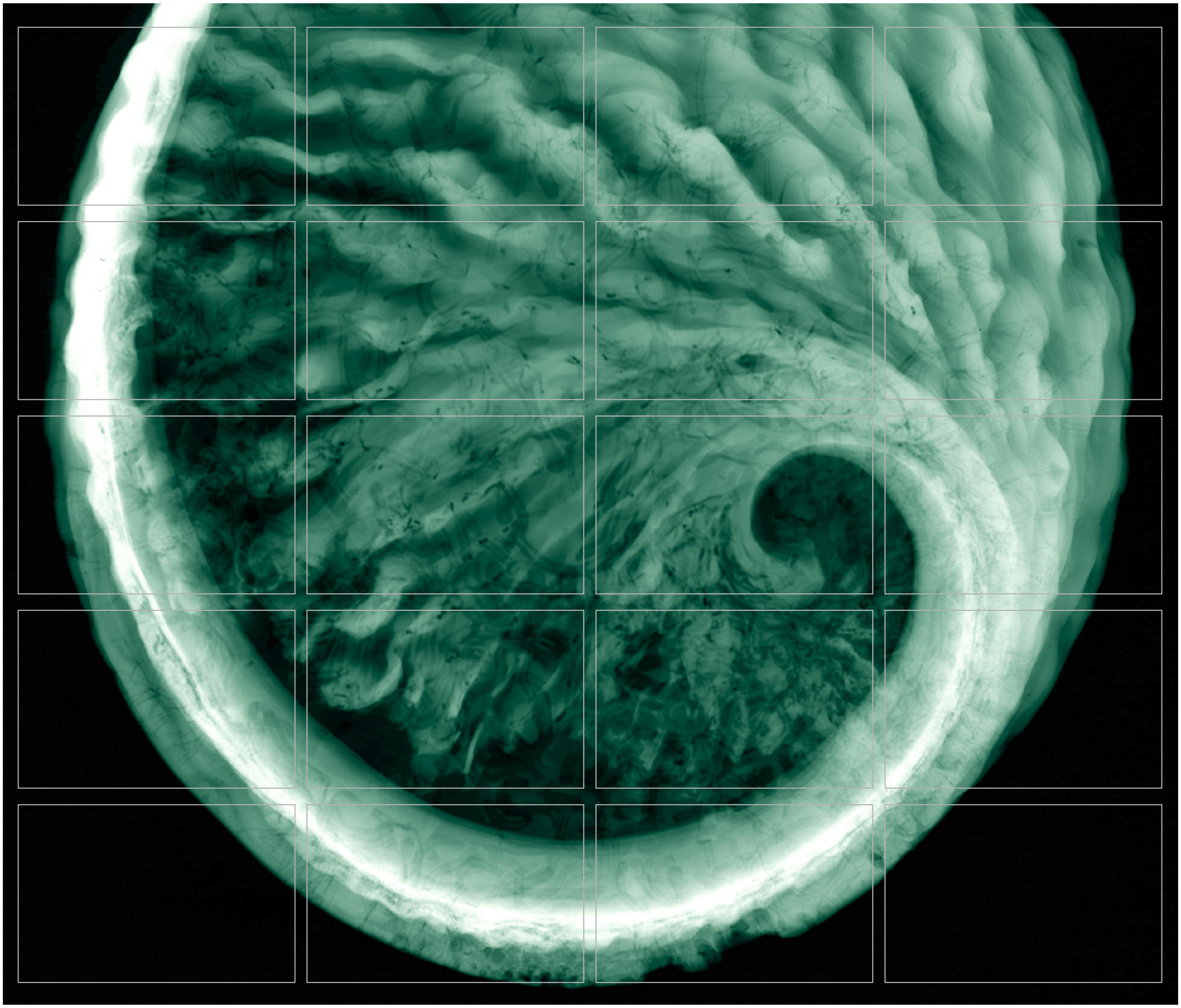

New York State Department of Environmental Conservation

Off-Site Feasibility Study Report

Utility Manufacturing

New Cassel, Town of North Hempstead, Nassau County, NY

February 2006

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FINAL REPORT

New Cassel, Town of North Hempstead, Nassua County, New York

Utility Manufacturing Site (1-30-043H)

Feasibility Study

ERM Reference 0020117

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Engineer of Record

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6.0 OVERVIEW OF THE FEASIBILITY STUDY REPORT

This Off-Site Feasibility Study (FS) Report follows the December 2005 Off-Site Remedial Investigation (RI) Report prepared by ERM for the Utility Manufacturing Site. This Off-Site FS Report is supported by the data, findings and conclusions presented in the December 2005 Off-Site RI Report. In order to avoid repetition of the same information, this FS Report is structured to follow Section 5.0 of the Off-Site RI Report and starts as Section 6.0.

The FS Report consists of three sections with associated tables, figures and appendices. These sections are:

- **Section 6.0 –The remainder of this section defines the Remedial Goals and Remedial Action Objectives.** In support, a Conceptual Site Model was developed and the Media of Interest for this FS were identified based upon an evaluation of the RI (ERM, 2005a), which contained a Human Health and Environmental Exposure Assessment, and the accomplishments achieved by the On-Site Interim Remedial Measure (IRM). As appropriate, these remedial action objectives are based on Standards, Criteria and Guidelines (SCGs) or chemical specific remediation goals designed to protect human health and the environment for each media of interest. This section also identifies general response actions, which may achieve the remedial action objectives for the media of interest and performance goals for the remedial action alternatives.

- **Section 7.0 - Identification and Screening of Remedial Action Technologies:** This section identifies the various potential remedial action technologies, which might be used to accomplish the general response actions. These potential technologies are then screened to determine which technologies are appropriate for the media of interest. Potential technologies are screened based on: 1) their ability to meet the remedial action objectives, 2) implementability; and 3) short-term and long-term effectiveness.

- **Section 8.0 – Description and Evaluation of Remedial Action Alternatives:** This section combines the remedial action technologies into comprehensive remedial action alternatives. These remedial action alternatives are evaluated using the criteria established in the NCP and addressed in the aforementioned USEPA and NYSDEC guidance documents. This section also includes a comparison of the remedial action alternatives.

6.1 *REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES*

This section presents the remedial goals and remedial action objectives (RAOs) established for the Study Area media of interest (i.e., off-Site groundwater and soil vapor). For the purposes of this FS, the "Site" is defined as the 1-acre property located at 700 Main Street. The "Study Area" will refer to the entire off-Site area investigated during the Off-Site RI. The Study Area is bounded on the north by Main Street, the east by the shopping center located at 1065 Old Country Road, the south by Old Country Road, and on the west by State Street. The Site is located within the New Cassel Industrial Area (NCIA).

Remedial goals are common to all inactive hazardous waste sites on the Registry and are derived from the statute (i.e., 6 New York Code of Rules and Regulations [6NYCRR] Part 375) and NYSDEC guidance. The remedial goals express the intent of the remedial actions to restore the Study Area to conditions prior to disposal within certain confines. Examples of relevant remedial goals are set forth in the DER-10.

The remedial goals for the Study Area are:

- restoration to pre-disposal/pre-release conditions, to the extent feasible and authorized by law; and,

- eliminate or mitigate all significant threats to the public health and the environment caused by Site-related operations through the proper application of scientific and engineering principles.

Guidance on developing RAOs is provided in NYSDEC Technical and Administrative Guidance Memorandum (TAGM) No. 4030 (NYSDEC, 1990) and examples of RAOs are also set forth in DER-10 (NYSDEC, 2002). The RAOs are media-specific targets that are aimed at protecting the public health and the environment. In the case of protection of human health, RAOs usually reflect the concentration of a chemical of potential concern (COPC) and the potential exposure route. Protection may be achieved by reducing potential exposure (e.g., use restrictions, limiting access) as well as by reducing concentrations. RAOs, which are established for protection of environmental receptors, are usually intended to preserve or restore a resource. As such, environmental RAOs are set for a media of interest and a target concentration level.

Media that are candidates for remedial evaluation are identified based on the nature and extent of contamination and applicable or relevant and appropriate SCGs. As discussed in Section 2.0, potential Study Area media of interest, identified during the remedial investigation (RI), are groundwater and subsurface vapor. As identified in 6NYCRR375-1.10(c)(1)(ii), SCGs are provided in a guidance document provided by the NYSDEC. The most recent NYSDEC guidance containing SCGs is draft DER-10 (NYSDEC, 2002).

In addition to SCGs, certain site-specific factors are considered when developing the RAOs for Study Area media of interest. These site-specific factors relate to the impacted media, types of constituents and potential routes of exposure. The factors that were considered in developing RAOs for are discussed in the following subsections according to the media evaluated.

6.2 CONCEPTUAL SITE MODEL

The conceptual site model is a tool used to define a site's dynamics, streamline the risk evaluation, and develop remedial action objectives and subsequent response actions. The following conceptual site model was developed for the Study Area using the Off-Site RI results discussed in the previous sections.

Chlorinated VOCs (CVOCs) were reportedly discharged to dry wells at the Site. The discharge of CVOCs to these dry wells resulted in a release to adjacent subsurface soil and groundwater. The affected soil acted as a secondary source, leaching CVOCs through the unsaturated zone to groundwater. Once the CVOCs reached the water table, they dissolved and began to travel in the direction of groundwater flow toward the Bowling Green Water District (BGWD) supply wells.

Groundwater coming onto the Site contained CVOCs in the low ppb range (i.e., less than 25 ppb); however, prior to the on-Site IRM, groundwater leaving the Site exhibited CVOC concentrations two orders of magnitude higher than upgradient concentrations (i.e., 1 ppm). Therefore, although upgradient sources of CVOCs were evident, Site impacts were causing additional groundwater impacts.

An IRM consisting of an air sparge/soil vapor extraction (AS/SVE) system was installed to remediate on-Site soil and groundwater contamination (i.e., Operable Unit 1 (OU-1) of the Site). The AS/SVE system operated from December 2001 to December 2002. By December 2002, the system had reduced total VOCs levels in groundwater from 1,019 μg/l to 13 μg/l and the contaminant concentrations had stopped decreasing. The AS/SVE system was chosen as the final OU-1 remedy for on-Site contamination in the March 2003 OU-1 Record of Decision (ROD) (NYSDEC, 2003). After the AS/SVE system ceased operation, Utility's consultant obtained groundwater samples annually until 2005 to detect any rebound in groundwater contaminant concentrations. As no rebound was detected, the NYSDEC deemed the on-Site remediation to be complete.

The OU-1 IRM addressed the on-Site source and impacted groundwater. However, this remedy did not actively address the already impacted off-Site groundwater. For purposes of this document, the off-Site groundwater is limited to the Study Area, which is bounded on the north by Main Street, the east by the shopping center located at 1065 Old Country Road, the south by Old Country Road, and on the west by State Street.

In the Study Area, the depth to water ranges between 45 to 55 feet bgs depending on local changes in topography. Depending on the land surface elevation and groundwater levels, the water table can occur in either the upper glacial deposits (the upper glacial aquifer) or the Magothy Formation (the Magothy aquifer), and the saturated thickness of the upper glacial aquifer can range anywhere between 0 and 10 feet in the Study Area (Cartwright and Chu, 1996). Based on stratigraphic information obtained from the soil borings and the water level measurements collected during the RI, perched groundwater occurs at some locations in the upper glacial deposits, but the true water table surface occurs at the very top of the Magothy Formation beneath the Study Area. Groundwater flow is to the south-southwest and has a downward vertical component. Thus groundwater in the Study Area migrates in a south-southwest direction toward the BGWD supply wells (Well Nos. N8956 & N8957 located south of Old Country Road at the end of Iris Place adjacent to the NCDPW Recharge Basin No. 21). South of Old Country Road, off-Site groundwater commingles with VOC plumes from other sites in the NCIA.

In 2002, the NYSDEC ordered Utility Manufacturing to perform off-Site (down gradient) groundwater sampling to Old Country Road. Utility Manufacturing refused to perform this work in accordance with the NYSDEC's requirements. As such, NYSDEC elected to perform the work and issued a Work Assignment to ERM to perform an off-Site RI/FS. ERM prepared the Off-Site RI/FS Work Plan (ERM, 2004) that was approved by NYSDEC review, and subsequently implemented by ERM on behalf of NYSDEC. Off-Site groundwater and subsurface vapor quality was evaluated by ERM in 2004/2005 as OU-2. This delineation, which is discussed in Section 4, indicates VOC-impacted off-Site groundwater and subsurface vapor.

As discussed in the RI, off-Site groundwater total VOC concentrations range from 1 μg/l to 345 μg/l, with the predominant chemicals being PCE, TCE and cis-1,2-DCE. Groundwater sampling data from HP-03/MWs 01S & 01D (the corner of Old Country Road and State Street) indicate that VOC impacts extend to depths greater than 125 feet bgs as groundwater leaves the NCIA. The off-Site groundwater sampling depths were based upon on-Site groundwater sampling results and the extent of VOC impacts below 125 feet bgs between the Site and Old Country Road are unknown. However, this data gap is not significant in terms of the overall groundwater problem related the NCIA since efforts are already underway to remediate VOC-impacted groundwater in the area downgradient of the NCIA, but north of the BGWD public supply wells.

Impacted groundwater leaving the NCIA flows directly toward two BGWD public supply wells. An air stripper treatment system was constructed in 1996, and the water supplied to the public system from the BGWD wells has since then been treated by the air stripping system to meet Federal and New York State Drinking Water Maximum Contaminant Levels (MCLs) and guidelines.

Coincident with investigation and remedial activities at these sites, NYSDEC implemented a RI/FS for the three (3) plumes emanating from the NCIA (i.e., the central, eastern and western plumes), as OU-3. In November 2003, the NYSDEC issued the OU-3 ROD for the NCIA addressing the three plumes upgradient of the BGWD supply wells (NYSDEC, 2003). The selected remedy entails a remedial system consisting of a series of in-well vapor stripping wells. These wells will intercept the three plumes of VOC-impacted groundwater leaving the NCIA and reduce VOC concentrations in groundwater prior to reaching the BGWD public supply wells. A schematic of the selected OU-3 remedy is presented in Appendix F.

As part of the OU-3 remedial design, pre-design investigative activities will be performed to confirm the horizontal and vertical extent of contamination emanating from the NCIA. These data will be used to ensure that the remedial systems are designed and installed in a manner such that all targeted portions of the VOC-impacted aquifer will be affected in a manner consistent with the goals of the remedy. In November 2005, an Explanation of Significant Differences (ESD) was issued for the OU-3 ROD (NYSDEC, 2005). The ESD allows for implementation of the remedy for the central, eastern and western portions of the plume at different times to expedite implementation of the remedy.

In addition to off-Site groundwater concentrations, off-Site subsurface vapor concentrations were also assessed during the off-Site RI. These results indicated the presence of VOCs in subsurface vapor samples. VOC concentrations in soil vapor are depicted in Figure 3-13, 3-14 and 3-15. Both Site-related and non-Site related chemicals were detected in subsurface vapor samples. One indoor air sample was collected at 1025 Old Country Road in May 2005; however, this sample did not exhibit detectable concentrations of the Site-related chemicals of concern (COCs). Additional discussion regarding the groundwater COCs is presented in the following section.

6.3 MEDIA OF INTEREST

The following Study Area media were identified during the RI and evaluated below as potential media of interest requiring RAOs: (1) off-Site groundwater; and (2) off-Site subsurface vapor/indoor air. The RI sampling results for these media were discussed in Section 3.0 and the human health and environmental exposure assessment associated with these media was presented in Section 4.0.

6.3.1 Off-Site Groundwater

As discussed in Section 1.3.3, the presumed source of off-Site groundwater contamination, the impacted soils in the vicinity of the on-Site dry wells, were remediated via the OU-1 IRM. The OU-1 IRM (i.e., AS/SVE system) operated from December 2001 to December 2002. By December 2002, the system had reduced total VOCs levels in groundwater from 1,019 μg/l to 13μg/l and the contaminant concentrations had stopped decreasing. The AS/SVE system was chosen for the final remedy for on-Site contamination in the ROD, dated March 2003 (NYSDEC, 2003). Subsequent groundwater monitoring results indicate that VOC concentrations in groundwater beneath the Site have not rebounded. Although the on-Site soils and groundwater beneath the Site have been remediated by the IRM, the RI has confirmed that a plume of VOC-impacted groundwater remains unmitigated, extending from the Site to at least Old Country Road.

6.3.1.1 Remedial Requirements

<u>SCGs</u>

A comparison of Study Area Hydropunch groundwater analytical results and monitoring well analytical results to the New York State Class GA standards was presented in Tables 3-3 and 3-4. Based on these comparisons, the following exceedances are noted:

Groundwater COCs		
Constituent	***Standard (µg/l)***	***Maximum (µg/l)***
Tetrachloroethene (PCE)	5	220
Trichloroethene (TCE)	5	100
Cis-1,2-Dichloroethene (1,2-DCE)	5	84
1,1-Dichloroethene (1,1-DCE)	5	22
Toluene	5	22
1,1,1-Trichloroethane (1,1,1-TCA)	5	17
Methylene Chloride	5	10

Thus, there are seven (7) chemicals of concern (COCs) for the off-Site groundwater plume. They are: PCE; TCE; 1,2-DCE; 1,1-DCE; toluene; 1,1,1-TCA; and methylene chloride.

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The BGWD provides public water to the area. Supply wells for this water district are located downgradient of the NCIA and these wells have been impacted by NCIA-related contamination. In 1996, an air stripping treatment system was constructed to treat the water supply wells. The BGWD system is routinely monitored for compliance with New York State Drinking Water Standards. No Site-related contaminants have been detected exceeding drinking water standards in the water distributed to the public.

Furthermore, monitoring wells have also been installed upgradient of the water supply wells as a precaution to detect any migrating plumes that could impact the well field above the capacity of the treatment system. Lastly, groundwater south of Old Country Road will be treated using the OU-3 in-well vapor stripping wells planned for design and installation in 2006. These wells will intercept VOC-impacted groundwater leaving the NCIA and reduce VOC concentrations in groundwater prior to reaching the BGWD public supply wells. With these measures in place, the use of groundwater in the area is not currently considered an exposure pathway of concern.

6.3.1.2 Remedial Action Objectives for Groundwater

Based on the evaluation discussed above, the draft NYSDEC guidance regarding development of RAOs in DER-10 (NYSDEC, 2002) and the *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites*, EPA, October 1996 (USEPA, 1996), the remedial action objectives for on-Site groundwater are:

GWRAO1. Prevent exposure to contaminated groundwater, above acceptable risk levels.

GWRAO2. Prevent or minimize further migration of the contaminant plume (plume containment).

GWRAO3. Prevent or minimize further migration of contaminants from source materials to groundwater (source control).

GWRAO4. Return groundwaters to their expected beneficial uses wherever practicable (aquifer restoration).

On-site groundwater monitoring results have demonstrated that the OU-1 IRM has eliminated the source materials related to the off-Site groundwater plume (i.e., the impacted soils in the vicinity of the dry wells). Consequently, GWRAO3 (source control) has been achieved without any additional remedial action. Technologies will be assessed in Section 7.0 to address the remaining groundwater remedial action objectives.

6.3.1.3 Extent of Impacted Groundwater

As discussed above, Study Area groundwater exceeds Class GA standards for a number of VOCs. The extent of off-Site groundwater contamination is presented in Figure 3-3.

6.3.2 Subsurface Vapor/Indoor Air

A total of 17 soil vapor/indoor air/outdoor air samples were collected from various locations across the Study Area to assess the potential for migration of VOC vapors emanating from impacted groundwater at the water table surface. Given the iterative nature of the investigation and the results of the initial soil vapor samples collected at the 11 Hydropunch vertical boring location, subsequent follow up sampling was warranted.

A total of 30 VOCs were detected in the soil vapor/indoor/outdoor air samples. TVOC concentrations ranged from 22.4 $\mu g/m^3$ to a maximum of 7,598 $\mu g/m^3$ at HP-08. All 30 VOCs are listed below with their respective maximum detected concentrations. Nine of the 13 VOCs detected in groundwater beneath the Study Area were also detected in the soil vapor/indoor air/outdoor air samples and are shown in **Bold.** These 9 VOCs are the subsurface vapor COCs.

Constituents Detected In Soil Vapor/Indoor Air/Outdoor Air Samples	
Constituent	*Maximum (µg/m³)*
Tetrachloroethene (PCE)	1,600
Acetone	1,000
Cyclohexane	960
Xylene (total)	780
Isooctane	750
Toluene	720
m+p-Xylene	520
1,2,4-Trimethylbenzene	490
p-Ethyltoluene	290
Dichlorodifluoromethane	270
n-Hexane	240
o-Xylene	220
1,3,5-Trimethylbenzene	210
Benzene	200
Ethylbenzene	180
1,1,1-Trichloroethane (1,1,1-TCA)	130
2-Butanone	110
Trichloroethene (TCE)	97
1,4-Dichlorobenzene	43
Carbon Disulfide	28
1,3-Butadiene	17
Freon 113	15
Trichlorofluoromethane	15
Methylene Chloride	14
n-Heptane	9.8
Chloroform	7.8
Styrene	7.2
2-Hexanone	4.9
1,1-Dichloroethane (1,1-DCA)	3.2
Chloromethane	1.9

The remaining four VOCs that were detected in groundwater but not in the soil vapor/indoor air/outdoor air samples are as follow:

Constituents Detected In Groundwater But Not In Soil Vapor/Indoor Air/Outdoor Air Samples	
Methyl Tert Butyl Ether	Cis-1,2-Dichloroethene
Trans-1,2-Dichloroethene	1,1-Dichloroethene

The subsurface vapor COCs are: PCE; acetone; toluene; 1,1,1-TCA; TCE; carbon disulfide, Freon 113, methylene chloride; and 1,1-DCA.

6.3.2.1 *Remedial Requirements*

SCGs

According to the draft guidance "Guidance for Evaluating Soil Vapor Intrusion in the State of New York, Public Comment Draft, February 2005" (NYSDOH, 2005), the NYSDOH currently does not have any standards, criteria or guidance values for concentrations of compounds in subsurface vapors. Instead, the aforementioned document presents decision matrices comparing sub slab versus indoor air concentrations of PCE, TCE and 1,1,1-TCA that have been developed concerning the need for active mitigation, continued monitoring or no further action. The aforementioned document can be found on the NYSDOH website at:

http://www.health.state.ny.us/environmental/indoors/vapor_intrusion/

NYSDOH does have guidelines for PCE and TCE in indoor air of 100 $\mu g/m^3$ and 5 $\mu g/m^3$, respectively. While these two VOCs were detected in subslab vapor along with 1,1,1-TCA in SS-01, none of these VOCs were detected in the indoor air sample IA-01. While VOCs are present in soil vapor beneath the floor slab of the office building at 1025 Old Country Road, most of the first floor is unoccupied, as it is parking garage space.

The indoor air sample was collected in late-May 2005 at the end of the heating season. Typically, indoor air quality should be evaluated during worst-case conditions for VOCs to accumulate in indoor air (i.e. during the heating season when doors and windows are shut). The sub slab concentrations of PCE, TCE and 1,1,1-TCA at SS-01 and corresponding detection limits for the non-detect results for these VOCs in the air sample IA-01 were evaluated in terms of the criteria set forth in the matrices presented in the draft guidance document referenced above.

Based on those evaluations, the 24 March 2005 and 26 May 2005 sub slab sampling at 1025 Old Country Road detected PCE, TCE and 1,1,1-TCA at levels that could potentially impact indoor air. Although these compounds were not detected in the 26 May 2005 indoor air sample, the draft NYSDOH Soil Vapor Intrusion Guidance instructs that, based on the previous sub slab detections, continued monitoring of indoor air at the 1025 Old Country Road building is needed. Additional sub slab soil vapor and indoor air samples need to be collected, preferably during the heating season, to determine if concentrations in indoor air or sub slab soil vapor have changed at this location.[1]

[1] NYSDOH recommends that indoor air samples be collected during heating seasons to assess worst-case indoor air conditions. However, if fresh air is not introduced to

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As noted above, continued monitoring of indoor air at the 1025 Old Country Road building is needed preferably during the heating season, to determine if concentrations in indoor air or sub slab soil vapor have changed at this location. Moreover, additional sub slab soil vapor and indoor air quality surveys may be warranted in the Study Area.

6.3.2.2 *Remedial Action Objectives for Subsurface Vapor*

The following RAOs have been established for the Study Area subsurface vapor:

SVRAO1: Prevent unacceptable inhalation risks for subsurface vapors, if they are present.

SVRAO2: Eliminate the potential for vapor intrusion into indoor air, if needed.

6.3.2.3 *Extent of Impacted Subsurface Vapor*

As noted above, a total of 17 soil vapor/indoor air/outdoor air samples were collected from various locations across the Study Area to assess the potential for migration of VOC vapors emanating from impacted groundwater at the water table surface. The extent of VOCs in subsurface vapor is presented in Figures 3-13, 3-14 and 3-15.

6.4 IDENTIFICATION OF SCGS

SCGs include promulgated standards and non-promulgated guidance, which govern activities that may affect the environment. The standards and criteria (SCs) are those cleanup standards, standards of control and other substantive requirements, criteria or limitations that are officially promulgated under federal or state law. Though guidance does not represent a legal requirement, it should be considered based on professional judgment when applicable to site conditions (NYSDEC, 2002).

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building interiors during summer months (e.g., via windows), summer indoor air concentrations may be similar to winter indoor air concentrations.

Table 6-1 presents potential SCGs, which may govern remedial actions at the Study Area. This table lists: the citation; a description of the SCG; SCG type (i.e., chemical, action or location specific); and, reason the SCG is listed (e.g., remedy selection and/or remedial action) and how it applies to the remedy evaluation.

Certain SCGs are considered in the development of the Study Area media of interest RAOs. These SCGs are discussed with the remedial requirements for the media of interest in the following sections. The relevance of the SCGs to the remedial alternatives is discussed with the evaluation of each alternative in Section 8.0 (i.e., in the evaluation of the ability of each remedial action alternative to comply with the SCGs).

7.0 TECHNOLOGY SCREENING

This section screens a variety of remedial technologies that may be employed individually or in combination to achieve the RAOs for Study Area media of interest. Remedial technologies that pass the evaluation process are organized into remedial alternatives. The remedial action alternatives for the Study Area are then are presented and evaluated in detail in Section 8.0.

The remedial technologies considered for media of interest are general engineering approaches that would rely on ex-situ, in-situ or institutional/containment types of response actions that could meet one or more of the RAOs. The considered technologies were identified through a review of NYSDEC information, USEPA guidelines, relevant literature, off-Site conditions, and experience in developing feasibility studies and remedial action plans for similar types of environmental conditions.

The identified technologies underwent a screening against the following criteria: the ability to meet the RAOs, effectiveness, and implementability. Table 7-1 provides an evaluation of the potential remedial technologies screened for the Study Area. They are:

Type	**Technology/Control**
Institutional Controls	Access and Use Restrictions
Containment	Sub-Slab Depressurization (SSD)
In-Situ Treatment	In-Situ Chemical Oxidation (ISCO) of Off-Site Groundwater Air Sparge/Soil Vapor Extraction (AS/SVE) of Off-Site Groundwater
Natural Recovery	Monitored Natural Attenuation (MNA) of Off-Site Groundwater
Others	Groundwater Monitoring

Effectiveness considers how a technology would impact the Study Area in the short-term during its use and its ability to meet the RAOs in the long-term. Protection of human health and environment considers potential positive and adverse impacts that may result from the use of a particular technology. This evaluation incorporates elements of the NYSDEC guidance documents TAGM 4030 and the draft DER-10 (NYSDEC, 1990; NYSDEC, 2002) and the Guidance for *Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988).

The evaluation of implementability focused on institutional aspects associated with use of the remedial technology, along with constructability and operation and maintenance (O&M) requirements. These subcategories are consistent with the approach for remedial alternative evaluation in TAGM 4030. Institutional aspects involve permits or access approvals for on-site use, off-site work, and off-site treatment, storage and disposal services. Constructability, or technical feasibility, refers to the ability to construct, reliably operate and meet technical specifications or criteria, and the availability of specific equipment and technical specialty personnel to operate necessary process units.

The evaluation of effectiveness, implementability and ability to meet the RAOs further reduced the list of remedial technologies. Those exhibiting more favorable characteristics in the evaluated areas were carried forward. As shown in Table 7-1, all of the proposed remedial technologies for Study Area media of interest are carried forward for development of the remedial alternatives section.

8.0 DESCRIPTION AND EVALUATION OF REMEDIAL ACTION ALTERNATIVES

Using the seven criteria listed below, the remedial alternatives retained after the screening in Table 7-1 are fully described and evaluated in accordance with the NYSDEC TAGM 4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites (NYSDEC, 1990), Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988) and Draft DER-10. The evaluative criteria are:

- overall protection of human health and the environment;
- compliance with Standards, Criteria and Guidance (SCGs);
- long-term effectiveness and permanence;
- reduction of toxicity, mobility or volume;
- short-term effectiveness;
- implementability; and
- cost.

The first two criteria, overall protection of human health and the environment and compliance with SCGs, are considered threshold criteria. Consequently, there is an expectation that each selected remedial action alternative would achieve these two criteria.

The associated costs for the alternatives are conceptual design cost estimates. Changes in the quantities of the media requiring remediation (e.g., extent of Off-Site groundwater and buildings require soil gas mitigative activities), detailed engineering, as well as other factors not foreseen at the time this report was prepared, could increase costs by as much as 50 percent or decrease costs by as much as 30 percent, as defined in Section 6.2.3.7 of *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988). An inflation rate of two percent (2%) was used to determine future costs and an interest rate of five percent (5%) was used to compute the present worth of all future costs. The inflation rate is consistent with the US Department of Labor Consumer Price Index (CPI) change between 2002 and 2003 (USDOL, 2003). The assumed interest rate, which corresponds to the current interest rate for a 30-year treasury bond, was selected to "produce an amount at which the environmental liability theoretically could be settled in an arm's length transaction with a third party, or if such a rate is not readily determinable, the discount should not exceed the interest rate on "risk-free" monetary assets with maturities comparable to the environmental liability" in accordance with the US Securities and Exchange Commission (SEC) Staff Accounting Bulletin (SAB) No. 92 (SEC, 1993). SAB No. 92 provides generally accepted accounting principles for estimating and reporting environmental liability.

The alternatives undergoing detailed evaluation are:

Alternative 1: No Action
Alternative 2: Monitored Natural Attenuation (MNA) of Off-Site Groundwater Plume
Alternative 3: In-Situ Chemical Oxidation (ISCO) of Off-Site Groundwater
Alternative 4: Air Sparge/Soil Vapor Extraction (AS/SVE) of Off-Site Groundwater

8.1 ALTERNATIVE 1: NO ACTION

8.1.1 Description

Section 300.430(e)(6) of the NCP recommends describing and evaluating a No Action Alternative as a measure of identifying the potential risks posed by a site if no remedial action were implemented. Pursuant to 6 NYCRR Part 375-1.10(c), a remedial program for a site listed on the Registry must not be inconsistent with the NCP. Accordingly, a No Action Alternative (Alternative 1) has been developed to fulfill the NCP requirement and is evaluated in this section.

Under this Alternative, no remedial actions would be implemented at the Site or within the Study Area.

8.1.2 Evaluation

8.1.2.1 Overall Protection of Human Health and the Environment

As discussed above, at a minimum, additional monitoring of indoor air quality at 1025 Old Country Road is needed. Since this alternative would not include this additional indoor air monitoring and would not ensure that access to impacted off-Site groundwater is controlled, it would not be protective of human health and the environment.

8.1.2.2 Compliance with SCGs

A summary of the applicable SCGs for the groundwater and soil vapor is presented in Table 8-1. Since no remedial actions would be conducted under this alternative, none of the location-specific and a limited number of the action-specific SCGs are applicable to this alternative. The alternative would not comply with the applicable action- or chemical-specific SCGs.

8.1.2.3 *Long Term Effectiveness and Permanence*

Since this alternative does not provide for the indoor air or groundwater monitoring, and does not ensure use restrictions, it would not provide long-term effectiveness or permanence.

8.1.2.4 *Reduction of Toxicity, Mobility or Volume*

This alternative provides no means to confirm that a reduction in toxicity or volume of chemicals in groundwater will occur via natural attenuation. There would be no reduction of toxicity, mobility or volume for chemicals in Study Area subsurface vapor under this alternative.

8.1.2.5 *Short-Term Effectiveness*

There are no short-term effects associated with this alternative since there are no actions included with this alternative.

8.1.2.6 *Implementability*

As there are no specific actions related to this alternative, it would be readily implementable.

8.1.2.7 *Cost*

There are no actions taken under this alternative. As such, there are no costs associated with the implementation of Alternative 1.

8.2 *ALTERNATIVE 2: MONITORED NATURAL ATTENUATION OF OFF-SITE GROUNDWATER*

8.2.1 *Description*

This alternative would include the following remedial components:

- Use Restrictions
- Sub-Slab Soil Vapor and Indoor Air Investigation
- Monitored Natural Attenuation (MNA) of Off-Site Groundwater Plume
- Sub-Slab Depressurization (SSD) Beneath Impacted Off-Site Buildings, If Needed

As discussed above, the southern edge of the Study Area ground water is Old Country Road. Based on a simple ground water transport estimate (see Appendix G), it would take 13.5 years for the last molecule of the impacted Study Area ground water to reach Old Country Road. Thus, the MNA portion of this alternative would be completed in approximately 15 years. Design would be completed within the first two months of the remedy, and long-term monitoring would continue for 15 years after ROD approval.

8.2.1.1 *Use Restrictions*

Under this alternative, Part 5 of the New York State Department of Health State Sanitary Code, which prevents installation of a private potable water supply well in areas that are served by a public water supply system, would continue to be enforced. This would prevent contact with the off-Site groundwater before it is treated via natural processes, treated via the OU-3 remedy for the NCIA and/or is extracted and treated at the BGWD supply wells.

8.2.1.2 *Monitored Natural Attenuation of the Off-Site Groundwater Plume*

Under this remedial action, annual groundwater monitoring would be conducted in the Study Area. In addition to MW-01S/D and NC-12, three additional nested pairs of groundwater monitoring wells would be installed. Each of these well nests would be screened from 85-95 feet bgs (shallow) and from 115-125 feet (deep). The proposed well locations are presented in Figure 8-1. Samples would be analyzed for VOCs. For cost estimation purposes, 15 years of sampling has been assumed. In addition to VOCs, the groundwater samples from these wells would also be analyzed/monitored for the following degradation parameters: dissolved oxygen, nitrates, sulfates, dissolved iron, carbon dioxide and methane to evaluate MNA progress. The sampling results would be reviewed periodically to determine if the remedy is progressing towards the remedial goals.

8.2.1.3 *Sub-Slab Soil Vapor and Indoor Air Investigation*

Elevated VOC concentrations were observed in the soil vapor samples collected around and below the off-Site buildings. Under this task, additional sub-slab vapor and indoor air sampling would be conducted at properties in the Study Area that may be impacted by infiltration of subsurface vapors.

For cost estimation purposes, collection of a total of ten (10) sub-slab vapor samples, 10 indoor air samples and 2 outdoor air samples will be collected and submitted to a NYSDOH ELAP-certified laboratory for Full List VOC analyses using United States Environmental Protection Agency

(USEPA) Method TO-15. Sampling would be consistent with the methodologies employed during the RI. These samples would be used to determine which buildings have been impacted. Additional subslab vapor, indoor air and outdoor air samples may be needed after this investigation is conducted; however, these samples are not included in the cost estimate for this alternative.

8.2.1.4 *Sub-Slab Depressurization (SSD) Beneath Impacted Off-Site Buildings, If Needed*

In the event that the additional sub-slab vapor and indoor air sampling results exceed the mitigation threshold criteria set forth under the NYSDOH draft guidance "Guidance for Evaluating Soil Vapor Intrusion in the State of New York, Public Comment Draft, February 2005", then remediation would be required and SSD systems would be installed to mitigate this exposure pathway.

For cost estimation purposes, it has been assumed that the additional sub-slab vapor and indoor air sampling results will indicate the need for SSD at 1025 Old Country Road. The SSD system will consist of vertical suction points installed through the floor slab. The suction points will be piped to externally-mounted fans that will draw soil gas from beneath the building to an exhaust point above the roof of the building. Minor cracks in the floor slab will also be sealed.

Since the actual sub-slab conditions are not known, a communication test will be performed to determine the optimum spacing of suction points, and the necessary fan size and quantity. The communication test entails applying a vacuum below the slab at various points around the building. Small monitoring holes are drilled through the building floor, and the vacuum response is measured. For cost estimating purposes, it is assumed that a forty-foot spacing of suction points with an applied vacuum of four inches water column (w.c.) will generate a minimum vacuum of 0.004 inches w.c. across the entire building footprint. The anticipated in-line fan will generate 10 cubic feet per minute (cfm) at four inches w.c. vacuum. It is anticipated that three fans and twelve suction points will be needed.

To create the suction points, a three-inch hole will be cored through the floor slab, and a small void will be created by removing soil within the vicinity of the cored holed. A three-inch Schedule 40 PVC pipe will be inserted into the hole, and the space between the pipe and the floor will be sealed. The pipes will be run as inconspicuously as possible along floors, and ceilings, and will manifold together upstream of the inline fan. All three fans will be located outside the building to reduce the potential for vapors to be released into the building. The fan exhaust will be delivered through one dual phase granular activated carbon (GAC) vessels for treatment before release to the atmosphere at a point above the roof of the building. The dual phase GAC system will be comprised of two, 200 lb GAC units. When the installation is complete, a pressure field extension test will be performed. This test is similar to the communication test in that several holes will be drilled through the floor slab when the system is operating and the vacuum response will be measured. The goal is to confirm that a minimum 0.004 inches w.c. vacuum extends across the building footprint. Following installation, an Operations, Maintenance, and Monitoring (OM&M) Plan will be prepared for the SSD system, and the property owner will be instructed in the operations of the system.

The SSD system will be visited monthly to collect field VOC measurements from the SSD outlet and ensure the proper operation of the SSD system. Vapor samples would also be collected on a quarterly basis from the GAC system and submitted for TO-15 analysis. Samples would be collected from the primary bed inlet and outlet and the secondary bed outlet. This information would be correlated to the PID concentrations to determine carbon change out requirements. It is estimated that the GAC will require replacement on an annual basis and that all waste GAC will be regenerated off-site. The duration of SSD is estimated to be 15 years.

It has also been assumed that continued collection of sub-slab and indoor air samples will be required during this remedial alternative. For cost estimation purposes, it has been assumed the two (2) subslab, two (2) indoor air and one outdoor air (i.e., background) sample will be collected annually and submitted to a laboratory for TO-15 analysis for the purposes of monitoring the SSD system. This testing would be conducted during the 15 years of SSD operation.

8.2.2 *Evaluation*

8.2.2.1 *Overall Protection of Human Health and the Environment*

This alternative would provide adequate protection of human health and the environment for the off-Site groundwater and subsurface vapor. The SSD system, if needed, would address any subsurface vapor risks and eliminate the pathway for this media of interest. The use restrictions would prevent exposure to contaminated groundwater and the MNA of groundwater would result in a decrease in the groundwater COCs present in the shallow groundwater, the source of the subsurface vapor. Although in the short-term, groundwater in the deeper portion of the Magothy aquifer would continue to exhibit VOC concentrations in excess of the MCLs, groundwater migrating south of Old Country Road would be treated by the OU-3 remedy. If any contaminated groundwater migrates past the OU-3 remedy, the groundwater would be treated by the existing wellhead treatment at the BGWD supply wells to ensure that the drinking water is suitable for consumption prior to its distribution. Given the existing and planned groundwater treatment to protect the BGWD supply wells, the use restriction portion of the remedy would be sufficient to provide adequate protection of human health and the environment.

8.2.2.2 *Compliance with SCGs*

A summary of the applicable SCGs that apply to this alternative is presented in Table 8-1. This alternative would address the chemical-specific SCGs through sub-slab depressurization systems and use restrictions. Due to the relatively small area of impacted off-Site groundwater and the rapid groundwater flow rate, as well as the limited biodegradation occurring in deeper portion of the Magothy aquifer, attenuation of the groundwater concentrations to meet the MCLs prior to reaching Old Country Road is not expected in the short-term. Thus groundwater concentrations in excess of the MCLs would exit the Study Area under this alternative. This groundwater would however be collected and treated by the OU-3 remedy and/or the BGWD supply wells.

8.2.2.3 *Long-Term Effectiveness and Permanence*

This alternative would prevent risks associated with the media of interest through use restrictions, additional sub-slab vapor and indoor air sampling, SSD and groundwater monitoring. Additional limited protection would be provided through MNA, however as noted above, given the other remedies undertaken for the BGWD supply wells would adequately address the groundwater ingestion risks, the use restriction portion of the remedy would be sufficient to provide adequate protection of human health and the environment for the impacted groundwater.

The continued effectiveness of this alternative would be mandated through institutional controls and monitoring. This alternative provides for the long-term groundwater monitoring, as well as the OM&M of the SSD systems, if needed.

8.2.2.4 *Reduction of Toxicity, Mobility or Volume*

Through MNA and SSD, if needed, this alternative would result in a decrease in the toxicity, mobility and volume of the chemicals in groundwater and subsurface vapor. This reduction would be confirmed via groundwater monitoring and indoor air monitoring. It should be noted that MNA could result in short-term increase in toxicity due to the potential for generation of vinyl chloride; however, given the concentrations of VOCs in groundwater, it is unlikely that vinyl chloride would be generated at concentrations above its MCL of 2 μg/l. Additionally, the mass of individual VOCs could increase temporarily as natural attenuation progresses. Reduction in mobility and volume of chemicals in subsurface vapors would occur through operation of the SSD system. SSD system vapor controls would provide further reduction in the toxicity, mobility and volume of the recovered chemicals since they would be destroyed during the carbon regeneration process.

8.2.2.5 Short-Term Effectiveness

There would be minimal short-term impacts associated with this alternative. These would relate to implementation of the sub-slab and indoor air sampling, installation of the SSD system, if needed, and installation of groundwater monitoring wells.

8.2.2.6 Implementability

There are implementability concerns related to access for installation of monitoring wells and installation and OM&M of the SSD systems, if needed. The main components of this alternative could be completed within six months of NYSDEC approval of the Remedial Design (RD) for this project. Groundwater monitoring, use restrictions and limited annual OM&M activities related to the SSD system would continue beyond this time frame.

8.2.2.7 Cost

The capital and O&M costs for this alternative are provided in Table 8-2. The cost estimate assumes that SSD beneath the building located at 1025 Old Country Road will be needed.

8.3 ALTERNATIVE 3: IN-SITU CHEMICAL OXIDATION OF OFF-SITE GROUNDWATER

8.3.1 Description

This alternative includes the following remedial components:

- Use Restrictions
- In-Situ Chemical Oxidation (ISCO) of Off-Site Groundwater
- Sub-Slab Soil Vapor and Indoor Air Investigation
- Sub-Slab Depressurization (SSD) Beneath Impacted Off-Site Buildings, If Needed

- Groundwater Monitoring

The time to complete this alternative has been estimated to be approximately 7 years following NYSDEC approval of the RD. Design would be completed within 6 months of ROD issuance. Implementation of ISCO would be conducted at the beginning of Year 2. Construction of the SSD system would occur at the end of Year 1 and operation of this system would continue through the end of Year 6. Groundwater monitoring would be conducted from ROD issuance through the end of Year 7.

8.3.1.1 Use Restrictions

Under this alternative, Part 5 of the New York State Department of Health State Sanitary Code, which prevents installation of a private potable water supply well in areas that are served by a public water supply system, would continue to be enforced. This would prevent contact with the off-Site groundwater before it is treated via natural processes, via the OU-3 remedy for the NCIA, and/or is extracted and treated at the BGWD supply wells.

8.3.1.2 In-Situ Chemical Oxidation (ISCO) of Off-Site Groundwater

The purpose of ISCO would be to eliminate the chemical mass in the impacted off-Site groundwater plume. Either potassium or sodium permanganate would be injected as an oxidant. Potassium permanganate could be applied as either a solid or in solution, and sodium permanganate could be applied as a solution. The type and phase of the oxidant would be determined during the remedial design. Solid potassium permanganate is generally the more cost-effective oxidant; however, pneumatic fracturing would be needed to inject this solid material. For cost estimation purposes, a liquid solution of potassium permanganate (the next most cost-effective oxidant) was assumed.

As part of the RD, pre-design studies would be conducted to determine the most appropriate and effective oxidant, and to refine the dosing estimates regarding oxidant application. Under this task, injection wells would be installed at 6 locations identified in Figure 8-2. Bench-scale testing would then be conducted using the soil collected from newly installed wells to determine the Site-specific oxidant demand. Using this information, the design oxidant dose would be determined. For cost estimation purposes, a soil oxidant demand (SOD) of 2 g/kg has been assumed. This value is based on SOD values for nearby sites. Based on this SOD, and the size of the off-Site groundwater plume, approximately 89,000 lbs of potassium permanganate in a 3% solution would be injected in this area. The design oxidant dose would be mixed and applied to the subsurface via the 6 injection wells.

The injection locations were selected based on the assumption that vertical application wells have a 30-foot radius of influence and there is 200 feet of downgradient advective flow with minimal dispersion.[2] Each injection location would extend to approximately 90 or 120 feet bgs and would be targeted to treat either the 90 to 120 feet bgs zone or the 60 to 90 feet bgs zone. Four-inch diameter stainless steel monitoring wells would be installed at each injection point using sonic or other drilling methods and 6-inch diameter temporary casings. The injection well would be constructed inside the temporary casing. Conceptually:

- Injection wells would be drilled setting well screen across the target injection interval(s).

- Passive diffusion bags will be installed and sampled.

- Dry media potassium permanganate would be delivered to the staging area in 3,300-pound cycle bins. The material will be moved about the site using trucks and forklifts.

- A mixing and dilution system would provide and dilution. Flash mixing using fire hydrant water (assumed as available) would be employed to create the desired application liquid concentration, while booster pumps increase the application pressures for injection.

- Diluted permanganate solution will be applied into adjustable five to 10 foot long packer-isolated sections of the injection screen adjusted by the site staff as needed.

Following oxidant injection, groundwater monitoring would be conducted to determine the effectiveness of this technology. Additional discussion regarding groundwater monitoring conducted under this alternative is provided in Section 8.3.1.4.

8.3.1.3 Sub-Slab Soil Vapor and Indoor Air Investigation

Elevated VOC concentrations were observed in the soil vapor samples collected around and below the off-Site buildings. Under this task, additional sub-slab vapor and indoor air sampling would be conducted at

[2] Selected based upon historical transport on LI projects

properties in the Study Area Site that may be impacted by infiltration of subsurface vapors.

For cost estimation purposes, collection of a total of ten (10) sub-slab vapor samples, 10 indoor air samples and 2 outdoor air samples will be collected and submitted to a NYSDOH ELAP-certified laboratory for Full List VOC analyses using United States Environmental Protection Agency (USEPA) Method TO-15. Sampling would be consistent with the methodologies employed during the RI. These samples would be used to determine which buildings have been impacted. Additional subslab vapor, indoor air and outdoor air samples may be needed after this investigation is conducted; however, these samples are not included in the cost estimate for this alternative.

8.3.1.4 SSD Beneath Impacted Off-Site Buildings, If Needed

In the event that the additional sub-slab vapor and indoor air sampling results exceed the mitigation threshold criteria set forth under the NYSDOH draft guidance "Guidance for Evaluating Soil Vapor Intrusion in the State of New York, Public Comment Draft, February 2005", then remediation would be required and SSD systems would be installed to mitigate this exposure pathway.

For cost estimation purposes, it has been assumed that the additional sub-slab vapor and indoor air sampling results will indicate the need for SSD at 1025 Old Country Road. Addition discussion regarding the proposed SSD system was previously presented in Section 8.2.1.4. However, under this alternative, the SSD system would be operated for five (5) years.

It has also been assumed that continued collection of sub-slab and indoor air samples will be required during this remedial alternative. For cost estimation purposes, it has been assumed the two (2) subslab, two (2) indoor air and one outdoor air (i.e., background) sample will be collected semi-annually and submitted to a laboratory for TO-15 analysis for the purpose of monitoring the SSD system.

8.3.1.5 Groundwater Monitoring

Under this remedial action, annual groundwater monitoring would be conducted in the Study Area to evaluate the effectiveness of the ISCO injections. In addition to MW-01S/D and NC-12, three additional nested pairs of groundwater monitoring wells would be installed. These well nests would be screened from 85-95 feet bgs (shallow) and from 115-125 feet (deep). The proposed well locations are presented in Figure 8-1.

Samples would be analyzed for VOCs. For cost estimation purposes, seven (7) years of annual sampling has been assumed.

8.3.2 Evaluation

8.3.2.1 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for the groundwater and subsurface vapor. The use restrictions would prevent exposure to contaminated groundwater. In addition, ISCO would address the residual levels of VOCs present in the off-Site groundwater and thus provide for additional protection of human health and the environment. The SSD system, if needed, would also address any subsurface vapor risks and eliminate the pathway for this media of interest.

8.3.2.2 Compliance with SCGs

A summary of the applicable SCGs that apply to this alternative is presented in Table 8-1. As shown in this table, this alternative would address the chemical-specific SCGs through ISCO, SSD, use restrictions and groundwater monitoring.

8.3.2.3 Long-Term Effectiveness and Permanence

This alternative would provide treatment of groundwater and therefore would provide long-term effectiveness and permanence for this media. In addition, the continued effectiveness of this remedy would be mandated through use restrictions and groundwater monitoring. This alternative would also provide long-term effectiveness and permanence for subsurface vapor, if needed, through the removal of accumulated sub-slab vapors and the elimination of the source of VOCs in the subsurface vapor (i.e., contaminated groundwater) through groundwater treatment.

8.3.2.4 Reduction of Toxicity, Mobility or Volume

Through ISCO and SSD, this alternative would result in a decrease in the toxicity, mobility and volume of the chemicals in groundwater and subsurface vapor. This reduction would be confirmed via groundwater monitoring. In addition, ISCO would also destroy the VOCs present in the groundwater providing a permanent remedy. Reduction in mobility and volume of chemicals in subsurface vapors would occur through operation of the SSD system. SSD system vapor controls would provide further reduction in the toxicity, mobility and volume of the recovered chemicals since they would be destroyed during the carbon regeneration process.

8.3.2.5 *Short-Term Effectiveness*

There would be moderate short-term impacts associated with this alternative. These would relate to installation of the injection wells and injection of the oxidant, sub-slab and indoor air sampling, installation of the SSD systems and installation of groundwater monitoring wells.

8.3.2.6 *Implementability*

Potential locations for ISCO injection will be limited by the location of subsurface utilities and overhead power lines in the streets. Although this will pose implementability concerns, they can be overcome. In addition, secure land area will be needed in the vicinity of the injection points to dilute and apply the oxidants. If this is not possible, the oxidant mixing system and storage (solid or liquid) would have to be adequately secured or removed from the work area daily to limit the potential for non-worker exposures, prevent tampering and decrease the potential for unintended releases. This would in turn, however, limit the amount of material that can be added daily.

There would be additional concerns related to access for installation of monitoring wells and installation and OM&M of the SSD systems, if needed. The main components of this alternative (ISCO and SSD) could be completed within five years of NYSDEC approval of the RD for this project. Groundwater monitoring and use restrictions continue beyond this time frame.

8.3.2.7 *Cost*

The capital and O&M costs for this alternative are provided in Table 8-3. The cost estimate assumes that SSD beneath the building located at 1025 Old Country Road will be needed.

8.4 *ALTERNATIVE 4: AIR SPARGE/SOIL VAPOR EXTRACTION OF OFF-SITE GROUNDWATER*

8.4.1 ***Description***

This alternative would include the following components:

- Use Restrictions

- Air Sparge/Soil Vapor Extraction (AS/SVE) of Off-Site Groundwater Plume
- Sub-Slab Soil Vapor and Indoor Air Investigation
- SSD Beneath Impacted Off-Site Buildings, If Needed
- Groundwater Monitoring

The time to complete this alternative has been estimated to be approximately 7 years following NYSDEC approval of the RD. Design would be completed within 6 months of the ROD approval. Construction of the AS/SVE system would be conducted at the beginning of Year 2 and operation would occur for two years. Construction of the SSD system would occur at the end of Year 1 and operation of this system would continue through the end of Year 6. Groundwater monitoring would be conducted from ROD approval through the end of Year 7.

8.4.1.1 Use Restrictions

Under this alternative, Part 5 of the New York State Department of Health State Sanitary Code, which prevents installation of a private potable water supply well in areas that are served by a public water supply system, would continue to be enforced. This would prevent contact with the off-Site groundwater before it is treated via natural processes, via the OU-3 remedy for the NCIA and/or is extracted and treated at the BGWD supply wells.

8.4.1.2 AS/SVE of Off-Site Groundwater Plume

Under this task, AS/SVE of the off-Site groundwater plume would be conducted to reduce the concentrations of COC in groundwater. This would entail injection of air into the Magothy aquifer using air sparge points and the extraction of the generated soil vapor via soil vapor extraction points.

Prior to implementation of this task, a pilot test would be conducted to confirm the spacing of the air sparge and vapor extraction points. For cost estimation purposes, it has been assumed that air will be injected into the impacted off-Site groundwater via a total of thirty-nine (39), 2-inch diameter air sparge points. Twenty nine (29) of these points will be screened in the shallower portion of the Magothy aquifer, from 50 to 95 feet bgs and the remaining ten (10) points (all located on the western side of 1025 Old Country Road) will be screened in the deeper portion of the Magothy aquifer, from 50 to 120 feet bgs. Each sparge point is expected to have a radius of influence of approximately 20 feet. The spacing between the air sparge points will range from 10 to 40 feet apart. The more closely spaced sparge points will be located on the southwest side of 1025 Old

Country Road, where the highest COC concentrations in groundwater were observed. Based on the absence of elevated COC concentrations in the northeastern corner of the building, air sparge points are not proposed for this area. In addition, a greater spacing between the air sparge points was assumed for the southeastern corner of the building where low groundwater concentrations are assumed. Each air sparge point will be 2-inches in diameter and supplied with 10 cfm of air. The locations of the air sparge points are presented in Figure 8-5. Due to access constraints, sparge points were not located beneath the office area.

The VOCs generated during the air sparge process will be collected via a total of twenty (27), 2-inch diameter soil vapor extraction points. These soil vapor extraction points will be installed to a depth of 55 feet bgs and will be screened from 35 to 55 feet bgs. Based on the geology in the Study Area and similar project experience, a 10 cubic feet/minute/foot extraction flow rate has been assumed. The soil vapor extraction points will be placed from 10 to 80 feet apart. Each vapor extraction point is expected to have a radius of influence of 40 feet. The more closely spaced extraction points will be located on the southwest side of 1025 Old Country Road, where the highest COC concentrations in groundwater were observed. The greater spacing between the soil vapor extraction points was assumed for the northeastern and southeastern corner of the building. Although, air sparge points are not assumed for the northeastern corner of the building, installation of vapor extraction points has been included to ensure thorough collected of vapor generated from air sparging. The location of the vapor extraction points is presented in Figure 8-5. Due to access constraints, extraction points were not located beneath the office area.

The air sparge points will be connected to one, 426 CFM blower via piping. The extraction points will be manifolded to a total of seven, 580 CFM blowers. The vapor extraction blower exhausts will be delivered through four, 2,000-pound GAC vessels for treatment before release to the atmosphere at a point above the top of the building. Spent GAC will be sent off-site for regeneration.

For cost estimation purposes, it has been assumed that the AS/SVE system will be operated for two (2) years. Following installation, an OM&M Plan will be prepared for the AS/SVE system. Monthly field PID measurements will be conducted to ensure the proper operation of the AS/SVE system. Vapor samples would also be collected on a quarterly basis from the GAC system and submitted for TO-15 analysis. Samples would be collected from the primary bed inlet and outlet and the secondary bed outlet. This information would be correlated to the PID concentrations to determine carbon change out requirements. It is estimated that the GAC will require replacement on a semi-annual basis.

8.4.1.3 Sub-Slab Soil Vapor and Indoor Air Investigation

Elevated VOC concentrations were observed in the soil vapor samples collected around and below the off-Site buildings. Under this task, additional sub-slab vapor and indoor air sampling would be conducted at properties in the Study Area that may be impacted by infiltration of subsurface vapors.

For cost estimation purposes, collection of a total of ten (10) sub-slab vapor samples, 10 indoor air samples and 2 outdoor air samples will be collected and submitted to a NYSDOH ELAP-certified laboratory for Full List VOC analyses using USEPA Method TO-15. Sampling would be consistent with the methodologies employed during the RI. These samples would be used to determine which buildings have been impacted. Additional subslab vapor, indoor air and outdoor air samples may be needed after this investigation is conducted; however, these samples are not included in the cost estimate for this alternative.

8.4.1.4 SSD Beneath Impacted Off-Site Buildings, If Needed

In the event that the additional sub-slab vapor and indoor air sampling exceed the mitigation threshold criteria set forth under the NYSDOH draft guidance "Guidance for Evaluating Soil Vapor Intrusion in the State of New York, Public Comment Draft, February 2005", then remediation would be required and SSD systems would be installed to mitigate this exposure pathway.

For cost estimation purposes, it has been assumed that the additional sub-slab vapor and indoor air sampling results along with outdoor (i.e., background) air results will indicate the need for SSD at 1025 Old Country Road. Addition discussion regarding the proposed SSD system was previously presented in Section 8.2.1.4. However, under this alternative, the SSD system would be operated for five (5) years.

8.4.1.5 Groundwater Monitoring

Under this remedial action, annual groundwater monitoring would be conducted in the Study Area to evaluate the effectiveness of the AS/SVE. In addition to MW-01S/D and NC-12, three additional nested pairs of groundwater monitoring wells would be installed. These well nests would be screened from 85-95 feet bgs (shallow) and from 115-125 feet (deep). The proposed well locations are presented in Figure 8-1. Samples would be analyzed for VOCs. For cost estimation purposes, 7 years of ground water sampling has been assumed

8.4.2 Evaluation

8.4.2.1 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for the groundwater and subsurface vapor. The use restrictions would prevent exposure to contaminated groundwater. In addition, AS/SVE would address the residual levels of COCs present in the off-Site groundwater. The SSD system would also address subsurface vapor risks, if needed, and eliminate the pathway for this media of interest.

8.4.2.2 Compliance with SCGs

A summary of the applicable SCGs that apply to this alternative is presented in Table 8-1. As shown in this table, this alternative would address the chemical-specific SCGs through AS/SVE, SSD, use restrictions and groundwater monitoring.

8.4.2.3 Long-Term Effectiveness and Permanence

This alternative would provide treatment of groundwater and therefore would provide long-term effectiveness and permanence for this media. In addition, the continued effectiveness of this remedy would be mandated through institutional controls and groundwater monitoring. This alternative would also provide long-term effectiveness and permanence for subsurface vapor, if needed, through the removal of accumulated sub-slab vapors and the elimination of the source of VOCs in subsurface vapor (i.e., contaminated groundwater) through groundwater treatment. Vapor controls would ensure that SSD and AS/SVE are permanent remedies.

8.4.2.4 Reduction of Toxicity, Mobility or Volume

Through AS/SVE and SSD, this alternative would result in a decrease in the mobility and volume of the chemicals in groundwater and subsurface soil vapor. This reduction would be confirmed via groundwater monitoring. Reduction in mobility and volume of chemicals in subsurface vapors would occur through operation of the SSD system. SSD system and AS/SVE vapor controls would provide further reduction in the toxicity, mobility and volume of the recovered chemicals since they would be destroyed during the carbon regeneration process ensuring permanence of this remedy.

8.4.2.5 *Short-Term Effectiveness*

There would be moderate short-term impacts associated with this alternative. These would relate to installation of the air injection wells and vapor recovery system, SSD system and groundwater monitoring wells.

8.4.2.6 *Implementability*

Potential locations for air injection will be limited by the location of subsurface utilities and overhead power lines in the streets. Although this will pose implementability concerns, they can be overcome.

Given the highly developed nature of the Study Area, numerous subsurface conduits exist, which could serve as unintentional preferential pathways for vapors generated during air sparging. There is therefore the potential for vapors generated during this alternative to migrate away from the treatment area along these pathways. Successful implementation of this alternative would require installation of sufficient, properly placed extraction wells. Pilot testing would reduce the potential for this to occur; but it cannot be eliminated.

There are also additional concerns related to access for installation of monitoring wells and installation and OM&M of the SSD systems, if needed.

The main components of this alternative could be completed within five years of NYSDEC approval of the RD for this project. Groundwater monitoring, use restrictions and limited annual OM&M activities related to the SSD system would continue beyond this time frame.

8.4.2.7 *Cost*

The capital and O&M costs for this alternative are provided in Table 8-3. The cost estimate assumes that SSD beneath the building located at 1025 Old Country Road will be needed.

8.5 COMPARISON OF REMEDIAL ACTION ALTERNATIVES

This section compares each of the remedial action alternatives that were developed for the media of interest. As discussed in Section 8.1 through 8.4, these remedial action alternatives are:

Alternative 1:	No Action
Alternative 2:	MNA of Off-Site Groundwater
Alternative 3:	ISCO of Off-Site Groundwater
Alternative 4:	AS/SVE of Off-Site Groundwater

The NYSDEC guidance on the selection of remedial actions at inactive hazardous waste disposal sites (NYSDEC, 1990 and NYSDEC, 2002) require that alternatives be developed that protect human health and the environment by eliminating, reducing and controlling potential risks posed through each pathway at a site.

The NCP provides for a review of remedial alternatives that: (1) require no action {40 CFR 300.430(e)(6)}; (2) involve little or no treatment but protect human health and the environment by preventing or controlling potential exposures to hazardous substances through engineering or institutional controls {40 CFR 300.430(e)(3)(ii)}; and (3) reduce the toxicity, mobility or volume of hazardous substances through treatment {40 CFR 300.430(e)(3)(i)}.

Alternative 1, evaluated in this FS complies with the NCP requirement to evaluate the applicability of not implementing any further remedial actions targeted at the off-Site groundwater. Alternative 2 addresses the requirement to review remedial alternatives that involve little or no treatment but protect human health and the environment by preventing or controlling potential exposures to hazardous substances through engineering or institutional controls. Alternatives 3 and 4 address the requirement to review remedial alternatives that reduce the toxicity, mobility or volume of hazardous substances through treatment.

Each alternative was evaluated against the seven criteria identified in NYSDEC guidance for the selection of remedial actions (NYSDEC, 1990; NYSDEC, 2002). An evaluation of the seven criteria provide the basis for identifying a preferred remedial alternative, which is presented in a proposed remedial action plan (PRAP) issued by the agency following completion of the RI/FS. Once the RI/FS is finalized and the PRAP issued, the NCP and the NYSDEC guidance (NYSDEC, 1990; NYSDEC, 2002) also provide for public review as part of a modifying criteria to evaluate community acceptance of the preferred remedial alternative.

In accordance with the NYSDEC guidance (NYSDEC, 1990; NYSDEC, 2002), the first two performance criteria (i.e., protect human health and the environment and compliance with SCGs) are considered threshold criteria. Remedial action alternatives must achieve these two threshold criteria, unless a waiver is justified. The remaining five criteria (identified below) are considered primary balancing criteria. These balancing criteria address the following issues:

1. How will the remedial actions perform in the future (long-term effectiveness and permanence)?

2. Does the alternative reduce the toxicity, mobility or volume of hazardous substances?

3. Does the implementation of the alternative create adverse impacts (short-term effectiveness)?

4. Can the alternative be implemented (implementability)?

5. What is the total cost of the alternative?

The comparative analysis or evaluation highlights the particular advantages, disadvantages and/or similarities of each alternative for the specific criteria. This comparative analysis is discussed below.

Overall Protection of Human Health and the Environment

Protection of human health and the environment is measured by the ability of an alternative to address the remedial action objectives for the media of interest.

The RAOs for off-Site groundwater and subsurface vapor are:

GWRAO1: Prevent exposure to contaminated groundwater, above acceptable risk levels;

GWRAO2: Prevent or minimize further migration of the contaminant plume (plume containment);

GWRAO3: Prevent or minimize further migration of contaminants from source materials to groundwater (source control); and

GWRAO4: Restore, where practical, groundwater to their expected beneficial uses.

SVRAO1: Prevent unacceptable inhalation risks for subsurface vapors, if they are present; and

SVRAO2: Eliminate the potential for vapor intrusion into indoor air, if needed

The source of off-Site groundwater contamination (i.e., the impacted dry well) was addressed through the implementation of the OU-1 IRM. Thus, all four alternatives would prevent or minimize further migration of contaminants from source materials to groundwater and all the remedial alternatives address GWRAO3.

Alternative 1 would not provide adequate protection of human health and the environment since it would only address one of the six RAOs (i.e., GWRAO3) and would not eliminate, reduce or control the potential exposure pathways for the off-Site groundwater or subsurface vapor.

Alternatives 2, 3 and 4 would all rely on a variety of institutional and engineering controls to achieve GWRAO1 and would achieve SVRAO1 and SVRAO2 through SSD, if needed. Alternatives 3 and 4 would further address GWAO1 and would address GWRAO2 through active treatment of the off-Site groundwater plume. In addition, Alternative 2 would ultimately achieve GWRAO2 through MNA; however, in the short-term, the OU-3 remedy and existing treatment at BGWD supply wells would address this RAO.

With regard to GWRAO4, restoration of groundwater to its beneficial use, Alternatives 2, 3 and 4 would ultimately reduce the chemical concentrations in the off-Site groundwater to the higher of the MCLs or the background concentrations. This reduction would occur faster in Alternatives 3 and 4 than Alternative 2.

In conclusion, all alternatives, with the exception of Alternative 1 would provide adequate protection of human health and the environment. All three alternatives would rely to some degree on long-term OM&M to ensure continued protection of human health and the environment.

Compliance with SCGs

Compliance with SCGs is also a threshold criterion. Table 6-1 contains a list of potential SCGs for the media of interest and Table 8-1 presents a summary of each alternative's compliance with these SCGs.

As discussed in the previous sections and in Tables 6-1 and 8-1, the SCG can be chemical specific, action specific and/or location specific. The following comparison takes into consideration the types of SCGs.

As shown in Table 8-1, Alternative 1 would not comply with any of the applicable chemical-specific SCGs. In addition, Alternative 1 would not address the 6 NYCRR Part 375 goals to: eliminate or mitigate all significant risk to the public health and the environment; restore the site to pre-disposal/ pre-release conditions, to the extent feasible and authorized by law. Since Alternative 1 does not include any remedial activities, none of the action-specific SCGs would apply to this alternative.

As shown in Table 8-1, Alternatives 2, 3 and 4 would meet all of the applicable action, chemical and location-specific SCGs. Although Alternative 2 would likely not meet the MCLs in the short-term, use restrictions would prevent access to groundwater containing COCs in excess of the MCLs and the OU-3 downgradient remedies would treat this groundwater before it reaches the GCWD supply wells.

Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence is measured by the magnitude of the residual risk and the adequacy and reliability of controls. Alternative 1 would not provide any long-term effectiveness or permanence. Under this alternative, there would be no investigation or mitigation of the subsurface vapors; however, use restrictions upgradient of the OU-3 remedy would continue to be enforced.

Alternatives 2, 3 and 4 would provide passive treatment (i.e., MNA) or active treatment (i.e., ISCO or AS/SVE) of the impacted off-Site groundwater and would equally assess and address subsurface vapors, if needed. Although MNA is occurring for some of the off-Site groundwater COCs, concentrations are not currently being reduced to the MCLs prior to reaching Old Country Road. This is expected to occur at a later date. Alternative 3 would provide the most rapid long-term permanence in reducing the chemical concentrations in the off-Site groundwater to the higher of the MCLs or background concentrations followed by Alternative 4.

Reduction of Toxicity, Mobility or Volume

The remedial alternatives address this criterion to different extents and in different manners. Some alternatives contain more permanent remedial components than others.

If SSD is determined to be needed, Alternatives 2, 3 and 4 would result in a reduction in the toxicity, mobility and volume of the subsurface vapor COCs through collection of these chemicals onto GAC and ultimately regeneration of the GAC collection media. Alternative 3 would also include the destruction of groundwater COCs via ISCO, thus reducing the toxicity, mobility and volume of COCs in the off-Site groundwater. This is a permanent remedial component. Alternative 4 would also result in the reduction of toxicity, mobility and volume of COCs in groundwater and subsurface vapor through AS/SVE and the collection and ultimate destruction of these COCs through carbon regeneration.

Short-Term Effectiveness

Short-term effectiveness refers to the potential effects and related risks associated with the implementation of the remedy. Potential short-term effects would occur during construction and operation of the remedial action alternatives. Since Alternative 1 does not include any future remedial activities, it would not have any short-term impacts.

With the exception of Alternative 1, Alternative 2 would have the lowest potential for short-term impacts. The only new activity under Alternative 2 would be the installation of SSD system, if needed, and the installation of monitoring wells. Alternatives 3 and 4 would have short-term impacts resulting from the construction activities associated with these alternatives.

Implementability

Implementability concerns are related to potential technical and institutional problems associated with a remedial action alternative. Since Alternative 1 does not include the implementation of any future remedial actions, there are no implementability concerns associated with this alternative.

Alternatives 2, 3 and 4 would have implementability concerns associated with installation of SSD systems and monitoring wells. In addition, Alternative 3 would have implementability concerns associated with gaining regulatory permission for chemical injection, locating unobstructed injection points and securing an area for storage of oxidants. Alternative 4 would have implementability concerns associated with locating unobstructed injection and extraction points, and ensuring that vapors generated during air sparging do not unintentionally migrate away from the treatment area via underground preferential pathways.

Cost

Following is a summary of the estimated costs for the groundwater remedial action alternatives. Costs assume that SSD will be implemented for all alternatives. The detailed cost estimates are provided in Tables 8-2 through 8-4.

No.	Remedial Action Alternative	Total Capital Costs	Total O&M NPV	Total NPV Cost
1	No Action	$0	$0	$0
2	MNA of Off-Site Groundwater	$205,928	$367,229	$573,157
3	ISCO of Off-Site Groundwater	$786,221	$149,835	$936,057
4	AS/SVE of Off-Site Groundwater	$1,065,706	$1,017,152	$2,082,859

TABLES

Table 6-1
Potential SCGs
700-712 Main Street
North Hempstead, Nassau County, New York

CITATION	DESCRIPTION	TYPE	POTENTIAL APPLICABILITY TO DEVELOPING REMEDIAL ACTION OBJECTIVES	POTENTIAL APPLICABILITY TO EVALUATING REMEDIAL ACTION ALTERNATIVES
STANDARDS, CRITERIA AND GUIDANCE (SCGS)				
6 NYCRR Part 375	Inactive Hazardous Waste Disposal Site Remedial Program	Action	This statute would be used to determine remedial requirements for at the Site.	This standard relates to all Site remedial activities (i.e. remedy selection and remedial action).
6 NYCRR Part 598	Handling and Storage of Hazardous Substances	Action	Not applicable.	This standard would relate to any remedial activities that include handling and storage of hazardous substances.
6 NYCRR Parts 700- 706	NYSDEC Water Quality Standards, Surface Water and Ground Water	Action, Chemical	This standard provides promulgated numeric standards that would be applicable to the development of remedial requirements for Site ground water.	This standard would relate to alternatives that include ground water monitoring.
40 CFR Part 144	Underground Injection Control (UIC) Program	Action	Not applicable.	Governs injection of chemicals or substances into the groundwater.
40 CFR 261 (RCRA)	Determination of whether a waste is hazardous	Action, Chemical	This standard relates to identification of hazardous waste and may aid in determining remedial requirements for hazardous wastes.	This standard relates to the characterization and management of hazardous waste generated by the remedial action.
OSHA; 29 CFR 1910	Guidelines/Requirements for Workers at Hazardous Waste Sites (Subpart 120) and Standards for Air	Action	Not applicable.	May relate to certain remedial action activities

Table 6-1
Potential SCGs
700-712 Main Street
North Hempstead, Nassau County, New York

CITATION	DESCRIPTION	TYPE	POTENTIAL APPLICABILITY TO DEVELOPING REMEDIAL ACTION OBJECTIVES	POTENTIAL APPLICABILITY TO EVALUATING REMEDIAL ACTION ALTERNATIVES
	Contaminants (Subpart 1).			
OSHA; 29 CFR 1926	Safety and Health Regulations for Construction	Action	Not applicable	May relate to certain remedial action activities
NYSDEC DER-10	Technical Guidance for Site Investigation and Remediation	Action, Chemical	Draft guidance relates to development of remedial action objectives.	Relates to all Site remedial action activities.
NYSDEC Division of Air Resources -1	Guidelines for the control of Toxic Ambient Air Contaminants	Chemical	Not applicable.	Provides guidelines for the control of toxic ambient air contaminants.
NYSDEC TAGM HWR-90-4030	Selection of Remedial Actions at Inactive Hazardous Waste Sites	Action	Guidance is applicable to developing the remedial action objectives.	May relate to selection of remedial action.
NYSDEC TOGS 1.1.1	Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations	Action, Chemical	Guidance would be applicable for development of groundwater RAOs.	Guidance would be applicable for remedial action alternatives that involve work associated with Site groundwater.
NYSDOH Community Air Monitoring Plan for Intrusive Activities	Requirements real-time monitoring for volatile organic compounds (VOCs) and particulates	Action, Chemical	Not applicable.	Would relate to any intrusive remedial activities.

Table 6-1
Potential SCGs
700-712 Main Street
North Hempstead, Nassau County, New York

CITATION	*DESCRIPTION*	*TYPE*	*POTENTIAL APPLICABILITY TO DEVELOPING REMEDIAL ACTION OBJECTIVES*	*POTENTIAL APPLICABILITY TO EVALUATING REMEDIAL ACTION ALTERNATIVES*
NYSDOH Soil Vapor Intrusion Guidance	Provides guidance on identifying and addressing potential and current risks associates with human exposure to contaminated vapors from environmental contamination.	Action, Chemical	Guidance is applicable to developing appropriate remedial action objectives to minimize human health risks.	Guidance is applicable for evaluating the effectiveness of a remedial alternative
TAGM HWR-94-4046	Determination of Soil Cleanup Objectives and Cleanup Levels	Chemical	Guidance is applicable for the development of remedial action objectives for Site soil.	Guidance is applicable for evaluating the effectiveness of a remedial alternative.
USEPA Integrated Risk Information System	USEPA database containing toxicity data for various chemicals.	Action, Chemical	Provides guidance on the human health evaluation activities conducted during the baseline risk assessment, such as data collection and toxicity assessment. May relate to the selection of the final remedial action.	Provides guidance on the human health evaluation activities conducted during the baseline risk assessment, such as data collection and toxicity assessment. May relate to the selection of the final remedial action.

GLOSSARY OF ACRONYMS

CFR	Code of Federal Regulations
DER	Division of Environmental Remediation
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health

Table 6-1
Potential SCGs
700-712 Main Street
North Hempstead, Nassau County, New York

NYCRR	New York Code of Rules and Regulations
OSHA	Occupational Safety and Health
RCRA	Resource Conservation and Recovery Act
TAGM	Technical and Administrative Guidance Memorandum
TOGS	Technical and Operational Guidance Series
USEPA	U. S. Environmental Protection Agency

Table 7-1
Technology Screening and Selection
700-712 Main Street
North Hempstead, Nassau County, New York

Technology	*Description*	*Ability to Meet the RAOs**	*Effectiveness*	*Implementability*	*Technology Carried Forward?*
Use Restrictions	This technology would rely on existing State Sanitary Code restrictions for the installation of water supply wells in areas served by public water supply.	This technology would help meet the following RAOs: GWRA01	This technology would need to be used in conjunction with other technologies to be effective.	This technology is readily implementable.	Yes.
Monitored Natural Attenuation (MNA)	Relies on natural processes to breakdown groundwater contaminants. Natural attenuation processes include physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants. Groundwater samples are collected to track contaminant trends and breakdown byproducts to monitor progress and nutrients.	This technology would meet the following RAOs in the shallow groundwater: GWRA01, GWRA02, GWRA04	MNA can be effective for remediation of groundwater VOC plumes proven to be stable or shrinking. Groundwater results indicate that abiotic degradation of 1,1,-TCA and anaerobic biotic reductive dechlorination of PCE and TCE are occurring in the shallow portion of the Magothy aquifer. Based on the groundwater results, biodegradation does not appear to be occurring in the deeper sampled portion of the Magothy aquifer.	MNA is readily implementable. Demonstration of MNA requires significant sampling frequency and parameters.	Yes.
In-situ Chemical Oxidation (ISCO)	Chemical oxidants are introduced into a contaminated soil or groundwater matrix using a variety of reagent injection and mixing apparatus. The oxidants interact with organic contaminants and degrade them in-situ into innocuous end products. The oxidizing agents most commonly used are ozone, hydrogen peroxide, permanganates and persulfates.	This technology would meet the following RAOs: GWRA01, GWRA02, GWRA04	Based on testing at other sites on Long Island with similar contamination, ISCO would likely be an effective technology. Permangenate and persulfate would be suitable oxidants for the chlorinated alkenes and toluene. Due to safety issues, hydrogen peroxide and ozone would not be considered suitable oxidants for this application. Heated persulfate could be used for the chlorinated alkanes. Site-specific soil oxidant demand (SOD) testing would be needed to determine the oxidant needs for the off-Site plume.	ISCO would require construction of chemical injection wells, mixing and injection of oxidant and securing sufficient space for the mixing and injection of the oxidant. Administrative implementability depends upon the regulatory approval for injection of chemicals.	Yes.
Air Sparging/Soil Vapor Extraction (AS/SVE)	This technology involves injection of air into groundwater to volatize dissolved VOCs and the collection of the generated soil vapor gases.	This technology would meet the following RAOs: GWRA01, GWRA02, GWRA04 (and possibly SRA01, and SRA02).	AS/SVE has been proven effective for treatment of VOCs in groundwater at numerous LI sites. This technology effectively remediated the Site source area via OU-1 IRM. In addition, this technology was also successfully	AS/SVE would require construction of air injection wells, vapor extraction wells, and securing sufficient space for the blowers and emission controls. Given the developed nature of the Study Area and the potential for numerous underground	Yes.

Table 7-1
Technology Screening and Selection
700-712 Main Street
North Hempstead, Nassau County, New York

Technology	*Description*	*Ability to Meet the RAOs**	*Effectiveness*	*Implementability*	*Technology Carried Forward?*
			implemented at the nearby Tishcon NCIA site to address the on-site groundwater contamination and is currently being implemented for the off-site portion of this plume.	utilities and conduits, there is a concern for uncontrolled migration of generated vapors along preferential pathways.	
Sub-Slab Depressurization (SSD)	This technology involves the installation of subsurface piping to collect soil gas. The collected vapors are then transferred to the atmosphere through emission controls, if needed. The sub-slab depressurization system utilizes a blower and controls to create the vacuum.	This technology meet the following RAOs: SRA01, SRA02	Sub-slab depressurization is effective in collecting soil gas from beneath slabs. Systems of this type have been used for years to mitigate intrusion of radon gas into enclosed structures.	Installation of a SSD system is implementable at the 1025 Old Country Road site since the first floor of this building is predominantly occupied by a garage. Due to the compact nature of these systems and their use at numerous residential and commercial properties, installation would also be implementable at other properties within the Study Area, if needed.	Yes.

*Remedial Action Objectives

<u>Soil RAOs</u>
SRAO1. Prevent unacceptable inhalation risks for subsurface vapors, if they are present
SRAO2. Eliminate the potential for vapor intrusion into indoor air, if needed

<u>Groundwater RAOs</u>
GWRAO1. Prevent exposure to contaminated groundwater, above acceptable risk levels
GWRAO2. Prevent or minimize further migration of the contaminant plume (plume containment)
GWRAO3. Prevent or minimize further migration of contaminants from source materials to groundwater (source control)
GWRAO4. Return groundwater to their expected beneficial uses wherever practicable (aquifer restoration)

TABLE 8-1
COMPLIANCE WITH APPLICABLE SCGs
700-712 MAIN STREET
NORTH HEMPSTEAD, NASSAU COUNTY, NEW YORK

Citation	Description	Type	ALTERNATIVES				Manner of Compliance
			1	2	3	4	
STANDARDS, CRITERIA, AND GUIDANCE (SCGs)							
6 NYCRR Part 375	Inactive Hazardous Waste Disposal Site Remedial Program	Action, Chemical, Location	NC	NC	X	X	The Inactive Hazardous Waste Disposal Site Remedial Program requests that Sites be restored to pre-disposal conditions and the remedial actions would eliminate or mitigate all significant threats to the environment. Alternatives 3 and 4 would actually restore the Site to pre-disposal conditions in compliance with this regulation. In addition, these alternatives would eliminate or mitigate all significant threats to the environment.
6 NYCRR Part 598	Handling and Storage of Hazardous Substances	Action	--	--	X	--	Hazardous substances (e.g., oxidant injected under Alternative 3) would be stored and handled in compliance with the regulation.
6 NYCRR Parts 700- 706	Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations	Chemical	NC	NC	X	X	Under the alternatives, the off-Site groundwater would be treated to achieve the more stringent of the groundwater standards or the background concentrations.
40 CFR Part 144	Underground Injection Control (UIC) Program	Action	--	--	X	--	Inventory information (e.g., project location, purpose of well, identification of formation and chemical of injection and other information) would be prepared and provided to the USEPA prior to the installation of ISCO wells for Alternative 3.
40 CFR 261 (RCRA)	Determination of whether a waste is hazardous	Action, Chemical	--	X	X	X	Appropriate waste characterization would be implemented when necessary for the Alternatives that generate waste (e.g., groundwater purge water, soil cuttings in during all Alternatives.
29 CFR (OSHA) Part 1910	Guidelines/Requirements for Workers at Hazardous Waste Sites	Action	--	X	X	X	Alternatives 2 through 4 will include preparation and implementation of a HASP that will address the requirements of this regulation.
29 CFR (OSHA) Part 1926	Safety and Health Regulations for Construction		--	X	X	X	The HASP prepared for Alternatives 2 through 4 will include provisions for construction safety to comply with this regulation.
NYSDEC Division of Air Resources -1	Guidelines for the control of Toxic Ambient Air Contaminants	Chemical	--	X	X	X	The need of air pollution controls will be determined during the Remedial Design. For evaluation purposes, all alternatives that include sub-slab depressurization and air sparging/soil vapor extraction would utilize vapor control equipment.
NYSDEC *Draft* DER-10	Technical Guidance for Site Investigation and Remediation	Chemical	X	X	X	X	Development of remedial goals, objectives and alternatives have been conducted in accordance with this draft document; remedial design and O&M would address the requirements of this document once finalized.
NYSDEC TAGM HWR-90-4030	Selection of Remedial Actions at Inactive Hazardous Waste Sites	Chemical	X	X	X	X	The remedy selection for implementation considered the hierarchy of remedial technologies presented in TAGM 4030.
NYSDEC TOGS 1.1.1	Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations	Action, Chemical	NC	X	X	X	TOGS 1.1.1 contains both the promulgated suface and groundwater standards, as well as proposed guidance values. TOGS 1.1.1 contains only the promulgated standards for PCE, TCE, TCA, Methylene Chloride, and DCE - no guidance values. TOGS 1.1. contains promulgated standards for toluene with regards to drinking water (surface water and groundwater) and guidance values
NYSDOH Community Air Monitoring Plan for Intrusive Activities		Action, Chemical	--	X	X	X	Air monitoring conducted during intrusive and construction activities in Alternatives 2 through 4 will address the requirements of this document. Fugitive dust and particulate suppression controls will be employed, if necessary.
NYSDOH Soil Vapor Intrusion Guidance	Evaluation of Human Health Risks	Action, Chemical	NC	X	X	X	Sub-slab depressurization would address any risks identified via the requirements of this document and the remedy would be consistent with the document.

<u>Acronym Definitions</u>
CFR: Code of Federal Regulations
DER: Division of Environmental Remediation
HASP: Health and Safety Plan
NYSDEC: New York State Department of Environmental Conservation
NYSDOH: New York State Department of Health
NYCRR: New York Environmental Conservation Rules and Regulations
OSHA: Occupational Safety and Health Administration
RCRA: Resource Conservation and Recovery Act
TAGM: Technical and Administrative Guidance Memorandum
TOGS: Technical Operational Guidance Series
USEPA: United States Environmental Protection Agency

X Alternative complies with this SCG.
NC Alternative does not comply with this SCG.
-- SCG is not applicable to this alternative.

TABLE 8-2
ALTERNATIVE 2: MONITORED NATURAL ATTENUATION OF OFF-SITE GROUNDWATER
700-712 MAIN STREET
NORTH HEMPSTEAD, NASSAU COUNTY, NY

Item Description	Unit	Unit Cost	Quantity	Total Cost	Reference
CAPITAL COSTS					
Sub-Slab Vapor and Indoor/Outdoor Air Investigation	ls	$16,000	1	**$16,000**	1
Sub-Slab Depressurization System					
Communication test	each	$8,120	1	$8,120	2
Supply					
- Piping (3-inch PVC schedule 40)	ft	$1.99	2,080	$4,135	3
- Fittings (elbows, vent caps, clamps, etc.)	ls	$8,291	1	$8,291	4
- Core drill rental and bit	week	$1,207	3	$3,621	5
- Fans	each	$193	10	$1,929	6
- Skid-mounted vapor phase carbon (VPC) system	each	$5,000	1	$5,000	7
Freight for above supplied equipment	1	5%	22,976	$1,149	8
Installation labor	hr	$180	172	$30,960	9
Licensed electrician	day	$800	2	$1,600	10
Pressure field extension test	each	$7,250	1	$7,250	11
		Subtotal, SSD System		**$72,055**	
Monitoring Well Installation					
Mobilization/Demobilization	ls	$1,800	1	$1,800	34
Drilling of 2" casing vertical wells	ft	$20	660	$13,200	32
Supply and install 2" flush mount covers	each	$150	6	$900	31
Supply and install 2" PVC piping	ft	$16	660	$10,641	32 , 55
Well surface completions	each	$175	6	$1,050	28
Monitoring Well Development	hour	$160	12	$1,920	39
Hydrant Fees	each	$175	1	$175	40
Road Opening Permits	each	$350	1	$350	42
Concrete/Asphalt Coring	each	$175	6	$1,050	41
		Subtotal, Well Installation		**$31,086**	
Prepare site-specific OM&M Plan	each	$20,000	1	**$20,000**	12
		Subtotal, Capital Costs		**$139,141**	

Remedial Action Cost Estimate

Subtotal Remedial Action Capital Cost	$139,141	
Contingency (15%)	$20,871	56 , 57
Remedial Design (15 %)	$20,871	56 , 57
Project Management (8 %)	$11,131	56 , 57
Construction Management (10%)	$13,914	56 , 57
Total Remedial Action Capital Cost	**$205,928**	

OPERATIONS AND MAINTENANCE COSTS

	Unit	Unit Cost	Quantity	Present Value	
Sub-Slab Depressurization					
Annual certification of system performance	hour	$120	24	$2,880	14
Maintenance visits	hour	$75	96	$7,200	64
Field analytical with PID	visit	$120	12	$1,440	54
GAC system vapor sampling	event	$825	2	$1,650	43
Carbon regeneration and replacement	lb	$1.50	800	$1,200	50
Freight for carbon shipments	event	$500	2	$1,000	45
Sampling manpower	day	$600	2	$1,200	51
Misc. supplies and expenses	visit	$50	12	$600	46
Subslab, indoor and outdoor air samples	event	$1,375	2	$2,750	44
		Annual Subtotal		$19,920	
Subtotal, SSD System Present Value at 5% Discount Rate for 15 years				**$217,101**	

Groundwater Monitoring					
Sampling for 15 years for VOCs and additional parameters in 9 wells	yr	$8,635	1	$8,635	60
			Annual Subtotal	$8,635	
Subtotal, GW Monitoring Present Value at 5% Discount Rate				**$94,110**	
			Total O&M Costs	$311,211	
			Project Management Costs (8%)	$24,897	
			Contingency (10%)	$31,121	
Total Present Worth of Annual Operations and Maintenance Costs				**$367,229**	
TOTAL PRESENT WORTH OF COSTS				**$573,157**	
Non-Discounted Annual O&M Cost, Years 1-15				**$33,695**	

TABLE 8-3
ALTERNATIVE 3: IN-SITU CHEMICAL OXIDATION OF OFF-SITE GROUNDWATER
700-712 MAIN STREET
NORTH HEMPSTEAD, NASSAU COUNTY, NY

Item Description	Unit	Unit Cost	Quantity	Total Cost	Reference
CAPITAL COSTS					
Sub-Slab Vapor and Indoor/Outdoor Air Investigation	ls	$16,000	1	**$16,000**	1
Sub-Slab Depressurization System					
Communication test	each	$8,120	1	$8,120	2
Supply					
- Piping (3-inch PVC schedule 40)	ft	$1.99	2,080	$4,135	3
- Fittings (elbows, vent caps, clamps, etc.)	ls	$8,291	1	$8,291	4
- Core drill rental and bit	week	$1,207	3	$3,621	5
- Fans	each	$193	10	$1,929	6
- Skid-mounted GAC system	each	$5,000	1	$5,000	7
Freight for above supplied equipment	1	5%	22,976	$1,149	8
Installation labor	hr	$180	172	$30,960	9
Licensed electrician	day	$800	2	$1,600	10
Pressure field extension test	each	$7,250	1	$7,250	11
			Subtotal	**$72,055**	
ISCO Pre-Design Studies					
Bench scale tests to determine SOD	each	$7,500	2	$15,000	65
Data Evaluation and Reporting	ls	$2,500	1	$2,500	
			Subtotal	**$17,500**	
In-Situ Chemical Oxidation (ISCO) Injections					66
ISCO H&S Plan	ls	$5,000	1	$5,000	
Permitting and Authorizations	ls	$10,000	1	$10,000	
ISCO Equipment					
Pumping Skid	day	$150	74	$11,100	
Trailer	day	$70	74	$5,180	
Health and Safety	day	$50	74	$3,700	
Hose, Fittings, Disposables	ls	$3,000	1	$3,000	
Misc Equipment	ls	$2,000	1	$2,000	
Tankage (5,000 gallon)	day	$140	74	$10,360	
Secondary Containment	day	$55	74	$4,070	
Tank Mobilization	ls	$750	1	$750	
Permanganate	lb	$1.75	89,000	$155,750	
Water	gal	$0.01	356,000	$3,560	
Utilities	ls	$1,000	1	$1,000	
ISCO Application					
Preparation, Mob, Demob	day	$1,500	5	$7,500	
Injection	day	$1,500	74	$111,000	61
Travel, Meals	day	$220	74	$16,280	62
			Subtotal	**$350,250**	
Monitoring Well Installation					
Mobilization/Demobilization	ls	$1,800	1	$1,800	34
Drilling of 2" casing vertical wells	ft	$20	660	$13,200	32
Supply and install 2" flush mount covers	each	$150	6	$900	31
Supply and install 2" PVC piping	ft	$16	660	$10,641	32 , 55
Well surface completions	each	$175	6	$1,050	28
Monitoring Well Development	hour	$160	12	$1,920	39
Hydrant Fees	each	$175	1	$175	40
Road Opening Permits	each	$350	1	$350	42
Concrete/Asphalt Coring	each	$175	6	$1,050	41
		Subtotal, Well Installation		**$31,086**	

	Unit	Unit Cost	Quantity	Present Value	
Prepare site-specific OM&M Plan	each	$20,000	1	**$20,000**	12
Waste Disposal					
Frac Tank rental (5000 gallons)	ls	$1,000	1	$1,000	67
Drums for cuttings					
- In-Situ Chemical Oxidation	each	$45	2	$90	18
Disposal of Cuttings					
- In-Situ Chemical Oxidation	hour	$150	4	$600	17
		Subtotal, Waste Disposal		**$1,690**	
		Subtotal, Capital Costs		**$508,581**	

Remedial Action Cost Estimate

Subtotal Remedial Action Capital Cost	$508,581	
Contingency (15%)	$17,871	
Contingency for ISCO System (25%)	$91,938	35
Remedial Design (15 %)	$76,287	63 , 57
Project Management (8 %)	$40,686	63 , 57
Construction Management (10%)	$50,858	63 , 57
Total Remedial Action Capital Cost	**$786,221**	

OPERATIONS AND MAINTENANCE COSTS

	Unit	Unit Cost	Quantity	Present Value	
Sub-Slab Depressurization					
Annual certification of system performance	hour	$120	24	$2,880	14
Maintenance visits	hour	$75	96	$7,200	64
Field analytical with PID	visit	$120	12	$1,440	54
GAC system vapor sampling	event	$825	2	$1,650	43
Carbon regeneration and replacement	lb	$1.50	800	$1,200	50
Freight for carbon shipments	event	$500	2	$1,000	45
Sampling manpower	day	$600	2	$1,200	51
Misc. supplies and expenses	visit	$50	12	$600	46
Subslab, indoor and outdoor air samples	event	$1,375	2	$2,750	44
			Annual Subtotal	$19,920	
Subtotal, SSD System Present Value at 5% Discount Rate for 5 years				**$90,555**	
Groundwater Monitoring					
Sampling for 7 years for VOCs in 9 wells	yr	$5,995	1	$5,995	60
			Annual Subtotal	$5,995	
Subtotal, GW Monitoring Present Value at 5% Discount Rate				**$36,424**	

Total O&M Costs	$126,979
Project Management Costs (8%)	$10,158
Contingency (10%)	$12,698
Total Present Worth of Annual Operations and Maintenance Costs	**$149,835**

TOTAL PRESENT WORTH OF COSTS **$936,057**

Non-Discounted Annual O&M Cost, Year 1-5	**$30,580**
Non-Discounted Annual O&M Cost, Year 6-7	**$7,074**

TABLE 8-4
ALTERNATIVE 4: AIR SPARGING/SOIL VAPOR EXTRACTION OF OFF-SITE GROUNDWATER
700-712 MAIN STREET
NORTH HEMPSTEAD, NASSAU COUNTY, NY

Item Description	Unit	Unit Cost	Quantity	Total Cost	Reference
<u>CAPITAL COSTS</u>					
Sub-Slab Vapor and Indoor/Outdoor Air Investigation	ls	$16,000	1	**$16,000**	1
Sub-Slab Depressurization System					
Communication test	each	$8,120	1	$8,120	2
Supply					
- Piping (3-inch PVC schedule 40)	ft	$1.99	2,080	$4,135	3
- Fittings (elbows, vent caps, clamps, etc.)	ls	$8,291	1	$8,291	4
- Core drill rental and bit	week	$1,207	3	$3,621	5
- Fans	each	$193	10	$1,929	6
- Skid-mounted GAC system	each	$5,000	1	$5,000	7
Freight for above supplied equipment	1	5%	22,976	$1,149	8
Installation labor	hr	$180	172	$30,960	9
Licensed electrician	day	$800	2	$1,600	10
Pressure field extension test	each	$7,250	1	$7,250	11
			Subtotal, SSD	**$72,055**	
Soil Vapor Extraction					13
Drilling of 2" casing vertical wells	ft	$20	1485	$29,700	15
Supply and install 2" flush mount covers	each	$150	27	$4,050	31
Supply and install 2" PVC piping	ft	$16	2285	$36,842	20 , 55
Supply and install flow control valves	each	$150	27	$4,050	33
Supply and install flow meter	each	$250	6	$1,500	59
Supply and install vacuum port & sample ports	each	$37	27	$999	19
Supply and install misc. pipe fittings, etc.	well	$99	27	$2,660	21
Control system	each	$5,000	1	$5,000	22
Trailer for blower and controls	each	$8,726	1	$8,726	23 , 55
Supply and install blower (580 SCFM, 30 H.P)	each	$15,081	7	$105,568	24 , 55
Condensate tank and pump	each	$716	1	$716	25
Concrete/Asphalt Coring	each	$175	27	$4,725	26
GAC system	each	$20,664	8	$123,984	27
Well surface completions	each	$175	27	$4,725	28
Conduct Pilot Test	ls	$25,000	1	$25,000	29
Cutting/ Fluids Handling/ Decontamination	hour	$150	27	$4,050	38
Mobilization/Demobilization	ls	$1,800	1	$1,800	34
Hydrant Fees	each	$175	1	$175	40
Road Opening Permits	each	$350	1	$350	42
		Subtotal, Soil Vapor Extraction		**$364,619**	
Air Sparging					13
Drilling of 2" casing vertical wells	ft	$20	3955	$79,100	30
Supply and install 2" flush mount covers	each	$150	39	$5,850	31
Supply and install 2" PVC piping	ft	$16	5155	$83,115	30 , 55
Supply and install flow control valves	each	$150	39	$5,850	33
Supply and install misc. pipe fittings, etc.	ls	$99	39	$3,842	21
Supply and install flow meter	each	$250	6	$1,500	59
Supply and install vacuum port & sample ports	each	$37	39	$1,443	19
Mobilization/Demobilization	ls	$1,800	1	$1,800	34
Well surface completions	each	$175	39	$6,825	28
Cutting/ Fluids Handling/ Decontamination	hour	$160	39	$6,240	38
Concrete/Asphalt Coring	each	$175	39	$6,825	36
Blowers (426 scfm, 84 H.p., 30 psi)	each	$18,584	1	$18,584	37 , 55
Hydrant Fees	each	$175	0	$0	40
Road Opening Permits	each	$350	0	$0	42
		Subtotal, Air Sparging		**$220,974**	

Monitoring Well Installation					
Mobilization/Demobilization	ls	$1,800	1	$1,800	34
Drilling of 2" casing vertical wells	ft	$20	660	$13,200	32
Supply and install 2" flush mount covers	each	$150	6	$900	31
Supply and install 2" PVC piping	ft	$16	660	$10,641	32 , 55
Well surface completions	each	$175	6	$1,050	28
Monitoring Well Development	hour	$160	12	$1,920	39
Hydrant Fees	each	$175	1	$175	40
Road Opening Permits	each	$350	1	$350	42
Concrete/Asphalt Coring	each	$175	6	$1,050	41
		Subtotal, Well Installation		**$31,086**	
Prepare site-specific OM&M Plan	each	$20,000	1	**$20,000**	12
Waste Disposal					
Frac Tank rental (5000 gallons)	ls	$1,000	1	$1,000	67
Drums for cuttings					
- Air Sparging System	each	$45	8	$357	16
- Soil Vapor Extraction System	each	$45	4	$180	16
Disposal of Cuttings					
- Air Sparging System	hour	$150	8	$1,200	17
- Soil Vapor Extraction System	hour	$150	8	$1,200	17
		Subtotal, Waste Disposal		**$31,086**	
		Subtotal, Capital Costs		**$755,820**	
				Remedial Action Cost Estimate	
		Subtotal Remedial Action Capital Cost		$755,820	
		Contingency (15%)		$113,373	56 , 57
		Remedial Design (12 %)		$90,698	56 , 57
		Project Management (6 %)		$45,349	56 , 57
		Construction Management (8%)		$60,466	56 , 57
		Total Remedial Action Capital Cost		**$1,065,706**	56 , 57

OPERATIONS AND MAINTENANCE COSTS

	Unit	Unit Cost	Quantity	Present Value	
Sub-Slab Depressurization					
Annual certification of system performance	hour	$120	24	$2,880	14
Maintenance visits	hour	$75	96	$7,200	64
Field analytical with PID	visit	$120	12	$1,440	54
GAC system vapor sampling	event	$825	2	$1,650	43
Carbon regeneration and replacement	lb	$1.50	800	$1,200	50
Freight for carbon shipments	event	$500	2	$1,000	45
Sampling manpower	day	$600	2	$1,200	51
Misc. supplies and expenses	visit	$50	12	$600	46
Subslab, indoor and outdoor air samples	event	$1,375	2	$2,750	44
			Annual Subtotal	$19,920	
Subtotal, SSD System Present Value at 5% Discount Rate for 5 years				**$90,555**	
AS/SVE Maintenance (annual costs)					
Equipment maintenance and parts	weeks	$600	52	$31,200	48
Electrical usage	kilowatt-hr	$0.14	1,920,506	$268,871	47
O&M manpower	weeks	$600	52	$31,200	48
Carbon changeout (cost for freight and forklift rental)	event	$2,500	2	$5,000	49
Carbon regeneration and replacement	lb	$1.50	16,000	$24,000	50
Sampling manpower	day	$600	2	$1,200	51
GAC system vapor sampling	event	$3,300	2	$6,600	52
Field air monitoring with PID	day	$150	56	$8,400	53
			Annual Subtotal	$376,471	
Subtotal, SVE System Present Value at 5% Discount Rate for 2 years				**$735,014**	

Groundwater Monitoring					
Sampling for 7 years for VOCs in 9 wells	yr	$5,995	1	$5,995	
			Annual Subtotal	$5,995	
			Subtotal, GW Monitoring Present Value at 5% Discount Rate	**$36,424**	60
			Total O&M Costs	$861,993	
			Project Management Costs (8%)	$68,959	
			Contingency (10%)	$86,199	
			Total Present Worth of Annual Operations and Maintenance Costs	**$1,017,152**	
TOTAL PRESENT WORTH OF COSTS				**$2,082,859**	
			Non-Discounted Annual O&M Cost, Year 1-2	$474,815	
			Non-Discounted Annual O&M Cost, Year 3-5	$30,580	
			Non-Discounted Annual O&M Cost, Year 6-7	$7,074	

NOTES FOR TABLE 8-2, 8-3, AND 8-4
700-712 MAIN STREET
NORTH HEMPSTEAD, NASSAU COUNTY, NY

Notes

1 Cost includes collection and TO-15 analysis of 10 indoor air samples, 10 sub-slab vapor samples, and 2 outdoor air samples in the area overlying impacted off-Site groundwater. Costs are based on prior project experience.

2 Cost includes performance of a 10-day communications test to determine the optimum spacing of the SSD system. Cost based on the average of 2 bids obtained for a 2,700 sf building located in Watkins Glens, NY. The average cost and duration of that work was $725 and 1 day. Thus, 10 days was assumed for completion of a communication test at 1025 Old Country Road, for a total cost of $7,250 and adjusted for inflation. Cost adjusted to Long Island costs using a means localization factors of 1.12

3 Cost includes supply of 3-inch diameter PVC schedule 40 piping (McMaster-Carr 2003 catalog). Quantity based on the amount of piping that would be needed throughout the building. A total of 160' would be needed for each main run through the building, 10' for miscellaneous turns and connections to outside , and a total of ten runs would be needed. In addition, 340' of discharge piping is needed as well as a 40' stack for discharge. Thus, the total amount of piping would be 2080 feet.

4 Cost includes supply of fittings, including elbows, vent caps, and clamps. Lump sum of individual costs based on previous ERM experience.

5 Cost based on a quote obtained from American Rent-all, Inc. of New Hyde Park, NY for a weekly rental of drilling equipment. Quantity assumes 3 weeks to install points

6 Cost based on a quote obtained from RadonAway, Inc. of Ward Hill, MA for a model # GP501 fan. Quantity based on one fan for every five extraction points; the SSD system would include 50 extraction points. Thus, 10 fans would be needed.

7 Cost includes supply of 200-lb dual phase granular activated carbon (GAC) system operated in series or parallel. System includes two 200-lb carbon beds. The cost is based on previous ERM experience.

8 Cost includes transport of references 3 to 7. Cost based on 5% of these supplied costs, and based on previous ERM experience.

9 Cost includes labor for two personnel for four weeks, plus 12 hours of setup. The unit costs are $100/hr and $80/hr for the two personnel, and are based on previous ERM experience.

10 Cost accounts for the labor of an electrician for 2 days to install fans and associated materials. Unit cost based on previous ERM experience.

11 Cost includes a pressure field extension test that would be used to confirm that the SSD system is adequately spaced to extract vapors. This test would take 10 days. Unit cost was obtained from an average of quotes provided by EnviroTesting, Inc. and Seabird Environmental, Inc.

12 Cost based on previous ERM experience.

13 The AS/SVE system would be installed beneath 1025 Old Country Road, both inside and outside the building, which is approximately 350 feet long by 180 feet wide. Inside the building, 50 air sparging points would be necessary, and 20 soil vapor extraction points would be installed. Outside the building, 8 air sparging points and 7 soil vapor extraction points would be installed.

14 Cost accounts for the services of a professional engineer or other acceptable professional to visit site, confirm engineering controls are in place and are performing properly and remain effective, and report results in a document.

15 Cost includes installation of 27, 2" diameter extraction points would be installed to a depth of 55 feet bgs. Unit cost based on pricing developed in the RI phase. Quantity based on drilling depths and number of points. (27 points X 55 feet bgs = 1,485 feet.)

16 55-gallon drums would be used to collect the cuttings from installation of the AS/SVE system. A 70% porosity is assumed for the soil above the groundwater table, and the soil below the groundwater table. The AS system would require the collection of cuttings from 120 foot bgs wells as well as 90 foot bgs wells: (29 wells X 90 feet X (1"-radius)^2 X PI X 70% porosity) + (10 wells X 120 feet X (1"-radius)^2 X PI X 70% porosity) = 58 cubic feet. 58 cubic feet X 7.5 gallons/cubic foot = 436 gallons. 436 gallons/55-gallon drums= 8 drums. The SVE system would require the collection of cuttings from 55 foot bgs wells: 27 wells X 55 feet X (1"-radius)^2 X PI X 70% porosity= 23 cubic feet X 7.5 gallons/cubic foot = 170 gallons. 170 gallons/55-gallon drums = 4 drums. Unit cost based on pricing developed in the RI phase.

NOTES FOR TABLE 8-2, 8-3, AND 8-4
700-712 MAIN STREET
NORTH HEMPSTEAD, NASSAU COUNTY, NY

Notes

17 Disposal of cuttings would require approximately 2 personnel at $75/hour. Unit cost based on pricing developed in the RI phase.

18 55-gallon drums would be used to collect the cuttings from installation of the ISCO system. A 70% porosity is assumed for the soil above the groundwater table, and the soil below the groundwater table. The ISCO system would require the collection of cuttings from 120 foot bgs wells as well as 90 foot bgs wells: (3 wells X 90 feet X (1"-radius)^2 X PI X 70% porosity) + (3 wells X 120 feet X (1"-radius)^2 X PI X 70% porosity) = 10 cubic feet. 10 cubic feet X 7.5 gallons/cubic foot/55-gallon drums= 2 drums. Unit cost based on pricing developed in the RI phase.

19 Sample ports would be used for pressure gauging and sampling. Unit cost based on previous ERM experience. Each port would require 1/2 hour to install ($50/hour labor cost) and $12/port for sampling purposes. Quantity based on the number of points.

20 Unit cost obtained from RS Means (A), 3-345. Cost assumes 5 runs and piping to connect the runs to a blower. An average of 40 feet between each of the vapor points was assumed as well as use of 2" diameter PVC, Schedule 40 piping.

21 Cost includes couplings, elbows, and tees for each point. Unit cost obtained from McMaster Carr, 2003. Quantity based on the number of points.

22 Cost includes control panel, motor starters, etc. Unit cost based on previous ERM experience. Quantity based on the size of the AS/SVEN system.

23 Cost assumes a 8ft X 20ft trailer to house the blowers. Unit cost obtained from RS Means, 3-345. Quantity based on the size of the blowers. Each blower is 3 feet long by 3 feet wide by 3 feet high.

24 Seven, 580 scfm blowers would be needed. Each blower is 3 feet long by 3 feet wide by 3 feet high. Unit cost obtained from RS Means (A), 3-345.Blower size is based on a 10cfm/ft gas flow rate as recommended by RS Means (B) Methods, 2003 and a 20 foot screening length. 10cfm/ft X 20feet X 27 wells = 5400 cfm gas flow rate. The gas flow rate was assumed to be approximately 27.5% less based on previous experience, resulting in a 3900 cfm flow rate. Thus 7, 580 cfm blowers would be needed.

25 Cost includes the supply and installation of one 550 gallon polyethylene tank and a 1/2 HP Berkeley centrifugal pump to collect condensate. Unit cost obtained from USA Bluebook catalog 2004-2005.

26 The extraction points will have to be drilled through concrete or asphalt. Unit cost based on pricing developed during the RI phase. Quantity based on the number of points.

27 Cost assumes supply and installation of eight 2,000 SCFM GAC dual phase vessels (i.e., 2 adsorbers per each vessel). This would provide primary and secondary beds for treatment of 4,000 cfm of vapors and replacement beds to allow semi-annual regeneration. The unit cost for each dual bed, 2000 CFM Parallel Series, 2000lb fill unit was obtain from RS Means (A), 3-51.

28 Cost assumes that for each well or point, a concrete pad, manhole, and cover with cap would be needed. Unit cost based on pricing developed during the RI phase. Quantity based on number of points or wells.

29 A pilot test would be conducted in a small area using the newly installed monitoring wells to refine the radii of influence for the air sparging and soil vapor extraction points. The cost includes labor for one week, carbon canisters, and groundwater sampling, and is based on previous ERM experience.

30 Unit cost for 2" PVC obtained from RS Means (A), 3-345 and drilling costs based on priving developed in RI. Thirty-one points would be installed in the Site building, and 8 points would be installed outside of the building. Quantity based on number of points and depths of each well. 5 main runs across the building would be used to transport the air from the blowers to the points, and an additional 160 feet would be used to connect these runs. The piping for the points outside would approximately equal 160 feet as well. 200 feet + 200 feet+ 160 feet+ 160 feet+ 120 feet + (160 feet + 160 feet) = 1,160 feet for piping. Piping (well casings, 2" PVC) would also be used to install the points. Ten of these points would be installed to a depth of 120 feet bgs, and 29 points would be installed to a depth of 95 feet bgs. (10 points X 120 feet) + (29 points X 95 feet bgs) = 3,955 feet for well casings. Thus, the entire length of PVC needed would be 1,160 feet + 3,995 feet = 5,155 feet.

31 Unit cost based on previous ERM experience. Quantity based on the number of points.

NOTES FOR TABLE 8-2, 8-3, AND 8-4
700-712 MAIN STREET
NORTH HEMPSTEAD, NASSAU COUNTY, NY

Notes

32 Cost includes the drilling of three nested pairs of wells with a 2-inch diameter to a depth of approximately 95 feet (shallow) and 125 fee (shallow)t. The unit cost is based on costs developed during the RI phase. Quantity based on number of wells and depth of drilling. 3 wells X 125 feet bgs = 375 feet bgs, and 3 wells X 95 feet bgs = 285 feet bgs.

33 Unit cost is based on previous ERM experience. Quantity based on installing a valve for each point.

34 Cost based on pricing developed in RI. Cost accounts for mobilization of drilling equipment to and from the Site.

35 Contingency for the ISCO system would be 25%.

36 Supplemental cost for installing air sparge injection points through concrete or beneath asphalt . Unit cost based on pricing developed during the RI phase. Quantity based on the number of points.

37 Blower size and price obtained from RS Means (B) for a water column height of 35 to 65 feet and RS Means (A), 3-6. Blower size based on an assumed extraction flow rate of 10 CFM. Thus, 39 points X 10 CFM = 390 cfm total flow rate. The next largest blower was assumed.

38 Cost includes drillers labor surcharge for handling of fluids and cuttings generated during points drilling, and decontamination of the equipment. Quantity assumes that 2 points can be drilled per day and this work takes 2 hours/day to complete. 27 days/2 wells X 2 hours = 27 hours. Unit cost based on pricing developed during the RI phase.

39 The development of 3 nested pairs of new monitoring wells would take 6 hours. The unit cost is based on costs developed during the RI phase.

40 Cost covers the use of water during drilling activities. Unit cost based on pricing developed during the RI phase. Assumed one hydrant could be used for air sparge and SVE drilling.

41 The monitoring wells would have to be drilled through concrete sidewalks or asphalt. Unit cost based on pricing developed during the RI phase. Quantity based on the number of wells.

42 Cost assumes that the points along Old Country Road could be installed using a road opening permit. The unit cost is based on costs developed during the RI phase.

43 Cost includes summa canister collection and TO-15 analysis of samples: one at the primary bed inlet, one at the primary bed outlet, and one at the secondary bed outlet for each carbon vessel for a total of three samples per vessel. The samples would be taken semi-annually. Quote of $275 per sample obtained from Air Toxics of Folsom, CA for VOCs using TO-15.

44 Two subslab samples, two indoor samples, and one outdoor air (i.e., background) sample would be taken semi-annually at $275/ sample.

45 Quote for the transportation and disposal of spent carbon during the changeout was obtained from Environmental Service Group of Buffalo, NY.

46 Cost includes gloves, sample tubing, mileage to/from site, etc., per monthly visit and is based on previous ERM experience.

47 The amount of electricity that would be used is based on the following formula for each 30-HP blower for the AS/SVE system: 30 HP x (0.7457 kw/HP) x 24 hr/day x 365 day/year = 195,970 kw-hr. 195, 970 kw-hr X 7 blowers (AS/SVE) = 1,371,790 kw-hr. In addition, electricity would be used the SSD blower: 84 HP X (0.7457 kw/HP) X 24 hours/day X 365 days/year = 548,716 kw-hrs. Thus, in total, 1,371,790 kw-hrs + 548,716 kw-hrs = 1,920,506 kw-hours. The unit cost was obtained from the Long Island Power Authority typical rates.

48 Cost accounts for a weekly site visit for operations and maintenance of the system at $75/hour for an 8-hour day.

49 The cost includes transportation of the spent GAC to the regeneration facility ($1200), material shipment back to the Site ($800), and forklift rentals ($500). Cost based on previous ERM experience.

50 Cost assumes one changeout every six months would be required. Carbon would be regenerated and replaced. Quote was obtained from Envirotrol of Sewickley, PA. Quantity based on regenerating each vessel: Two 200-lb vessels for the SSD system, and 4, 2,000 vessels for the AS/SVE system. For the SSD systems, 2 vessels X 200 lbs/vessel = 400 lbs would be regenerated semi-annually (800 lbs anually). For the AS/SVE system, 2,000 lbs/vessel X 4 vessels = 8,000 lbs would be regenerated semi-annually (1,600 lbs anually).

51 Sampling of extracted vapors would occur semi-annually and would require one 8-hour day at $75/hour.

Notes

52 Cost includes collection and analysis of three samples at the carbon inlet, carbon outlet, and an intermediate sample taken at the carbon vessel. The samples would be taken semi-annually. Quote of $275 per sample obtained from Air Toxics of Folsom, CA for VOCs using TO-15. Therefore, a total of twelve samples (4 trains X 3 samples/train) would be collected at each event.

53 During weekly site visits, PID measurements would be collect on a quarterly bases and be compared against laboratory analytical results. Additional field monitoring would occur during the quarterly sampling events. Unit cost for PID rental.

54 Cost accounts for the monthly rental of a Photoionization Detector (PID) for GAC inlet and outlet measurements.

55 Costs were adjusted to 2006 using a conservative construction goods inflation rate of 7%/year, as recommended by RS Means (http://www.constructionbook.com/xq/ASP/ProductID.5036/id.460/qx/default2.htm) and a localization factor of 1.25.

56 A scope contingency of 10% and bid contingency of 5% was assumed for a total contingency 15%. Indirect costs for project management, remedial design, and construction management are based on a percentage of capital costs. The following summarizes percentages applied for these costs. These percentages were obtained from USEPA July 2000 "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". USEPA recommends project management costs for O&M as 5 to 10% of O&M costs (USEPA, 2000).

57

Exhibit 5-8
Example Percentages for Professional/Technical Services Capital Costs

Capital Cost Element	< $100K (%)	$100K-$500K (%)	$500K-$2M (%)	$2M-$10M (%)	> $10M (%)
Project Management	10	8	6	5	5
Remedial Design	20	15	12	8	6
Construction Management	15	10	8	6	6

58 Bench scale tests will be conducted in order to determine the Site-specific soil oxidant demands and estimate more accurate dosages of oxidant.

59 Cost based on previous ERM experience. Cost includes the installation of a flow meter every 7 or 8 points.

60 Groundwater sampling would occur annually for 15 years for Alternative 2 or for 7 years in Alternatives 3 and 4. VOCs would be sampled, and in Alternative 2, the following additional parameters would be sampled or field monitored: dissolved oxygen, nitrates, sulfates, dissolved iron, carbon dioxide and methane. It is assumed that sampling would require the use of 2 personnel five days a year at $75/hour/person at 10 hours per day. Samples would be taken at each of the 9 wells (3 nested wells, NC-12, and MW 01D/S), as well as 4 additional samples for quality control (QC) as a field blank, trip blank (for VOC analysis only), MS/MSD, and duplicate. Samples of VOCs only would cost $115 each, and samples for VOC analysis as well as additional parameters (Alternative 2) would be $335 each. Additional costs would be incurred due to the collection of extra samples per visit for data quality objectives. For Alternatives 3, and 4: (9 wells X 1 sample/ well X $115/sample) + (4 QC samples X $115/sample) = $1,495. For Alternative 2: (9 wells X 1 sample/well X $335/well) + (3 QC samples X $335/sample) + (1 VOC QC sample X $115/sample) = $4,135.

61 Cost accounts for the labor of 2 field personnel, 10 hours daily.

62 Cost accounts for trucks, mileage, and meals for 2 field personnel.

63 Cost accounts for the use of drums during the drilling 39, 2-inch diameter points drilled in an area with a depth to water of 50 feet below ground surface.

64 Cost accounts for a monthly visit by a field personnel.

65 Cost based on previous ERM experience. Pre-design studies would determine the natural oxidant demand in the ground.

66 Six points would be used as injection points of potassium permanganate. 3 points would be injected at depths of 90 to 120 feet bgs to the southwest portion of 1025 Old Country Road. The remaining 3 points would be injected at depths of 60 to 90 feet bgs to the southwest of 1025 Old Country Road. The SOD was assumed to be 2 g/kg and the number of workdays required for injection of 89,000 pounds of oxidant in a 3% solution is assumed to be 74 days.

NOTES FOR TABLE 8-2, 8-3, AND 8-4
700-712 MAIN STREET
NORTH HEMPSTEAD, NASSAU COUNTY, NY

Notes

67 Cost based on previous ERM experience. The frac tank would be used to collect water during installation of the AS system and the ISCO system.

FIGURES

TITLE

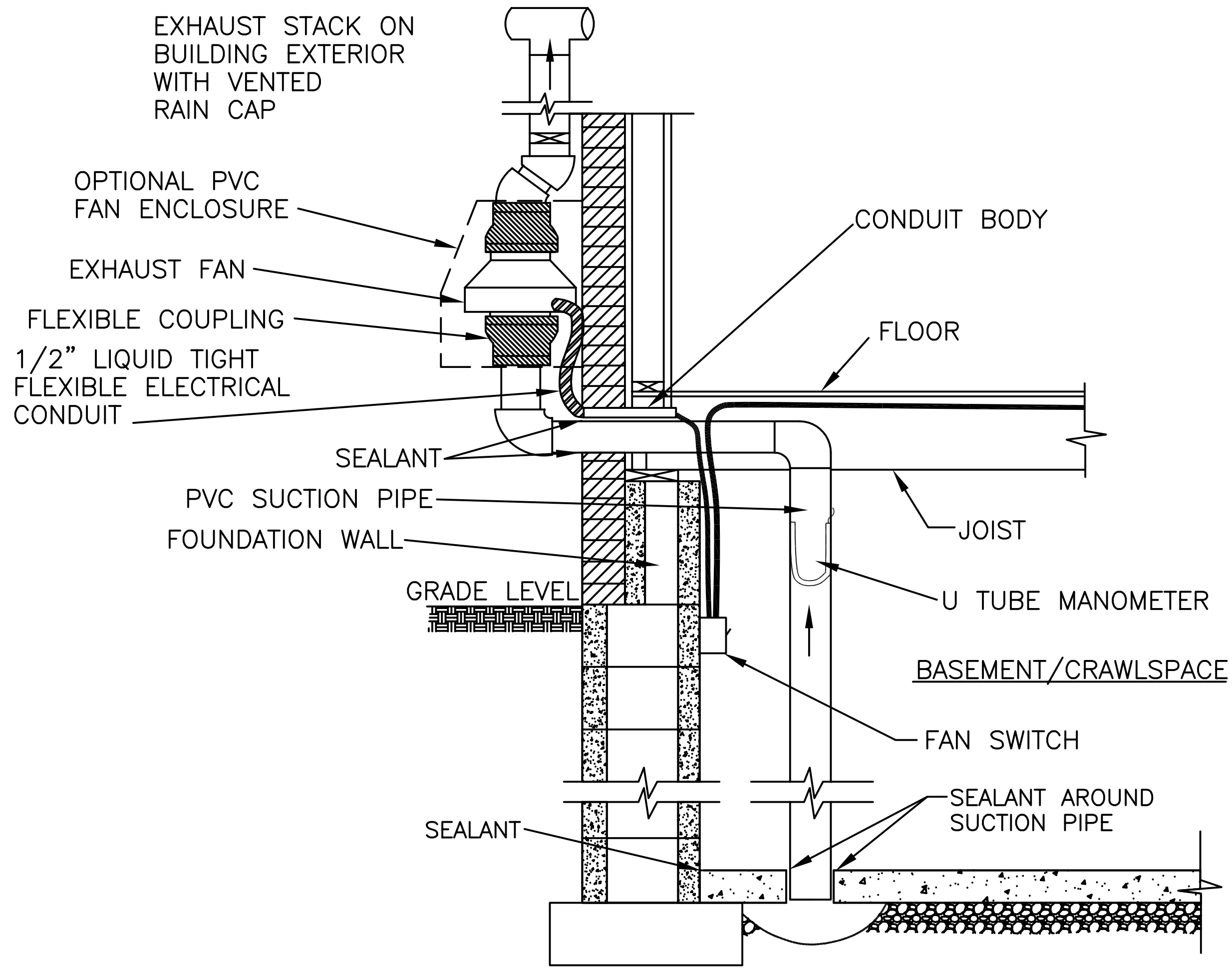
LOCATIONS OF MONITORING WELLS

PREPARED FOR

NYSDEC SITE CODE No.1–30–043H

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
EMF/CWW	0020117	0020117–00–024	GRAPHIC	8–1
			DATE: 2/16/06	



TYPICAL SECTION
NOT TO SCALE

SOURCE: NYSDOH VI PRESENTATION

TITLE: SCHEMATIC OF THE SUBSLAB DEPRESSURIZATION SYSTEM				
PREPARED FOR: NYSDEC SITE CODE NO. 1-30-043H				
ERM Environmental Resources Management			SCALE: NTS	FIGURE: 8-2
DRAWN: EMF/CWW	JOB NO.: 0020117	FILE NAME: 0020117-00-023	DATE: 2/16/06	

LEGEND

- EXISTING MONITORING WELL LOCATION
- NEW NESTED MONITORING WELL LOCATION
- DEEP ISCO INJECTION POINTS (90'–120' bgs)
- SHALLOW ISCO INJECTION POINTS (60'–90' bgs)

0 300' 600'

APPROX. GRAPHIC SCALE

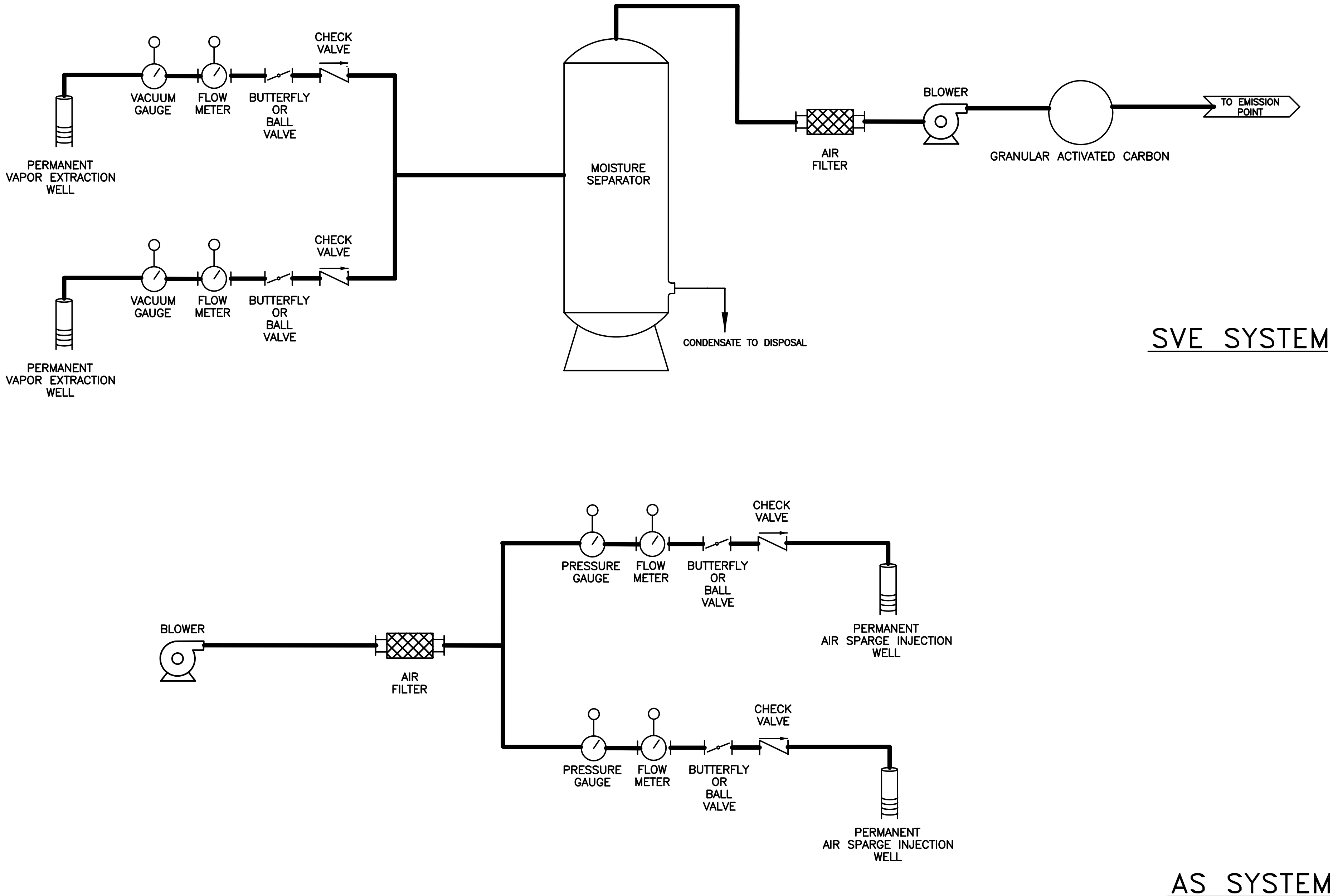
N

TITLE
LOCATIONS OF PROPOSED
ISCO INJECTION POINTS
UTILITLY MANUFACTURING
700–712 MAIN STREET
NEW CASSEL, NEW YORK

PREPARED FOR
NYSDEC SITE CODE No.1–30–043H

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
EMF/CWW	0020117	0020117–00–027	GRAPHIC	8–3
			DATE: 2/16/06	



NYSDEC SITE CODE NO. 1-30-043H

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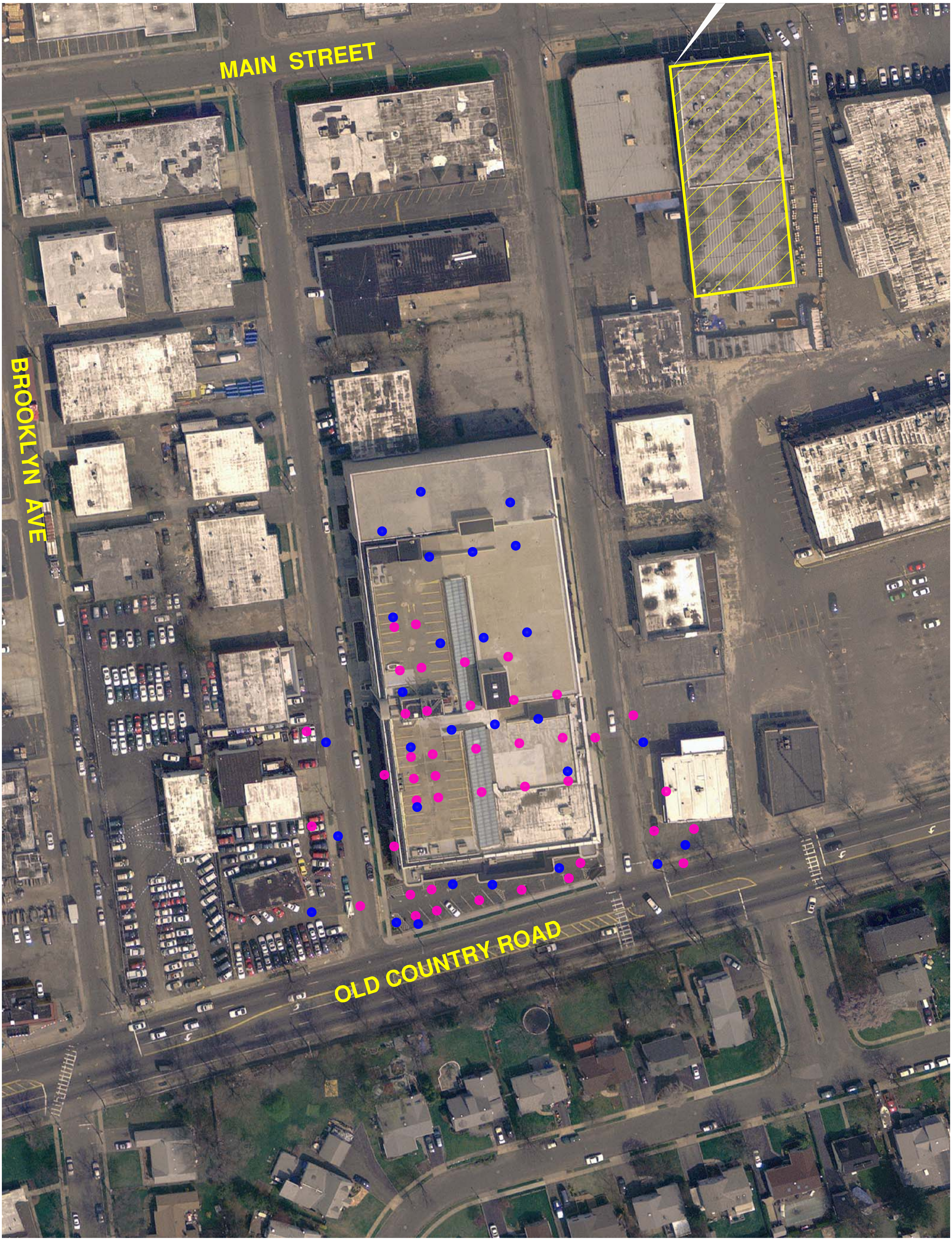
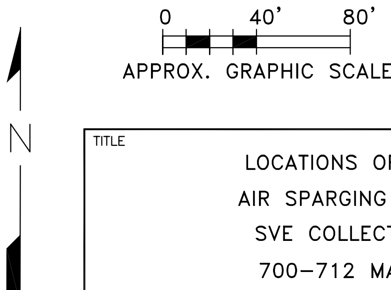
SCHEMATIC OF THE PROPOSED AS/SVE SYSTEMS

FIGURE 8-4

DRAWN YS/EMF/CWW | DATE 2/16/06 | SCALE NONE | JOB NO. 0020117 | FILE NAME 0020117-00-025

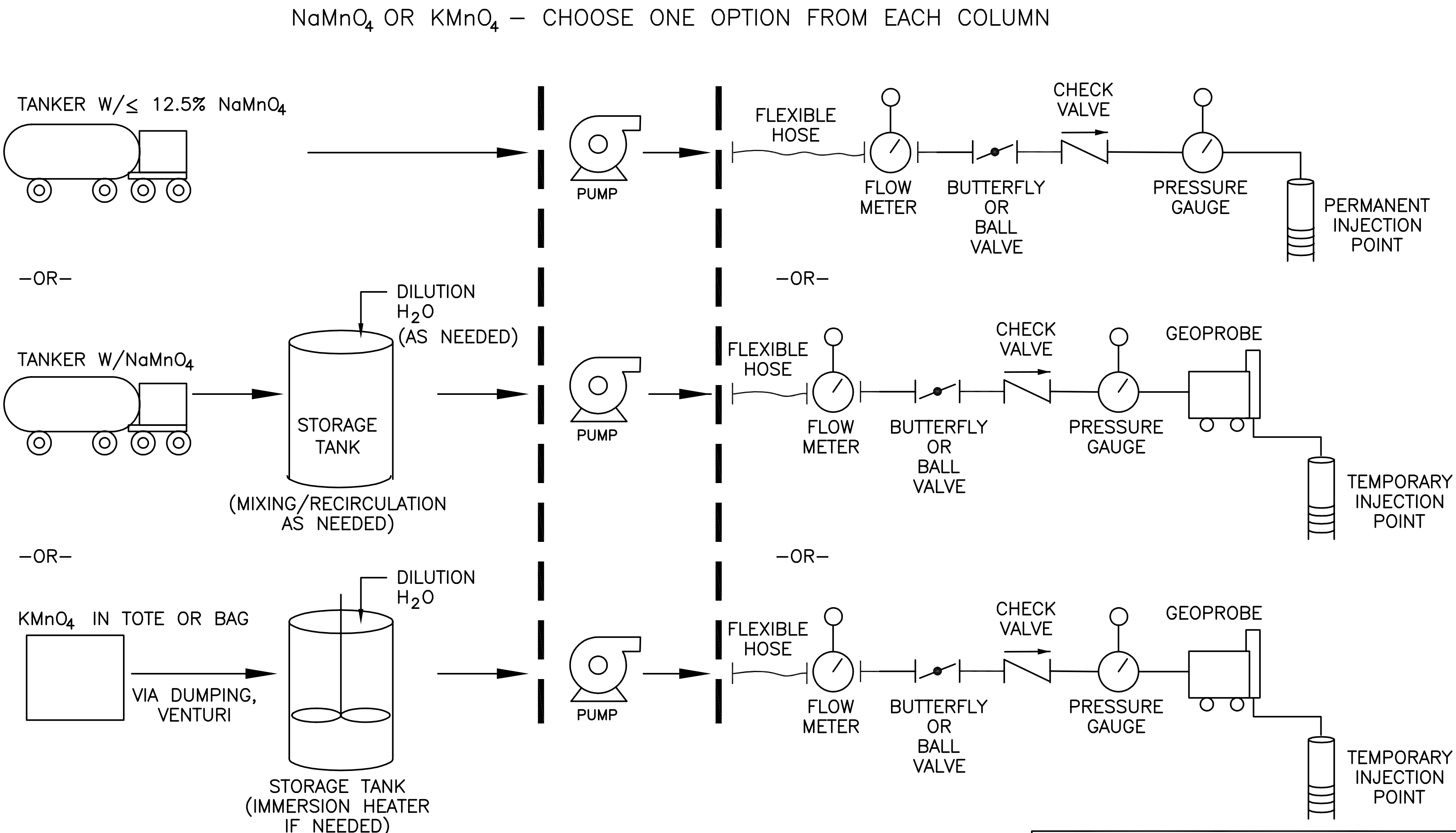




LEGEND

- SVE POINTS
- AS POINTS

TITLE LOCATIONS OF PROPOSED AIR SPARGING POINTS AND SVE COLLECTION AREAS 700–712 MAIN STREET NEW CASSEL, NEW YORK	
PREPARED FOR NYSDEC SITE CODE No. 1–30–043H	
ERM Environmental Resources Management	SCALE GRAPHIC DATE 2/16/06 FIGURE 8–5
DRAWN: EMF/CWW · JOB NO.: 0020117 · FILE NAME: 0020117-00-026	



TITLE

SCHEMATIC OF THE IN-SITU CHEMICAL OXIDATION SYSTEM

PREPARED FOR

NYSDEC SITE CODE NO. 1-30-043H

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	DATE	FIGURE
EMF/CWW	0020117	0020117-00-028	NTS	2/16/06	8-6

APPENDIX F

Alternative 8, NCIA Sites OU-3, ROD, New Cassel Industrial Sites


Legend
NOTE: All locations are approximate
Treatment well (140 ft BGS)
Treatment well (225 ft BGS)
Treatment well
(250 ft BGS)
Planned off-site treatment system
Active on-site treatment system
Planned on-site treatment system
Average total VOC concentration (ppb)
for groundwater depths of 65 to 200 ft bgs
1996-2000 plumes)
Early warning wells Couplet
Monitoring well Couplet
Monitoring well
Monitoring well Quadruplet
0
600 ft
APPROX. SCALE
1 in. = 600 ft
N
Bowling Green Well Field
OLD COUNTRY ROAD
MAIN STREET
BOULEVARD
RAILROAD
ISLAND
SUMMA
STREET
AVENUE
GRAND
MAGNOLIA
GARDEN
HOPPER
SWALM
URBAN
KINKEL
NEW YORK
STATE
BOND
FROST
CARMAN
FIELDSTONE
GRAYSTON
ELTON
HILTON
BRYANT
MASON
FLOWER
HYACINTH
CHOIR
CAMEO
SALISBURY
VOLANTE
REGENT
100
1000
\650\428\graphics\alternative map.dsf
Appendix F
Alternative 8
Full Plume Remediation of Upper and Deep Portions of the Aquifer to 225 ft bgs with In-Well Vapor Stripping/Localized Vapor Treatment
New Cassel Industrial Area
NYSDEC Site No. 130043

APPENDIX G

Travel Time Estimates

TABLE 3

Solute Residence Time: Boring VP-08/SB-27
to New Market Road to Garden City Wells 13 & 14
FS Remedial Option GW-4
150 Fulton Avenue Site - Garden City, NY

Utility Manufacturing Site
PCE Residence Time: Site to Old Country Road

1. Magothy Retardation Factor

Parameter	Unit	Value	Source
Organic Carbon (F_{oc})	dimensionless	0.001	Assumed Value (0.1%)
Bulk Density	kg/L	1.700	Typical Value
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Partition Coefficient (K_{oc} - PCE)	L/kg	364	Pankow and Cherry (1996)
Distribution Coefficient (K_d - PCE)	L/kg	0.364	K_d (PCE) = F_{oc} x K_{oc} (PCE)
Retardation Factor R_f (PCE)	dimensionless	3.475	R_f (PCE) = 1 + ((bulk density/n) x K_d (PCE))

2. From SW Corner of Site to Old Country Road in Magothy Aquifer

Parameter	Unit	Value	Source
Magothy Conductivity (k)	ft/day	100	Prince & Schneider (1989)
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Gradient (i)	dimensionless	0.00115	Measured Gradient: MW-7D to MW-01D
Seepage Velocity (V_w)	ft/day	0.460	Darcy's Law: V_w = ki/n
Mag. PCE Retardation Factor	dimensionless	3.475	Calculated
Travel Distance	feet	600	
Travel Time	years	12.42	

TABLE 3
Solute Residence Time: Boring VP-08/SB-27
to New Market Road to Garden City Wells 13 & 14
FS Remedial Option GW-4
150 Fulton Avenue Site - Garden City, NY

Utility Manufacturing Site
TCE Residence Time: Site to Old Country Road

1. Magothy Retardation Factor

Parameter	Unit	Value	Source
Organic Carbon (F_{oc})	dimensionless	0.001	Assumed Value (0.1%)
Bulk Density	kg/L	1.700	Typical Value
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Partition Coefficient (K_{oc} - TCE)	L/kg	126	Pankow and Cherry (1996)
Distribution Coefficient (K_d - TCE)	L/kg	0.126	K_d (TCE) = F_{oc} x K_{oc} (TCE)
Retardation Factor R_f (TCE)	dimensionless	1.857	R_f (TCE) = 1 + ((bulk density/n) x K_d (TCE))

2. From SW Corner of Site to Old Country Road in Magothy Aquifer

Parameter	Unit	Value	Source
Magothy Conductivity (k)	ft/day	100	Prince & Schneider (1989)
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Gradient (i)	dimensionless	0.00115	Measured Gradient: MW-7D to MW-01D
Seepage Velocity (V_w)	ft/day	0.460	Darcy's Law: V_w = ki/n
Mag. TCE Retardation Factor	dimensionless	1.857	Calculated
Travel Distance	feet	600	
Travel Time	years	6.64	

TABLE 3

Solute Residence Time: Boring VP-08/SB-27 to New Market Road to Garden City Wells 13 & 14 FS Remedial Option GW-4 150 Fulton Avenue Site - Garden City, NY

Utility Manufacturing Site
cis-1,2-DCE Residence Time: Site to Old Country Road

1. Magothy Retardation Factor

Parameter	Unit	Value	Source
Organic Carbon (F_{oc})	dimensionless	0.001	Assumed Value (0.1%)
Bulk Density	kg/L	1.700	Typical Value
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Partition Coefficient (K_{oc} - 1,2-DCE)	L/kg	86	Pankow and Cherry (1996)
Distribution Coefficient (K_d - 1,2-DCE)	L/kg	0.086	K_d (1,2-DCE) = F_{oc} x K_{oc} (1,2-DCE)
Retardation Factor R_f (1,2-DCE)	dimensionless	1.585	R_f (1,2-DCE) = 1 + ((bulk density/n) x K_d (1,2-DCE))

2. From SW Corner of Site to Old Country Road in Magothy Aquifer

Parameter	Unit	Value	Source
Magothy Conductivity (k)	ft/day	100	Prince & Schneider (1989)
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Gradient (i)	dimensionless	0.00115	Measured Gradient: MW-7D to MW-01D
Seepage Velocity (V_w)	ft/day	0.460	Darcy's Law: V_w = ki/n
Mag. 1,2-DCE Retardation Factor	dimensionless	1.585	Calculated
Travel Distance	feet	600	
Travel Time	years	5.66	

TABLE 3

Solute Residence Time: Boring VP-08/SB-27
to New Market Road to Garden City Wells 13 & 14
FS Remedial Option GW-4
150 Fulton Avenue Site - Garden City, NY

Utility Manufacturing Site
1,1-DCE Residence Time: Site to Old Country Road

1. Magothy Retardation Factor

Parameter	Unit	Value	Source
Organic Carbon (F_{oc})	dimensionless	0.001	Assumed Value (0.1%)
Bulk Density	kg/L	1.700	Typical Value
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Partition Coefficient (K_{oc} - 1,1-DCE)	L/kg	65	Pankow and Cherry (1996)
Distribution Coefficient (K_d - 1,1-DCE)	L/kg	0.065	K_d (1,1-DCE) = F_{oc} x K_{oc} (1,1-DCE)
Retardation Factor R_f (1,1-DCE)	dimensionless	1.442	R_f (1,1-DCE) = 1 + ((bulk density/n) x K_d (1,1-DCE))

2. From SW Corner of Site to Old Country Road in Magothy Aquifer

Parameter	Unit	Value	Source
Magothy Conductivity (k)	ft/day	100	Prince & Schneider (1989)
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Gradient (i)	dimensionless	0.00115	Measured Gradient: MW-7D to MW-01D
Seepage Velocity (V_w)	ft/day	0.460	Darcy's Law: V_w = ki/n
Mag. 1,1-DCE Retardation Factor	dimensionless	1.442	Calculated
Travel Distance	feet	600	
Travel Time	years	5.15	

TABLE 3

Solute Residence Time: Boring VP-08/SB-27
to New Market Road to Garden City Wells 13 & 14
FS Remedial Option GW-4
150 Fulton Avenue Site - Garden City, NY

Utility Manufacturing Site

TCA Residence Time: Site to Old Country Road

1. Magothy Retardation Factor

Parameter	Unit	Value	Source
Organic Carbon (F_{oc})	dimensionless	0.001	Assumed Value (0.1%)
Bulk Density	kg/L	1.700	Typical Value
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Partition Coefficient (K_{oc} - TCA)	L/kg	152	Pankow and Cherry (1996)
Distribution Coefficient (K_d - TCA)	L/kg	0.152	K_d (TCA) = F_{oc} x K_{oc} (TCA)
Retardation Factor R_f (TCA)	dimensionless	2.034	R_f (TCA) = 1 + ((bulk density/n) x K_d (TCA))

2. From SW Corner of Site to Old Country Road in Magothy Aquifer

Parameter	Unit	Value	Source
Magothy Conductivity (k)	ft/day	100	Prince & Schneider (1989)
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Gradient (i)	dimensionless	0.00115	Measured Gradient: MW-7D to MW-01D
Seepage Velocity (V_w)	ft/day	0.460	Darcy's Law: V_w = ki/n
Mag. TCA Retardation Factor	dimensionless	2.034	Calculated
Travel Distance	feet	600	
Travel Time	years	7.27	

TABLE 3
Solute Residence Time: Boring VP-08/SB-27 to New Market Road to Garden City Wells 13 & 14
FS Remedial Option GW-4
150 Fulton Avenue Site - Garden City, NY

Utility Manufacturing Site
Methylene Chloride Residence Time: Site to Old Country Road

1. Magothy Retardation Factor

Parameter	Unit	Value	Source
Organic Carbon (F_{oc})	dimensionless	0.001	Assumed Value (0.1%)
Bulk Density	kg/L	1.700	Typical Value
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Partition Coefficient (K_{oc} - MC)	L/kg		Pankow and Cherry (1996)
Distribution Coefficient (K_d - MC)	L/kg	0.000	K_d (MC) = F_{oc} x K_{oc} (MC)
Retardation Factor R_f (MC)	dimensionless	1.000	R_f (MC) = 1 + ((bulk density/n) x K_d (MC))

2. From SW Corner of Site to Old Country Road in Magothy Aquifer

Parameter	Unit	Value	Source
Magothy Conductivity (k)	ft/day	100	Prince & Schneider (1989)
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Gradient (i)	dimensionless	0.00115	Measured Gradient: MW-7D to MW-01D
Seepage Velocity (V_w)	ft/day	0.460	Darcy's Law: V_w = ki/n
Mag. MC Retardation Factor	dimensionless	1.000	Calculated
Travel Distance	feet	600	
Travel Time	years	3.57	Unretarded - Needs Koc value

TABLE 3
Solute Residence Time: Boring VP-08/SB-27
to New Market Road to Garden City Wells 13 & 14
FS Remedial Option GW-4
150 Fulton Avenue Site - Garden City, NY

Utility Manufacturing Site
Toluene Residence Time: Site to Old Country Road

1. Magothy Retardation Factor

Parameter	Unit	Value	Source
Organic Carbon (F_{oc})	dimensionless	0.001	Assumed Value (0.1%)
Bulk Density	kg/L	1.700	Typical Value
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Partition Coefficient (K_{oc} - Tol)	L/kg		Pankow and Cherry (1996)
Distribution Coefficient (K_d - Tol)	L/kg	0.000	K_d (Tol) = F_{oc} x K_{oc} (Tol)
Retardation Factor R_f (Tol)	dimensionless	1.000	R_f (Tol) = 1 + ((bulk density/n) x K_d (Tol))

2. From SW Corner of Site to Old Country Road in Magothy Aquifer

Parameter	Unit	Value	Source
Magothy Conductivity (k)	ft/day	100	Prince & Schneider (1989)
Effective Porosity (n)	dimensionless	0.250	Literature Consensus for sand
Gradient (i)	dimensionless	0.00115	Measured Gradient: MW-7D to MW-01D
Seepage Velocity (V_w)	ft/day	0.460	Darcy's Law: V_w = ki/n
Mag. Tol Retardation Factor	dimensionless	1.000	Calculated
Travel Distance	feet	600	
Travel Time	years	3.57	Unretarded - Needs Koc value