored at the downwind perimeter of the exclusion zone on a continuous basis.

If the PID deflection at the downwind perimeter of the work area exceeds 5 ppm above background for a 15-minute average, work activities will be temporarily halted and monitoring continued. Once the deflection decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

If the PID deflection at the downwind perimeter of the work area persists at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of the vapors will be identified, corrective actions will be taken to abate the emissions, and monitoring will continue. After these steps have been taken, work activities will resume provided that the PID deflection 200 feet downwind of the perimeter of the work area or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less-but in no case less than 20 feet, is below 5 ppm over background for a 15-minute average.

If the PID deflection is above 25 ppm at the perimeter of the work area, activities will be shutdown.

### Indoor Monitoring

Consistent with the outdoor monitoring activities, VOCs will be monitored using an intrinsically safe PID during all ground intrusive and non-intrusive activities that are conducted indoors. However, the PID monitoring will be limited to the work area due to the absence of an upwind or downwind perimeter. In addition to PID monitoring, indoor ambient air quality monitoring will be conducted to evaluate whether the activities are affecting indoor ambient air quality. The indoor ambient air quality monitoring will conducted in accordance with the procedures outlined in the Remedial Action Work Plan (RAWP).

Indoor ambient air quality monitoring events will be conducted when each indoor activity is first implemented in order to aid in the evaluation of indoor ambient air quality data. In addition, follow-up indoor ambient air quality monitoring events may be conducted at regular intervals based on the duration of the activity. The sampling locations and frequency of the events will be determined on an activity-specific basis. Prior to implementing an indoor activity, the work, along with the associated indoor ambient air quality monitoring program, will be described in the monthly progress reports. The constituents of concern (COCs) for indoor air include PCE, TCE, 1,1,1-TCA, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCA, 1,1-DCE, and VC. The concentrations of these COCs in indoor air will be compared to their respective background levels, which were established by the New York State Department of Health (NYSDOH) in a study conducted by the Bureau of Toxic Substance Assessment. The study was conducted between 1989 and 1996 and is entitled "Background Indoor/Outdoor Air Levels of Volatile Organic Compounds in Homes Sampled by the New York State Department of Health, 1989-1996". If it is determined that site-related COC concentrations in indoor air are consistent with background levels, then additional indoor ambient air quality monitoring will not be conducted.

## Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. Real-time air monitoring for particulates will be conducted using an MIE personal DataRAM monitor. In addition, fugitive dust migration will be visually assessed during work activities.

If the downwind PM-10 particulate level (i.e., particulate matter less than 10 micrometers in size) is 100 micrograms per cubic meter ($\mu g/m^3$) greater than background (upwind perimeter) for a 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. If downwind PM-10 particulate levels do not exceed 150 $\mu g/m^3$ above the upwind level and provided that no visible dust is migrating from the work area, work activities will continue while dust suppression techniques are implemented.

If downwind PM-10 particulate levels are greater than 150 $\mu g/m^3$ above the upwind level after implementation of dust suppression techniques, work will be stopped and the activities reevaluated. If dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 μg/$m^3$ of the upwind level and in preventing visible dust migration, work activities will resume.