Feasibility Study Report
Former Damshire Cleaners (401059)
Albany County, Colonie, New York
Work Assignment D007624-23

Prepared for

New York State Department of Environmental Conservation
Division of Environmental Remediation
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Albany, New York 12233-7017

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January 2017
Version: FINAL
EA Project No. 14907.23

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January 2017
Version: FINAL
EA Project No. 14907.23

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	Micrograms per Liter
µg/m^3	Micrograms per cubic meter
amsl	Above mean sea level
ARAR	Applicable or relevant and appropriate requirement(s)
AWQS	Ambient Water Quality Standards
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Contaminant of concern
CVOC	Chlorinated volatile organic compound
DCE	Dichloroethene
DER	Division of Environmental Remediation
EA	EA Engineering, P.C. and Its Affiliate EA Science and Technology
EPA	United States Environmental Protection Agency
FS	Feasibility study
ft	Feet (foot)
GRA	General Response Action(s)
in.	Inch(es)
mg/kg	milligrams per kilogram
No.	Number
NRCS	Natural Resources Conservation Service
NTU	Nephelometric turbidity units
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ORP	Oxidation-reduction potential
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PID	Photoionization detector
ppm	Parts per million
psi	Pounds per square inch

RAO	Remedial action objectives
RI	Remedial investigation
SC	Site characterization
SCG	Standards, criteria, and guidance
SCO	Soil cleanup objectives
SSDS	Sub-slab depressurization system
SVI	Soil vapor intrusion
TCE	Trichloroethene
USEPA	United States Environmental Protection Agency
UU	Unrestricted use
VOC	Volatile organic compound

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1. INTRODUCTION AND PROJECT OVERVIEW

EA Engineering, P.C. and its affiliate EA Science and Technology (EA), under Contract to the New York State Department of Environmental Conservation (NYSDEC) (Work Assignment Number [No.] D007624-23) were tasked to perform a Remedial Investigation (RI) and Feasibility Study (FS) at the Former Damshire Cleaners (NYSDEC Site No. 401059) located in the Town of Colonie, Albany County, New York (Figure 1-1). The site is listed as a Class "2" site in the State Registry of Inactive Hazardous Waste Sites (State Superfund sites), which implies the site represents a significant threat to public health or the environment, and action is required. The hazardous waste material disposed at the site and the resulting primary contaminants of concern (COC) are chlorinated solvents related to dry cleaning operations, particularly tetrachloroethene (PCE), trichloroethene (TCE), and *cis*-1,2-dichloroethene (DCE). The quantity of hazardous waste disposed at the site is unknown.

The site consists of one operable unit; however, for the purposes of the RI and FS, the site has been divided into the following areas (Figure 1-2):

- Onsite area consisting of the 0.39 acre Former Damshire Cleaners parcel
- Offsite area which was affected by the former dry cleaning operations.

1.1 PURPOSE AND SCOPE

This FS Report has been prepared to develop and evaluate alternatives for remedial action. The FS will determine which alternative conforms to relevant and appropriate standards, criteria and guidance (SCGs), is most cost effective, and is protective of public health and the environment. The selected option is intended to reduce onsite mass contamination, allowing the onsite area to be designated for restricted use, and the offsite area to be designated for unrestricted use (UU). A RI report was prepared by EA in December 2015.

The FS was prepared in accordance with the most recent versions of the *Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act* (United States Environmental Protection Agency [EPA] 1988) and Division of Environmental Remediation (DER)-10, *Technical Guidance for Site Investigation and Remediation* (NYSDEC 2010), and focused on remedial alternatives proven effective at addressing site-related contamination.

1.2 REPORT ORGANIZATION

The FS report has been organized as follows:

- **Section 1**—Introduction and Project Overview
- **Section 2**—Summary of RI and Exposure Assessment
- **Section 3**—Development of Remedial Action Objectives (RAOs)
- **Section 4**—General Response Actions (GRAs)

- **Section 5—**Identification and Screening of Technologies
- **Section 6—**Scoping and Development of Remedial Alternatives
- **Section 7—**Costing and Evaluation Criteria
- **Section 8—**Detailed Analysis of Alternatives and Recommendations
- **Section 9—**References.

1.3 SITE BACKGROUND

1.3.1 Site Location

The Former Damshire Cleaners site is located at 1205 Central Avenue, Colonie, Albany County, New York (Tax Map No.: 53.06-06-35.1 [Figure 1-2]) on a corner lot at the intersection of Rooney Avenue and Central Avenue. Access to the site is from Central Avenue. The site encompasses approximately 0.39 acres and contains an approximately 3,600 square foot, one-story masonry block building (Former Damshire Cleaners building) with a concrete slab-on-grade foundation surrounded by an asphalt parking lot to the northwest and southwest, a grassy area and dirt/gravel driveway to the southeast, and a wooded area to the northeast. A potential former septic area is located in the grassy area southeast of the building.

1.3.2 Site History

Based upon a review of historical information, the site appears to have been developed with three small, one-story structures in the mid-1930s. According to a Sanborn image provided by the NYSDEC, the site was originally utilized as a residential property until approximately 1951. The Town of Colonie property description report for the site states the current onsite building was constructed in 1968. The site was utilized as a dry cleaning business for residential customers; however, records do not identify the year during which dry cleaning operations began.

The site was tested for air quality on multiple occasions between June 1999 and October 2000 by the NYSDEC after routine inspections found PCE on the floor within the building. Air results from within the building indicated PCE levels ranging from two to five times the allowable limit. Multiple equipment violations were also noted including valves missing from machinery used to control emissions, and condenser equipment used to clean air taken into the system located outside the building and not in use. The facility was court ordered to be shut down in December 2000, and the property owner was fined for the multiple violations. It was concluded that PCE had been leaking on the floor below the dry cleaning equipment for as long as a year prior to shut down in 2001.

In October 2001, a limited subsurface soil and indoor air investigation was completed by DW Solutions on behalf of the former property owner to determine if hazardous materials, particularly dry cleaning solvents, were present at the site (DW Solutions 2001). Subsurface soil sampling was conducted at two locations immediately east of the Former Damshire Cleaners building, with PCE detected at concentrations ranging from 0.039 milligrams per kilogram (mg/kg) to 0.8 mg/kg. Two air samples were collected within the confines of the Former Damshire Cleaners building using carbon tubes; PCE was detected in one of the air samples with a concentration of 1.1 micrograms per cubic meter [$\mu g/m^3$]. The concentration of PCE in the other air sample was below the detection limit of 1.0 $\mu g/m^3$.

In November 2001, a fuel oil spill at the site was reported to NYSDEC's Spill Response Program. Chlorinated solvent contamination was discovered in soil during the underground storage tank removal, which resulted in the spill project to remain open.

Ownership of the Former Damshire Cleaners site was transferred in September 2007 when the property was purchased by a new owner with a plan to convert the Former Damshire Cleaners building into a restaurant. The NYSDEC and New York State Department of Health (NYSDOH) met with the current property owner on September 3, 2009 to discuss further investigative work to determine the extent of contamination present due to previous dry cleaning operations. In October 2009, C.T. Male Associates, P.C. conducted an initial evaluation of the site on behalf of the current property owner (C.T. Male Associates, P.C. 2010). The focus was to determine the purpose of drainage features along the eastern wall and several pipe protrusions extending up through the floor slab of the building. The pipes were traced beneath the slab using a utility locator (Figure 1-2). A photoionization detector (PID) was used to collect readings from several of the pipes, with readings ranging from 2.7 to 60 parts per million (ppm).

Based on the October 2009 findings, C.T. Male Associates, P.C. conducted a limited soil vapor intrusion (SVI) investigation in January 2010 (C.T. Male Associates, P.C. 2010), with sampling of one indoor air and two sub-slab locations within the northeast portion of the Former Damshire Cleaners building in the area of the former dry cleaning equipment. PCE was detected in indoor air at a concentration of 57 $\mu g/m^3$, in sub-slab vapor at concentrations up to 130,000 $\mu g/m^3$, and TCE was detected in sub-slab vapor at concentrations up to 220 $\mu g/m^3$. Analytical results indicated a release of chlorinated solvents from the building had impacted soil vapor beneath the building slab, and mitigation as defined by the NYDOH, was warranted. Based on the information in the report, the NYSDEC notified the owner that the site would be designated as a P-Site, and indicated that the NYSDEC, as required by law, intended to investigate the site.

On behalf of the NYSDEC, an initial Site Characterization (SC)/Phase I Investigation and a Phase I Supplemental Investigation was conducted by EA in January and May 2011, (EA 2011a, 2011b). As the current owner did not allow access to the site, investigative activities were conducted offsite. A limited Geoprobe® investigation was conducted in the right-of-ways, and on adjacent properties cross-gradient and downgradient of the site, with five shallow 1-inch (in.) diameter monitoring wells (MW-01 through MW-05, screened from 10 to 20 feet (ft) below ground surface (bgs) installed in January, and six additional 1.5-in. diameter shallow wells (MW-06 through MW-11, screened from 10 to 30 ft bgs) installed in May 2011 (Figure 1-3). Soil and groundwater samples were collected during each phase, and analytical results indicated concentrations of PCE and TCE in soil and groundwater above applicable SCG values (Figures 1-3 and 1-4, respectively). Elevated concentrations of PCE were detected at cross-gradient well MW-02, and immediately downgradient wells MW-03, MW-04, and MW-05 (as high as 48,000 micrograms per liter [µg/L]), while PCE was only slightly elevated at furthest downgradient well MW-07 (44 µg/L).

1.3.3 Current Land Use

Onsite Area

The Former Damshire Cleaners site is zoned Neighborhood Commercial Office Residential. The former dry cleaning facility would be considered commercial use under the aforementioned zoning designation. The Former Damshire Cleaners building is currently unoccupied and vacant. The site has remained vacant since shut down of dry cleaning operations in 2001.

Offsite Area

The offsite area consists of mixed residential and commercial properties, with adjacent commercial property to the southeast, Rooney Avenue and commercial properties (including Greens Appliance store) to the northwest, a residential area to the northeast, and commercial and residential areas to the southwest across Central Avenue (Figure 1-2).

1.3.4 Physiography

The subject site is located within the Hudson-Mohawk Lowlands physiographic province, characterized by low relief resulting from glaciation and former Glacial Lake Albany. Elevation increases and topography becomes more rugged near the southwestern half of Albany County. Topography at the Former Damshire Cleaners site is relatively flat, with a ground surface elevation of approximately 247 ft above mean sea level (amsl). Elevation decreases south and southeast of the site.

There are no surface water bodies at or in the immediate vicinity of the Former Damshire Cleaners site. Regionally, surface water drainage flows south toward Patroon Creek, located approximately a ½ mile south of the site. Patroon Creek flows east towards the Hudson River, located approximately 4 miles southwest of the site.

1.3.5 Site Geology

According to the Natural Resources Conservation Service (NRCS) in Albany County, the Former Damshire Cleaners site and surrounding area is classified as urban land, which consists of asphalt, concrete, buildings, and other impervious materials associated with soil that has been disturbed by grading or filling during construction activities.

Surficial deposits at the Former Damshire Cleaners site consists of topsoil and organics. Backfill material containing asphalt and brick was observed within the grassy area southeast of the Former Damshire Cleaners building. During advancement of soil borings as part of the RI, a void was encountered at SB-04 at 8–12 ft bgs in the grassy area approximately 20 ft southeast and cross gradient of where the sewer connection exits the Former Damshire Cleaners building. This void may indicate the location of a former septic system.

Overburden at and in the vicinity of the site consists of glaciofluvial deposits of interbedded coarse to fine sand, silt, and clay. During the RI, coarse-grained lenses of gravel and pebbles were encountered at MW-04D, located immediately downgradient from the Former Damshire Cleaners building, with depths of 20–22 ft bgs (medium to fine sand, little silt, and some coarse gravel), and 28–30 ft bgs (fine sand, some silt, and trace pebbles). These coarse-grained lenses may serve as preferential pathways for groundwater and dissolved-phase contaminant migration. A clay confining unit was encountered at 60–61 ft bgs. A geologic cross section for the site and downgradient area is presented in Figure 1-5.

Bedrock was not encountered during previous investigations or the RI; however, it is assumed that the clay confining unit overlies weathered shale bedrock. Regional bedrock geologic information indicates that bedrock at the site consists of upper to middle Ordovician shale of the Lorraine, Trenton; and Black River Groups including the Utica Shale, Canajoharie Shale, and Normanskill Shale. These units can be up to 4,500-ft thick.

1.3.6 Site Hydrology/Hydrogeology

Shallow groundwater at and immediately downgradient from the site is located at 3–7 ft bgs, with the depth increasing downgradient to 8–12 ft bgs. Groundwater generally flows in a southwesterly direction at and immediately downgradient from the site, and turns in a more westward direction southwest of Central Avenue. An overall horizontal hydraulic gradient of 0.014 ft/ft was calculated across and downgradient of the site. A downward vertical gradient of 0.027 ft/ft was observed at wells MW-04 and MW-04D, located immediately downgradient from the Former Damshire Cleaners building. An interpreted groundwater contour map illustrating the direction of groundwater flow for the latest gauging event conducted in January 2015 is presented in Figure 1-6.

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2. SUMMARY OF REMEDIAL INVESTIGATION AND EXPOSURE ASSESSMENT

The following sections briefly summarize the environmental impacts at the Former Damshire Cleaners site as determined during the RI (EA 2015). Media that were evaluated during the RI included onsite surface and subsurface soil, onsite and offsite groundwater, onsite sub-slab soil vapor, and offsite soil vapor.

This section is organized by areas of potential concern and media. These areas of concern and the impacts associated with the environmental media are based on analytical results and their comparison with the appropriate SCGs:

- ***Soil***—6 New York Code of Rules and Regulations (NYCRR) Part 375 Environmental Remediation Programs – Restricted Use – Commercial – Soil Cleanup Objectives (SCOs) and/or 6 NYCRR Part 375 Environmental Remediation Programs —Unrestricted Use— SCOs (NYSDEC 2006, as amended).

- ***Groundwater***—6 NYCRR Part 703.5 Class GA Groundwater Quality Regulations, as presented in the Division of Water Technical and Operational Guidance Series 1.1.1 (NYSDEC 1998, as amended).

- ***Soil Vapor***—New York State Department of Health (NYSDOH) SVI Guidance (2006) and as amended in 2013 and 2015.

- ***Sub-Slab Vapor and Indoor Air***—NYSDOH SVI Guidance (2006) and as amended in 2013 and 2015.

A full analysis of all data collected during the RI is included in the RI Report (EA 2015).

2.1 FORMER DAMSHIRE CLEANERS BUILDING INVESTIGATION

A building investigation was conducted in October 2013 to identify a potential source of known impacts. During this inspection, the recessed drainage pit (rear sump) and sewer line access pit (cleanout) were observed along the southeastern wall (Figure 2-1). Water was observed within a discharge pipe of the rear sump, and an opening/crack was observed in the base of the sump, indicating that the integrity of the rear sump was compromised.

The results of the building investigation indicated that the primary source of chlorinated solvents associated with the Former Damshire Cleaners site appeared to be the rear sump within the vacant building. Impacted sediment/debris, soil, and water data at and within the immediate vicinity of the rear sump suggests the opening/crack allowed for discharge of hazardous material to the subsurface. PCE was detected above the UU SCO (1.3 mg/kg) in sediment/debris collected from the opening/crack in the rear sump (3.4 mg/kg) and in soil collected below the base of the rear sump at 2–4 ft bgs (8.1 mg/kg). In addition, PCE (55,000 µg/L), TCE

(4,000 µg/L), and *cis*-1,2-DCE (69,000 µg/L), were detected in discharge water collected from the pipe at concentrations above Class GA Ambient Water Quality Standards (AWQS) (5 µg/L each).

To further delineate the extent of soil impacts beneath the Former Damshire Cleaners building, subsurface soil samples were collected from two locations beneath the building slab in March 2015. These borings were located approximately 15 ft northwest (ISB-1) and 30 ft west (ISB-2) of the rear sump. PCE was detected above the UU SCO at both locations (6.2 and 12 mg/kg, respectively).

Based on existing data and known depths of soil impacts from directly beneath the building and rear sump, and assuming impacts extend to 6 ft beneath the slab with an area of 3,600 square ft, the volume of impacted soil exceeding UU SCOs could be estimated at 800 cubic yards. Because the full extent of soil impacts was not defined, this volume of impacted soil may vary significantly, as UU SCOs were exceeded at deeper depth intervals at MW-04 and MW-04D located immediately downgradient from the building.

2.2 ONSITE SURFACE AND SUBSURFACE SOIL

The onsite surface and subsurface soil investigation was conducted to delineate the nature and extent of impacts to soil at the Former Damshire Cleaners property. RI data were compared to Unrestricted Use and Commercial SCOs selected to identify areas that may require remediation sufficient for the current and future anticipated use of the property, which may also require institutional controls (e.g., land-use restrictions) as applicable to the onsite area.

PCE was the only volatile organic compound (VOC) detected above the UU SCO (1.3 mg/kg), with elevated concentrations in deep subsurface soil samples collected during installation of MW-04D immediately downgradient from the building (1.8 mg/kg at 32–34 ft bgs and 4.7 mg/kg at 54–56 ft bgs). VOCs were not detected above Commercial SCOs in any onsite surface or subsurface soil samples collected during the RI. Figures 2-2 and 2-3 depict surface and subsurface VOC soil results, respectively. However, during the 2011 Site Characterization (SC)/Phase I Investigation, PCE was detected above the Commercial SCO of 150 mg/kg in one subsurface soil collected at 15–20 ft bgs immediately downgradient from the site (MW-04, 830 mg/kg).

Several SVOCs, particularly polycyclic aromatic hydrocarbons (PAH), were detected above their respective UU and Restricted Use Commercial SCOs at six surface soil sample locations including Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene.

Indeno(1,2,3-cd)pyrene was the only SVOC detected above the UU SCO (0.5 mg/kg), with a concentration of 0.6 mg/kg detected in shallow subsurface soil collected from SB-04 at 3-4 ft bgs. No SVOCs were detected above the Restricted Use Commercial SCOs. Figures 2-4 and 2-5 depict surface and subsurface SVOC soil results, respectively.

2.3 ONSITE GROUNDWATER

The RI groundwater program included collection of *in situ* groundwater samples in October 2013, installation of four shallow onsite monitoring wells and one onsite deep monitoring well in December 2014, and completion of a round of groundwater sampling in January 2015. Groundwater analytical results indicate elevated concentrations of PCE, TCE, and/or *cis*-1,2-DCE above Class GA standards (5 µg/L each) in shallow onsite groundwater. The table below provides a summary of the frequency of groundwater concentrations exceeding applicable groundwater quality standards.

Constituents	Groundwater Standards and Guidance Values[(a)] (µg/L)	No. of Exceedances/ No. of Samples	Concentration Range (µg/L)	Location of Maximum Concentration
January 2014 Sampling Event				
Tetrachloroethene	5	14/27	1.2 - 4,100	MW-15, rear sump (source area)
Trichloroethene	5	10/27	1.2 - 190	SB-06, void (second source area)
Cis-1,2-dichloroethene	5	13/27	1.1 - 630	MW-13, downgradient from void
(a) NYSDEC 1998, as amended. NOTE: µg/L = Micrograms per liter No. = Number NYSDEC = New York State Department of Environmental Conservation				

Based on analytical results of groundwater sampled during previous investigations and the RI, a dissolved-phase groundwater plume extends southwest in the direction of groundwater flow from the rear sump within the Former Damshire Cleaners building toward Central Avenue (Figure 2-6). The PCE component of the dissolved-phase plume is the most extensive (Figure 2-7). In addition, analytical data suggests a second potential discharge zone at the void area east/southeast of the Former Dry Cleaners Building, with elevated concentrations extending south/southwest of the void/former septic area to and beyond MW-13. The onsite portion of the shallow groundwater contaminant plume has a lateral thickness extending at least 128 ft from the northern edge of the Former Damshire Cleaners building to the adjacent southeast property.

The presence of elevated concentrations at the bottom of borings advanced downgradient from the void area indicates downward vertical migration, as would be expected with migration patterns associated with DNAPLs. In addition, the elevated concentration of PCE detected in deep groundwater at monitoring well MW-04D (96 µg/L) suggests vertical migration of the dissolved-phase plume immediately downgradient from the Former Dry Cleaners building (Figure 2-8). No other deep monitoring wells are installed in the onsite area. A clay confining layer encountered at 60-70.4 ft bgs in offsite downgradient profiling points likely serves as a barrier to vertical migration and indicates the vertical limit of the plume.

2.4 ONSITE VAPOR INTRUSION INVESTIGATION

In January 2010, a limited SVI investigation (C.T. Male Associates, P.C. 2010) was conducted within the former Damshire Cleaners building which was vacant at the time of sampling. The previous report did not identify if the building was heated during the sampling. During the vapor intrusion investigation, one indoor air sample and two sub-slab samples were collected within the northeast portion of the building in the area of the former dry cleaning equipment. Sample results indicated that vapor intrusion from contaminated groundwater is occurring onsite, with both PCE and TCE detected in exceedance of the NYSDOH Air Guideline Values (30 and 2 $\mu g/m^3$, respectively). PCE was detected in indoor air at a concentration of 57 $\mu g/m^3$ and in sub-slab vapor at concentrations up to 130,000 $\mu g/m^3$, while TCE was detected in sub-slab vapor at concentrations up to 220 $\mu g/m^3$. Additional SVI investigations/mitigation within the former Damshire Cleaners building has not been conducted since the building is currently vacant.

In March 2015 one sub-slab vapor and co-located indoor air sample was collected from a building located upgradient of the site (referred to as “Structure 1”). Elevated concentrations of PCE (350 $\mu g/m^3$) and TCE (8.8 $\mu g/m^3$) were detected in the indoor air duplicate sample above NYSDOH Air Guideline Values (30 and 2 $\mu g/m^3$, respectively); however, PCE and TCE were not detected in sub-slab vapor or in the indoor air parent sample (Table 3-17). As a result of the discrepancy between the indoor air parent and duplicate samples, sub-slab vapor and indoor air at Structure 1 was resampled in May 2015. During the second sampling event, PCE and TCE were detected in sub-slab vapor at concentrations of 1.4 and 3.2 $\mu g/m^3$, respectively, with TCE above the NYSDOH Air Guideline Value of 2 $\mu g/m^3$. PCE and TCE were not detected in the indoor air parent sample; however, PCE was detected in the duplicate sample at 2.4 $\mu g/m^3$ which is below the NYSDOH Air Guideline Value of 30 $\mu g/m^3$.

VI investigation analytical results suggest that PCE and TCE are volatilizing from shallow groundwater beneath Structure 1. No additional structures were included in the VI evaluation as a result of being unable to obtain access agreements.

2.5 JUNE 2016 GROUNDWATER SAMPLING EVENT

Additional groundwater sampling was conducted in June 2016 per request of the NYSDEC, with samples collected from four well locations (MW-04, MW-12, MW-13, and MW-15) for analysis of SVOCs by EPA Method 8270D, PCBs by EPA method 8082, pesticides by EPA method 8081A, metals by EPA method 6010B, mercury by EPA method 7470A, and cyanide by EPA method 9010B.

Pesticides, PCBs, mercury, and cyanide were not detected in groundwater samples. The SVOC 2,4-dimethylphenol was detected at a concentration of 10 µg/L at MW-13, which is below the NYSDEC AWQS of 50 µg/L. No other SVOCs were detected in groundwater. 16 metals were detected in one or more groundwater samples (Figure 2-9). Iron was detected in all four monitoring wells at concentrations exceeding the NYSDEC AWQS of 300 µg/L, with concentrations ranging from 2,400 to 110,000 µg/L. Lead was detected in MW-04 only, with a concentration of 33 µg/L which exceeds the NYSDEC AWQS of 25 µg/L. Manganese was detected in all four monitoring wells; the concentration in MW-04 (8,200 µg/L) exceeded the NYSDEC AWQS of 300 µg/L. Sodium was detected in all four monitoring wells at concentrations exceeding the NYSDEC AWQS of 20,000 µg/L, with concentrations ranging from 28,000 to 62,000 µg/L.

2.6 HUMAN HEALTH EXPOSURE ASSESSMENT

A qualitative assessment of human health exposure pathways for all impacted media was completed using analytical data obtained during the RI. The qualitative human exposure assessment has indicated that there are potential pathways through which populations could be exposed to potentially hazardous materials related to former dry cleaning operations at the Former Damshire Cleaners site. Analytical results of sub-slab soil beneath the Former Damshire Cleaners building, subsurface soil immediately downgradient from the building, onsite and offsite groundwater, and downgradient soil vapor indicate that these media are impacted from improper management of dry cleaning solvents at the Former Damshire Cleaners site.

Current and future onsite construction and utility workers could be exposed to impacted subsurface soil beneath the building slab or downgradient from the building during construction and excavation and utility work/repairs, which could present the potential for dermal contact and incidental ingestion. Current and future commercial and industrial workers, and adult and child visitors/residents both onsite and offsite are not expected to come into contact with subsurface soil.

Exposure to drinking water is not a viable pathway since impacted downgradient groundwater is not used as a source of potable water. Although there is potential for the shallow groundwater to intrude into downgradient buildings with basements and sumps, based on groundwater data from the RI, downgradient offsite contaminated groundwater is present at depths that would not impact sumps/basements (i.e., greater than 9-ft below grade [basement depth]).

Sub-slab vapor and indoor air analytical results from previous investigations indicate that historical use of the site (i.e., dry cleaners), improper management of dry cleaning solvents (i.e., PCE leaking from dry cleaning equipment onto the floor of the building), and VI from contaminated groundwater beneath the building is impacting indoor air quality within the building. The NYSDOH recommended mitigation measures; however, no measures have been conducted to date.

Downgradient soil gas analytical results indicate that soil gas is impacted and there is a potential for VI into structures within the extent of the groundwater contamination plume. However, due to access restrictions, downgradient VI evaluations were not conducted at commercial/industrial or residential properties. Another attempt should be made to obtain access for VI evaluations to determine if the indoor air at these properties is impacted.

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3. DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

Goals for the remedial program have been established through the remedy selection process stated in NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, May 2010. The remedial goal for all remedial actions is considered to be the restoration of the site to the pre-disposal/pre-release conditions to the extent practicable and legal. Remedial action objectives (RAOs) are defined as the operable unit or media-specific objectives for the protection of public health and the environment, and are developed based on contaminant-specific SCGs (described in Section 2) to address contamination identified at a site. Multiple media were evaluated during the RI, including soil (surface and subsurface), onsite and offsite groundwater and soil vapor.

Groundwater

- RAOs for Public Health Protection
  - Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
  - Prevent contact with, or inhalation of volatiles, from contaminated groundwater.
- RAOs for Environmental Protection
  - Restore ground water aquifer to pre-disposal/pre-release conditions, to the extent practicable.
  - Remove the source of ground or surface water contamination.

Soil

- RAOs for Public Health Protection
  - Prevent ingestion/direct contact with contaminated soil.
  - Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.
- RAOs for Environmental Protection
  - Prevent migration of contaminants that would result in groundwater or surface water contamination.

Soil Vapor

- RAO for Public Health Protection
  - Mitigate impacts to public health resulting from existing or the potential for, soil vapor intrusion into buildings at the site.

3.1 MEDIA CLEANUP GOALS

The media cleanup goals for soil and groundwater are based on New York State SCGs, the site-specific risk assessment, contaminants of concern, site characteristics, and feasible actions. The contaminants of concern for soil and groundwater at the Former Damshire Cleaners site identified during the RI are chlorinated volatile organic compounds (CVOC), primarily PCE and its breakdown compounds TCE and 1,2 DCE. In addition, PAHs including benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected within site surface soil exceeding New York State SCGs. These goals can be achieved by either removing the soil and groundwater contamination, or preventing impacts to human or ecological receptors via ingestion/direct contact with impacted soil and groundwater.

The proposed cleanup goals for soil and groundwater at the Former Damshire Cleaners site is to achieve concentrations of COC's below 6 NYCRR Part 375 and the New York State Ambient Water Quality Standards and Guidance Values for drinking water as detailed in the table below.

Constituents	Soil 6 NYCRR Part 375 Unrestricted Use (ppm)	Groundwater New York State Ambient Water Quality Standards Guidance Values (µg/L)
cis-1,2-Dichloroethylene	0.25	5
Tetrachloroethylene	1.3	5
Trichloroethylene	0.47	5
Benzo(a)anthracene	1	0.002
Benzo(a)pyrene	1	NA
Benzo(b)fluoranthene	1	0.002
Benzo(k)fluoranthene	0.8	0.002
Chrysene	1	0.002
Dibenz(a,h)anthracene	0.33	NA
Indeno(1,2,3-cd)pyrene	0.5	0.002

Note: µg/L = Micrograms per liter
ppm = Parts per million
NYCRR = New York Code of Rules and Regulations

3.2 EXTENT OF IMPACT TO ENVIRONMENTAL MEDIA

The approximate extent of groundwater that exceeds SCOs is shown on Figure 3-1. The areal extent of the groundwater plume onsite covers approximately 69 percent of the 0.39 acres. The vertical extent of the plume is approximately 60-ft below ground surface.

The approximate extent of soil that exceeds SCOs is shown on Figure 3-2. A total of 3,014 ft^2 of soil beneath the former Damshire Cleaners building to a depth of 4-ft bgs is above SCO's. Impacted surface soil covers just over 4,700 ft^2. There is a 150 ft^2 area of impacted subsurface soil to a depth of 6 ft bgs.

3.3 POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Applicable or relevant and appropriate requirements (ARARs) are local, state, and federal regulations, including environmental laws and regulations that are used in the selection of remedial alternatives, as well as other non-environmental laws and regulations, such as the Occupational Safety and Health Act. New York State ARARs will supersede all other ARARs unless there is a more stringent federal or local standard. The development and evaluation of remedial alternatives presented in Section 6 include a comparison of alternative site remedies to ARARs. The recommended remedial action for the site must satisfy all ARARs unless specific waivers have been granted.

EPA defines "applicable" and "relevant and appropriate" in the revised National Contingency Plan, codified at 40 Code of Federal Regulations (CFR) 300.5 as follows:

- ***Applicable Requirements*****—**substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site.

- ***Relevant and Appropriate Requirements*****—**standards of control that address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site.

To determine whether a requirement is relevant and appropriate, characteristics of the remedial action, the hazardous substances present, and the physical characteristics of the site must be compared to those addressed in the statutory or regulatory requirement. In some cases, a requirement may be relevant, but not appropriate. In other cases, only part of a requirement will be considered relevant and appropriate. When it has been determined that a requirement is both relevant and appropriate, the requirement must be complied to the same degree as if it were applicable (EPA 1988).

ARARs for remedial action alternatives at the Former Damshire Cleaners site can be generally classified into one of the following three functional groups: chemical, action, or location-specific.

To be considered materials (e.g., federal/state criteria, advisories, and guidance values) are non-promulgated advisories or guidance issued by federal or state government, which are not legally binding, and therefore, do not have the status of potential ARARs:

- Federal criteria, advisories, and guidance documents
- State of New York criteria, advisories, and guidance documents.

Federal and state guidance documents or criteria that are not generally enforceable, but are advisory, do not have the status of potential ARARs. Guidance documents or advisories to be considered in determining the necessary level of cleanup for protection of human health or the environment may be used where no specific ARARs exist for a chemical or situation, or where such ARARs are not sufficient to afford protection.

Federal and state requirements for soil, groundwater, and air were considered to determine if they were ARARs, based on site characteristics, site location, and the alternatives considered. The following sections summarize the specific federal, state, and local ARARs for the remedial actions that may be taken at the Former Damshire Cleaners site, and for the types of technologies that will be developed into remedial alternatives. As identified at the beginning of Section 3, groundwater is the focus of the FS at the Former Damshire Cleaners Site; in addition, the contaminants of concern identified during the RI consist of CVOCs, primarily PCE, TCE and DCE. Thus, each of the following ARARs has been chosen for its potential applicability or relevance and appropriateness.

3.3.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements

Chemical-specific requirements are established health- or risk-based numerical values or methodologies that establish cleanup levels or discharge limits in environmental media for specific substances or pollutants. Cleanup standards for impacted groundwater are defined in the New York State Ambient Water Quality Standards and Guidance Values with SCGs specified based on drinking water standards.

3.3.2 Action-Specific Applicable or Relevant and Appropriate Requirements

Action-specific ARARs set controls or restrictions on the design, implementation, and performance levels of activities related to the management of hazardous substances, pollutants, or contaminants.

The potential action-specific ARARs include:

Action-Specific ARARS

Requirement	Rationale
Clean Water Act **National Pollution Discharge Elimination System 40 Code of Federal Regulations (CFR) Part 122** The National Pollution Discharge Elimination System establishes permitting requirements, technology-based limitations and standards, control of toxic pollutants, and monitoring of effluents to assure discharge permit conditions and limits are not exceeded.	Applicable if groundwater will be extracted from ground and discharged.
Safe Drinking Water Act (National Primary and Secondary Drinking Water Regulations) (42 U.S.C. 300f, 40 CFR Part 141, 40 CFR Part 143) The Safe Drinking Water Act provides a national framework to ensure the quality and safety of drinking water. The primary standards establish maximum contaminant levels and maximum contaminant level goals for chemical constituents in drinking water. Secondary standards pertain primarily to the aesthetic qualities of drinking water.	The removal action is being conducted to reduce chemical concentrations in soil and groundwater, with a goal of meeting cleanup levels at the property boundary.
Clean Air Act, as Amended (42 U.S.C. 7401) The Clean Air Act is a comprehensive law which is designed to regulate any activities that affect air quality, and provides the national framework for controlling air pollution. The National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50) set standards for ambient pollutants which are regulated within a region. The National Emissions Standards for Hazardous Air Pollutants (40 CFR Part 61) establishes numerical standards for hazardous air pollutants.	The Clean Air Act will be required if any remediation alternatives produce air emissions.
Requirement	**Rationale**
Resource Conservation and Recovery Act Provides the governing regulations for owners and operators of hazardous waste treatment, storage, and disposal facilities; and for the generators and transporters of hazardous waste.	All waste generated during the removal action will be characterized and handled per Resource Conservation and Recovery Act regulations, as implemented by WAC 173-303.
Occupational Safety and Health Act (29 CFR 1910) Establishes the worker health and safety requirements for operations at hazardous waste sites.	Site activities will be conducted under appropriate Occupational Safety and Health Act standards.
Rules for Transport of Hazardous Waste (49 CFR 107, 171) The U.S. Department of Transportation establishes requirements for packaging, handling, and manifesting hazardous waste.	Any hazardous waste generated during site activities will be characterized as needed to determine packaging, handling, and transport requirements.

Action-Specific ARARS

State	
NYSDEC Environmental Remediation Programs. 6 NYCRR Part 375 This program applies to the development and implementation of remedial programs for environmental restoration sites.	Site cleanup will be conducted in accordance with 6 NYCRR Part 375.
Solid Waste Management Facilities. 6 NYCRR Part 360 Provides standards and regulations for permitting and operating solid waste management facilities.	These regulations will be followed for offsite treatment and disposal of hazardous waste.
Waste Transporter Permits. NYCRR Part 364 Provides standards and regulations for waste transporters.	
Land Disposal Restrictions. 6 NYCRR Part 376	
Hazardous Waste Management System. 6 NYCRR Part 370, 371, 372, 373, 375 Provides standards and regulations for the state hazardous waste management system, identification and listing of hazardous wastes, and provides standards, regulations, and guidelines for the manifest system, as well as additional standards for generators, transporters, and facilities.	
New York State Department of Transportation Rules for Hazardous Materials Transport. 49 CFR, Parts 107, 171.1-500. Addresses requirements for marking, manifesting, handling, and transport of hazardous materials; applicable if offsite treatment or disposal of wastes is required.	
Water Quality Regulations for Surface Waters and Groundwater. 6 NYCRR Part 700-706 Provides standards, regulations, and guidelines for the protection of waters within the state.	Water discharged from the site will comply with this guidance.
Implementation of NPDES Program in NYS. 6 NYCRR Part 750-757 Provides regulations regarding the SPDES program.	A SPDES permit may be required depending on selected remedial action.
Permits and Registration (Air). 6 NYCRR Part 201 Describes permits and registration requirements	Permit or registration may be required depending on selected remedial action.
State	
Air Quality Standards. 6 NYCRR Part 257 Air quality standards are designed to provide protection from the adverse health effects of air contamination; and they are intended further to protect and conserve the natural resources and environment.	All substantive requirements of the State air pollution control regulations will be followed during implementation of the remedial action.

3.3.3 Location-Specific Applicable or Relevant and Appropriate Requirements

Location-specific ARARs must be considered when developing alternatives because these types of ARARs may affect or restrict remedial activities. Generally, location-specific requirements serve to protect the individual site characteristics, resources, and specific environmental features.

The potential location-specific ARARs include:

Location-Specific ARARS

Requirement	Rationale
Land development standards, storm water and surface water regulations, and clearing and grading requirements.	Local permits are required depending on the selected remedial action.
Building permits and building codes.	Local permits are required depending on the selected remedial action.

4. GENERAL RESPONSE ACTIONS

In general, remedial technologies fit into one or more category of GRA. GRAs are generic, medium-specific, remedial actions that will satisfy the RAOs discussed earlier. GRAs may include no action, institutional controls, containment, removal, treatment, disposal, monitoring, or a combination thereof (USEPA 1988). The development of remedial alternatives for this FS begins with the identification of GRAs that can meet RAOs. These GRAs are then screened based on their effectiveness, implementability, and cost, and developed into remedial alternatives to address all contaminated media at the site. The GRAs for groundwater at the Former Damshire Cleaners Site (including no action, monitored natural attenuation, containment, removal, and treatment) are detailed in the following sections.

4.1 NO ACTION

The no action alternative is included to be used as the baseline alternative against which the effectiveness of all other remedial alternatives are judged.

4.2 MONITORED NATURAL ATTENUATION

For groundwater contaminated with CVOCs, monitored natural attenuation consists of sampling groundwater for contaminant concentrations and natural attenuation parameters. Natural attenuation with monitoring allows natural processes to achieve site-specific remedial objectives without enhancement or aggressive treatment. The "natural attenuation processes" in such a remediation approach at work include physical, chemical, or biological processes under favorable conditions, reduce the mass, toxicity, mobility, volume, or concentration of contaminants in the groundwater. Natural attenuation processes that could occur include biodegradation (aerobic or anaerobic), abiotic transformation (e.g., hydrolysis), adsorption, dispersion, or dilution.

4.3 CONTAINMENT

Containment can be accomplished via containment walls or via physical extraction of groundwater for *ex situ* treatment. Once groundwater is extracted, treatment technologies for groundwater could include air stripping, granular activated carbon, etc.

4.4 REMOVAL

Physical removal of impacted soil would be conducted by excavation, using standard construction equipment (i.e., excavators) to remove material from the ground and load it into transport mechanisms (i.e., trucks) for off-site treatment or disposal.

4.5 *IN SITU* TREATMENT

There are several potential *in situ* treatment technologies for groundwater that include:

- Enhanced bioremediation: The activity of naturally occurring microbes is stimulated by introducing water-based solutions into contaminated groundwater to enhance *in situ* biological degradation of organic contaminants. Nutrients, oxygen, or other amendments may be used to enhance biodegradation.

- Ozone sparging: In-well ozone sparging consists of injecting ozone into the VOC-contaminated groundwater, which dissolves in the water and oxidizes the contaminants. Because the contaminants are treated and not volatilized, vapor does not need to be managed.

- Air sparging and soil vapor extraction: Air is injected into saturated matrices to remove contaminants through volatilization. Once contaminants are volatilized, vapors are extracted from the vadose zone and treated.

- *In situ* enhanced reductive dechlorination: Includes injection of amendments/reagents into water to break down the COCs.

5. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

The potentially applicable technologies identified earlier are screened using the process defined in DER-10, Technical Guidance for Site Investigation and Remediation (NYSDEC 2010). Three preliminary screening criteria (i.e., effectiveness, implementability, and cost) were used to screen the remedial technologies identified earlier for each media of concern.

5.1 SCREENING CRITERIA

5.1.1 Effectiveness

This criterion is a measure of the ability of an option to: (1) reduce toxicity, mobility, or volume of contamination, (2) minimize residual risks, (3) afford long-term protection, (4) comply with applicable or relevant and appropriate requirements, (5) minimize short-term impacts, and (6) achieve protectiveness in a limited duration. Technologies that offer significantly less effectiveness than other proposed technologies may be eliminated from the alternative development process. Options that do not provide adequate protection of human health and environment likewise, may be eliminated from further consideration.

5.1.2 Implementability

Implementability is a measure of the technical feasibility and availability of the option and administrative feasibility of implementing it (e.g., obtaining permits for offsite activities, rights-of-way, or construction). Options that are technically or administratively infeasible or that would require equipment, specialists, or facilities that are not available within a reasonable period, may be eliminated from further consideration.

5.1.3 Cost

Qualitative relative costs for implementing the remedy are considered. Technologies that cost more to implement, but that offer no benefit in effectiveness or implementability over other technologies, may be excluded from the alternative development process.

5.2 SCREENING SUMMARY

The results of the technology screening are summarized in the following two sections. The first section discusses technologies that were not retained for further analysis, and the reasons for exclusion. The second section lists technologies that were retained for further analysis as individual components in remedial alternatives. The screening is presented in greater detail in Appendix A.

5.2.1 Technologies Not Retained for Further Analysis

From the list of technologies potentially applicable for remediation of the chemicals and media of concern at this site, numerous technologies were excluded from further consideration because they were considered ineffective, not implementable at this site, or too costly relative to the other alternatives under consideration. The reasons for exclusion are detailed below.

Containment walls will not treat contaminated groundwater and when implemented alone, do not prevent the further contamination of groundwater. Containment walls can only alter the groundwater flow direction, and thus, are considered ineffective for remediation of groundwater.

Groundwater pump and treat will prevent offsite migration of COC's; however, they will not treat the source area resulting in excessive long-term operations and maintenance.

Use of in-well air stripping at the site was eliminated from consideration based on implementability/constructability due to the presence of shallow groundwater. A thicker vadose zone is required to implement this technology.

Passive/reactive treatment walls will also not address reduction of containment mass and would require long-term groundwater monitoring.

5.2.2 Technologies Retained for Further Analysis

Technologies that passed through screening and will be retained and combined to create remedial alternatives for the site are listed below for each media of concern.

The focused list of remedial technologies considered in this FS for groundwater include:

- Enhanced *in situ* biological degradation of organic contaminants will require introducing water-based solutions into contaminated groundwater to stimulate the activity of naturally occurring microbes.

- There are several operations for *in situ* physical/chemical injection treatments that include Fentons reagent with sodium permanganate, ozone, or air sparging coupled with soil vapor extraction.

- Soil excavation and offsite disposal of impacted soil.

6. SCOPING AND DEVELOPMENT OF REMEDIAL ALTERNATIVES

Scoping and development of Remedial Alternatives (RAs) for the FS was completed based on correspondence between EA and the NYSDEC. EA performed the alternative comparison in accordance with DER-10 (NYSDEC 2010) and the EPA publication Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA l540lG-891004) (EPA 1988). The results of the technology screening process were summarized in a screening table prepared and submitted to the NYSDEC on September 1, 2015. The screening of alternatives was designed to provide a basis for an overall assessment of applicable technologies based on impacted media identified at the site and related areas during the RI.

The list of alternatives was limited to focus the FS on known and frequently implemented alternatives used for remediation of the COCs in groundwater with an understanding that the soil and soil vapor could be addressed concurrently through the selection of the appropriate technology.

The five remedial alternatives evaluated are:

- *In situ* enhanced bioremediation
- *In situ* ozone-enhanced aquifer air sparging and soil vapor extraction
- Air sparge and soil vapor extraction
- *In situ* enhanced reductive dechlorination
- Soil excavation and offsite disposal.

6.1 ALTERNATIVE 1: NO ACTION

The no action alternative is evaluated as a procedural requirement and as a basis for comparison. This alternative would leave the site in its present condition.

6.2 ALTERNATIVE 2: *IN SITU* ENHANCED BIOREMEDIATION

Direct-push methods would be used to inject an electron donor emulsion into the contaminated aquifer as well as into the vadose zone beneath the building. This emulsion would optimize anaerobic biodegradation, speeding up natural degradation processes. Two injection events are included in this alternative for the purpose of costing; however, it is possible additional events may be required to attain SCGs. The need for supplementary injections would depend on field conditions.

In situ enhanced bioremediation would be implemented as follows and as shown on Figure 6-1:

- A utility locator would be brought onsite to locate any underground utilities or other obstructions that may prove problematic to drilling.

- Three additional deep groundwater monitoring wells would be installed onsite and sampled prior to injections for baseline concentrations.

- Electron donor emulsion would be injected into the aquifer using direct-push equipment and a diaphragm pump with a rating of 700 pounds per square in. (psi). Emulsion would be diluted 10:1 prior to application.

- Emulsion would be injected into 100 points within the plume area spaced 10 ft apart. Injections would be completed over the areal extent of the dissolved phase plume.

- Emulsion would be injected into the vadose zone for the 28 locations located within the building. Emulsion would be injected until the vadose zone is saturated to ensure thorough application.

- Injection at each location would occur at 5-ft vertical intervals starting at a depth of 60 ft bgs and working upward to ground surface.

- Minimum of two rounds of injections would be required to achieve SCGs.

- Following injection, the temporary injection points would be filled with sand to the top of the treatment zone, then sealed with bentonite and a concrete or asphalt cap, as needed to prevent surfacing of the emulsion.

- Groundwater samples would be collected quarterly for the first 2 years and annually thereafter, to measure the concentration of VOCs (monitoring is estimated to be conducted for 10 years or until SCGs are achieved). Samples would be collected from up to 15 monitoring wells.

- A soil vapor intrusion investigation would be conducted in offsite buildings within proximity of the groundwater contaminant plume.

6.3 ALTERNATIVE 3: *IN SITU* OZONE-ENHANCED AQUIFER AIR SPARGING AND SOIL VAPOR EXTRACTION

Air combined with ozone would be forced into the aquifer via a network of wells installed as a grid designed to cover the extent of the plume; thereby, promoting contaminant degradation vertically and horizontally within the dissolved phase plume. This remedy would involve the installation of treatment infrastructure at the site. Horizontal soil vapor extraction wells would be installed to recover soil vapor. Ozone sparging would operate continuously until site data shows asymptotic conditions and the system becomes cost prohibitive as determined by the NYSDEC, which was estimated at 5 years for this FS.

In situ ozone sparging would be implemented as follows and as shown on Figure 6-2:

- A utility locator would be brought onsite to locate any underground utilities or other obstructions that may prove problematic to well installation.

- Three additional deep groundwater monitoring wells would be installed onsite and sampled prior to injections for baseline concentrations.

- Slug test would be performed at multiple wells across the site to determine radius of influence for the design.

- Assuming uniform geology is present at the site, an ozone pilot test would be completed (at one location) to confirm the radius of influence.

- A grid network of 15 stainless steel ozone injection wells would be installed at a 30-ft spacing throughout the plume footprint. Each ozone injection location would consist of two screened intervals. The lower screened interval would be 55–60 ft bgs, and the upper screened interval 25–30 ft bgs.

- An ozone generator would produce and relay ozone to an air sparger which would force the air/ozone into the wells by a network of conveyance hoses and pipes.

- Installation of horizontal soil vapor extraction wells and associated treatment building/equipment.

- Ozone/air sparging would be conducted within network wells on an alternating basis, to avoid creating preferential treatment pathways and maximize the radius of influence.

- Bi-weekly operation and maintenance visits would be required during treatment system operations.

- Groundwater samples would be collected quarterly for the first 2 years and annually thereafter to measure the concentration of VOCs (monitoring is estimated to be conducted for 10 years or until SCGs are achieved). Samples would be collected from 15 monitoring wells.

- A soil vapor intrusion investigation would be conducted in offsite buildings within proximity of the groundwater contaminant plume.

6.4 ALTERNATIVE 4: AIR SPARGE AND SOIL VAPOR EXTRACTION

Air would be forced into the aquifer via a network of wells installed as a grid designed to cover the extent of the plume; thereby, promoting contaminant degradation vertically and horizontally within the dissolved phase plume. This remedy would involve the installation of treatment infrastructure at the site. Horizontal soil vapor extraction wells would be installed to recover soil vapor. The system would operate continuously until site data shows asymptotic conditions and the system becomes cost prohibitive as determined by the NYSDEC, which was estimated at 5 years for this FS

Air sparging and soil vapor extraction would be implemented as follows and as shown on Figure 6-3:

- A utility locator would be brought onsite to locate any underground utilities or other obstructions that may prove problematic to well installation.

- Three additional deep groundwater monitoring wells would be installed onsite and sampled prior to injections for baseline concentrations.

- Slug test would be performed at multiple wells across the site to determine radius of influence for the design.

- Assuming uniform geology is present at the site, an air sparge pilot test would be completed to confirm the radius of influence.

- A grid network of 15 air sparge injection wells would be installed at a 30-ft spacing throughout the plume footprint. Each air sparge location would consist of two screened intervals. The lower screened interval would be 55–60 ft bgs, and the upper screened interval 25–30 ft bgs.

- Installation of horizontal soil vapor extraction wells.

- Installation of an air sparge and soil vapor extraction system trailer and a network of conveyance hoses and pipes.

- Bi-weekly operation and maintenance visits would be required during treatment system operations.

- Groundwater samples would be collected quarterly for the first 2 years and annually; thereafter, to measure the concentration of VOCs (monitoring is estimated to be conducted for 10 years or until SCGs are achieved). Samples would be collected from 15 monitoring wells.

- A soil vapor intrusion investigation would be conducted in offsite buildings within proximity of the groundwater contaminant plume.

6.5 ALTERNATIVE 5: *IN SITU* ENHANCED REDUCTIVE DECHLORINATION

Direct-push methods would be used to inject amendments/reagents (peroxide followed by sodium permanganate) into the contaminated aquifer and the vadose zone beneath the building. This sodium permanganate would break down the COC's. One injection event is included in this alternative, and it is possible that additional events may be required to attain SCGs. The need for supplementary injections would depend on field conditions.

In situ chemical injection would be implemented as follows and as shown on Figure 6-4:

- A utility locator would be brought onsite to locate any underground utilities or other obstructions that may prove problematic to drilling.

- Three additional deep groundwater monitoring wells would be installed onsite and sampled prior to injections for baseline concentrations.

- The oxidant would be injected into 100 points within the plume area each spaced 10 ft apart. Injections would be completed over the areal extent of the dissolved phase plume.

- Injection at each location would occur at 5-ft vertical intervals starting at a depth of 60-ft bgs and working upward to ground surface. Peroxide would be injected followed by the sodium permanganate.

- The sodium permanganate would be injected into the vadose zone for the 28 locations located within the building. Sodium permanganate would be injected until the vadose zone is saturated to ensure thorough application.

- Following injection, the temporary injection points would be filled with sand to the top of the treatment zone, sealed with bentonite and a concrete or asphalt cap, as needed to prevent surfacing of the oxidant.

- Groundwater samples would be collected quarterly for the first 2 years and annually; thereafter, to measure the concentration of VOCs (monitoring is estimated to be conducted for 10 years or until SCGs are achieved). Samples would be collected from up to 10 existing monitoring wells.

- A soil vapor intrusion investigation would be conducted in offsite buildings within proximity of the groundwater contaminant plume.

6.6 ALTERNATIVE 6: BUILDING DEMOLITION, SOIL EXCAVATION, AND AIR SPARGE/SVE

The Former Damshire Cleaners building would be demolished and the building material disposed of at a C&D landfill. Contaminated soil from beneath the building (446 yd^3) and the contaminated site soil outside the footprint of the building (210 yd^3) would then be excavated and removed from the site using an excavator and dump truck. Excavated soil would be transported to an approved offsite disposal facility. The excavated area would be restored to original grades using certified clean fill from an offsite source. Six inches of topsoil and seed would be placed over clean common fill. Approximately 656 yd^3 of impacted soil would be removed from the site under this alternative. Figure 6-5 depicts the proposed excavation extents under this alternative.

Following completion of building demolition and soil excavation and removal, an air sparging and soil vapor extraction system would be installed and implemented at the site as detailed in Alternative 4 (Figure 6-3). Following installation of the treatment system the site would be restored to its original condition.

A soil vapor intrusion investigation would be conducted in offsite buildings within proximity of the groundwater contaminant plume

7. COSTING AND EVALUATION CRITERIA

Cost assumptions were prepared for each alternative using EPA's *Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 1996). Net present value of the project costs was estimated using an interest rate of 5 percent. The cost assumptions were calculated using the most common products and application methods available for a remedial alternative. The EPA guidance was used in conjunction with *DER-10 Technical Guidance for Site Investigation and Remediation* (NYSDEC 2010).

Cost estimates were prepared for each alternative based on the assumptions detailed in Section 5. Appendix B shows the detailed FS cost estimates developed. A summary of the costs for all alternatives is provided in Section 7.1.1.

7.1 CRITERIA USED FOR ANALYSIS OF ALTERNATIVES

The criteria to which potential remedial alternatives are compared (and used during this detailed analysis) are defined in 6 NYCRR Part 375 (NYSDEC 2006) and are listed below:

- Overall protectiveness of public health and the environment
- Conformance to SCGs
- Long-term effectiveness and permanence
- Reduction in toxicity, mobility, or volume of contamination through treatment
- Short-term impacts and effectiveness
- Implementability
- Cost-effectiveness
- Land use
- Community acceptance.

A description of the criteria and how alternatives are evaluated against them follows.

***Overall Protectiveness of Public Health and the Environment*—**This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

***Conformance to SCGs*—**Compliance with SCGs addresses whether a remedy would meet environmental laws, regulations, and other standards and criteria. The SCGs were presented in Section 3.

***Long-Term Effectiveness and Permanence*—**This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain onsite after the recommended remedy has been implemented, the following items are evaluated: (1) magnitude of the remaining risks, (2) adequacy of the engineering and/or institutional controls intended to limit the risk, and (3) reliability of these controls.

***Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment*—**The degree to which the alternative permanently reduces the toxicity, mobility, or volume of hazardous substances including the adequacy of the alternative in destroying the hazardous substances, reduction or elimination of hazardous substance releases and sources of releases, degree of irreversibility of waste treatment process, and characteristics and quantity of treatment residuals generated. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the site.

***Short-Term Impacts and Effectiveness*—**Evaluation of the short-term effectiveness for an alternative includes consideration of the risk to human health, the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks. Impacts from remedial action implementation include vehicle traffic, temporary relocation of residences/buildings, temporary closure of public facilities, odor, open excavations, and noise, dust, and safety concerns associated with extensive heavy equipment activity. The greatest short-term risk to human health is related to safety and general construction activity.

***Implementability*—**The technical and administrative feasibility of implementing each alternative is evaluated. Technical feasibility includes the difficulties associated with construction of the remedy and ability to monitor its effectiveness. For administrative feasibility, the availability of the necessary personnel and materials is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, institutional controls, and so forth.

***Cost-Effectiveness*—**Capital costs and annual operation, maintenance, and monitoring costs are estimated for each alternative and compared on a present worth basis. Although cost-effectiveness is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the other criteria, it can be used as the basis for the final decision.

***Land Use*—**The current and anticipated future use of the site will be considered. Land use must comply with applicable zoning laws and maps.

***Community Acceptance*—**Public comments will be considered after the close of the public comment period.

7.1.1 Costs

Based on the results of the remedial technology screening (Appendix A) the following cost estimates were prepared for Alternatives 1 through 6. Appendix B shows the detailed cost estimates.

Alternative 1: No Action

Present Worth *$0*
Capital Cost *$0*
Annual Costs *$0*

Alternative 2: *In Situ* Enhanced Bioremediation

Present Worth *$1,684,000*
Capital Cost *$1,550,000*
Annual Costs (Years 1-2) *$40,400*
Annual Costs (Years 3-10) *$10,100*

Alternative 3: *In Situ* Ozone-Enhanced Aquifer Air Sparging and Soil Vapor Extraction

Present Worth *$958,000*
Capital Cost *$512,000*
Annual Costs (Years 1-2) *$112,400*
Annual Costs (Years 3-5) *$82,100*
Annual Costs (Years 6-10) *$10,100*

Alternative 4: Air Sparging and Soil Vapor Extraction

Present Worth *$641,000*
Capital Cost *$351,000*
Annual Costs (Years 1-2) *$76,400*
Annual Costs (Years 3-5) *$46,100*
Annual Costs (Years 6-10) *$10,100*

Alternative 5: *In Situ* Enhanced Reductive Dechlorination

Present Worth *$1,426,000*
Capital Cost *$1,292,000*
Annual Costs (Years 1-2) *$40,400*
Annual Costs (Years 3-10) *$10,100*

Alternative 6: Building Demolition, Soil Excavation, and Air Sparge/SVE

Present Worth *$971,000*
Capital Cost *$681,000*
Annual Costs (Years 1-2) *$76,400*
Annual Costs (Years 3-5) *$46,100*
Annual Costs (Years 6-10) *$10,100*

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8. DETAILED ANALYSIS OF ALTERNATIVES AND RECOMMENDATIONS

The purpose of this FS was to develop, screen, and evaluate potential remedial alternatives for the Former Damshire Drycleaners site. Remedies were identified and screened in accordance with USEPA and NYSDEC guidance.

Six remedial alternatives were developed in this FS, as identified below.

- **Alternative 1—**No Action
- **Alternative 2—***In Situ* Enhanced Bioremediation
- **Alternative 3—**Sub-Slab Depressurization System and *In Situ* Ozone-Enhanced Aquifer Air Sparging
- **Alternative 4—**Air Sparge and Soil Vapor Extraction
- **Alternative 5—***In Situ* Enhanced Reductive Dechlorination
- **Alternative 6:** Building Demolition, Soil Excavation, and Air Sparge/SVE.

8.1 COMPARISON OF ALTERNATIVES

The first two evaluation criteria are termed "threshold criteria" and must be satisfied in order for an alternative to be considered for selection. The remaining six "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies.

8.1.1 Overall Protection of Public Health and the Environment

This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

Alternative 1 does not protect public health because there will be no change in existing conditions at the site. Alternative 6 will be the most protective of public health and the environment because it addresses the source area (i.e. the building and contaminated soil beneath the building) and directly reduces the concentrations of COCs in all three media (soil, groundwater and soil vapor) at the site to levels that will not harm human health. Alternative 4 is also protective of public health because it directly reduces the concentrations of COCs in all three media (soil, groundwater and soil vapor) at the site to levels that will not harm human health it does not address building removal; however, Alternative 4 is less protective than Alternative 6 because it will require a longer period of time to treat address source removal. Alternatives 2 and 5 are also protective of public health and the environment; however, to a lesser degree than Alternative 4 because they do not address source area removal or directly address soil vapor. Alternative 3 will address site soil, groundwater, and soil vapor; however, it is the least protective because it is the least effective on soil contamination and does not address source area removal.

8.1.2 Standards, Criteria, and Guidance

Compliance with SCGs addresses whether a remedy will meet environmental laws, regulations, and other standards and criteria.

Alternative 1 does not meet this criterion because there will be no change in concentrations of COCs at the site. Alternative 6 will be the most compliant and efficient at achieving SCGs because it removes the source area (i.e. the onsite building and contaminated soil beneath the building) and directly reduces the concentrations of COCs in all three media (soil, groundwater and soil vapor). Alternative 4 will also achieve SCGs; however it will take a longer period of time to address source area removal. Alternatives 2 and 5 will also achieve SCGs; however, additional injections may be required. Alternative 3 will achieve SCGs in all soil, groundwater, and soil vapor media; however, it will take the longest to achieve SCGs in soil and address the source area.

8.1.3 Long-Term Effectiveness and Permanence

This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If fill or treated residuals remain onsite after the recommended remedy has been implemented, the following items are evaluated: (1) the magnitude of the remaining risks, (2) the adequacy of the engineering and/or institutional controls intended to limit the risk, and (3) the reliability of these controls.

Alternative 1 will not provide long-term effectiveness or permanence because there will be no change in concentrations of COCs at the site. Alternative 6 would be permanent for source area removal (i.e. the building and soil contamination both beneath the building) and soil contamination onsite. In addition, Alternative 6 would consist of installing a groundwater air sparge and soil vapor extraction treatment system which will directly address groundwater and soil vapor. Alternatives 2 and 5 may require one or more additional rounds of injections as rebound of COCs commonly occurs after the injectate is consumed; long-term monitoring would be used to identify the need for further action; however the cost for additional injections is not included in this FS. Alternatives 3 and 4 would be permanent treatment systems and will provide the most effectiveness with continued operation.

8.1.4 Reduction of Toxicity, Mobility, or Volume of Contamination

Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility, or volume of contamination at the site.

Alternative 1 will not reduce the toxicity, mobility, or volume of contamination because nothing would be done at the site. Alternatives 2 through 5 do not guarantee source area removal and Alternatives 2 and 5 could potentially displace the COCs within the groundwater plume during injections. Alternative 4 would significantly reduce toxicity in soil vapor with direct treatment. Alternatives 3 and 4 would directly reduce groundwater concentrations without mobilizing COCs. Alternative 6 includes guaranteed and rapid source removal (i.e. building and soil contamination beneath the building), directly eliminates soil contamination onsite, would most significantly reduce toxicity in soil vapor with direct treatment, and would directly reduce groundwater concentrations without mobilizing COCs.

8.1.5 Short-Term Impacts and Effectiveness

This criterion evaluates the potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

Alternative 1 does not pose additional risk to the community, workers, or environment, as there are no construction activities involved. Alternatives 3 and 4 pose increased short-term risks to the public during the site activities associated with the construction of the remediation systems, most notably during excavation for system installation and backfill around pipes, through the production of dust and the presence of construction equipment in a high traffic area; however, earthwork would only take a short amount of time during the two month construction period. In addition, the permanent treatment systems would produce nuisance noise during operations. Alternatives 2 and 5 pose increased short term risks to the public during the direct-push injection event(s), which are expected to take more than two months and potentially be repeated within the treatment period. Alternative 6 poses increased short-term risks to the public during building demolition, excavation and loading activities, and activities associated with the construction of the remediation system. These risks can be reduced through the implementation of standard dust mitigation construction practices, adequate fencing, and proper safety signs.

Workers can potentially be exposed to impacted media during construction of the remedial systems for Alternatives 3, 4, and 6, and during excavation activities for Alternative 6. Workers can also be exposed to the hazardous chemicals used for injectate in Alternatives 2 and 5 if not handled carefully. Risks can be minimized by implementing health and safety controls, including the use of appropriate personal protective equipment.

Alternative 6 is the quickest way to meet standards for groundwater and vapor due to source removal. Alternatives 2 through 5 are expected to reach the remedial objectives within a comparable timeframe, although the exact amount of time for each is unknown. This depends on both physical and chemical site conditions.

8.1.6 Implementability

This criterion evaluates the technical and administrative feasibility of implementing each alternative.

Alternatives 2, 5, and 6 would be easiest to implement because they require the least amount of design and construction. Alternatives 3 and 4 would include additional logistic effort during construction activities and design of a permanent treatment system. Alternative 6 would require negotiation/approval from the landowner (to proceed with building demolition activities) as well as additional logistic effort during the building demolition process, construction/disposal activities and site restoration. These alternatives have all been implemented successfully at similar sites.

8.1.7 Cost-Effectiveness

This criterion evaluates estimated capital costs, as well as annual operation, maintenance, and monitoring costs, on a present-worth basis.

Alternative 1 is the least expensive, but is also the least effective, as no remedial action would take place. Alternative 6 is the quickest way to meet SCGs via source removal, however it is the second most costly and requires full building demolition/disposal. Alternatives 2 through 5 would all be effective at achieving SCGs at the site. Alternative 2 is the most expensive and least cost-effective. Alternative 4 is the more desirable from a cost standpoint because it is the second most effective and overall the least expensive of the standalone alternatives. Alternative 3 is less expensive than Alternative 5 but Alternative 5 is more effective than Alternative 3.

8.1.8 Land Use

Alternatives 1–6 would not affect the future use of the site as a commercial property. Alternative 1 would not change the current condition, as no remedial action would be completed; however, the site could not be used as a commercial property. Alternatives 2–6 would result in the reduction of COCs in groundwater, allowing the site to be used as a commercial property. Alternative 6 is the most beneficial to future land use because it allows for pre-release conditions and unrestricted use of the site. Alternative 4 is beneficial to future land use because once installed and operating, a potential tenant could occupy the building. The SVE system would act as a sub-slab depressurization system which would allow for the issuance of an occupancy permit. Alternatives 3, 4 and 6 would restrict future development due to the presence of the treatment system. A certificate of occupancy could not be issued until Alternatives 2, 3 and 5 have achieved SCGs.

8.1.9 Community Acceptance

This criterion evaluates concerns of the community regarding the investigation and the evaluation of alternatives. The Damshire Cleaners site remedial approach has not been presented to the community for comment at this point.

Alternative 1 does not meet any of the RAOs. Alternatives 2 and 5 are the most expensive and may meet RAOs over time; however, it is not known how many injections will be required and long-term monitoring would need to be implemented to confirm rebounding does not occur.

Alternative 6 is the quickest way to meet standards for groundwater and vapor (SVI) since it includes source removal. Alternatives 3 and 4 will meet RAOs and in less time than Alternatives 2 and 5. Alternative 3 will take longer to reach SCGs than Alternative 4 or 6.

Alternative 4 is the recommended approach as this alternative represents the most effective remediation and treatment solution which will meet RAOs in a short amount of time and the least cost.

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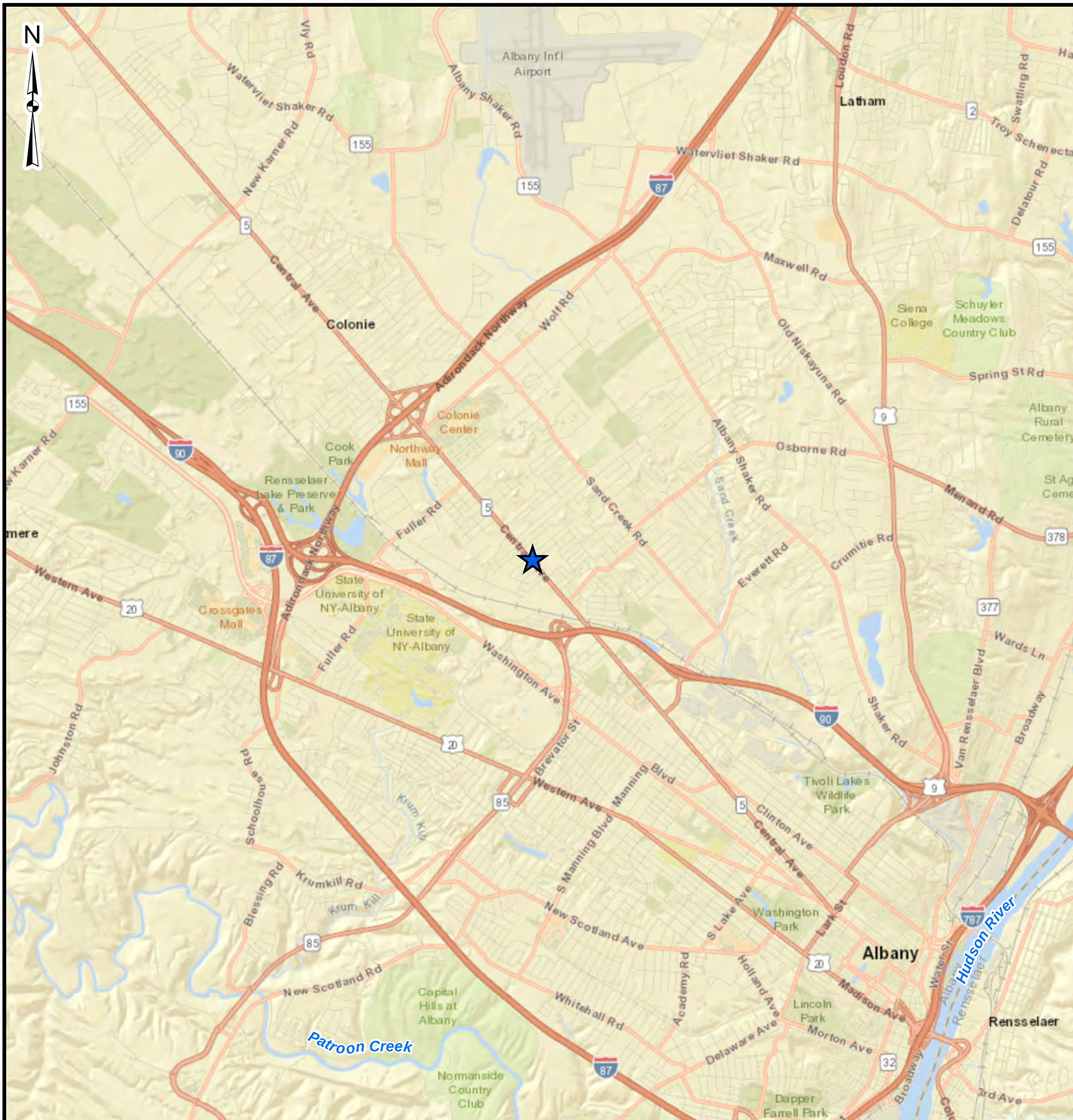
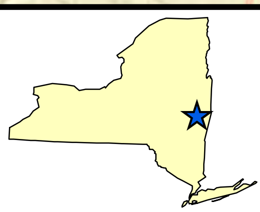
Figures





Legend

★ Site Location

Miles
0 0.5 1 2
1 in = 1 miles

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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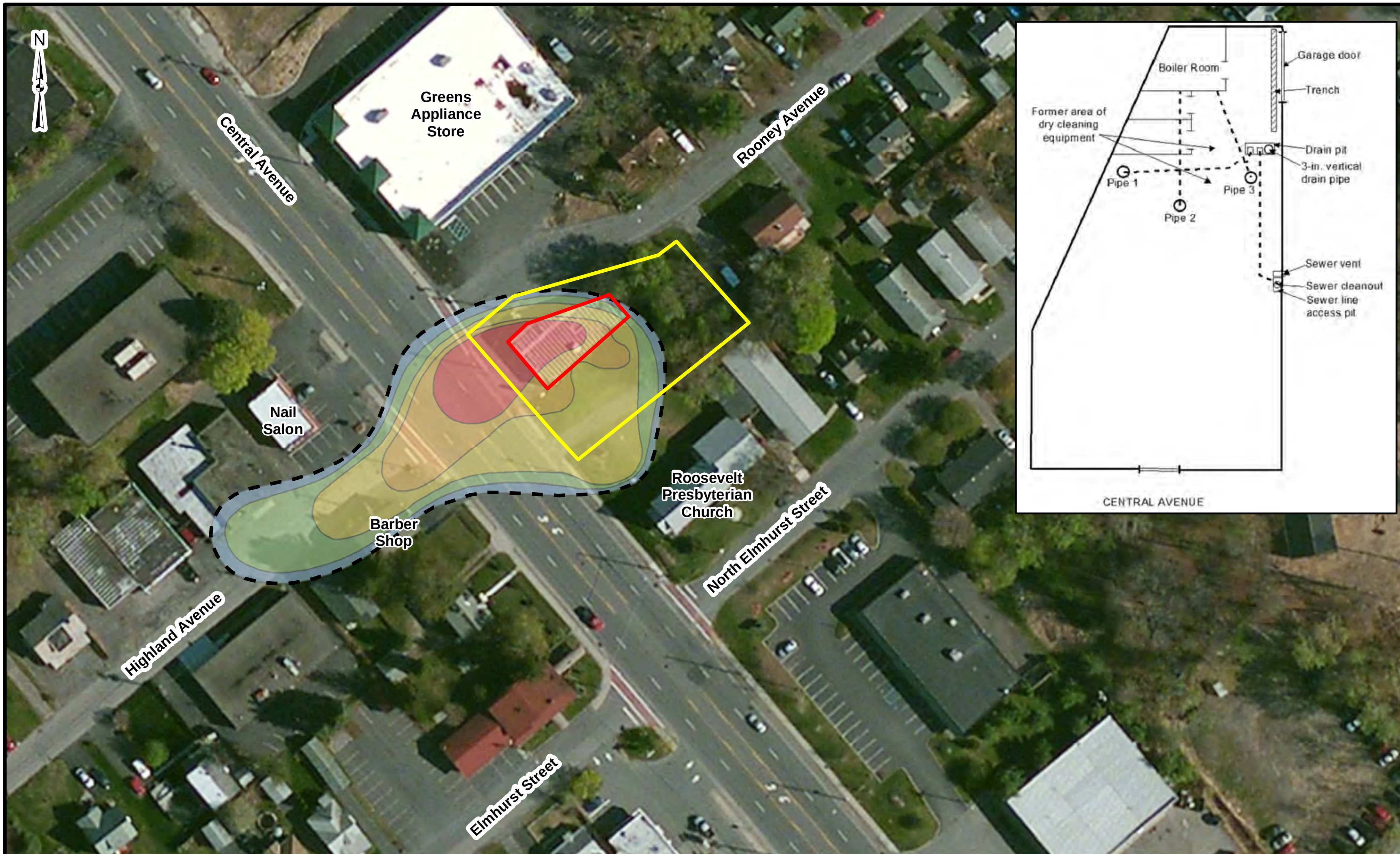
FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 1-1
SITE LOCATION

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/ FS_FIGURES/FIGURE 1-1



Legend

- Approximate Property Boundary
- Approximate Building Outline
- Interpreted Dissolved-Phase Plume Boundary

Chorinated Solvent Concentration (µg/L)

- 1-10
- 10-100
- 100-1,000
- 1,000-10,000
- >10,000

Feet
0 25 50 100 150 200
1 in = 100 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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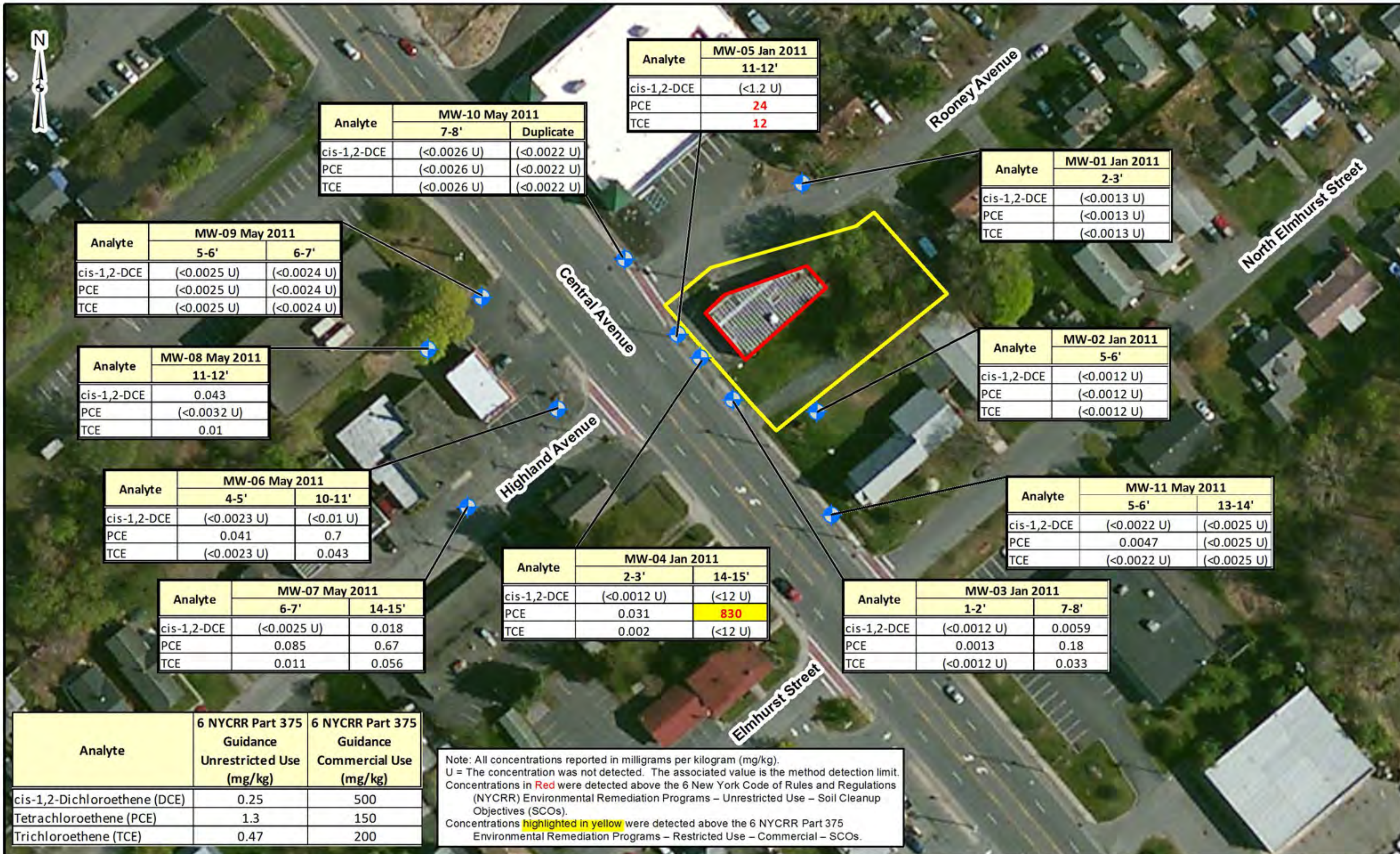
FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 1-2
SITE LAYOUT

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/FS_FIGURES/FIGURE 1-2



Analyte	MW-05 Jan 2011
	11-12'
cis-1,2-DCE	(<1.2 U)
PCE	24
TCE	12

Analyte	MW-10 May 2011	
	7-8'	Duplicate
cis-1,2-DCE	(<0.0026 U)	(<0.0022 U)
PCE	(<0.0026 U)	(<0.0022 U)
TCE	(<0.0026 U)	(<0.0022 U)

Analyte	MW-01 Jan 2011
	2-3'
cis-1,2-DCE	(<0.0013 U)
PCE	(<0.0013 U)
TCE	(<0.0013 U)

Analyte	MW-09 May 2011	
	5-6'	6-7'
cis-1,2-DCE	(<0.0025 U)	(<0.0024 U)
PCE	(<0.0025 U)	(<0.0024 U)
TCE	(<0.0025 U)	(<0.0024 U)

Analyte	MW-08 May 2011
	11-12'
cis-1,2-DCE	0.043
PCE	(<0.0032 U)
TCE	0.01

Analyte	MW-02 Jan 2011
	5-6'
cis-1,2-DCE	(<0.0012 U)
PCE	(<0.0012 U)
TCE	(<0.0012 U)

Analyte	MW-06 May 2011	
	4-5'	10-11'
cis-1,2-DCE	(<0.0023 U)	(<0.01 U)
PCE	0.041	0.7
TCE	(<0.0023 U)	0.043

Analyte	MW-11 May 2011	
	5-6'	13-14'
cis-1,2-DCE	(<0.0022 U)	(<0.0025 U)
PCE	0.0047	(<0.0025 U)
TCE	(<0.0022 U)	(<0.0025 U)

Analyte	MW-07 May 2011	
	6-7'	14-15'
cis-1,2-DCE	(<0.0025 U)	0.018
PCE	0.085	0.67
TCE	0.011	0.056

Analyte	MW-04 Jan 2011	
	2-3'	14-15'
cis-1,2-DCE	(<0.0012 U)	(<12 U)
PCE	0.031	830
TCE	0.002	(<12 U)

Analyte	MW-03 Jan 2011	
	1-2'	7-8'
cis-1,2-DCE	(<0.0012 U)	0.0059
PCE	0.0013	0.18
TCE	(<0.0012 U)	0.033

Analyte	6 NYCRR Part 375 Guidance Unrestricted Use (mg/kg)	6 NYCRR Part 375 Guidance Commercial Use (mg/kg)
cis-1,2-Dichloroethene (DCE)	0.25	500
Tetrachloroethene (PCE)	1.3	150
Trichloroethene (TCE)	0.47	200

Note: All concentrations reported in milligrams per kilogram (mg/kg).
U = The concentration was not detected. The associated value is the method detection limit.
Concentrations in Red were detected above the 6 New York Code of Rules and Regulations (NYCRR) Environmental Remediation Programs – Unrestricted Use – Soil Cleanup Objectives (SCOs).
Concentrations highlighted in yellow were detected above the 6 NYCRR Part 375 Environmental Remediation Programs – Restricted Use – Commercial – SCOs.

Legend

- Approximate Property Boundary
- Approximate Building Outline
- Monitoring Well

Feet
0 25 50 100 150 200
1 in = 100 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
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FIGURE 1-3
PREVIOUS SOIL VOC
ANALYTICAL RESULTS (2011)

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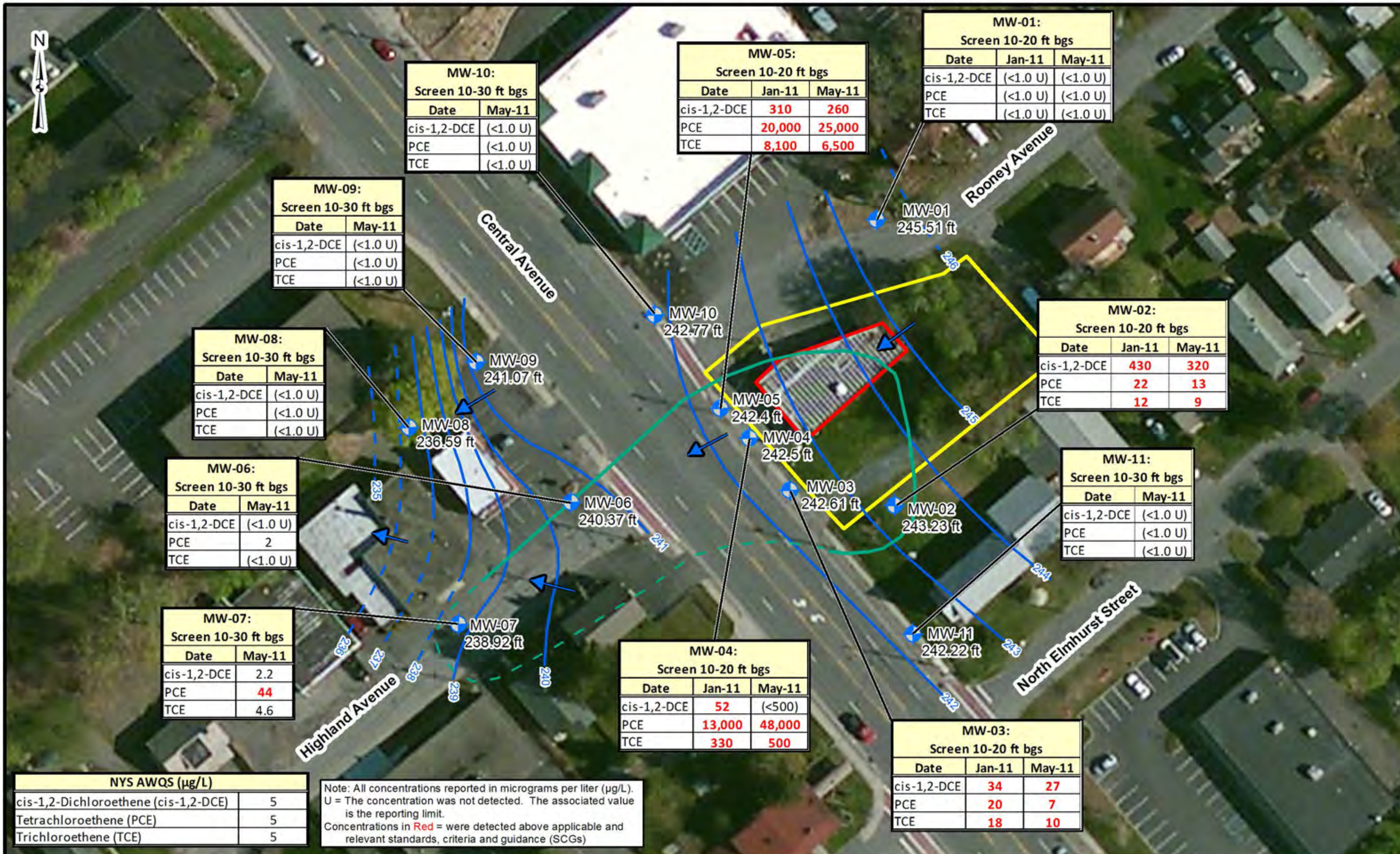
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/FS_FIGURES/FIGURE 1-3



MW-01: Screen 10-20 ft bgs

Date	Jan-11	May-11
cis-1,2-DCE	(<1.0 U)	(<1.0 U)
PCE	(<1.0 U)	(<1.0 U)
TCE	(<1.0 U)	(<1.0 U)

MW-02: Screen 10-20 ft bgs

Date	Jan-11	May-11
cis-1,2-DCE	430	320
PCE	22	13
TCE	12	9

MW-03: Screen 10-20 ft bgs

Date	Jan-11	May-11
cis-1,2-DCE	34	27
PCE	20	7
TCE	18	10

MW-04: Screen 10-20 ft bgs

Date	Jan-11	May-11
cis-1,2-DCE	52	(<500)
PCE	13,000	48,000
TCE	330	500

MW-05: Screen 10-20 ft bgs

Date	Jan-11	May-11
cis-1,2-DCE	310	260
PCE	20,000	25,000
TCE	8,100	6,500

MW-06: Screen 10-30 ft bgs

Date	May-11
cis-1,2-DCE	(<1.0 U)
PCE	2
TCE	(<1.0 U)

MW-07: Screen 10-30 ft bgs

Date	May-11
cis-1,2-DCE	2.2
PCE	44
TCE	4.6

MW-08: Screen 10-30 ft bgs

Date	May-11
cis-1,2-DCE	(<1.0 U)
PCE	(<1.0 U)
TCE	(<1.0 U)

MW-09: Screen 10-30 ft bgs

Date	May-11
cis-1,2-DCE	(<1.0 U)
PCE	(<1.0 U)
TCE	(<1.0 U)

MW-10: Screen 10-30 ft bgs

Date	May-11
cis-1,2-DCE	(<1.0 U)
PCE	(<1.0 U)
TCE	(<1.0 U)

MW-11: Screen 10-30 ft bgs

Date	May-11
cis-1,2-DCE	(<1.0 U)
PCE	(<1.0 U)
TCE	(<1.0 U)

NYS AWQS (µg/L)	
cis-1,2-Dichloroethene (cis-1,2-DCE)	5
Tetrachloroethene (PCE)	5
Trichloroethene (TCE)	5

Note: All concentrations reported in micrograms per liter (µg/L).
U = The concentration was not detected. The associated value is the reporting limit.
Concentrations in Red = were detected above applicable and relevant standards, criteria and guidance (SCGs)

Legend

- Approximate Property Boundary
- Approximate Building Outline
- Monitoring Well
- Interpolated Groundwater Contour May 2011 (Dashed Where Inferred)
- Groundwater Flow Direction
- Approximate Plume Boundary (Dashed Where Inferred)

Feet
0 20 40 80 120 160
1 in = 80 ft

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FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 1-4
PREVIOUS GROUNDWATER VOC ANALYTICAL RESULTS (2011)

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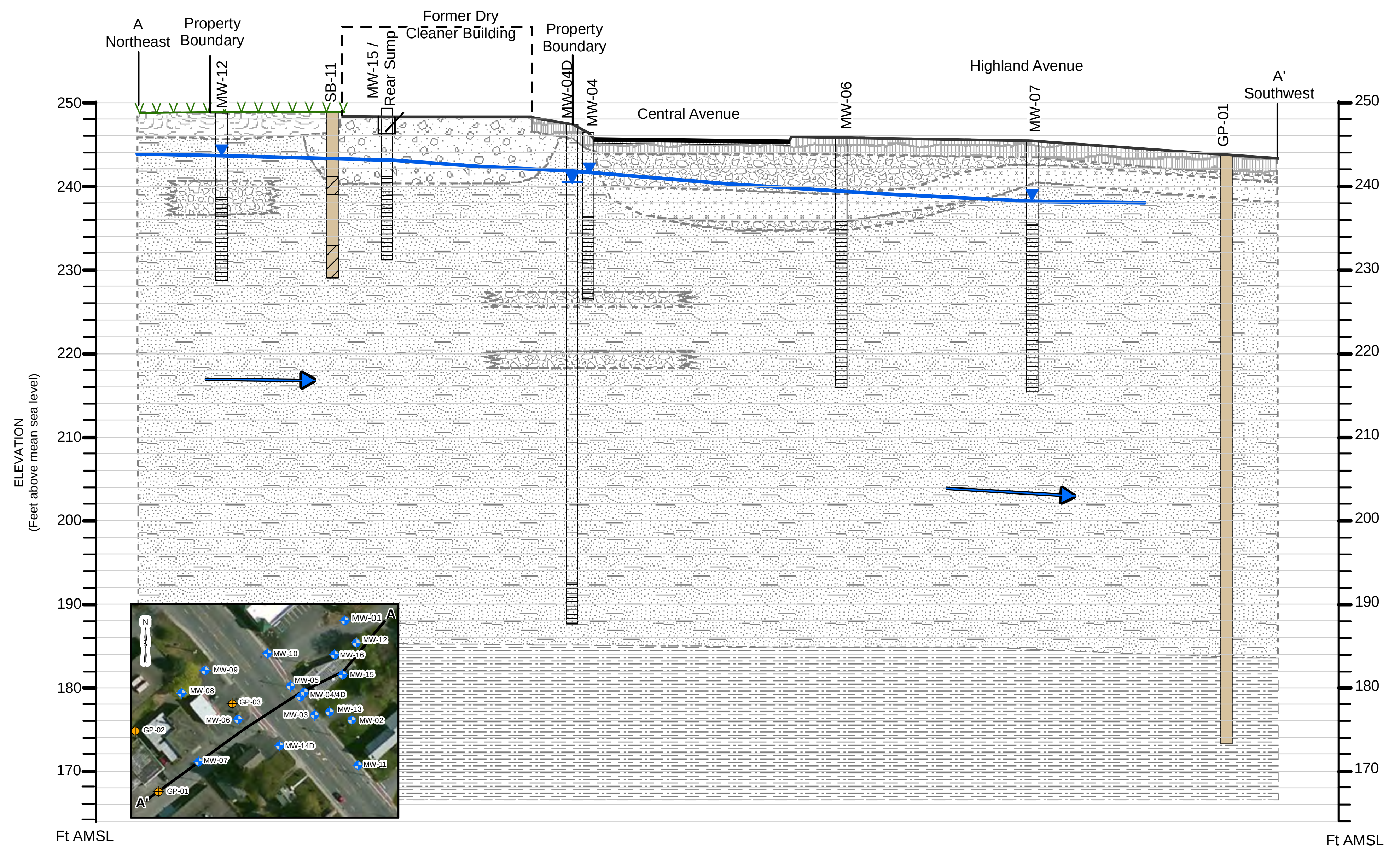

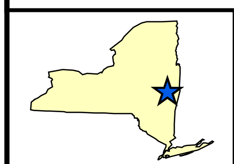

Legend

- Asphalt / Concrete
- Grass
- Central Ave
- Water Table
- Groundwater Elevation
- Groundwater Flow Direction
- Topsoil
- Fill
- Asphalt/Subbase
- Fine to Medium Sand, Trace to Some Gravel
- Fine to Medium Sand
- Fine to Very Fine Sand and Silt, Trace to Some Clay
- Clay (Confining Unit)

Feet

0 15 30 60 90 120

1 in = 60 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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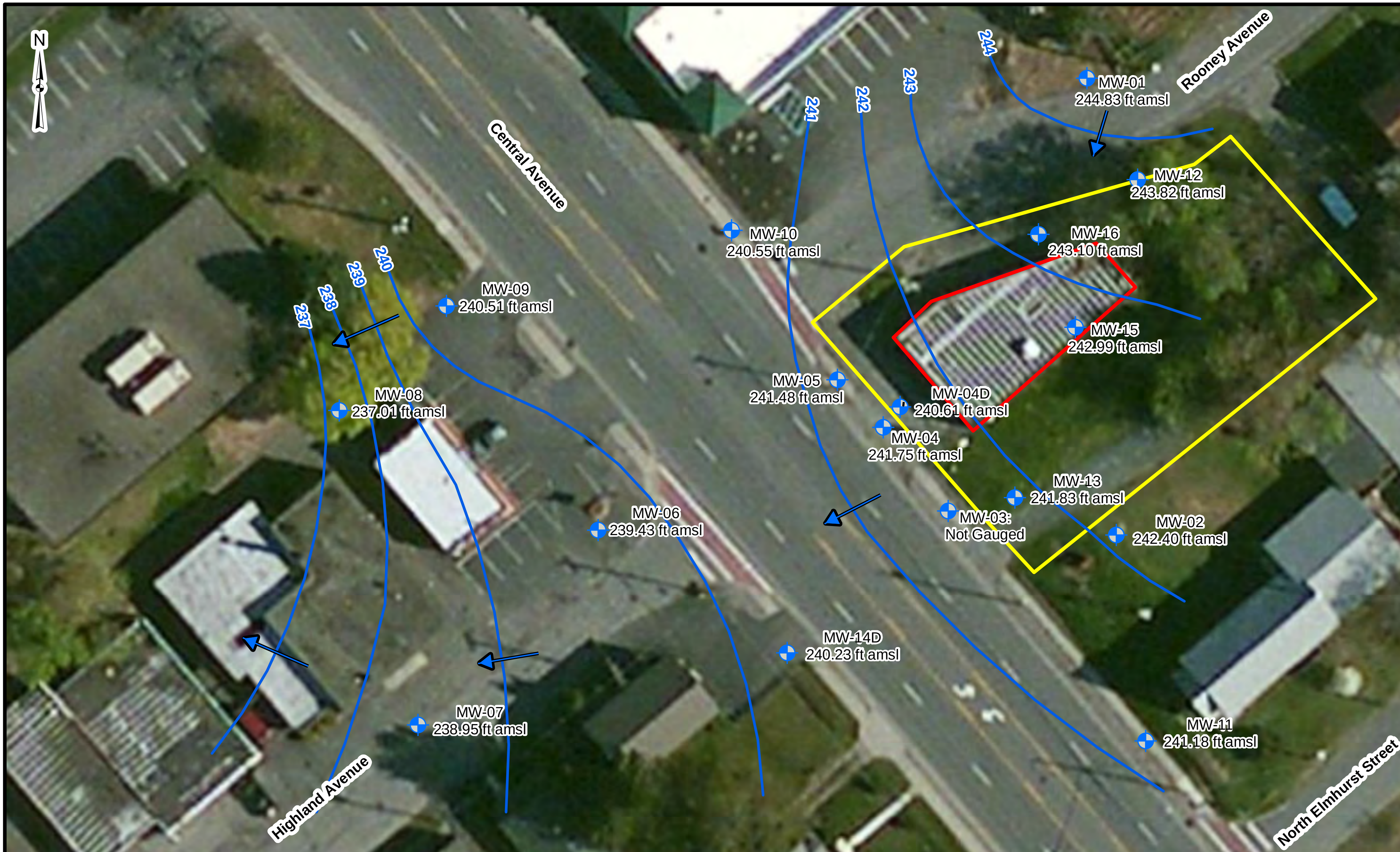
FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 1-5
GEOLOGIC CROSS SECTION A-A'
(NORTHEAST TO SOUTHWEST)

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/FS_FIGURES/FIGURE 1-5



Legend

- Approximate Property Boundary
- Approximate Building Outline
- Monitoring Well
- Interpolated 1-ft Groundwater Contour
- Groundwater Flow Direction

Feet
0 12.5 25 50 75 100
1 in = 50 ft

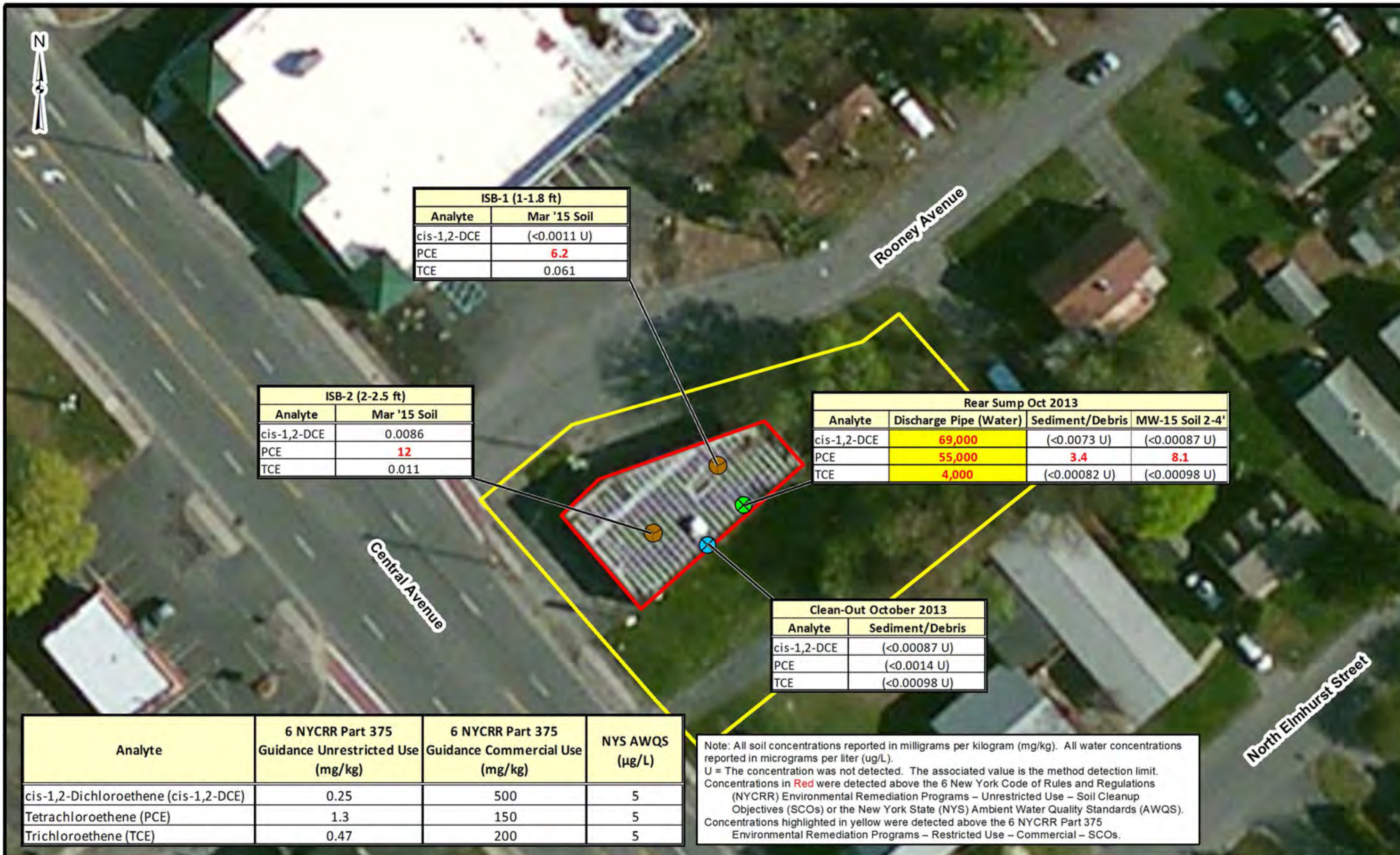
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 1-6
HYDROGEOLOGY
JANUARY 2015

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/FS_FIGURES/FIGURE 1-6



ISB-1 (1-1.8 ft)	
Analyte	Mar '15 Soil
cis-1,2-DCE	(<0.0011 U)
PCE	6.2
TCE	0.061

ISB-2 (2-2.5 ft)	
Analyte	Mar '15 Soil
cis-1,2-DCE	0.0086
PCE	12
TCE	0.011

Rear Sump Oct 2013			
Analyte	Discharge Pipe (Water)	Sediment/Debris	MW-15 Soil 2-4'
cis-1,2-DCE	69,000	(<0.0073 U)	(<0.00087 U)
PCE	55,000	3.4	8.1
TCE	4,000	(<0.00082 U)	(<0.00098 U)

Clean-Out October 2013	
Analyte	Sediment/Debris
cis-1,2-DCE	(<0.00087 U)
PCE	(<0.0014 U)
TCE	(<0.00098 U)

Analyte	6 NYCRR Part 375 Guidance Unrestricted Use (mg/kg)	6 NYCRR Part 375 Guidance Commercial Use (mg/kg)	NYS AWQS (µg/L)
cis-1,2-Dichloroethene (cis-1,2-DCE)	0.25	500	5
Tetrachloroethene (PCE)	1.3	150	5
Trichloroethene (TCE)	0.47	200	5

Note: All soil concentrations reported in milligrams per kilogram (mg/kg). All water concentrations reported in micrograms per liter (ug/L).
U = The concentration was not detected. The associated value is the method detection limit.
Concentrations in Red were detected above the 6 New York Code of Rules and Regulations (NYCRR) Environmental Remediation Programs – Unrestricted Use – Soil Cleanup Objectives (SCOs) or the New York State (NYS) Ambient Water Quality Standards (AWQS).
Concentrations highlighted in yellow were detected above the 6 NYCRR Part 375 Environmental Remediation Programs – Restricted Use – Commercial – SCOs.

Legend

- Approximate Property Boundary
- Approximate Building Outline
- Sump Location
- Clean-Out Location
- Sub-Slab Soil Sampling Location

Feet
0 12.5 25 50 75 100
1 in = 50 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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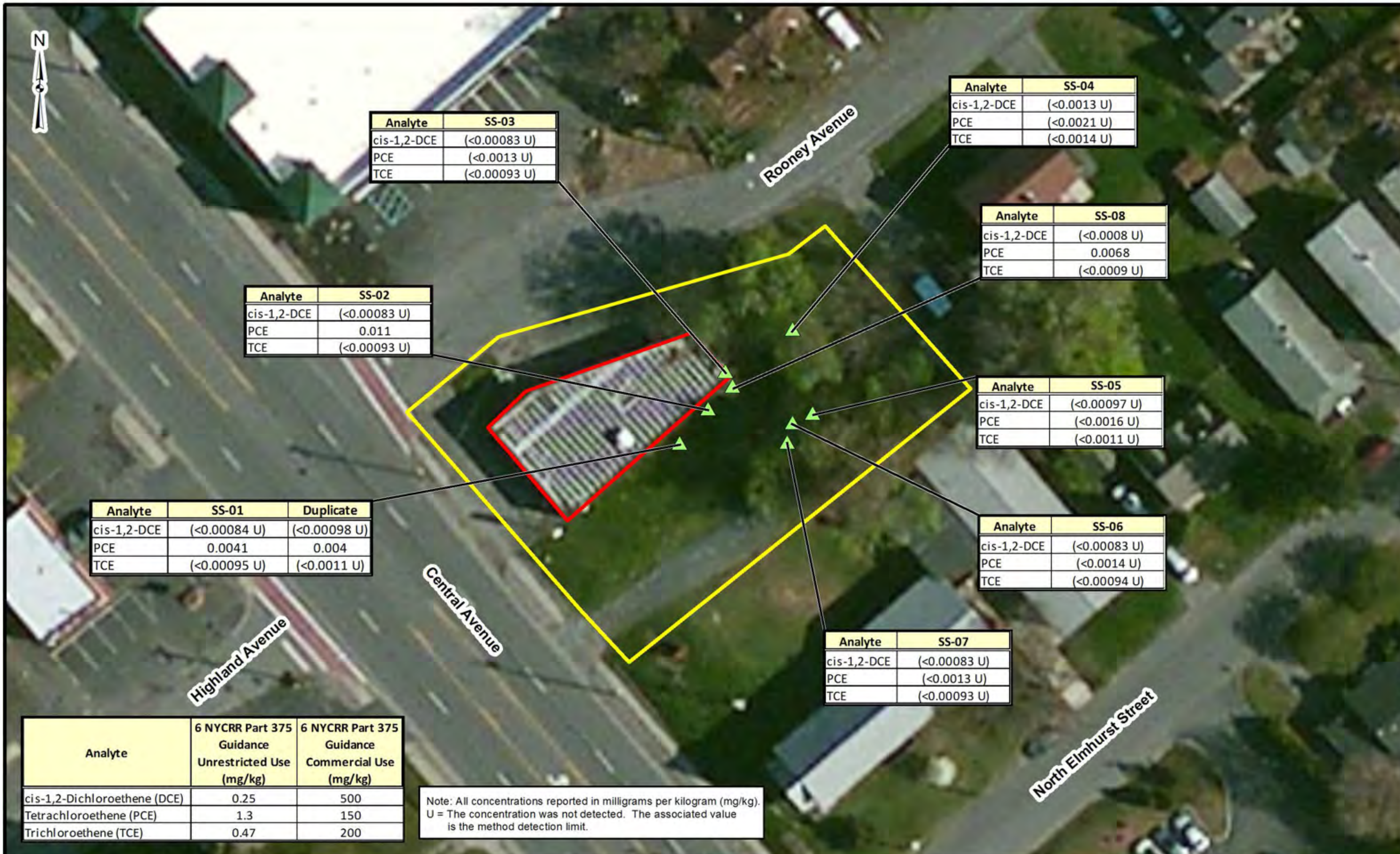
FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 2-1
FORMER DAMSHIRE CLEANERS BUILDING
ANALYTICAL RESULTS

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/ FS_FIGURES/FIGURE 2-1



Analyte	SS-03
cis-1,2-DCE	(<0.00083 U)
PCE	(<0.0013 U)
TCE	(<0.00093 U)

Analyte	SS-04
cis-1,2-DCE	(<0.0013 U)
PCE	(<0.0021 U)
TCE	(<0.0014 U)

Analyte	SS-08
cis-1,2-DCE	(<0.0008 U)
PCE	0.0068
TCE	(<0.0009 U)

Analyte	SS-02
cis-1,2-DCE	(<0.00083 U)
PCE	0.011
TCE	(<0.00093 U)

Analyte	SS-05
cis-1,2-DCE	(<0.00097 U)
PCE	(<0.0016 U)
TCE	(<0.0011 U)

Analyte	SS-01	Duplicate
cis-1,2-DCE	(<0.00084 U)	(<0.00098 U)
PCE	0.0041	0.004
TCE	(<0.00095 U)	(<0.0011 U)

Analyte	SS-06
cis-1,2-DCE	(<0.00083 U)
PCE	(<0.0014 U)
TCE	(<0.00094 U)

Analyte	SS-07
cis-1,2-DCE	(<0.00083 U)
PCE	(<0.0013 U)
TCE	(<0.00093 U)

Analyte	6 NYCRR Part 375 Guidance Unrestricted Use (mg/kg)	6 NYCRR Part 375 Guidance Commercial Use (mg/kg)
cis-1,2-Dichloroethene (DCE)	0.25	500
Tetrachloroethene (PCE)	1.3	150
Trichloroethene (TCE)	0.47	200

Note: All concentrations reported in milligrams per kilogram (mg/kg).
U = The concentration was not detected. The associated value is the method detection limit.

Legend

- Approximate Property Boundary
- Approximate Building Outline
- Surface Soil Sampling Location

Feet
0 12.5 25 50 75 100
1 in = 50 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 2-2
SURFACE SOIL VOC ANALYTICAL RESULTS
OCTOBER 2013

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/FS_FIGURES/FIGURE 2-2

Analyte	SB-06 3-4'
cis-1,2-DCE	(<0.0011 U)
PCE	(<0.0017 U)
TCE	(<0.0012 U)

Analyte	SB-10 3-4'
cis-1,2-DCE	(<0.00085 U)
PCE	(<0.0014 U)
TCE	(<0.00095 U)

Analyte	SB-11 3-5'
cis-1,2-DCE	(<0.00091 U)
PCE	(<0.0015 U)
TCE	(<0.001 U)

Analyte	SB-02 3-5'	Duplicate
cis-1,2-DCE	(<0.00086 U)	(<0.00084 U)
PCE	0.012	0.016
TCE	(<0.00096 U)	(<0.00095 U)

Analyte	SB-01 3-4'
cis-1,2-DCE	(<0.00075 U)
PCE	0.024
TCE	(<0.00084 U)

Analyte	SB-03 3-4'
cis-1,2-DCE	(<0.00081 U)
PCE	(<0.0013 U)
TCE	(<0.00091 U)

Analyte	SB-08 3-4'
cis-1,2-DCE	(<0.00091 U)
PCE	0.0032
TCE	(<0.001 U)

Analyte	MW-04D Dec 2013	
	32-34'	54-56'
cis-1,2-DCE	(<0.00095 U)	(<0.0010 U)
PCE	1.8	4.7
TCE	0.015 J	0.014

Analyte	SB-04 3-4'
cis-1,2-DCE	0.0047
PCE	0.069
TCE	0.0062

Analyte	SB-07 3-4'
cis-1,2-DCE	(<0.00085 U)
PCE	0.007
TCE	(<0.00096 U)

Analyte	SB-05 3-6'
cis-1,2-DCE	(<0.00089 U)
PCE	(<0.0014 U)
TCE	(<0.001 U)

Analyte	SB-09 3-4'
cis-1,2-DCE	(<0.00091 U)
PCE	(<0.0015 U)
TCE	(<0.001 U)

Analyte	6 NYCRR Part 375 Guidance Unrestricted Use (mg/kg)	6 NYCRR Part 375 Guidance Commercial Use (mg/kg)
cis-1,2-Dichloroethene (DCE)	0.25	500
Tetrachloroethene (PCE)	1.3	150
Trichloroethene (TCE)	0.47	200

Note: All concentrations reported in milligrams per kilogram (mg/kg).
U = The concentration was not detected. The associated value is the method detection limit.

Concentrations in Red were detected above the 6 New York Code of Rules and Regulations (NYCRR) Environmental Remediation Programs – Unrestricted Use – Soil Cleanup Objectives (SCOs).

Legend

- Approximate Property Boundary
- Approximate Building Outline
- Soil Boring
- Newly Installed Monitoring Well

Feet
0 12.5 25 50 75 100
1 in = 50 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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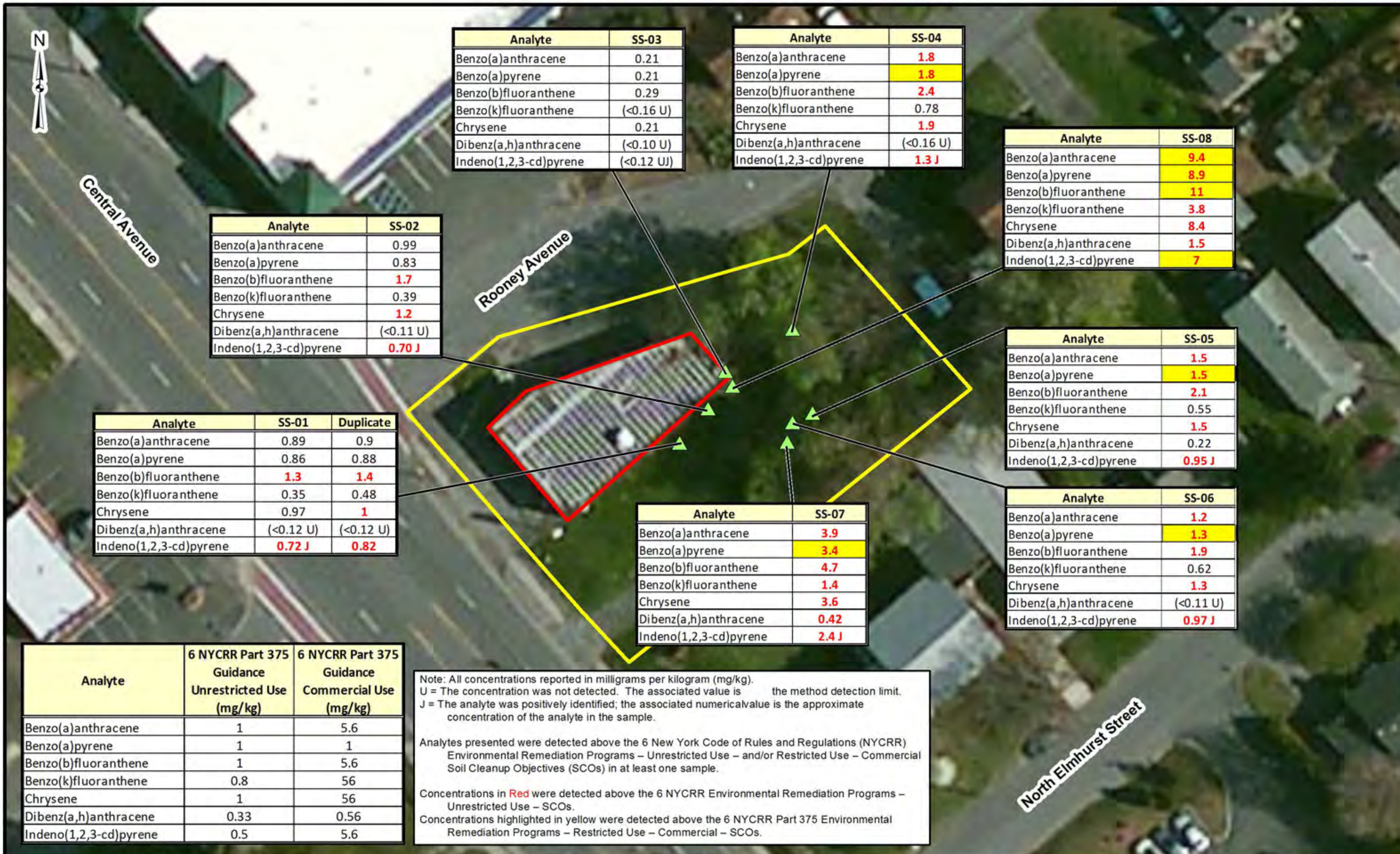
FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 2-3
SUBSURFACE SOIL VOC ANALYTICAL RESULTS
OCTOBER/DECEMBER 2013

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/FS_FIGURES/FIGURE 2-3



Analyte	SS-03
Benzo(a)anthracene	0.21
Benzo(a)pyrene	0.21
Benzo(b)fluoranthene	0.29
Benzo(k)fluoranthene	(<0.16 U)
Chrysene	0.21
Dibenz(a,h)anthracene	(<0.10 U)
Indeno(1,2,3-cd)pyrene	(<0.12 UJ)

Analyte	SS-04
Benzo(a)anthracene	1.8
Benzo(a)pyrene	1.8
Benzo(b)fluoranthene	2.4
Benzo(k)fluoranthene	0.78
Chrysene	1.9
Dibenz(a,h)anthracene	(<0.16 U)
Indeno(1,2,3-cd)pyrene	1.3 J

Analyte	SS-08
Benzo(a)anthracene	9.4
Benzo(a)pyrene	8.9
Benzo(b)fluoranthene	11
Benzo(k)fluoranthene	3.8
Chrysene	8.4
Dibenz(a,h)anthracene	1.5
Indeno(1,2,3-cd)pyrene	7

Analyte	SS-02
Benzo(a)anthracene	0.99
Benzo(a)pyrene	0.83
Benzo(b)fluoranthene	1.7
Benzo(k)fluoranthene	0.39
Chrysene	1.2
Dibenz(a,h)anthracene	(<0.11 U)
Indeno(1,2,3-cd)pyrene	0.70 J

Analyte	SS-05
Benzo(a)anthracene	1.5
Benzo(a)pyrene	1.5
Benzo(b)fluoranthene	2.1
Benzo(k)fluoranthene	0.55
Chrysene	1.5
Dibenz(a,h)anthracene	0.22
Indeno(1,2,3-cd)pyrene	0.95 J

Analyte	SS-01	Duplicate
Benzo(a)anthracene	0.89	0.9
Benzo(a)pyrene	0.86	0.88
Benzo(b)fluoranthene	1.3	1.4
Benzo(k)fluoranthene	0.35	0.48
Chrysene	0.97	1
Dibenz(a,h)anthracene	(<0.12 U)	(<0.12 U)
Indeno(1,2,3-cd)pyrene	0.72 J	0.82

Analyte	SS-07
Benzo(a)anthracene	3.9
Benzo(a)pyrene	3.4
Benzo(b)fluoranthene	4.7
Benzo(k)fluoranthene	1.4
Chrysene	3.6
Dibenz(a,h)anthracene	0.42
Indeno(1,2,3-cd)pyrene	2.4 J

Analyte	SS-06
Benzo(a)anthracene	1.2
Benzo(a)pyrene	1.3
Benzo(b)fluoranthene	1.9
Benzo(k)fluoranthene	0.62
Chrysene	1.3
Dibenz(a,h)anthracene	(<0.11 U)
Indeno(1,2,3-cd)pyrene	0.97 J

Analyte	6 NYCRR Part 375 Guidance Unrestricted Use (mg/kg)	6 NYCRR Part 375 Guidance Commercial Use (mg/kg)
Benzo(a)anthracene	1	5.6
Benzo(a)pyrene	1	1
Benzo(b)fluoranthene	1	5.6
Benzo(k)fluoranthene	0.8	56
Chrysene	1	56
Dibenz(a,h)anthracene	0.33	0.56
Indeno(1,2,3-cd)pyrene	0.5	5.6

Note: All concentrations reported in milligrams per kilogram (mg/kg).
U = The concentration was not detected. The associated value is the method detection limit.
J = The analyte was positively identified; the associated numericalvalue is the approximate concentration of the analyte in the sample.

Analytes presented were detected above the 6 New York Code of Rules and Regulations (NYCRR) Environmental Remediation Programs – Unrestricted Use – and/or Restricted Use – Commercial Soil Cleanup Objectives (SCOs) in at least one sample.

Concentrations in Red were detected above the 6 NYCRR Environmental Remediation Programs – Unrestricted Use – SCOs.
Concentrations highlighted in yellow were detected above the 6 NYCRR Part 375 Environmental Remediation Programs – Restricted Use – Commercial – SCOs.

Legend

- Approximate Property Boundary
- Approximate Building Outline
- Surface Soil Sampling Location

Feet
0 12.5 25 50 75 100
1 in = 50 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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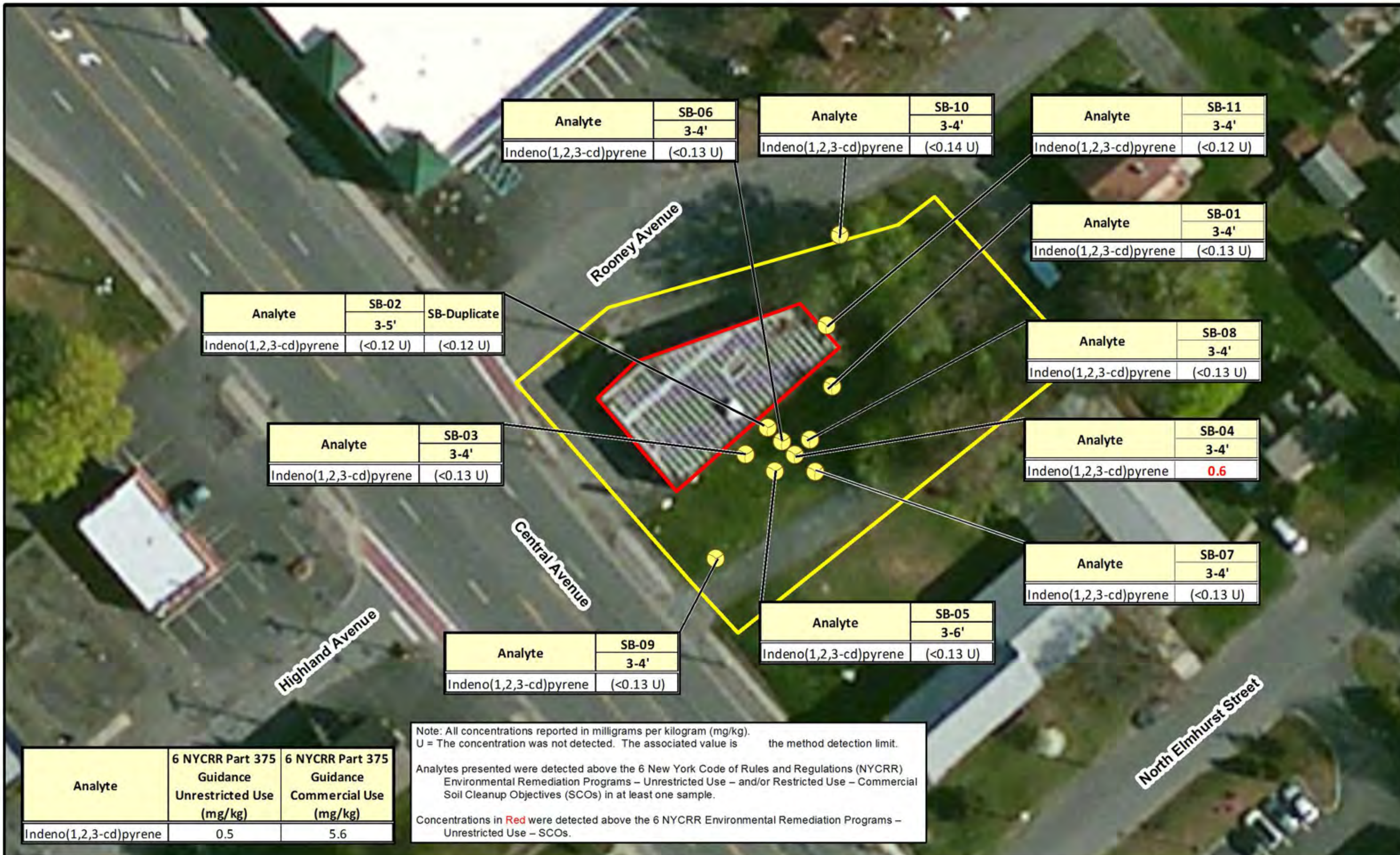
FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 2-4
SURFACE SOIL SVOC ANALYTICAL RESULTS
OCTOBER 2013

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/ fs_FIGURES/FIGURE 2-4



Analyte	SB-06 3-4'
Indeno(1,2,3-cd)pyrene	(<0.13 U)

Analyte	SB-10 3-4'
Indeno(1,2,3-cd)pyrene	(<0.14 U)

Analyte	SB-11 3-4'
Indeno(1,2,3-cd)pyrene	(<0.12 U)

Analyte	SB-01 3-4'
Indeno(1,2,3-cd)pyrene	(<0.13 U)

Analyte	SB-02 3-5'	SB-Duplicate
Indeno(1,2,3-cd)pyrene	(<0.12 U)	(<0.12 U)

Analyte	SB-08 3-4'
Indeno(1,2,3-cd)pyrene	(<0.13 U)

Analyte	SB-03 3-4'
Indeno(1,2,3-cd)pyrene	(<0.13 U)

Analyte	SB-04 3-4'
Indeno(1,2,3-cd)pyrene	0.6

Analyte	SB-07 3-4'
Indeno(1,2,3-cd)pyrene	(<0.13 U)

Analyte	SB-05 3-6'
Indeno(1,2,3-cd)pyrene	(<0.13 U)

Analyte	SB-09 3-4'
Indeno(1,2,3-cd)pyrene	(<0.13 U)

Analyte	6 NYCRR Part 375 Guidance Unrestricted Use (mg/kg)	6 NYCRR Part 375 Guidance Commercial Use (mg/kg)
Indeno(1,2,3-cd)pyrene	0.5	5.6

Note: All concentrations reported in milligrams per kilogram (mg/kg).
U = The concentration was not detected. The associated value is the method detection limit.

Analytes presented were detected above the 6 New York Code of Rules and Regulations (NYCRR) Environmental Remediation Programs – Unrestricted Use – and/or Restricted Use – Commercial Soil Cleanup Objectives (SCOs) in at least one sample.

Concentrations in Red were detected above the 6 NYCRR Environmental Remediation Programs – Unrestricted Use – SCOs.

Legend
- Approximate Property Boundary
- Soil Boring
- Approximate Building Outline

Feet: 0 12.5 25 50 75 100

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 2-5
SUBSURFACE SOIL SVOC ANALYTICAL RESULTS
OCTOBER 2013

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/ FS_FIGURES/FIGURE 2-5

GP-03 (GW) Jan 15					
Depth	20 ft	30 ft	40 ft	50 ft	60 ft
cis-1,2-DCE	(<0.15 U)	(<0.15 U)	(<0.15 U)	(<0.15 U)	(<0.15 U)
PCE	(<0.08 U)	(<0.08 U)	(<0.08 U)	(<0.08 U)	(<0.08 U)
TCE	(<0.077 U)	(<0.077 U)	(<0.077 U)	(<0.077 U)	(<0.077 U)

MW-10: Screen 10-30 ft bgs	
Date	Jan-14
cis-1,2-DCE	(<0.15 U)
PCE	(<0.08 U)
TCE	(<0.077 U)

MW-04: Screen 10-20 ft bgs	
Date	Jan-14
cis-1,2-DCE	(<29 U)
PCE	14,000
TCE	(<15 U)

MW-4D: Screen 54.5-59.5 ft bgs	
Date	Jan-14
cis-1,2-DCE	(<0.15 U)
PCE	96
TCE	4.0

MW-12: Screen 10-20 ft bgs	
Date	Jan-14
cis-1,2-DCE	(<0.15 U)
PCE	(<0.08 U)
TCE	(<0.077 U)

MW-09: Screen 10-30 ft bgs	
Date	Jan-14
cis-1,2-DCE	(<0.15 U)
PCE	(<0.08 U)
TCE	(<0.077 U)

MW-16 : Screen 10-20 ft bgs	
Date	Jan-14
cis-1,2-DCE	(<0.15 U)
PCE	(<0.08 U)
TCE	(<0.077 U)

MW-08: Screen 10-30 ft bgs	
Date	Jan-14
cis-1,2-DCE	(<0.15 U)
PCE	(<0.08 U)
TCE	(<0.077 U)

MW-15: Screen 5-10 ft bgs	
Date	Jan-14
cis-1,2-DCE	54
PCE	4,100
TCE	72

MW-06: Screen 10-30 ft bgs	
Date	Jan-14
cis-1,2-DCE	(<0.15 U)
PCE	(<0.08 U)
TCE	(<0.077 U)

MW-13: Screen 10-20 ft bgs	
Date	Jan-14
cis-1,2-DCE	630
PCE	64
TCE	67

MW-07: Screen 10-30 ft bgs	
Date	Jan-14
cis-1,2-DCE	(<0.15 U)
PCE	52
TCE	1.8

MW-02: Screen 10-20 ft bgs	
Date	Jan-14
cis-1,2-DCE	270
PCE	26
TCE	18

GP-01 (GW) Dec 14				
Depth	20 ft	37.4 ft	49 ft	59 ft
cis-1,2-DCE	(<0.15 U)	(<0.15 U)	(<0.15 U)	(<0.15 U)
PCE	(<0.08 U)	(<0.08 U)	(<0.08 U)	(<0.08 U)
TCE	(<0.077 U)	(<0.077 U)	(<0.077 U)	(<0.077 U)

MW-14D: Screen 54.5-59.5 ft bgs	
Date	Jan-14
cis-1,2-DCE	(<0.15 U)
PCE	(<0.08 U)
TCE	(<0.077 U)

MW-11: Screen 10-30 ft bgs	
Date	Jan-14
cis-1,2-DCE	(<0.15 U)
PCE	(<0.08 U)
TCE	(<0.077 U)

NYS AWQS (µg/L)	
cis-1,2-Dichloroethene (DCE)	5
Tetrachloroethene (PCE)	5
Trichloroethene (TCE)	5

Note: All concentrations reported in micrograms per liter (µg/L).
U = The concentration was not detected. The associated value is the method detection limit.
Concentrations in Red = were detected above applicable and relevant standards, criteria and guidance (SCGs)

Chorinated Solvent Concentration (µg/L)
- 1-10
- 10-100
- 100-1,000
- 1,000-10,000
- >10,000
- Further Delineation Needed

FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 2-6
GROUNDWATER VOC ANALYTICAL RESULTS AND DISSOLVED-PHASE VOC PLUME (PLAN VIEW)

0 20 40 60 80
Feet
1 in = 50 ft

Legend
- Approximate Property Boundary
- Approximate Building Outline
- Previously Existing Monitoring Well
- Newly Installed Monitoring Well
- Profiling Point

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PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	PROJECT NO:	DATE:	SCALE:	FILE NO:
JMB	ALK	ALK	SN	14907.23	DECEMBER 2016	AS SHOWN	GIS/PROJECTS/ FS_FIGURES/ FIGURE 2-6

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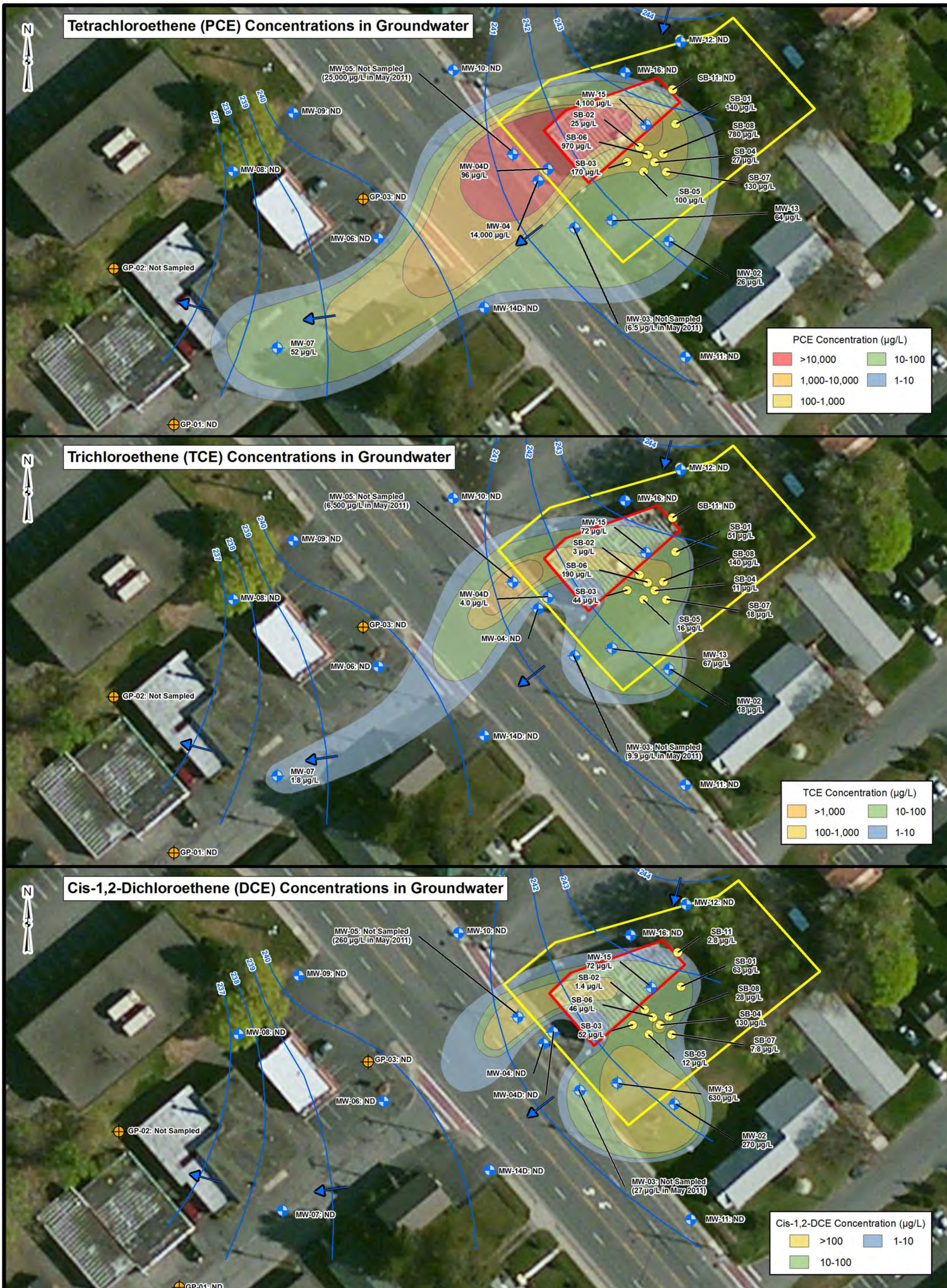

Legend

- Approximate Property Boundary
- Approximate Building Outline
- In Situ Groundwater Sampling Location
- Monitoring Well
- Profiling Point
- Interpolated 1-ft Groundwater Contour
- Groundwater Flow Direction

Feet
0 15 30 60 90 120
1 in = 60 ft

Note: All concentrations are in micrograms per liter (µg/L).
ND = Not detected.
SB-02 was not used in generation of concentration isoleths.

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FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 2-7
PCE, TCE, AND CIS-1,2-DCE
CONCENTRATIONS IN GROUNDWATER

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/FS_FIGURES/FIGURE 2-7

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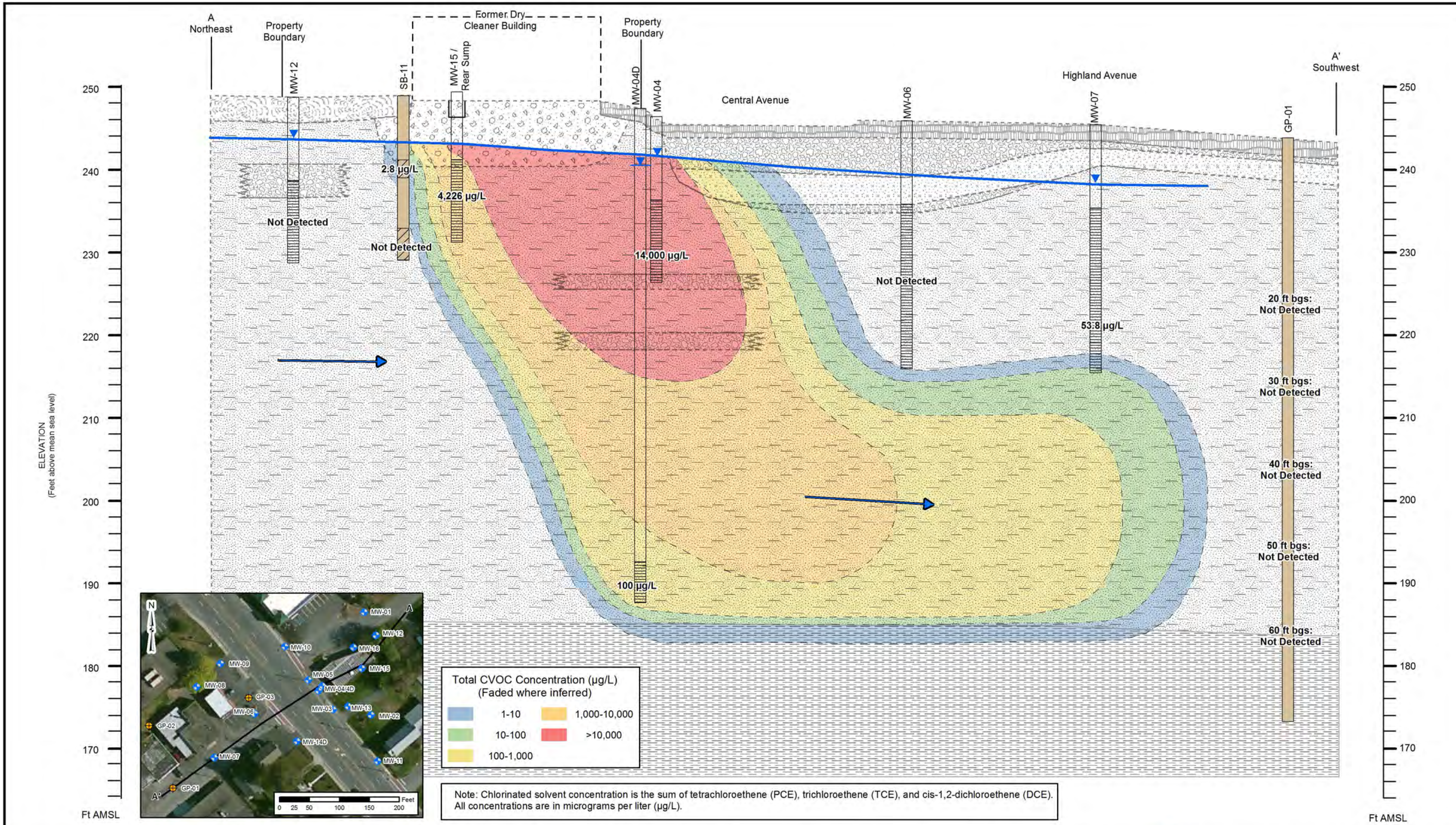

Note: Chlorinated solvent concentration is the sum of tetrachloroethene (PCE), trichloroethene (TCE), and cis-1,2-dichloroethene (DCE).
All concentrations are in micrograms per liter (µg/L).

EA	NEW YORK STATE OF OPPORTUNITY Department of Environmental Conservation	FEASIBILITY STUDY FORMER DAMSHIRE CLEANERS SITE (401059) COLONIE, NEW YORK		FIGURE 2-8 CHLORINATED SOLVENT PLUME CROSS SECTION A-A' (NORTHEAST TO SOUTHWEST)		0 20 40 60 80 Feet 1 in = 40 ft
PROJECT MGR: JMB	DESIGNED BY: ALK	CREATED BY: ALK	CHECKED BY: SN	PROJECT NO: 14907.23	DATE: DECEMBER 2016	SCALE: AS SHOWN

FILE NO:
GIS/PROJECTS/FS_FIGURES/
FIGURE 2-8

- Asphalt / Concrete
- Grass
- Central Ave
- Groundwater Elevation
- Groundwater Flow Direction
- Water Table
- Topsoil
- Fill
- Asphalt/Subbase
- Fine to Medium Sand, Trace to Some Gravel
- Fine to Medium Sand
- Fine to Very Fine Sand and Silt, Trace to Some Clay
- Clay (Confining Unit)

MW-04: Screen 10-20 ft bgs	
Date	Jan-11
SVOCs	
2,4-Dimethylphenol	(<10 U)
Metals	
Aluminum	33,000
Arsenic	11 D
Barium	370 D
Calcium	1,000,000
Chromium, Total	22 D
Cobalt	27 D
Copper	37 D
Iron	**110,000**
Lead	**33 D**
Magnesium	120
Manganese	**8,200 D**
Nickel	64 D
Potassium	14,000
Sodium	**62,000**
Vanadium	41 D
Zinc	82 D

MW-12: Screen 10-20 ft bgs	
Date	Jan-11
SVOCs	
2,4-Dimethylphenol	(<10 U)
Metals	
Aluminum	(<50 U)
Arsenic	(<2 U)
Barium	120 D
Calcium	100,000
Chromium, Total	(<5 U)
Cobalt	(<5 U)
Copper	(<25 U)
Iron	**2,800**
Lead	(<5 U)
Magnesium	17
Manganese	330 D
Nickel	(<25 D)
Potassium	(<2,000 U)
Sodium	36,000
Vanadium	(<25 U)
Zinc	(<50 U)

MW-15: Screen 5-15 ft bgs	
Date	Jan-11
SVOCs	
2,4-Dimethylphenol	(<10 U)
Metals	
Aluminum	120
Arsenic	2.5 D
Barium	(<50 U)
Calcium	88,000
Chromium, Total	(<5 U)
Cobalt	(<5 U)
Copper	(<25 U)
Iron	**2,400**
Lead	(<5 U)
Magnesium	13
Manganese	210 D
Nickel	(<25 U)
Potassium	2,900
Sodium	28,000
Vanadium	(<25 U)
Zinc	(<50 U)

MW-13: Screen 10-20 ft bgs	
Date	Jan-11
SVOCs	
2,4-Dimethylphenol	10
Metals	
Aluminum	(<50 U)
Arsenic	(<2 U)
Barium	85 D
Calcium	100,000
Chromium, Total	(<5 U)
Cobalt	(<5 U)
Copper	(<25 U)
Iron	**3,000**
Lead	(<5 U)
Magnesium	17
Manganese	310 D
Nickel	(<25 U)
Potassium	2,000 U)
Sodium	35,000
Vanadium	(<25 U)
Zinc	(<50 U)

NYS AWQS (µg/L)	
SVOCs	
2,4-Dimethylphenol	1,000
Metals	
Aluminum	NSL
Arsenic	25
Barium	1,000
Calcium	NSL
Chromium, Total	50
Cobalt	NSL
Copper	200
Iron	300
Lead	25
Magnesium	35,000
Manganese	300
Nickel	100
Potassium	NSL
Sodium	20,000
Vanadium	190
Zinc	2,000

Note: All concentrations reported in micrograms per liter (µg/L).
U = The concentration was not detected. The associated value is the method detection limit.
D = Reported value is the result of a dilution run.
Concentrations in Red = were detected above applicable and relevant standards, criteria and guidance (SCGs)

Legend

- Approximate Property Boundary
- Approximate Building Outline
- Previously Existing Monitoring Well
- Newly Installed Monitoring Well

Feet: 0 12.5 25 50 75 100

1 in = 50 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 2-9
GROUNDWATER SVOC AND METALS ANALYTICAL RESULTS JUNE 2016

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/FS_FIGURES/FIGURE 2-9

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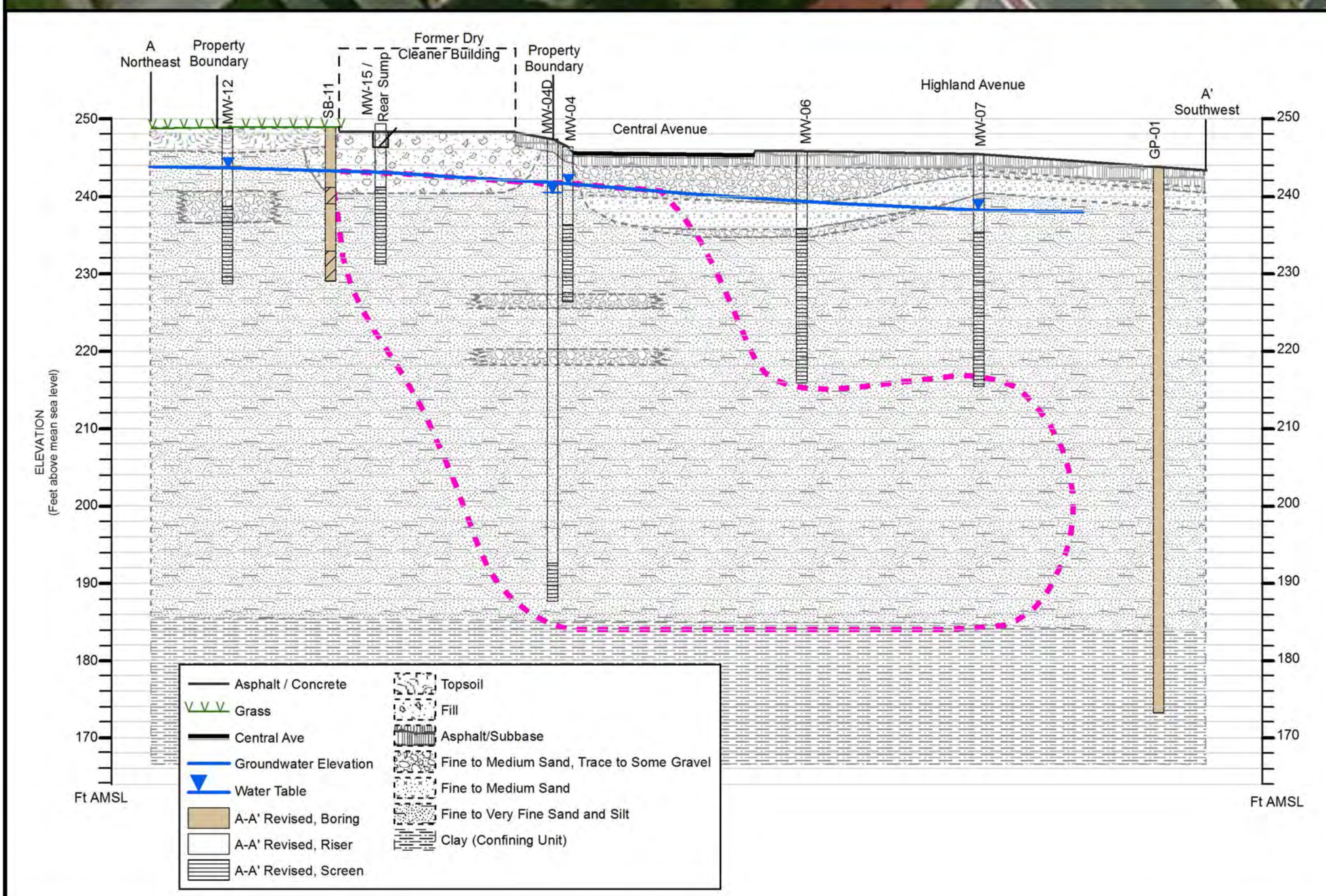

Legend

Groundwater Concentration above Ambient Water Quality Standard

Feet: 0 15 30 60 90 120

1 in = 60 ft

EA / New York State Department of Environmental Conservation	FEASIBILITY STUDY FORMER DAMSHIRE CLEANERS SITE (401059) COLONIE, NEW YORK	FIGURE 3-1 EXTENT OF GROUNDWATER THAT EXCEEDS AMBIENT WATER QUALITY STANDARDS

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/FS_FIGURES/FIGURE 3-1

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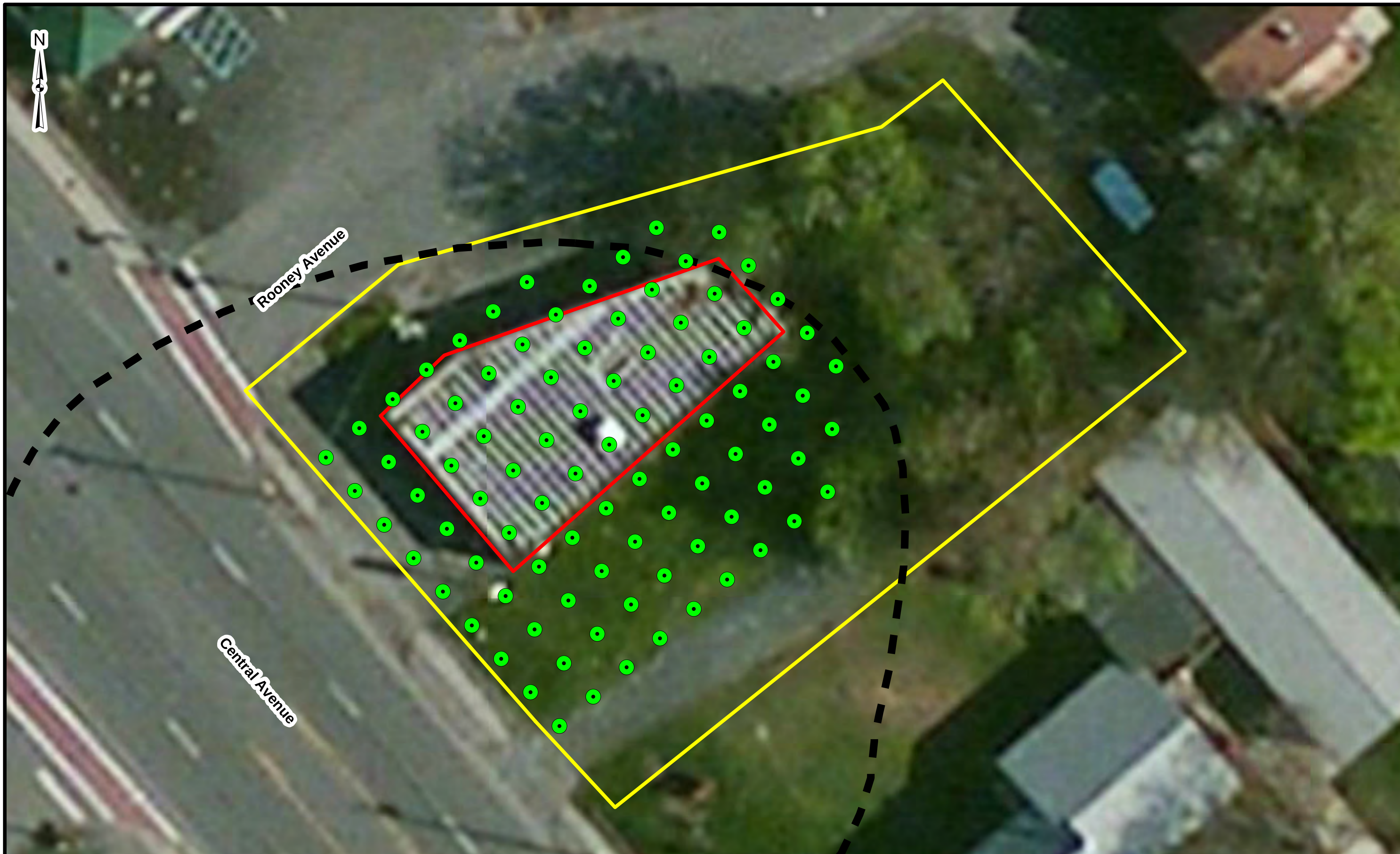
FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 3-2
EXTENT OF SURFACE AND SUBSURFACE SOIL THAT EXCEEDS SOIL CLEANUP OBJECTIVES

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/FS_FIGURES/FIGURE 3-2



Legend

- Approximate Property Boundary
- Approximate Building Outline
- Approximate Dissolved-Phase Plume Boundary
- Enhanced Bioremediation Well

0 7.5 15 30 45 60 Feet

1 in = 30 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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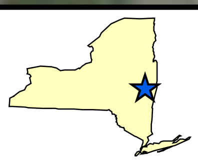
FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 6-1
ENHANCED BIOREMEDIATION

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/ FS_FIGURES/FIGURE 6-1



Legend

- Approximate Property Boundary
- Approximate Building Outline
- Approximate Dissolved-Phase Plume Boundary
- Ozone Injection Point
- Air Sparge Well
- Soil Vapor Extraction Trench

Feet: 0, 7.5, 15, 30, 45, 60

1 in = 30 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 6-2
Ozone Injection and SVE System

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/ FS_FIGURES/FIGURE 6-2

Legend

- Approximate Property Boundary
- Approximate Building Outline
- Approximate Dissolved-Phase Plume Boundary
- Air Sparge Well
- Soil Vapor Extraction Trench

Feet: 0, 7.5, 15, 30, 45, 60

1 in = 30 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 6-3
Air Sparge / SVE System

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/ FS_FIGURES/FIGURE 6-3

Legend

- Approximate Property Boundary
- Approximate Building Outline
- Approximate Dissolved-Phase Plume Boundary
- In-Situ Chemical Oxidation Point

Feet: 0, 7.5, 15, 30, 45, 60

1 in = 30 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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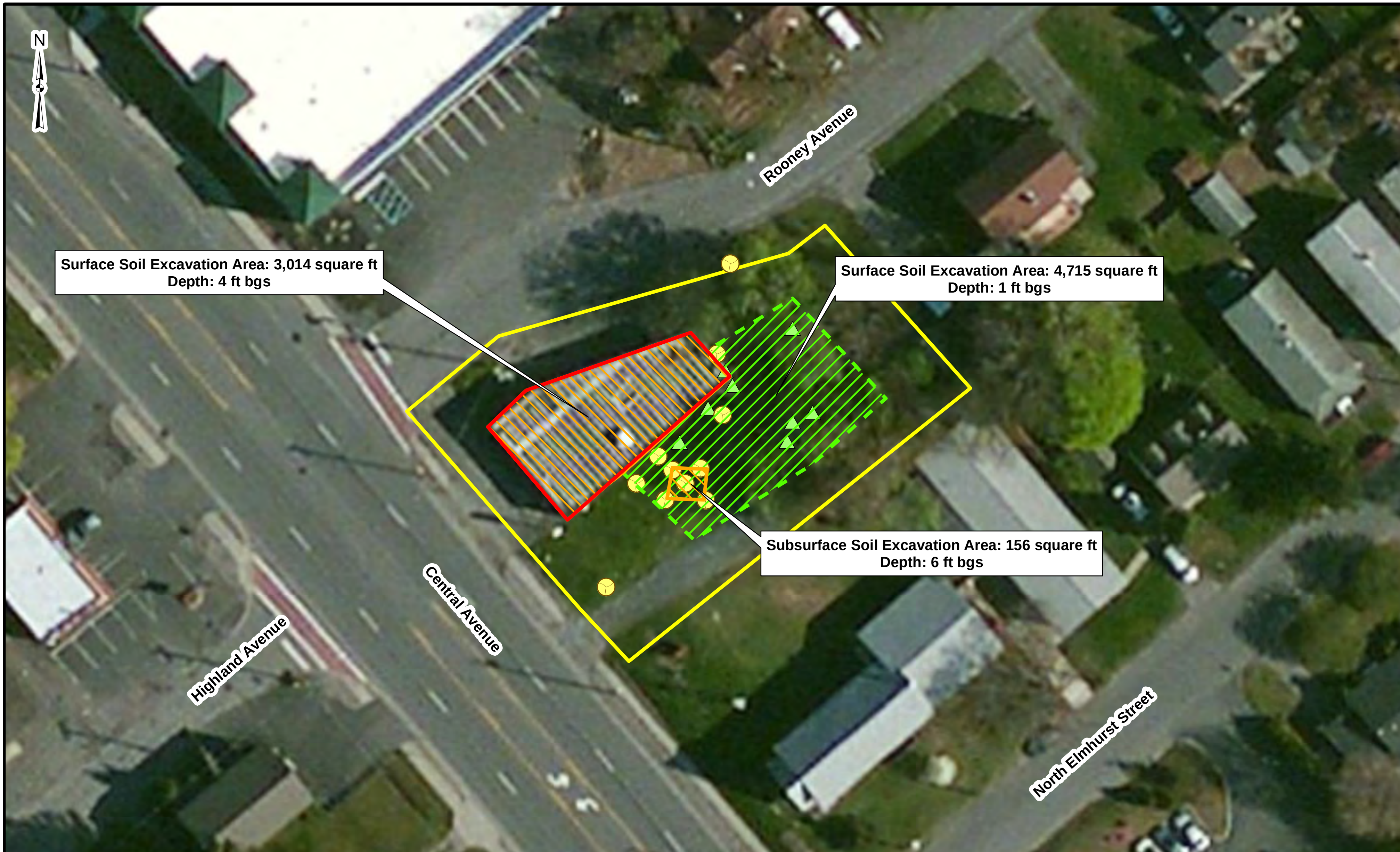
FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 6-4
In Situ Chemical Oxidation

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/ FS_FIGURES/FIGURE 6-4



Legend

- Approximate Property Boundary
- Approximate Building Outline
- Surface Soil Sampling Location
- Soil Boring
- Subsurface Soil Excavation Area
- Surface Soil Excavation ARea

Feet

0 12.5 25 50 75 100

1 in = 50 ft

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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FEASIBILITY STUDY
FORMER DAMSHIRE CLEANERS SITE (401059)
COLONIE, NEW YORK

FIGURE 6-5
SURFACE AND SUBSURFACE SOIL EXCAVATION AREAS

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
JVU	ALK	ALK	SN	AS SHOWN	DECEMBER 2016	1490723	GIS/PROJECTS/FS_FIGURES/FIGURE 6-5

Appendix A

Technology Screening Letter

EA Engineering, P.C.
EA Science and Technology

6712 Brooklawn Parkway, Suite 104
Syracuse, NY 13211-2158
Telephone: 315-431-4610
www.eaest.com

14 January 2016

Mr. Michael McCabe
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway, 12th Floor
Albany, New York 12233-7017

RE: Contract/Work Assignment No: D007624-23
Site/Spill No./Pin: Former Damshire Cleaner Site (401059)
Remedial Action Objectives and Feasibility Study Technology Screening

Dear Mr. McCabe:

EA Engineering, P.C. and its affiliate EA Science and Technology (EA) is providing the New York State Department of Environmental Conservation (NYSDEC) with this technology screening review letter to facilitate development of the feasibility study (FS) being prepared for the Former Damshire Cleaners (401059), located in the town of Colonie, New York. The FS is being conducted in accordance with the NYSDEC Division of Environmental Remediation (DER) *Technical Guidance for Site Investigation and Remediation* (NYSDEC 2010)[1].

INTRODUCTION

The 0.39-acre Former Damshire Cleaners site is a commercial dry cleaners property formerly known as Damshire Cleaners located at 1205 Central Avenue, Albany, New York, located in a mixed residential and commercial area in the Town of Colonie (Tax Map Number [No.] 53.06-06-35.1). The site contains of a vacant 3,600 square foot (ft), one-story masonry block building with a concrete slab-on-grade foundation. The vacant building is surrounded by an asphalt parking lot to the northwest and southwest, a grassy area and dirt/gravel driveway to the southeast, and a wooded area to the northeast.

The site is currently inactive and zoned Neighborhood Commercial Office Residential. The former dry cleaning facility would be considered commercial use under the aforementioned zoning designation. The site is bordered by Roessleville Presbyterian Church to the southeast, Greens Appliances to the northwest, residential areas to the northeast, and commercial areas and residential areas to the southwest.

[1] NYSDEC. 2010. DER-10/Technical Guidance for Site Investigation and Remediation. May 3.

The site was utilized as a dry cleaning business for residential customers; however, records do not identify the year during which dry cleaning operations began. Dry cleaning operations were shut down in 2001 following notices of violation pertaining to fugitive air emission exceedances. Ownership of the Former Damshire Cleaners site was transferred in September 2007 when the property was purchased by a new owner with a plan to convert the former dry cleaners building into a restaurant. The Former Damshire Cleaners building is currently unoccupied and vacant.

Previous investigations have identified impacts from chlorinated solvents (particularly tetrachloroethene [PCE], trichloroethene [TCE], and *cis*-1,2-dichloroethene [DCE]) to indoor air within and sub-slab vapor below the Former Damshire Cleaners building, as well as offsite soil and groundwater. In January 2010, a limited soil vapor intrusion investigation completed by CT Male, the property owner's environmental consultant, identified chlorinated compounds related to dry cleaning operations in sub-slab vapor below and indoor air within Former Damshire Cleaners building. An initial Site Characterization/Phase I Investigation and Phase I Supplemental Investigation were conducted in January and May 2011 in offsite areas, as the property owner did not allow access to the site. Data collected during the 2011 offsite investigations indicated significant impacts to groundwater immediately downgradient from the site. The site was referred to the State Superfund Program in 2012 and is currently listed as a Class "2" site in the State Registry of Inactive Hazardous Waste Sites. A remedial action (RI) investigation was conducted from October 2013 through March 2015.

The goal for all remedial actions is considered to be the restoration of the site to the pre-disposal/pre-release conditions to the extent practicable. Remedial action objectives (RAOs) are defined as the medium-specific or area-specific cleanup objectives to provide protection of public health and the environment. The RAOs are based on contaminant-specific standards, criteria, and guidance (SCGs) for impacted media as defined in the RI). The RI results were compared to media-specific SCGs. The SCGs were selected based on the current and reasonably ascertainable future land use and potential human and ecological receptors. The SCGs used to evaluate the RI data included:

- ***Soil****—6 New York Code of Rules and Regulations (NYCRR) Part 375 Environmental Remediation Programs—Commercial—Soil Cleanup Objectives (SCOs)* and/or *6 NYCRR Part 375 Environmental Remediation Programs —Unrestricted Use (UU)—SCOs* (NYSDEC 2006, as amended).

- ***Groundwater****—6 NYCRR Part 703.5 Class GA Groundwater Quality Regulations, as presented in the Division of Water Technical and Operational Guidance Series 1.1.1* (NYSDEC 1998, as amended).

- ***Soil Vapor****—New York State Department of Health (NYSDOH) SVI Guidance* (2006) and as amended in 2013 and 2015.

- ***Sub-Slab Vapor and Indoor Air***—*NYSDOH SVI Guidance* (2006) and as amended in 2013 and 2015.

REMEDIAL INVESTIGATION SUMMARY

The purpose of the RI was to identify a potential onsite source area, define the nature and extent of contamination from historical dry cleaning activities in soil, groundwater, and soil vapor, evaluate the potential for human exposure to contaminants of concern, and collect the data necessary to complete a FS for the Former Damshire Cleaners site. A building investigation was conducted to identify a potential source of known impacts, and onsite media including surface and subsurface soil and groundwater to delineate the nature and extent of impacts to soil at the Former Damshire Cleaners property. Analytical results indicate that onsite soil beneath the building slab, onsite and offsite soil immediately downgradient from the Former Damshire Cleaners site, and onsite groundwater is impacted by chlorinated solvents related to historical activities at the Former Damshire Cleaners site. In addition, analytical results from previous investigations indicate impacts to sub-slab vapor and indoor air. Based on a comparison of onsite media to SCGs, the contaminants of concern at the site include PCE, TCE, and *cis*-1,2-DCE.

Building Investigation

The results of the building investigation indicated that the primary source of chlorinated solvents associated with the Former Damshire Cleaners site appeared to be the rear sump within the vacant building. Water was observed within a discharge pipe of the rear sump, and an opening/crack was observed in the base of the sump, indicating that the integrity of the rear sump was compromised. PCE was detected above the UU SCO (1.3 mg/kg) in sediment/debris collected from the opening/crack in the rear sump (3.4 milligrams per kilogram [mg/kg]) and in soil collected below the base of the rear sump at 2–4 ft below ground surface (bgs) (8.1 mg/kg). In addition, PCE (55,000 micrograms per liter [µg/L]), TCE (4,000 µg/L), and *cis*-1,2-DCE (69,000 µg/L), were detected in discharge water collected from the pipe at concentrations above Class GA Ambient Water Quality Standards (AWQS) (5 µg/L each), and PCE was detected above the UU SCO at two sub-slab soil sampling locations collected approximately 15 ft northwest and 30 ft west of the rear sump (6.2 and 12 mg/kg, respectively).

Soil

Elevated concentrations of PCE in soil beneath the building slab indicate soil impacts related to discharge of hazardous material from the opening/crack in the rear sump. Concentrations in surface and shallow (3–6 ft bgs) subsurface soil samples collected east/southeast of the Former Damshire Cleaners building and rear sump area were below UU SCOs, indicating that impacts to surface and shallow subsurface soil are limited to the footprint of the building. However, PCE was detected above the UU SCO (1.3 mg/kg) in deep subsurface soil collected at MW-04D located immediately downgradient of the Former Damshire Cleaners building (1.8 mg/kg at 32–34 ft bgs and 4.7 mg/kg at 54–56 ft bgs). In addition, during the 2011 Site Characterization

(SC)/Phase I Investigation, PCE was detected above the Commercial SCO of 150 mg/kg in one subsurface soil collected at 15–20 ft bgs immediately downgradient from the site (MW-04, 830 mg/kg).

Based on existing data and known depths of soil impacts from directly beneath the building and rear sump, and assuming impacts extend to 6 ft beneath the slab with an area of 3,600 square ft, the volume of impacted soil exceeding UU SCOs could be estimated at 800 cubic yards. Because the full extent of soil impacts was not defined, this volume of impacted soil may vary significantly, as UU SCOs were exceeded at deeper depth intervals at MW-04 and MW-04D located immediately downgradient from the building.

Groundwater

The RI groundwater program included collection of *in situ* groundwater samples in October 2013, installation of four shallow onsite monitoring wells, and one onsite deep monitoring well in December 2014, and completion of a round of groundwater sampling in January 2014. Groundwater analytical results indicate elevated concentrations of PCE, TCE, and/or *cis*-1,2-DCE above Class GA standards (5 µg/L each) in shallow onsite groundwater. The table below provides a summary of the frequency of groundwater concentrations exceeding applicable groundwater quality standards.

Constituent	**NYS AWQS Guidance Values µg/L/parts per billion**	**No. of Exceedances /No. of Samples**	**Range of Exceedances (µg/L)**
Groundwater (January 2013)			
Cis-1,2-Dichloroethylene	5	13/27	1.1 - 630
Tetrachloroethylene	5	14/27	1.2 - 4,100
Trichloroethylene	5	10/27	1.2 - 190

Based on analytical results of groundwater sampled during previous investigations and the RI, a dissolved-phase groundwater plume extends southwest in the direction of groundwater flow from the rear sump within the Former Damshire Cleaners building toward Central Avenue. The onsite portion of the shallow groundwater contaminant plume has a lateral thickness extending at least 128 ft from the northern edge of the Former Damshire Cleaners building to the adjacent church property. The presence of elevated concentrations at the bottom of borings advanced downgradient from the void area indicates downward vertical migration, as would be expected with migration patterns associated with dense non-aqueous phase liquids (DNAPLs). In addition, the elevated concentration of PCE detected in deep groundwater at monitoring well MW-04D (96 µg/L) suggests vertical migration of the dissolved-phase plume immediately downgradient from the Former Dry Cleaners building. No other deep monitoring wells are installed in the onsite area. A clay confining layer encountered at 60–70.4 ft bgs in offsite downgradient profiling points likely serves as a barrier to vertical migration and indicates the vertical limit of the plume.

FEASIBILITY STUDY

The summarized criteria and initial screening to be used to develop the FS Report are:

- Pursuant to DER-10 (NYSDEC 2010)[1], remedial goals for the site are defined by the applicable regulations for New York State Inactive Hazardous Waste Disposal Site Remedial Program (State Superfund Program), as defined by Environmental Conservation Law, Article 27, Title 13.

- RAOs are medium-specific objectives for the protection of public health and the environment, and are developed based on contaminant-specific SCGs to address contamination identified at a site. NYSDEC has developed generic RAOs for various media that will be used during the development of the FS and remedy selection process. The RAOs for impacted media identified at the site are listed below.

  — Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.

  — Restore groundwater aquifer to pre-release conditions, to the extent practicable.

  — Prevent contact with contaminated groundwater.

EA completed the technology screening in accordance with DER-10 (NYSDEC 2010)[1] and the 1988 United States Environmental Protection Agency (EPA) publication *Guidance for Conducting Remedial Investigations and Feasibility Studies Under Comprehensive Environmental Response, Compensation, and Liability Information System* (EPA l540lG-891004) (EPA 1988)[2]. The basis of the screening was designed to evaluate applicable technologies based on impacted media identified at the site during the RI.

TECHNOLOGY SCREENING

The technology screening assessed applicable technologies based on area-specific media and contaminants, as well as with the following five categories:

1. Compliance with RAO
2. Effectiveness
3. Implementability
4. Reduction of toxicity, mobility, and volume
5. Cost.

2 EPA. 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Information System* (EPA l540lG-891004). October.

The technology screening matrix (Table 1) provides a review of each screened technology for potentially addressing groundwater, with understanding the soil and soil vapor will be addressed concurrently through the selection of the appropriate technology. EA has evaluated multiple technologies known to be effective in the remediation of contaminants of concern (i.e., PCE, TCE, and *cis*-1,2-DCE) in groundwater.

Based on the screening matrix, EA proposes to develop an FS evaluating the remedial alternatives presented in Table 1. Please provide concurrence and/or comments with the proposed remedial alternatives so that EA may move forward with preparation of the FS for the Former Damshire Cleaners site. If you have any questions, please do not hesitate to contact me at (315) 431-4610.

Sincerely,

EA SCIENCE AND TECHNOLOGY

Joe Von Uderitz P.G.
Project Manager

EA ENGINEERING, P.C.

Donald Conan, P.E.
Vice President

Attachment

Table 1 Technology Screening Matrix - Groundwater

Technology	Process Description	Effectiveness in Addressing RAOs	Implementability	Key Factors	Cost	Status
No Action						
No Action	NA	Ineffective	Easily implemented	NA	None	Retain per NCP
Institutional Controls						
Engineering and Institutional controls	Land use restrictions	Effective for human health risk RAOs associated with contact of groundwater	Easily implemented	Requires regulatory and public acceptance of restricted/diminished resource use.	Low	Retain for potential combination with other technologies
Removal						
Building Demolition and sub-slab soil excavation	Physical removal of site building and source area	Effective for addressing the source	Easily implemented	Requires regulatory and public acceptance of restricted/diminished resource use.	Low	Retain for potential combination with other technologies
On-site soil Excavation	Physical removal of impacted site soil	Effective for human health risk RAOs associated with contact of site soil	Easily implemented	Requires regulatory and public acceptance of restricted/diminished resource use.	Low	Retain for potential combination with other technologies
In situ Biological Treatment						
Enhanced Biodegradation	The activity of naturally occurring microbes is stimulated by introducing water-based solutions into contaminated groundwater to enhance in situ biological degradation of organic contaminants. Nutrients, oxygen, or other amendments may be used to enhance biodegradation.	Effective for risk-based RAOs and source control	Easily implemented. Groundwater injection wells would be required to be installed	Requires treatability testing and baseline microbial/groundwater geochemistry assessment. Would require multiple injections/amendments	Moderate	Retained
Natural Attenuation	Natural subsurface processes - such as dilution, volatilization, biodegradation, adsorption, and chemical reactions with subsurface materials – are allowed to reduce contaminant concentrations to acceptable levels.	Ineffective in short term but potentially effective in the long term, dependent on addressing the source	Easily implemented	Source reduction prior to implementation	Low	Retain for potential combination with other technologies
Containment						
Slurry Wall	Subsurface barriers consist of vertically excavated trenches filled with slurry. The slurry, usually a mixture of bentonite and water, hydraulically shores the trench to prevent collapse and retards ground water flow.	Effectively addresses migration of onsite impacted water, however is not effective for source reduction	Difficult to implement due to the depth of the confining unit (70-ft bgs)	Will not address reduction of containment mass and would require long-term groundwater monitoring	High	Not retained.
Groundwater Pump and Treat	Ground water pumping is a component of many pump-and-treat processes, which are some of the most commonly used ground water remediation technologies at contaminated sites.	Effect for risk-based RAOs and partially effective for source control	Moderately difficult to implement, requires minor construction and well installation	High capital investigates and high long term treatment system operation cost	High	Not retained.
In Situ Physical/Chemical Treatment						
Sodium Permanganate	Addition of amendments/reagents to water to break down COC's	Effective for risk-based RAOs and source control	Easily implemented. Groundwater injection wells would be required to be installed.	Requires treatability testing and baseline groundwater geochemistry assessment. Would require multiple injections/amendments	Moderate	Retained
Ozone Injection	Ozone is injected into the groundwater to break down COC's	Effective for risk-based RAOs and source control	Easily implemented with minor construction.	System design (wells/conveyance/system components) must account for corrosive nature of ozone in the process stream. Would require a intensive monitoring program to ensure no side effects of ozone outside the target treatment area.	High	Retained
Air Sparge/SVE	Air is injected into saturated matrices to remove contaminants through volatilization.	Effective for risk-based RAOs and source control	Easily implemented with minor construction	Soil type, vapor extraction required due to residential setting	Low, Moderate	Retained

Table 1 Technology Screening Matrix - Groundwater

Technology	Process Description	Effectiveness in Addressing RAOs	Implementability	Key Factors	Cost	Status
In Situ Physical/Chemical Treatment						
Passive/Reactive Treatment Walls	These barriers allow the passage of water while prohibiting the movement of contaminants by employing such agents as chelators (ligands selected for their specificity for a given metal), sorbents, microbes, and others.	Effectively addresses migration of onsite impacted water, however is not effective for source reduction	Difficult to implement due to the depth of the confining unit (70-ft bgs)	Will not address reduction of containment mass and would require long-term groundwater monitoring	Moderate	Not Retained
In-Well Air Stripping	Air is injected into a double screened well, lifting the water in the well and forcing it out the upper screen. Simultaneously, additional water is drawn in the lower screen. Once in the well, some of the VOCs in the contaminated ground water are transferred from the dissolved phase to the vapor phase by air bubbles. The contaminated air rises in the well to the water surface where vapors are drawn off and treated by a soil vapor extraction system.	Effective for risk-based RAOs and source control	Easily implemented with minor construction. Well installation/construction is moderately difficult due to depth and diameter of borehole.	Shallow depth to water would limit construction options during well installation	High	Not Retained

Appendix B

Costs

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Costing Summary

Option	Total NPV Cost	Capital Cost	Lifetime Monitoring	Lifetime O&M	Construction	Operation	Monitoring	Time to Complete
No Action	$0	$0	$0	$0	0 months	0 months	0 years	0 years
In-Situ Enhanced Bioremediation	$1,684,000	$1,550,000	$134,300	$0	3 months	3 months	10 years	10 years
In-Situ Ozone-Enhanced Aquifer Air Sparging with Soil Vapor Extraction	$958,000	$512,000	$134,300	$311,700	2 months	5 months	10 years	10 years
Air Sparge and Soil Vapor Extraction	$641,000	$351,000	$134,300	$155,900	2 months	5 years	10 years	10 years
In-Situ Enhanced Reductive Dechlorination	$1,426,000	$1,292,000	$134,300	$0	3 months	3 months	10 years	10 years
Building Demolition, Soil Excavation, and Air Sparge/SVE	$967,000	$677,000	$134,300	$155,900	6 months	5 years	10 years	10 years

TECHNOLOGY	LOCATION	MEDIA	Estimated Cost to Implement	$1,684,000	
Groundwater Alternative 2 In-Situ Enhanced Bioremediation	Damshire Drycleaners Site Colonie, NY	Groundwater	Construction Time:	3	months
			Operation Time:	3	months
			Post Remediation Monitoring	10	years

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantity Unit	Cost Breakdown (if available): Material Unit Cost	Material Total Cost	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$1,550,000**
		1									**$1,156,708**
Site Preparation											
Utility Locator (based on recent bids)	*NY Leak Detection*	1	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,475.00	$2,475
Slug Test											
Field/Office Labor		40	hours	$ -	$ -	$ 85	$ 3,400	$ -	$ -	$ -	$3,400
Offsite Soil Vapor Intrusion Investigation											
Labor		80	hours	$ -	$ -	$ 85	$ 6,800	$ -	$ -		$6,800
Laboratory Analysis TO-15	*Con-Test*	33	each							$ 203.31	$6,709
Shipping		9.00	each							$ 50.00	$450
Drill Rig and Crew for Monitoring Well Installation											
Mobilization/Demobilization	*Aztech*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,500.00	$2,500
MW Installation	*Aztech*	180	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 29.00	$5,220
Flush Mount Well Covers	*Aztech*	3	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 150.00	$450
Well Development	*Aztech*	12	hr	$ -	$ -	$ -	$ -	$ -	$ -	$ 155.90	$1,871
Pre-Implementation Sampling											
Sampling for 1 event- includes collection of field parameters)		15	wells	$ -	$ 50	$ 340	$ 5,100	$ 93	$ 1,392	$ -	$6,542
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 680.00	$680
Analysis for VOCs	*Chemtech*	18	ea	$ -	$ -	$ -	$ -	$ -	$ -	$84.36	$1,518
Drill Rig and Crew for Direct Push Application											
Mobilization/Demobilization	*Aztech*	2	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,500.00	$5,000
Decontamination Pad	*Aztech*	2	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 249.45	$499
Steam Generator	*Aztech*	68	day	$ -	-	$ -	$ -	$ -	$ -	$ 77.95	$5,262
Geoprobe	*Aztech*	68	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,039.36	$70,157
Sand -.5 CY per bag	*Aztech*	729	cf	$ -	$ -	$ -	$ -	$ -	$ -	$ 15.59	$11,364
Bentonite- 3 bags per point	*Aztech*	66	cf	$ -	$ -	$ -	$ -	$ -	$ -	$ 45.73	$3,030
Treatment											
Z-Loy	*On Materials*	100,360	lb	$ -	$ -	$ -	$ -	$ -	$ -	$ 5.50	$551,980
EVO	*On Materials*	286,740	lb							$ 1.00	$286,740
Shipment of product	*Recent quote*	2	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 22,500	$45,000
Mixing Tank	*ECHOS 33 32 0133*	4	mo	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,279.99	$5,120
Chemical feed pump, 0.86 GPH, 700 PSI	*ECHOS 33 32 0123*	6	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,198.36	$19,190
Labor		1,350	hr	$ -	$ -	$ 85	$ 114,750	$ -	$ -	$ -	$114,750
Contingency											**$173,506**
15% of Total Construction Activities										$1,156,708	$173,506
Professional/Technical Services											**$219,774**
8% Project Management										$1,156,708	$92,537
3% Remedial Design											$34,701
8% Construction Management											$92,537
LONG TERM MONITORING								**ANNUAL LTM COST (YRS 1-2)**			**$40,400**
								ANNUAL LTM COST (YRS 3-10)			**$10,100**
								LIFETIME LTM (NPV)			**$134,300**
Monitoring, Sampling, Testing and Analysis (Per Event)											$10,100
Site Monitoring											
Sampling for 1 event - Includes collection of field parameters		15	wells	$ -	$ 50	$ 340	$ 5,100	$ 93	$ 1,392	$ -	$6,542
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 680.00	$680
Reporting		16	hour	$85	$ 1,360.00	$ -	$ -	$ -	$ -	$ -	$1,360
Laboratory analysis											
VOCs (8260)	*Chemtech*	18	ea	$ -	$ -	$ -	$ -	$ -	$ -	$84.36	$1,518
Lifetime Long Term Monitoring (Net Present Value)											
2 Year of Quarterly Monitoring											
8 Years of Annual Monitoring											
5% Discount Factor (per NYSDEC)											

TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Post Remediation Monitoring) **$1,684,000**

Assumptions:

Working condition is Safety Level: D (Labor productivity: 82% ; Equipment productivity: 100%)

Weighted Average of city cost index (Rochester, 96.5% (not applicable for costs derived from vendor quotes).

Costs are loaded with a profit factor 10%

Inflation 3% per year 34% for 5 years of inflation

Consultant Bill Rates (as of 1/6/16) - Includes G&A and 10% Profit

Truck/SUV (1/2 ton or smaller)	$282.96	per week
Water Quality Analyzer	$295.10	per week
Water Level Meter	$127.19	per week
Submersible Pump	$457.71	per week
Generators: 220 Volt	$228.96	per week

Monitoring Well Installation/Development 3 wells; 60 ft length; 4 hrs development each

Injection Point Installation Assumed 135 Direct push injection points; 0.25 diameter (ft); 60 ft in length (direct push borings) Labor

4 Injections per day; 3 pi; 1 hour for well development per well

Sampling 15 wells; 2 Events per year (yrs 1-5); 2 hrs/sample; $85 Cost per hr

20% QA/QC; 1 Event per year (yrs 6-30)

4 hrs for travel per event; 2 workers per event

Analytical cost

VOCs $76.69 per sample

For each sampling event, assumed: $50 for materials (gloves, notebooks, etc.)

Work day consists of: 10 hrs

Notes

Discharge to storm sewer, no cost for water discharge

kW-hr	kilowatt-hour	O&M	Operation and maintenance
bcy	bank cubic yard		
lcy	loose cubic yard		
sf	square feet		
ls	lump sum		

TECHNOLOGY	LOCATION	MEDIA	Estimated Cost to Implement	$958,000	
Groundwater Alternative 3 In-Situ Ozone-Enhanced Aquifer Air Sparging with Soil Vapor Extraction	Damshire Drycleaners Site Colonie, NY	Groundwater	Construction Time:	2	months
			Operation Time:	5	years
			Monitoring	10	years

		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Material Unit Cost	Material Total Cost	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$512,000**
		1			**$0**		**$0**		**$0**	**$4,369**	**$345,789**
Site Preparation											
Utility Locator (based on recent bids)	*NY Leak Detection*	1	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,250.00	$2,250
Electrical Permit and Utility Connection to PCU	*Recent Quote*	1	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000.00	$5,000
Slug Test											
Field/Office Labor		40	hours	$ -	$ -	$ 85	$ 3,400	$ -	$ -	$ -	$3,400
Offsite Soil Vapor Intrusion Investigation											
Labor		80	hours	$ -	$ -	$ 85	$ 6,800	$ -	$ -		$6,800
Laboratory Analysis TO-15	*Con-Test*	33	each							$ 203.31	$6,709
Shipping		9.00	each							$ 50.00	$450
Drill Rig and Crew for Monitoring Well Installation											
Mobilization/Demobilization	*Aztech*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,500.00	$2,500
MW Installation	*Aztech*	180	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 29.00	$5,220
Flush Mount Well Covers	*Aztech*	3	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 150.00	$450
Well Development	*Aztech*	12	hr	$ -	$ -	$ -	$ -	$ -	$ -	$ 155.90	$1,871
Pre-Implementation Sampling											
Sampling for 1 event- includes collection of field parameters)		15	wells	$ -	$ 50	$ 340	$ 5,100	$ 93	$ 1,392	$ -	$6,542
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 680.00	$680
Analysis for VOCs	*Chemtech*	18	ea	$ -	$ -	$ -	$ -	$ -	$ -	$84.36	$1,518
Drill Rig and Crew for Air Sparge Well Installation											
Mobilization/Demobilization	*Aztech*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,500.00	$2,500
4 1/4" Hollow Stem Auger	*Aztech*	1,350	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 18.71	$25,259
Decontamination Pad	*Aztech*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 249.45	$249
Steam Generator	*Aztech*	15	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 77.95	$1,169
Standby Time (Decontamination)	*Aztech*	15	hour	$ -	$ -	$ -	$ -	$ -	$ -	$ 150.71	$2,261
Geoprobe Daily Rate - 8 hour day	*Aztech*	15	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,039.36	$15,590
Air Sparge Wells, Stainless Steel, 2"	*Aztech*	1,350	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 32.84	$44,334
Well covers	*Engineer's Estimate*	15	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 300	$4,500
Well head setup- stainless steel	*Engineer's Estimate*	15	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 500	$7,500
Treatment System											
Ozone Treatment System and enclosure	*Piper Environmental*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 112,500	$112,500
Shipping	*Engineer's Estimate*	1								$ 5,000	$5,000
HDPE air lines	*recent quote*	5	100 lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 63	$315
Sawcutting pavement, up to 3"	*02 41 19.25 0015*	240	lf							$ 1.76	$422
Trenching- 4' deep, 3/8 CY excavator	*31 23 16.13 0050*	296.30	bcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 10.63	$3,150
Bedding material	*31 23 23.16 0050*	13	lcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 36.14	$476
Base	*32 11 26.13 1600*	2	ecy	$ -	$ -	$ -	$ -	$ -	$ -	$ 85.19	$189
Binder	*32 12 16.13 0200*	13	sy	$ -	$ -	$ -	$ -	$ -	$ -	$ 19.95	$266
Top	*32 12 16.13 0380*	13	sy	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.49	$153
Concrete restoration		2	cy							$ 242.28	$538
Soil Vapor Extraction System											
Treatment System and enclosure	*PLC*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000	$60,000
Shipping	*Engineer's Estimate*	1								$ 5,000	$5,000
HDPE air lines	*recent quote*	12	100 lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 63	$756
Sawcutting pavement, up to 3"	*02 41 19.25 0015*	240	lf							$ 1.76	$422
Trenching- 4' deep, 3/8 CY excavator	*31 23 16.13 0050*	711.11	bcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 10.63	$7,559
Bedding material	*31 23 23.16 0050*	32	lcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 36.14	$1,142
Base	*32 11 26.13 1600*	2	ecy	$ -	$ -	$ -	$ -	$ -	$ -	$ 85.19	$189
Binder	*32 12 16.13 0200*	13	sy	$ -	$ -	$ -	$ -	$ -	$ -	$ 19.95	$266
Top	*32 12 16.13 0380*	13	sy	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.49	$153
Concrete restoration	*03 30 53.40 4650*	2	cy	$ -	$ -	$ -	$ -	$ -	$ -	$ 242.28	$538
Contingency											**$51,868**
15% of Total Construction Activities										$345,789	$51,868
Professional/Technical Services											**$114,110**
8% Project Management										$345,789	$27,663
15% Remedial Design											$51,868
10% Construction Management											$34,579
LONG TERM MONITORING								**ANNUAL LTM COST (YRS 1-2)**			**$40,400**
								ANNUAL LTM COST (YRS 3-10)			**$10,100**
								LIFETIME LTM (NPV)			**$134,300**
Monitoring, Sampling, Testing and Analysis (Per Event)											$10,100
Site Monitoring											
Sampling for 1 event - Includes collection of field parameters		15	well	$ -	$ 50	$ 340	$ 5,100	$ 93	$ 1,392	$ -	$6,542
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 680.00	$680
Reporting		16	hr	$85	$ 1,360.00	$ -	$ -	$ -	$ -	$ -	$1,360
Laboratory analysis											
Volatile Organic Compounds (8260B)	*Chemtech*	18	ea	$ -	$ -	$ -	$ -	$ -	$ -	$84.36	$1,518
Lifetime Long Term Monitoring (Net Present Value)											
2 Years of Quarterly Monitoring											
8 Years of Annual Monitoring											
5% Discount Factor (per NYSDEC)											
LONG TERM OPERATIONS AND MAINTENANCE											
								ANNUAL LTOM COST (YRS 1-5)			**$72,000**
								LIFETIME LTOM (NPV)			**$311,700**
System Operations (per month)											$5,850
Electricity	*NYSEG*	17,500	kW-hr	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.10	$1,750
Bi-weekly (year 1) general O&M visit- includes travel, onsite labor, reporting- per month		2	event	$ -	$ -	$ 1,000.00	$ 2,000.00	$ -	$ -	$ -	$2,000
Equipment Maintenance		1	event							$ 1,250.00	$1,250
Quarterly reports- Monthly cost		10	hr	$ -	$ -	$ 85.00	$ 850.00	$ -	$ -	$ -	$850
Lifetime Operations and Maintenance (Net Present Value)											
5 Years of Operations and Maintenance											
5% Discount Factor (per NYSDEC)											

TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Lifetime O&M + Post Remediation Monitoring) **$958,000**

Assumptions:

Working condition is Safety Level:	**D**	**(Labor productivity:**	**82%**	**; Equipment productivity:**	**100%**	**)**	
Weighted Average of city cost index (Rochester, NY)	**96.5%**	**(not applicable for costs derived from vendor quotes).**					
Costs are loaded with a profit factor	**10%**						
Inflation	**3%**	per year	**16%**	for 5 years of inflation			

Consultant Bill Rates (as of 1/6/16) - Includes G&A and 10% Profit

Truck/SUV (1/2 ton or smaller)	**$282.96**	per week
Water Quality Analyzer	**$295.10**	per week
Water Level Meter	**$127.19**	per week
Submersible Pump	**$457.71**	per week
Generators: 220 Volt	**$228.96**	per week

Monitoring Well Installation/Development		**3**	wells	**60**	ft length	**4**	hrs development each	
Sparge Wells	Assumed	**15**	wells will be installed 30 ft apart			**90**	ft in length (new wells) One 60-ft, one 30-ft at e. Labor	
		1	wells per day			**1**	hour for well development per well	
		500	ft pipe for air lines to wells					
Sampling		**15**	wells	**4**	Events per year (yrs 1-5)	**2**	hrs/sample	**$85** Cost per hr
		20%	added for Q	**1**	Event per year (yrs 6-30)			
		4	hrs for travel per event			**2**	workers per event	
Well Development		**1**	hrs per well					
Analytical cost								
	VOCs	**$76.69**	per sample					
	For each sampling event, assumed:	**$50**	for materials (gloves, notebooks, etc.)					

Work day consists of: **10** hrs

Notes

sy	square yard	mo	month
cy	cubic yard	ls	lump sum
lcy	loose cubic yard	O&M	Operation and maintenance
bcy	bank cubic yard	H&S	Health and Safety
lf	linear feet		
sf	square feet		
msf	1,000 square feet		

TECHNOLOGY	LOCATION	MEDIA	Estimated Cost to Implement	$641,000	
Groundwater Alternative 4 Air Sparge and Soil Vapor Extraction	Damshire Drycleaners Site Colonie, NY	Groundwater	Construction Time:	2	months
			Operation Time:	5	years
			Monitoring	10	years

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantity Unit	Cost Breakdown (if available): Material Unit Cost	Material Total Cost	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$351,000**
		1			**$0**		**$0**		**$0**	**$4,842**	**$237,436**
Site Preparation											
Utility Locator (based on recent bids)	*NY Leak Detection*	1	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,250.00	$2,250
Electrical Permit and Utility Connection to PCU	*Recent Quote*	1	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000.00	$5,000
Slug Test											
Field/Office Labor		40	hours	$ -	$ -	$ 85	$ 3,400	$ -	$ -	$ -	$3,400
Offsite Soil Vapor Intrusion Investigation											
Labor		80	hours	$ -	$ -	$ 85	$ 6,800	$ -	$ -		$6,800
Laboratory Analysis TO-15	*Con-Test*	33	each							$ 203.31	$6,709
Shipping		9.00	each							$ 50.00	$450
Drill Rig and Crew for Monitoring Well Installation											
Mobilization/Demobilization	*Aztech*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,500.00	$2,500
MW Installation	*Aztech*	180	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 29.00	$5,220
Flush Mount Well Covers	*Aztech*	3	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 150.00	$450
Well Development	*Aztech*	12	hr	$ -	$ -	$ -	$ -	$ -	$ -	$ 155.90	$1,871
Pre-Implementation Sampling											
Sampling for 1 event- includes collection of field parameters)		15	wells	$ -	$ 50	$ 340	$ 5,100	$ 93	$ 1,392	$ -	$6,542
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 680.00	$680
Analysis for VOCs	*Chemtech*	18	ea	$ -	$ -	$ -	$ -	$ -	$ -	$84.36	$1,518
Drill Rig and Crew for Air Sparge Well Installation											
Mobilization/Demobilization	*Aztech*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,500.00	$2,500
4 1/4" Hollow Stem Auger	*Aztech*	1,350	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 18.71	$25,259
Decontamination Pad	*Aztech*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 249.45	$249
Steam Generator	*Aztech*	8	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 77.95	$585
Standby Time (Decontamination)	*Aztech*	15	hour	$ -	$ -	$ -	$ -	$ -	$ -	$ 150.71	$2,261
Geoprobe Daily Rate - 8 hour day	*Aztech*	8	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,039.36	$7,795
Air Sparge Wells, Stainless Steel, 2"	*Aztech*	1,350	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 5.46	$7,371
Well covers	*Engineer's Estimate*	15	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 300	$4,500
Well head setup- stainless steel	*Engineer's Estimate*	15	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 500	$7,500
Treatment System											
Treatment System and enclosure	*PLC*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 120,000	$120,000
Shipping	*Engineer's Estimate*	1								$ 5,000	$5,000
HDPE air lines	*recent quote*	12	100 lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 63	$756
Sawcutting pavement, up to 3"	*02 41 19.25 0015*	240	lf							$ 1.76	$422
Trenching- 4' deep, 3/8 CY excavator	*31 23 16.13 0050*	711.11	bcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 10.63	$7,559
Bedding material	*31 23 23.16 0050*	32	lcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 36.14	$1,142
Base	*32 11 26.13 1600*	2	ecy	$ -	$ -	$ -	$ -	$ -	$ -	$ 85.19	$189
Binder	*32 12 16.13 0200*	13	sy	$ -	$ -	$ -	$ -	$ -	$ -	$ 19.95	$266
Top	*32 12 16.13 0380*	13	sy	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.49	$153
Concrete restoration	*03 30 53.40 4650*	2	cy	$ -	$ -	$ -	$ -	$ -	$ -	$ 242.28	$538
Contingency											**$35,615**
15% of Total Construction Activities										$237,436	$35,615
Professional/Technical Services											**$78,354**
8% Project Management										$237,436	$18,995
15% Remedial Design											$35,615
10% Construction Management											$23,744
LONG TERM MONITORING								**ANNUAL LTM COST (YRS 1-2)**			**$40,400**
								ANNUAL LTM COST (YRS 3-10)			**$10,100**
								LIFETIME LTM (NPV)			**$134,300**
Monitoring, Sampling, Testing and Analysis (Per Event)											$10,100
Site Monitoring											
Sampling for 1 event - Includes collection of field parameters		15	well	$ -	$ 50	$ 340	$ 5,100	$ 93	$ 1,392	$ -	$6,542
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 680.00	$680
Reporting		16	hr	$85	$ 1,360.00	$ -	$ -	$ -	$ -	$ -	$1,360
Laboratory analysis											
Volatile Organic Compounds (8260B)	*Chemtech*	18	ea	$ -	$ -	$ -	$ -	$ -	$ -	$84.36	$1,518
Lifetime Long Term Monitoring (Net Present Value)											
2 Years of Quarterly Monitoring											
8 Years of Annual Monitoring											
5% Discount Factor (per NYSDEC)											
LONG TERM OPERATIONS AND MAINTENANCE								**ANNUAL LTOM COST (YRS 1-5)**			**$36,000**
								LIFETIME LTOM (NPV)			**$155,900**
System Operations (per month yrs 1-2)											$3,350
Electricity	*NYSEG*	15,000	kW-hr	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.10	$1,500
Monthly general O&M visit- includes travel, onsite labor		1	event	$ -	$ -	$ 1,000.00	$ 1,000.00	$ -	$ -	$ -	$1,000
Quarterly reports- Monthly cost		10	hr	$ -	$ -	$ 85.00	$ 850.00	$ -	$ -	$ -	$850
Lifetime Operations and Maintenance (Net Present Value)											
10 Years of Operations and Maintenance											
0% Discount Factor (per NYSDEC)											
TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Lifetime O&M + Post Remediation Monitoring)											**$641,000**

Assumptions:

Working condition is Safety Level: D (Labor productivity: 82% ; Equipment productivity: 100%)
Weighted Average of city cost index (Rochester, NY) 96.5% (not applicable for costs derived from vendor quotes).
Costs are loaded with a profit factor 10%
Inflation 3% per year 16% for 5 years of inflation

Pump Test:

10 Hours worked to set up pump test
10 60 minutes, every 10 minutes for 60-120 minutes, and every 30 minutes for 120 minutes-10 hours
10 Hours worked (total) second and third day of pump test (measurements taken every 4 hours to 48 hours, then one more time before the end of the test
2 People working during pump test
per day

Consultant Bill Rates (as of 1/6/16) - Includes G&A and 10% Profit

Truck/SUV (1/2 ton or smaller)	$282.96	per week
Water Quality Analyzer	$295.10	per week
Water Level Meter	$127.19	per week
Submersible Pump	$457.71	per week
Generators: 220 Volt	$228.96	per week

Monitoring Well Installation/Development 3 wells 60 ft length 4 hrs development each

Sparge Wells Assumed 15 wells will be installed 30 ft apart; 90 ft in length (new wells) Labor
2 wells per day; 1 hour for well development per well
500 ft air lines to wells
SVE 700 ft sve lines
Sampling 15 wells; 4 Events per year (yrs 1-5); 2 hrs/sample; $85 Cost per hr
20% added for Q; 1 Event per year (yrs 6-30)
4 hrs for travel per event; 2 workers per event
Well Development 1 hrs per well
Analytical cost
VOCs $76.69 per sample
For each sampling event, assumed: $50 for materials (gloves, notebooks, etc.)

Work day consists of: 10 hrs

Notes

sy	square yard	mo	month
cy	cubic yard	ls	lump sum
lcy	loose cubic yard	O&M	Operation and maintenance
bcy	bank cubic yard	H&S	Health and Safety
lf	linear feet		
sf	square feet		
msf	1,000 square feet		

TECHNOLOGY	LOCATION	MEDIA	Estimated Cost to Implement	$1,426,000	
Groundwater Alternative 5 In-Situ Enhanced Reductive Dechlorination	Damshire Drycleaners Site Colonie, NY	Groundwater	Construction Time:	3	months
			Operation Time:	3	months
			Post Remediation Monitoring	10	years

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantity Unit	Cost Breakdown (if available): Material Unit Cost	Material Total Cost	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$1,292,000**
		1			**$50**		**$15,300**		**$1,392**	**$15,284**	**$1,009,670**
Site Preparation											
Utility Locator (based on recent bids)	*NY Leak Detection*	1	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,475.00	$2,475
Slug Test											
Field/Office Labor		40	hours	$ -	$ -	$ 85	$ 3,400	$ -	$ -	$ -	$3,400
Offsite Soil Vapor Intrusion Investigation											
Labor		80	hours	$ -	$ -	$ 85	$ 6,800	$ -	$ -		$6,800
Laboratory Analysis TO-15	*Con-Test*	33	each							$ 203.31	$6,709
Shipping		9.00	each							$ 50.00	$450
Drill Rig and Crew for Monitoring Well Installation											
Mobilization/Demobilization	*Aztech*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,500.00	$2,500
MW Installation	*Aztech*	180	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 29.00	$5,220
Flush Mount Well Covers	*Aztech*	-	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 150.00	$0
Well Development	*Aztech*	12	hr	$ -	$ -	$ -	$ -	$ -	$ -	$ 155.90	$1,871
Pre-Implementation Sampling											
Sampling for 1 event- includes collection of field parameters)		15	wells	$ -	$ 50	$ 340	$ 5,100	$ 93	$ 1,392	$ -	$6,542
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 680.00	$680
Analysis for VOCs	*Chemtech*	18	ea	$ -	$ -	$ -	$ -	$ -	$ -	$84.36	$1,518
Drill Rig and Crew for Direct Push Application											
Mobilization/Demobilization	*Aztech*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,500.00	$2,500
Decontamination Pad	*Aztech*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 249.45	$249
Steam Generator	*Aztech*	34	day	$ -	-	$ -	$ -	$ -	$ -	$ 77.95	$2,631
Geoprobe	*Aztech*	34	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,039.36	$35,078
Sand -.5 CY per bag	*Aztech*	364	cf	$ -	$ -	$ -	$ -	$ -	$ -	$ 15.59	$5,682
Bentonite- 3 bags per point	*Aztech*	33	cf	$ -	$ -	$ -	$ -	$ -	$ -	$ 45.73	$1,515
Treatment											
Sodium Permanganate	*Slack Chemical*	22,971	gal	$ -	$ -	$ -	$ -	$ -	$ -	$ 24.00	$551,304
Peroxide	*U.S. Peroxide*	76,570	gal							$ 4.25	$325,423
Shipment of product	*Engineer's Estimate*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000.00	$5,000
Mixing Tank	*ECHOS 33 32 0133*	3	mo	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,279.99	$3,840
Chemical feed pump, 0.86 GPH, 700 PSI	*ECHOS 33 32 0123*	3	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,198.36	$9,595
Labor		337.50	hr	$ -	$ -	$ 85	$ 28,688	$ -	$ -	$ -	$28,688
Contingency											**$151,451**
15% of Total Construction Activities										$1,009,670	$151,451
Professional/Technical Services											**$131,257**
5% Project Management										$1,009,670	$50,484
3% Remedial Design											$30,290
5% Construction Management											$50,484
LONG TERM MONITORING								**ANNUAL LTM COST (YRS 1-2)**			**$40,400**
								ANNUAL LTM COST (YRS 3-10)			**$10,100**
								LIFETIME LTM (NPV)			**$134,300**
Monitoring, Sampling, Testing and Analysis (Per Event)											$10,100
Site Monitoring											
Sampling for 1 event - Includes collection of field parameters		15	wells	$ -	$ 50	$ 340	$ 5,100	$ 93	$ 1,392	$ -	$6,542
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 680.00	$680
Reporting		16	hour	$85	$ 1,360.00	$ -	$ -	$ -	$ -	$ -	$1,360
Laboratory analysis											
VOCs (8260)	*Chemtech*	18	ea	$ -	$ -	$ -	$ -	$ -	$ -	$84.36	$1,518
Lifetime Long Term Monitoring (Net Present Value)											
2 Year of Quarterly Monitoring											
8 Years of Annual Monitoring											
5% Discount Factor (per NYSDEC)											
TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Post Remediation Monitoring)											**$1,426,000**

Assumptions:

Working condition is Safety Level: **D** **(Labor productivity: 82% ; Equipment productivity: 100%)**

Weighted Average of city cost index (Rochester, N **96.5%** **(not applicable for costs derived from vendor quotes).**

Costs are loaded with a profit factor **10%**

Inflation **3%** per year **34%** for 5 years of inflation

Consultant Bill Rates (as of 1/6/16) - Includes G&A and 10% Profit

Truck/SUV (1/2 ton or smaller)	**$282.96**	per week
Water Quality Analyzer	**$295.10**	per week
Water Level Meter	**$127.19**	per week
Submersible Pump	**$457.71**	per week
Generators: 220 Volt	**$228.96**	per week

Monitoring Well Installation/Development **3** wells **60** ft length **4** hrs development each

Injection Point Installation Assumed **135** Direct push injection points **0.25** diameter (ft) **60** ft in length (direct push borings) Labor

4 Injections per day **3** pi **1** hour for well development per well

Sampling **15** wells **2** Events per year (yrs 1-5) **2** hrs/sample **$85** Cost per hr

20% QA/QC **1** Event per year (yrs 6-30)

4 hrs for travel per event **2** workers per event

Analytical cost

VOCs **$76.69** per sample

For each sampling event, assumed: **$50** for materials (gloves, notebooks, etc.)

Work day consists of: **10** hrs

Notes

Discharge to storm sewer, no cost for water discharge

kW-hr	kilowatt-hour	O&M	Operation and maintenance
bcy	bank cubic yard		
lcy	loose cubic yard		
sf	square feet		
ls	lump sum		

TECHNOLOGY		LOCATION		MEDIA				Estimated Cost to Implement		$967,000	
Alternative 6 Building Demolition, Soil Excavation, and Air Sparge/SVE		Damshire Drycleaners Site Colonie, NY		Groundwater				Construction Time:		6	months
								Operation Time:		5	years
								Monitoring		10	years
		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Material Unit Cost	Material Total Cost	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$677,000**
		1			**$0**		**$0**		**$0**	**$4,842**	**$457,520**
Site Preparation											
Utility Locator (based on recent bids)	*NY Leak Detection*	1	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,250.00	$2,250
Electrical Permit and Utility Connection to PCU	*Recent Quote*	1	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,000.00	$5,000
Slug Test											
Field/Office Labor		40	hours	$ -	$ -	$ 85	$ 3,400	$ -	$ -	$ -	$3,400
Offsite Soil Vapor Intrusion Investigation											
Labor		80	hours	$ -	$ -	$ 85	$ 6,800	$ -	$ -		$6,800
Laboratory Analysis TO-15	*Con-Test*	33	each							$ 203.31	$6,709
Shipping		9.00	each							$ 50.00	$450
Demolition											
Community Air Monitoring (Dust) 2 hrs per day labor and equipment	*recent quote - Pine Environmental*	1.00	mo	$ -	$ -	$ 3,400.00	$ 3,400	$ 3,420	$ 3,420	$ -	$6,820
Brick Demolition	*02 41 13.30 1200*	520	cf							$ 6.09	$3,167
Block Demolition	*02 41 13.30 1000*	450	cf							$ 3.04	$1,368
Slab Demolition	*02 41 13.30 4300*	111	cy							$ 121.69	$13,521
Hauling, light, dust control, includes loading	*31 23 23.20 2500*	7	day							$ 2,320.10	$16,241
C&D disposal	*Recent quote- HES*	338	ton							$ 38.00	$12,855
Excavation											
Characterization sampling (collection, analysis, shipping)	*Con-Test*	2.00								$ 660.00	$1,320
Hauling, light, dust control, includes loading	*31 23 23.20 2500*	62	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,154.90	$71,604
Excavation for minor structures, bank measure, sandy clay or loam, 2 CY bucket	*31 23 16.16 6260*	656	bcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 12.01	$7,876
Topographic Survey	*02 21 23 09 0020*	1.00	acre	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,250.00	$2,250
Confirmation Sampling											
Grab Samples- 1 per 900 square feet, 1 per 30 lf along side walls		24	sample	$ -	$ 50	$ 21.25	$ 510	$ 1.71	$ 41.04	$ -	$601
Lab Analyses - SVOCs, Metals, VOC	*SGS-Accutest*	30	sample	$ -	$ -	$ -	$ -	$ -	$ -	$ 237	$7,110
Non-Hazardous Soil Disposal											
Soil transportation and disposal	*Recent quote- HES*	984	ton	$ -	$ -	$ -	$ -	$ -	$ -	$ 38.00	$37,381
Site Restoration											
Supply and Transportation of NYS Certified Clean Back Fill Material	*Recent quote- HES*	649	lcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 26.50	$17,209
Backfill 300HP Dozer, 150' haul	*31 23 23.14 5220*	649	lcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.64	$1,065
Grading by dozer	*31 23 23.20 2300*	649	lcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 2.61	$1,695
Compacting backfill, 12" lift, 2 passes w/ drum roller	*31 23 23.23 5060*	747	ecy	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.30	$224
Topsoil	*Recent quote- ESG from Seven Springs*	105	lcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 31.47	$3,297
Finishing grading slopes, gentle	*31 22 16.10 3300*	524	sy	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.22	$115
Utility mix, 7#/M.S.F., Hydro or air seeding, with mulch and fertilizer	*32 92 19.14 5400*	1	msf	$ -	$ -	$ -	$ -	$ -	$ -	$ 59.93	$60
Asphalt - 6" stone, 2" binder, 2" topping	*32 12 16 14 0025*	3,000	sf							$ 3.44	$10,320
Asphalt hauling	*31 23 2320 0154*	182	lcy							$ 9.55	$1,733
Topographic Survey	*02 21 23 09 0020*	1.00	acre							$ 2,250.00	$2,250
Drill Rig and Crew for Monitoring Well Installation											
Mobilization/Demobilization	*Aztech*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,500.00	$2,500
MW Installation	*Aztech*	180	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 29.00	$5,220
Flush Mount Well Covers	*Aztech*	3	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 150.00	$450
Well Development	*Aztech*	12	hr	$ -	$ -	$ -	$ -	$ -	$ -	$ 155.90	$1,871
Pre-Implementation Sampling											
Sampling for 1 event- includes collection of field parameters)		15	wells	$ -	$ 50	$ 340	$ 5,100	$ 93	$ 1,392	$ -	$6,542
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 680.00	$680
Analysis for VOCs	*Chemtech*	18	ea	$ -	$ -	$ -	$ -	$ -	$ -	$84.36	$1,518
Drill Rig and Crew for Air Sparge Well Installation											
Mobilization/Demobilization	*Aztech*	1	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,500.00	$2,500
4 1/4" Hollow Stem Auger	*Aztech*	1,350	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 18.71	$25,259
Decontamination Pad	*Aztech*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 249.45	$249
Steam Generator	*Aztech*	8	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 77.95	$585
Standby Time (Decontamination)	*Aztech*	15	hour	$ -	$ -	$ -	$ -	$ -	$ -	$ 150.71	$2,261
Geoprobe Daily Rate - 8 hour day	*Aztech*	8	day	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,039.36	$7,795
Air Sparge Wells, Stainless Steel, 2"	*Aztech*	1,350	lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 5.46	$7,371
Well covers	*Engineer's Estimate*	15	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 300	$4,500
Well head setup- stainless steel	*Engineer's Estimate*	15	ea	$ -	$ -	$ -	$ -	$ -	$ -	$ 500	$7,500
Treatment System											
Treatment System and enclosure	*PLC*	1	ls	$ -	$ -	$ -	$ -	$ -	$ -	$ 120,000	$120,000
Shipping	*Engineer's Estimate*	1								$ 5,000	$5,000
HDPE air lines	*recent quote*	12	100 lf	$ -	$ -	$ -	$ -	$ -	$ -	$ 63	$756
Sawcutting pavement, up to 3"	*02 41 19.25 0015*	240	lf							$ 1.76	$422
Trenching- 4' deep, 3/8 CY excavator	*31 23 16.13 0050*	711.11	bcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 10.63	$7,559
Bedding material	*31 23 23.16 0050*	32	lcy	$ -	$ -	$ -	$ -	$ -	$ -	$ 36.14	$1,142
Base	*32 11 26.13 1600*	2	ecy	$ -	$ -	$ -	$ -	$ -	$ -	$ 85.19	$189
Binder	*32 12 16.13 0200*	13	sy	$ -	$ -	$ -	$ -	$ -	$ -	$ 19.95	$266
Top	*32 12 16.13 0380*	13	sy	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.49	$153
Concrete restoration	*03 30 53.40 4650*	2	cy	$ -	$ -	$ -	$ -	$ -	$ -	$ 242.28	$538
Contingency											**$68,628**
15% of Total Construction Activities										$457,520	$68,628
Professional/Technical Services											**$150,982**
8% Project Management										$457,520	$36,602
15% Remedial Design											$68,628
10% Construction Management											$45,752
LONG TERM MONITORING								**ANNUAL LTM COST (YRS 1-2)**			**$40,400**
								ANNUAL LTM COST (YRS 3-10)			**$10,100**
								LIFETIME LTM (NPV)			**$134,300**
Monitoring, Sampling, Testing and Analysis (Per Event)											$10,100
Site Monitoring											
Sampling for 1 event - Includes collection of field parameters		15	well	$ -	$ 50	$ 340	$ 5,100	$ 93	$ 1,392	$ -	$6,542
Mobilization/Demobilization of Field Sampling Crew		1	event	$ -	$ -	$ -	$ -	$ -	$ -	$ 680.00	$680
Reporting		16	hr	$85	$ 1,360.00	$ -	$ -	$ -	$ -	$ -	$1,360
Laboratory analysis											
Volatile Organic Compounds (8260B	*SGS-Accutest*	18	ea	$ -	$ -	$ -	$ -	$ -	$ -	$84.36	$1,518
Lifetime Long Term Monitoring (Net Present Value)											
2 Years of Quarterly Monitoring											
8 Years of Annual Monitoring											
5% Discount Factor (per NYSDEC)											
LONG TERM OPERATIONS AND MAINTENANCE								**ANNUAL LTOM COST (YRS 1-5)**			**$36,000**
								LIFETIME LTOM (NPV)			**$155,900**
System Operations (per month yrs 1-2)											$3,350
Electricity	*NYSEG*	15,000	kW-hr	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.10	$1,500
Monthly general O&M visit- includes travel, onsite labor		1	event	$ -	$ -	$ 1,000.00	$ 1,000.00	$ -	$ -	$ -	$1,000
Quarterly reports- Monthly cost		10	hr	$ -	$ -	$ 85.00	$ 850.00	$ -	$ -	$ -	$850
Lifetime Operations and Maintenance (Net Present Value)											
10 Years of Operations and Maintenance											
0% Discount Factor (per NYSDEC)											
TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Lifetime O&M + Post Remediation Monitoring)											**$967,000**

Assumptions:

Working condition is Safety Level: **D** **(Labor productivity: 82% ; Equipment productivity: 100%)**
Weighted Average of city cost index (Rochester, NY) **96.5%** **(not applicable for costs derived from vendor quotes).**
Costs are loaded with a profit factor **10%**
Inflation **3%** per year **16%** for 5 years of inflation

Pump Test:

10 Hours worked to set up pump test
10 Hours worked first day of pump test (water level measurements taken every 30 sec for 3 minutes, every minute for 3-15 minutes, every 5 minutes for
10 Hours worked (total) second and third day of pump test (measurements taken every 4 hours to 48 hours, then one more time before the end of the test
2 People working during pump test
per day

Consultant Bill Rates (as of 1/6/16) - Includes G&A and 10% Profit

Truck/SUV (1/2 ton or smaller)	**$282.96**	per week
Water Quality Analyzer	**$295.10**	per week
Water Level Meter	**$127.19**	per week
Submersible Pump	**$457.71**	per week
Generators: 220 Volt	**$228.96**	per week

Confirmation Sampling — **4715** area (SF); **215** perimeter (LF); **0.25** hrs/sample; **$0** Cost per hr
15% QA/QC
156 SF additional 5 ft depth; **1** workers per event

Monitoring Well Installation/Development — **3** wells; **60** ft length; **4** hrs development each

Sparge Wells — Assumed **15** wells will be installed 30 ft apart; **90** ft in length (new wells); Labor
2 wells per day; **1** hour for well development per well
500 ft air lines to wells

SVE — **700** ft sve lines

Sampling — **15** wells; **4** Events per year (yrs 1-5); **2** hrs/sample; **$85** Cost per hr
20% added for Q; **1** Event per year (yrs 6-30)
4 hrs for travel per event; **2** workers per event

Well Development — **1** hrs per well

Analytical cost

VOCs **$76.69** per sample
For each sampling event, assumed: **$50** for materials (gloves, notebooks, etc.)

Work day consists of: **10** hrs

Notes

sy	square yard	mo	month
cy	cubic yard	ls	lump sum
lcy	loose cubic yard	O&M	Operation and maintenance
bcy	bank cubic yard	H&S	Health and Safety
lf	linear feet		
sf	square feet		
msf	1,000 square feet		

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