FINAL FEASIBILITY STUDY REPORT

Ronhill Cleaners
71 Forest Avenue
Glen Cove, Nassau County, New York
Site Number 130071
Contract Work Authorization Number: D006132-29

Shaw Project No.: 134685.29

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Prepared for:

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Table of Contents

List of Tables

List of Figures

Acronyms and Abbreviations

µg/L	Micrograms per liter
µg/m^3	Micrograms per cubic meter
ARs	Applicable Requirements
ARARs	Applicable or Relevant and Appropriate Requirements
AS	Air Sparge
AST	Aboveground storage tank
ASW	Air Sparge Wells
BASE	Building Assessment and Survey
bgs	below ground surface
CDM	Camp Dresser & McKee
CFR	Code of Federal Regulations
CT	Carbon Tetrachloride
cVOCs	Chlorinated Volatile Organic Compounds
CY	Cubic Yards
DCE	Dichloroethene
DER	Division of Environmental Remediation
DHC	dehalococcoides
DNAPL	Dense non-aqueous phase liquids
DUP	Duplicate
EA	Environmental Assessment
EI	Environmental Investigation
ERM	Environmental Resource Management
FS	Feasibility Study
IRM	Interim Remedial Measure
ISCO	In-Situ Chemical Oxidation
ISCR	In-Situ Chemical Reduction
lb(s)	Pound(s)
MW	Monitoring Well
NAPL	Non-aqueous phase liquids
NCDOH	Nassau County Department of Health
NCP	National Contingency Plan
NYCRR	New York Codes, Rules and Regulations

NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department Of Health
NYSGWQS	New York State Groundwater Quality Standards
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PCE	Tetrachloroethylene
ppb	parts per billion
PRP	Potentially responsible party
PSA	Preliminary Site Assessment
PVC	Polyvinyl chloride
RAOs	Remedial Action Objectives
RI	Remedial Investigation
ROD	Record of Decision
ROI	Radius of Influence
Roux	Roux Associates, Inc.
RSCO	Remedial Soil Cleanup Objective
SCOs	Soil Cleanup Objective
SCGs	Standards, Criteria and Guidelines
sf	square feet
Site	Former Ronhill Cleaners Site
SS	Sub-slab
SSDS	Sub-slab Depressurization System
SVE	Soil Vapor Extraction
Shaw	Shaw Environmental & Infrastructure Engineering of New York, P.C.
TBCs	To Be Considered Criteria
TCE	Trichloroethylene
TOGS	Technical and Operational Guidance Series
UIC	Underground Injection Control
US	United States
USGS	United States Geological Survey
VC	Vinyl Chloride
VEW	Vapor Extraction Well
VOCs	volatile organic compounds

WA	Work Assignment
ZVI	Zero Valent Iron

1.0 INTRODUCTION

1.1 Purpose and Organization

Shaw Environmental & Infrastructure Engineering of New York, P.C. (Shaw) has prepared this Feasibility Study (FS) for the former Ronhill Cleaners Site (Site) (Site # 130071). Located at 71 Forest Avenue, Glen Cove, NY (**Figure 1**), this work was completed for the New York State Department of Environmental Conservation (NYSDEC) under State Superfund Contract Work Assignment (WA) D006132-29. This FS was prepared using information from the sources described in **Section 5.0**.

A remedial investigation (RI) was completed by Shaw in August 2013 to characterize and delineate the extent of contamination on and surrounding the Site. RI details are described in the Remedial Investigation Report for the Ronhill Cleaners Site (Shaw, 2013).

The FS describes a selection of remedial alternatives that may be employed to address both on and off Site soil, groundwater and soil vapor contamination as characterized in the Shaw 2013 RI as well as previous site assessment activities as discussed in **Section 1.4**. The report has been prepared in five (5) sections which include:

- Section 1 – Purpose and Site background for preparation of the FS.
- Section 2 – The identification of applicable Standards, Criteria and Guidelines that are used to assist in the selection process for potential remedial alternatives.
- Section 3 – Identifies the selected remedial alternatives for the contaminated area and their respective applicability to the Site.
- Section 4 – Provides a detailed comparative analysis of each proposed remedial alternative including supporting methodology information, and preliminary cost estimates for each alternative.
- Section 5 – Provides all references used for preparation of the report.

1.2 Site Area Off-Site Property Description

The Site is located at the northeast intersection of Forest Avenue and Bryce Avenue in Glen Cove, New York on a 0.78 acre (33,688 square feet [sf]) asphalt parcel designated by the Nassau County Tax Assessor’s Office as Section 30, Block 052, Lot 26. The majority of the parcel surface is covered with asphalt with a small grass vegetated area located along the northern property boundary. The Site is occupied by a 3,600 sf one-story, commercial masonry block structure constructed in 1963. The foundation is slab on grade with no basement. The structure is currently occupied and used as retail space for a Payless Shoe Store. Land use to the north, northwest and south of the Site is primarily residential housing while land use to the east and west consists of commercial retail establishments. The surface features in the area of the Site are shown in **Figure 2**.

Historic records indicate that dry cleaning operations at the Site began shortly after the building was constructed in 1963 and continued until 1993. During the period of operation tetrachloroethylene (PCE) was discovered in the groundwater at two public supply wells (N-03892 and N-05261) located approximately 1,500 feet north of the Site. The PCE was presumed to have originated from the subject property based upon historic reports provided to Shaw.

1.3 Geology and Hydrogeology

1.3.1 Regional Geology

The investigative area is located in the Atlantic Coastal Plain Physiographic Province. Basement bedrock is composed of Precambrian to Early Paleozoic igneous or metamorphic consolidated bedrock. Unconformably overlying the basement is a thick succession of Late Cretaceous deposits: the Raritan and overlying Magothy Formations, both of fluvio-deltaic depositional origin. The Upper Cretaceous deposits are unconformably overlain by Pliocene and Pleistocene deposits, primarily of glacial origin. The focus of Site activities is within the recent glacial deposits, the Magothy and potentially the Raritan Formations. Additional regional geology is provided in the documents referenced in **Section 5**.

1.3.2 Local Geology

The Site is relatively flat and lies approximately 125 feet above sea level. The closest surface water body to the Site is Glen Cove Creek, which lies approximately 5,000 feet southwest of the Site. Glen Cove Creek discharges into Hempstead Harbor. The Glen Cove Creek is classified as C fresh surface water / SC saline surface water according to the NYSDEC *Part 701: Classifications-Surface Waters and Groundwater*. The surficial soils of the surrounding area have been classified as Urban-Land-Montauk-Riverhead according to the *General Soils Map of Nassau County* (US Dept. of Agriculture Soil Conservation Service Cornell University Experiment Station). Soils are defined as "dominantly Urban land and nearly level to strongly sloping, well drained, medium textured and moderately coarse textured." Overburden soils within the Site documented during the initial RI area consist of Light to Dark Brown Fine to

Coarse Sandy Silt underlain by Gravelly Clay. The sandy silt is part of Long Islands unconfined Upper Glacial Aquifer and overlies the deeper Magothy Formation the upper most unit in Long Islands reservoir containing the water table throughout most of the Island. The surficial Upper Glacial Aquifer ranges upwards of 600 feet thick; the saturated thickness is variable. According to the USGS (United States Geological Survey) *Water-Resources Investigations Report 03-4288: Hydrology and Extent of Saltwater Intrusion in the Northern Part of the Town of Oyster Bay, Nassau County, NY:1995-98* the Upper Glacial Aquifer from the area of study is approximately sea level to 120 feet below grade. Below the Upper Glacial Aquifer (consisting of the documented Gravelly Clay) is likely the upper portion of the Raritan Clay Member. The Raritan Member ranges in thickness between 150 feet and 250 feet thick and is the major confining unit on Long Island. The Raritan unit consists of solid, multicolored, compact clay (gray, white, red or tan) with interbedded lenses of sand with a low hydraulic conductivity.

Below the Raritan Clay is the Lloyd Sand Member of the Raritan Formation. The Lloyd Sand Member is Long Island’s deepest aquifer. Within the study area the approximate thickness is 170 feet, in other localities the fluvial/deltaic sand deposits may reach 500 feet. Basement bedrock was not encountered during local Site activities.

1.4 Remedial History

A brief remedial history and corresponding reports are presented below and unless specifically sited are referred throughout the remainder of this report as “historical RIs”:

- September through November 1990 – An Environmental Assessment (EA) and subsequent Environmental Investigation (EI) were conducted. Results from the EA indicated poor housekeeping practices and/or improper disposal of waste solvents which lead to the high PCE concentrations observed in the soil samples. Recommendations from the EA were for further investigation. The EI was conducted in response to the findings in the EA. Based on results from the EI it was recommended that contaminated soil be removed and the Nassau County Department of Health (NCDOH) be contacted in regards to the findings.
- March 1993 – the Site was listed in the New York State Registry of Inactive Hazardous Waste Site
- October 1993 – Bedford Affiliates entered into a Consent Order with the New York State Department of Environmental Conservation (NYSDEC) to perform a Preliminary Site Assessment (PSA).

- November 1993 through January 1995 – PSA was conducted at the Site. The discovery of PCE contaminated soil from piping between an aboveground storage tank (AST) to dry cleaning machine lead to the excavation and removal of approximately 73 tons of hazardous soil inside the building (December 1993).
- June 1995 – NYSDEC listed the Site as a Class 2 Inactive Hazardous Waste Site. A second Consent Order was entered into with Bedford Affiliates to perform an Interim Remedial Measure (IRM).
- August 1996 through May 2000 – an IRM was implemented at the Site. The IRM consisted of the design, installation and operation of a soil vapor extraction (SVE) system to remove volatile organic compounds (VOCs) from the vadose zone directly beneath and around the perimeter of the Site. In 1998, Roux Associates, Inc. (Roux) was contracted to perform an IRM evaluation and supplemental investigation at the Site. Roux ultimately recommended that the SVE system be discontinued and chemical oxidation using hydrogen peroxide be implemented. A former operator of the dry cleaner took over the project as a potentially responsible party (PRP) and developed a modified RI work plan which was approved by NYSDEC in December 1999.
- May 2001 – a RI was completed by Roux and included a geophysical survey, ambient air sampling, soil vapor survey, shallow and deep soil sampling, vertical groundwater profiling, monitoring well installation, monitoring well sampling, and groundwater level measurements. Analytical results obtained during the RI revealed that a non-aqueous phase liquid (NAPL) was present on Site and that the off Site VOC plume was much larger than anticipated. The data also suggested the presence of an off Site source of contamination originating east of the Site. Furthermore, VOC contamination has also been detected in the City of Glen Cove Public Water Supply Well Field located on Seaman Road, northeast of the Site. Based on the results of the RI it was concluded that additional investigation would be needed to delineate the extent of the VOC plume and caused the NYSDEC to consider the completion of a second IRM to address groundwater impacts beneath the Site. Seaman well locations are shown on **Figure 2**. The former operator declined to implement the IRM.
- 2005 – Environmental Resource Management (ERM) conducted an RI (groundwater sampling and indoor air/sub-slab sampling) and In-Situ Chemical Oxidation (ISCO) pilot study to determine whether ISCO could be used to mitigate observed groundwater impacts. Eight nearby residences and businesses agreed to receive sub-slab depressurization systems (SSDSs) based upon the sampling results.

- 2008 – Camp Dresser & McKee (CDM) evaluated results from the ERM ISCO Pilot Study and determined that it would be more effective to enhance the existing SVE system rather than employing ISCO. The enhancements were completed in June October 2008.
- 2009 – CDM oversaw the ozone pilot study at the Site. It was recommended at the conclusion of the pilot study that treatability testing and a possible second pilot study be conducted at the Site.
- 2011 – CDM Smith conducted additional RI activities to address data gaps, delineate the extent of both groundwater and soil vapor contamination in relation to nearby structures, determine if there were other contaminant plumes contributing to the on Site plume and evaluate if Site contamination was impacting a local public supply well. The report (issued in 2012) concluded that overall PCE concentrations at the Site decreased since 2006; however, the PCE concentration within the deep monitoring well (MW-6) had increased. The report concluded that the vertical extent of PCE contamination had not been fully delineated and that increases in PCE concentrations in deep wells would be expected because the PCE dense non-aqueous phase liquid (DNAPL) sinks over time. Other conclusions stated in the report were that the horizontal extent of PCE in groundwater had not been fully delineated and that there was an exposure pathway for vapor intrusion.
- 2013 – Shaw completed an RI to further characterize the extent of the groundwater impacts, vapor phase impacts, and complete a Radius of Influence (ROI) Test in order to assess the efficiency of the SVE system. In groundwater samples, PCE and acetone were the only analytes found to exceed the New York State Ground Water Quality Standards (NYSGWQS). The New York State Department of Health (NYSDOH) proposed that two locations be monitored/mitigated and one location be mitigated based upon the PCE results of the indoor air and sub-slab samples. The NYSDOH suggested that one location be mitigated and three locations take "reasonable and practical actions to identify source(s) and reduce exposures" based upon the trichloroethylene (TCE), Carbon Tetrachloride (CT), and vinyl chloride (VC) results. The results of the ROI tests indicated an approximate on Site horizontal vapor extraction well (VEW) ROI of between 20 – 25 feet at depths ranging from 1 – 5 feet bgs. See the 2013 Shaw RI, provided under separate cover for detailed results.

Additional details and information regarding previous investigations and studies can be found in the documents listed in **Section 5**.

1.5 Contamination Fate and Transport

Based on information provided in the RI, surface water contaminant infiltration or migration does not appear to contribute a significant transport mechanism due to the large amount of impervious surface area. There are no surface water bodies such as lakes, rivers, streams or ditches present at the Site. The closest water body is the Glen Cove Creek which is located approximately 5,000 feet southwest of the Site.

Infiltration from historic dry cleaner waste discharge through the soil pore space into groundwater below ground surface appears to be a transport mechanism. Currently chlorinated volatile organic compounds (cVOCs) are no longer used at the Site and contaminant infiltration is no longer anticipated as a transport mechanism.

The Site exhibits a gradual change in groundwater elevation across the area of study with a groundwater flow in a northeasterly to southwesterly direction closer to the Site and in a northwesterly to southeasterly direction further off Site in the vicinity of the monitoring well located west of Dosoris Lane. The hydraulic gradient is split from these two different hydrogeologic highs with one being defined as MW-17 Northeast and the other ERM-14 Northwest. The hydraulic gradient for MW-17 Northeast area is 0.00325 ft/ft while the hydraulic gradient for ERM-14 Northwest is 0.00906 ft/ft. Soils vary from mostly sands to some gravelly clay at depth. Groundwater flow is considered to be a significant lateral and vertical mechanism for cVOC contaminant transport both on and off the Site based on existing data. Information in historical RIs show a possible complex upper aquifer flow convergence due to unidentified subsurface geologic features or as a result of historic pumping.

Indoor, outdoor, sub-slab and soil vapor sampling has confirmed the presence of cVOC impacts in the vadose zone above the water table. Preferential pathways for soil vapor migration include permeable soil layer, utility bedding pathways as well as asphalt, concrete slab and footing cracks in roadways and buildings.

1.6 Qualitative Human Health Risk Evaluation

Currently the Ronhill Cleaners Site is used as a Payless Shoe Store surrounded by various commercial and residential properties. Based on these conditions of a varying population swath, retail employees, customers and private residences have been evaluated for contaminant exposure. In order for a contaminant to pose risk to human health, a complete exposure pathway must be present with contaminant concentrations high enough to potentially cause an adverse health effect. Human exposure pathways can occur through ingestion, inhalation, absorption and injection.

Ingestion, inhalation and absorption of soil are potential pathways for human exposure. Historical RIs have delineated shallow soil impacts along the northwest corner of the building on Site. The contamination detected is located below mostly impervious ground surfaces. However, the presence of these impacts at shallow depths (2-8 feet bgs) potentially poses a risk for the pathways of ingestion, inhalation and absorption. This risk can be considered minimal and would most likely occur during subsurface construction activities.

Ingestion and absorption of contaminated groundwater are pathways for human exposure. The Site groundwater table is located approximately 80 feet below ground surface, therefore absorption of groundwater is highly unlikely. Ingestion can be considered a human exposure pathway as drinking water supply wells are located both north and south of the Site. However, the proximity of groundwater impacts to the nearest supply well is greater than 1,500 feet, therefore risk to human health is considered to be minimal.

Inhalation of contaminated soil vapor from the subsurface soil/groundwater is a method for human exposure. The Shaw 2013 RI and historical RI's analytical results indicate elevated cVOC concentrations in the soil vapor and sub-slab sample locations. This information is indicative of a complete exposure pathway for Site workers, Site visitors and Residents. Soil vapor inhalation has been identified as the most prominent exposure pathway and is anticipated to pose the highest risk to human health based upon existing data.

2.0 IDENTIFICATION OF STANDARDS, CRITERIA, GUIDELINES AND REMEDIAL ACTION OBJECTIVES

2.1 Introduction

As identified in historical Site investigative activities, cVOCs were detected at various concentrations in groundwater and vapor matrices across the Site. However, as previously discussed in **Section 1.6**, cVOC soil vapor is the prominent human exposure pathway based upon existing analytical data. For purposes of this report only a human health exposure assessment has been provided. An ecological assessment was not conducted due to the Site being zoned as a commercial "shopping center district" property and the closest proximity to a down gradient surface water body greater than 0.3 miles.

2.2 Potentially Applicable Standards, Criteria, Guidelines (SCGs), and Remedial Action Objectives

Standards, Criteria and Guidelines (SCGs) are defined below as follows:

"Standards and criteria are cleanup standards, standards of control, and other substantive environmental requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance."

"Guidelines are non-promulgated criteria, advisories and/or guidance that are not legal requirements and do not have the same status as standards and criteria; however, remedial alternatives should consider guidance documents that, based on professional judgment, may be applicable to the project."

SCGs may include Applicable Requirements (ARs), Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Criteria (TBCs) where:

1) ARs are legally enforceable standards or regulations, such as groundwater standards for drinking water that have been promulgated under state law.
2) ARARs include those requirements that have been promulgated under state law that may not be "applicable" to the specific contaminant released or the remedial actions contemplated but are sufficiently similar to site conditions to be considered relevant and

appropriate. If a relevant or appropriate requirement is well suited to a site, it carries the same weight as an applicable requirement during the evaluation of remedial alternatives.

3) TBCs are non-promulgated advisories or guidance issued by state agencies that may be used to evaluate whether a remedial alternative is protective of human health and the environment in cases where there are no standards or regulations for a particular contaminant or site condition. These criteria may be considered along with SCGs when establishing cleanup goals for protection of human health and the environment.

2.2.1 Chemical Specific SCGs

Chemical Specific SCGs define health or risk based numerical limits on the concentration of contaminants in the environment. These concentration limits may be established by Government Agencies and are used to provide protective cleanup levels or may be used to consider the extents of contamination and the need for remediation at a site. For the purposes of the Ronhill Cleaners Site groundwater is considered Class GA. Class GA groundwater pertains to fresh groundwater found in the saturated zone of unconsolidated deposits and bedrock. The best usage of Class GA groundwater is a source of potable water supply; however, Site groundwater is not used as a drinking water source. The NYSGWQS and guidance values for Class GA groundwater are stipulated in:

1. New York Water Classifications and Quality Standards (6 NYCRR Parts 609, and700-704),

2. Technical and Operation Guidance Standards (TOGS) 1.1.1, Ambient Water Quality Standards and Guidance Values dated October 22, 1993 (reissued June1998)

As stated in Part 375-6, Soil Cleanup Objectives (SCOs) will be required to achieve the lowest of the three (3) potentially applicable contaminant specific SCOs for all soils above bedrock. NYSDEC has developed SCOs for protection of public health, for protection of groundwater, and for protection of ecological resources. The Ronhill Cleaners Site is zoned in a commercial area and is located greater than 0.3 miles from the nearest surface water body, therefore, the SCOs for the protection of ecological resources are not applicable to this Site. Applicable SCOs for the Site include clean up for the protection of groundwater which is more stringent than SCOs for the protection of public health. Chemical specific SCGs considered at the Ronhill Cleaners Site are provided in **Table 1**.

2.2.2 Location Specific SCGs

Potential location-specific SCGs are requirements that set restrictions on activities depending on the physical and environmental characteristics of the Site or its immediate surroundings. These are typically building, construction and zoning codes. Location-specific SCGs also generally include floodplain and wetland regulations, restrictions promulgated under federal acts. Potential location-specific SCGs that may be applicable to potential Site remedial technologies are the City of Glen Cove zoning ordinances and building codes. Location specific SCGs considered at the Ronhill Cleaners Site are provided in **Table 2**.

2.2.3 Action Specific SCGs

Action Specific SCGs are requirements determined by particular remedial activities taking place during the remediation process. Action specific SCGs establish controls or restrictions on the design, implementation, and performance of remedial activities. These can include reporting requirements for governments, general health and safety requirements and handling and disposing of waste (including permitting, manifesting, transportation and disposal, and treatment and disposal facility operations). Remedial actions conducted at the Site would be required to comply with applicable requirements established by the Occupational Safety and Health Administration (OSHA) and general industry standards. A complete list of Action Specific SCGs considered for this Site can be found in **Table 3**.

2.3 Remedial Action Objectives

The development of Remedial Action Objectives (RAOs) was completed with the goal of eliminating the potential to expose humans to contaminated media. These RAOs include the:

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

- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.
- Prevent migration of contaminants that would result in groundwater or surface water contamination.
- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at a site.

2.4 Cleanup Objectives and Volume of Impacted Media

2.4.1 Soil

2.4.1.1 Selection of Soil Cleanup Goals

Specific soil clean up objectives based on the protection of public health based on land use is found in 6 NYCRR Part 375-6.8. This guidance gives numeric guidance values for specific individual chemical compounds for various uses.

- Unrestricted Use: use without restriction or environmental controls;
- Residential Use: use with limited restrictions, such as not allowing the raising or animals for human consumption;
- Restricted Residential Use: use with restrictions, such as limiting ownership or size or number of units as well as the ability to grow vegetables for consumption. Recreational uses are included in this site;
- Commercial Use: use for the purposes of conducting businesses including buying and selling merchandise and services. This use includes passive recreational use with limited soil contact;
- Industrial Use: use for the processes of manufacturing, producing, or assembling goods. There is no recreational use included in this use.

The Ronhill Cleaners Site is currently categorized for Commercial Use operations. However the projected use of the structure is not known at this time. Regulation 6 NYCRR Part 375-6.8 describes the most applicable SCO for commercial structures as Commercial Use. Given the uncertainty of the projected use and proximity to residential structures, unrestricted use has been selected as the SCO for this Site.

Based on the selection of Unrestricted Use SCO, results of historical RIs were compared to the applicable SCO and any detections and exceedances were noted. Sample locations and results are provided in historical RIs under separate cover.

As previously mentioned, SCOs for the protection of ecological resources were not considered as indicated in 6 NYCRR Part 375-6.8 as the closest surface water body is greater than 0.3 miles from the Site and ecological receptors are not expected to be impacted by Site contamination.

For the protection of groundwater 6 NYCRR Subpart 375-6.5 (a) (1) states that the SCOs may not be applicable at locations where:

1) The on-site source will be addressed;

2) An environmental easement restricting groundwater use is in place;

3) The NYSDEC determines that the contaminated groundwater is not likely to migrate off-site and that groundwater quality will improve over time.

Based upon these regulations current analytical sample results have indicate that groundwater impacts exist off Site. As illustrated in historical RIs, soil analytical results were compared to unrestricted use and commercial use Remedial Soil Cleanup Objectives (RSCOs). There were three (3) exceedances of the contaminants of concern when compared the unrestricted use RSCO and no exceedances for contaminants of concern greater than commercial use RSCOs.

For comparison purposes, a list of soil cleanup goals for PCE is presented below. Based on historical RI soil sample analytical results, soil contamination appears to be of minimal concern, but has been addressed in the remedial alternatives due to shallow soil impacts delineated in historic RIs.

From regulation 6 NYCRR Part 375-6.8 Soil Cleanup Objective Tables:

Contaminant	Unrestricted Use	Protection of Public Health				Protection of Ecological Resources	Protection of Ground-water
		Residential	Restricted-Residential	Commercial	Industrial		
PCE	1.3	5.5	19	150	300	2	1.3

All soil cleanup objectives (SCOs) are in parts per million (ppm).

2.4.1.2 Selection of Contaminants of Concern

PCE is the contaminant of concern based on results from the Shaw 2013 RI and historic RIs that have been completed on and off the Site.

2.4.2 Soil Vapor Intrusion

2.4.2.1 Selection of Soil Vapor Intrusion Cleanup Goals

The State of New York has no official regulation for Soil Vapor; the NYSDOH issued *Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (2006) for the "guidance for parties evaluating soil vapor intrusion in the State of New York". This document provides indoor and outdoor air recommended guidance criteria for both PCE and TCE.

Elevated concentrations of PCE, TCE and cis-1,2-DCE were detected during the Shaw 2013 RI. A comparison should be made to determine the relevance of the concentration in regards to background levels. NYSDOH guidance presents the Building Assessment and Survey (BASE) database which can be used as a guide. As a conservative measure, the 90th percentile of background was chosen for PCE, TCE and cis-1,2-DCE.

2.4.2.2 Selection of Contaminants of Concern

PCE, TCE, and cis-1,2-DCE are the contaminants of concern at this Site based on the results of Shaw's 2013 RI and historic assessment reports.

The contaminants of concern and the selected clean up guidance is shown below. The maximum detected concentrations represent results detected in the Shaw 2013 RI.

Contaminant of Concern	NYS DOH Guidance Value (µg/m^3)	BASE Database (90th percentile) (µg/m^3)	Maximum Detected Concentration (µg/m^3)
PCE	**30**	15.9	58,000
TCE	**5**	4.2	8,100
cis-1,2-DCE	NA	**<1.9**	19,000

2.4.2.3 Determination of Extent of Soil Vapor Intrusion

Based on historical RIs, the highest detections occurred at the Site, with a PCE detection estimated at 1,300,000 µg/m^3 in a sub-slab sample (SS-1, 2005). There were also elevated PCE detections off Site in all directions with the most significant impacts being observed to the northeast in SS-10 at 160,000 µg/m^3 (historical RIs) and to the southwest at 58,000 µg/m^3 (Shaw

2013 RI). The sample locations and analytical results are provided in the Shaw 2013 RI and historical RIs.

2.4.3 Groundwater

2.4.3.1 Selection of Groundwater Cleanup Goals

New York State provides cleanup goals for Groundwater as part of the Division of Water, Technical and Operational guidance Series (1.1.1) (TOGS 1.1.1) *Ambient Water Quality Standards And Guidance Value And Groundwater Effluent Limitations.*

2.4.3.2 Selection of Contaminants of Concern

PCE, TCE and cis-1,2-DCE are the contaminants of concern based on the historic operations which took place at the Site. Detections above the TOGS guidance values only occurred for PCE, TCE and cis-1,2-DCE.

The maximum detected concentrations during the Shaw 2013 RI and the selected clean up guidance are shown below:

Contaminant of Concern	TOGS (1.1.1) (µg/L)	Maximum Detected Concentration (µg/L)
PCE	**5**	30,000 , (37,000 DUP)
TCE	**5**	2.9
cis-1,2-DCE	**5**	1 U

2.4.3.3 Determination of Extent of Contaminated Groundwater Plume

Most recent results from the Shaw 2013 RI indicate the presence of elevated dissolved cVOC constituents in “shallow”, “medium” and “deep” groundwater. Shallow, medium and deep groundwater zones have been defined in the Shaw 2013 RI under separate cover. The shallow zone plume appeared to decrease southwest to south of the Site. In comparison the medium groundwater plume displayed the highest concentration of PCE from an off Site location with concentrations decreasing to the south. The “medium” groundwater plume lacks vertical and horizontal delineation and, based on existing data, impacts in this zone are considered minimal. The deep groundwater plume had impacts form monitoring wells immediately to the southwest of the Site; however, further downgradient wells monitoring wells yield results below TOGS 1.1.1. All results are included in the Shaw 2013 RI.

3.0 IDENTIFICATION OF ALTERNATIVES

3.1 Introduction

The following section details the development of several remedial options to achieve the RAOs stated above. As previously discussed, based on the historical remedial investigation data, soil vapor intrusion, groundwater contamination and to a lesser extent adsorbed soil contamination have been identified as the potential risks to human health and the environment at the Site. Soil vapor impacts that have been identified to pose the greatest potential risk to human health and the environment based upon existing Site data and are located throughout the vadose zone at or immediately adjacent to the Site. The identified groundwater impacts posing the highest risk to human health and the environment is located within the upper 20 feet of the water table at or immediately adjacent to the Site. Soil impacts posing the highest risk to human health and the environment have been identified along the northwest corner of the former Ronhill Clearners building based upon a review of historic data provided to Shaw as no soil samples were collected during our RI. The alternatives described below propose to actively remediate and/or monitor these impacted areas for the contaminants of concern.

In consultation with the NYSDEC, Shaw has identified five alternatives to remediate the Site. These alternatives were selected based upon previous experience, historical environmental investigations as well as cost and technological constraints. Additional remedial alternatives have been briefly reviewed for applicability and feasibility purposes are described in **Table 4**.

3.2 Alternative Number 1: No Action

No action as an alternative is only an option at sites that could benefit from natural processes which would degrade the contamination to levels below the cleanup goals. This alternative is considered as a baseline for comparison as required by the National Contingency Plan (NCP). This alternative would not include institutional controls and would not involve quarterly monitoring to evaluate natural attenuation.

3.3 Alternative Number 2: Mitigation of Soil Vapor by Sealing Preferential Vapor Pathways, Installation of Sub-Slab Depressurization System(s) and Long Term Groundwater Monitoring

This alternative consists of mitigation methods that involve sealing preferential pathway infiltration points and actively manipulating the pressure differential between the former Ronhill Cleaners building's interior and exterior (on a continuous basis). The building's foundation is slab-on-grade. In conjunction with sealing potential subsurface vapor entry points, an active Sub-Slab Depressurization System (SSDS) would be installed to draw vapors from the soil beneath the buildings slab, creating a vacuum and subsequently discharging the vapors to the atmosphere. This Alternative includes the decommissioning of the existing SVE system and installation of SSDS's along neighboring properties as deemed necessary based on pre-design data collection. Additionally, implementation of this alternative will include long term air and groundwater monitoring to further evaluate contaminant migration and natural attenuation at the following frequency:

Air

- Annually for years 1 – 5
- Once every five years for years 6 – 30

Groundwater

- Quarterly for years 1 – 5
- Once every five years for years 6 – 30

Long term groundwater monitoring (years 6 – 30) has been selected at a one event per five year frequency for budgetary purposes only. The actual frequency maybe increased or decreased pending sampling analytical results from years one through five.

3.4 Alternative Number 3: Soil Vapor Extraction System Upgrade with Air Sparge Wells, Shallow Soil Excavation and Long Term Air and Groundwater Monitoring

This alternative proposes to install and upgrade the existing SVE system to an air sparge/SVE (AS/SVE), a technique historically used to remediate contaminated soil, soil vapor and groundwater. The AS/SVE system upgrade will include the installation of up to six Air Sparge

Wells (ASW) at locations of known elevated PCE concentrations in shallow groundwater. The ASW's will be utilized for the injection of air into the saturated zone (approximately 80-100 bgs) to facilitate a contaminate phase transfer from a dissolved to vapor phase. The determination of ASW locations will be based on historical and pre-design sample analytical results.

Once in the vapor phase, the existing Vapor Extraction Wells (VEW) using high flow rates, will be used to induce vacuum or a combination of high flow/induced vacuum to collect and remove vapor phase contamination. Up to three additional VEWs will be installed to more efficiently treat the remaining impacted soil and soil vapor areas that have been identified in the vadose zone. The SVE system upgrade will also be designed to mitigate vapor phase intrusion to indoor air. The upgraded system will be designed to reduce vapor concentrations at and around the former Ronhill Cleaners Structure. VEW locations will be determined during the pre-design investigation as well as any necessary modifications to the blower to accommodate additional flow capacity requirements.

This alternative additionally proposes the excavation of shallow contaminated soils that were identified along the northwest corner of the former Ronhill Cleaners building as existing data and review of historic remedial investigation reports do not indicate that this material has been previously addressed. The presence of contamination will be verified during the pre-design investigation. Excavation depths are not anticipated to exceed 10 feet. The anticipated area of concern is approximately 1,500 square feet and has estimated removal volume of 250 cubic yards.

Long term vapor and groundwater monitoring would be proposed to monitor soil vapor levels and groundwater contaminant natural attenuation at frequencies described in alternative 2.

3.5 Alternative Number 4: Soil Vapor Extraction System Upgrade with Shallow Soil Excavation and Shallow Groundwater Treatment Using In-Situ Chemical Reduction (ISCR).

This remedial alternative proposes to upgrade the SVE system, perform shallow soil excavation and apply in-situ shallow groundwater treatment to enhance PCE plume mitigation using In-Situ Chemical Reduction (ISCR). The SVE system upgrade will include the installation of the VEWs and system control modifications as described in alternative 3 (i.e. no air sparge wells). Proposed soil excavation would also be implemented as described in alternative 3.

"ISCR describes the synergistic effect of stimulated biological oxygen consumption (via degradation of added organic carbon sources), direct chemical reduction with reduced metals, and the corresponding enhanced thermodynamic decomposition reactions that are realized at the lowered redox (Eh) conditions. These combined effects are therefore characteristic for technologies that combine controlled-release carbon plus ZVI or another reduced metal, e.g. Zn(0) (Seech et al., 1995 and 2000) or other reducing agents (Szecsody et al., 2004) such as dithionite (Nzegung et al., 2001). Following placement of ISCR reagents into the subsurface environment, a number of physical, chemical and microbiological processes combine to create very strong (e.g., $Eh < -550$ mV) reducing conditions in situ that stimulate rapid and complete dechlorination of organic solvents and other recalcitrant compounds."

ISCR technology would be employed through injection using an in-situ amendment called EHC-L. The amendment would be injected directly below the water table (shallow groundwater) through permanent injection wells at a specified radius of influence (ROI) to destroy cVOCs at and immediately surrounding the Former Ronhill Cleaners building. An injection pattern will be implemented at locations of known elevated PCE concentrations and not placed over the entire plume footprint as it would not be feasible or cost effective based upon existing data. This alternative involves an initial pilot test injection of ISCR at a single (e.g. "Hot Spot") PCE location or as determined by pre-design investigation analytical results. Initial treatment will include the installation of injection wells at or near MW-3 (known elevated location of PCE impacts) to ensure adequate EHC-L product performance and to identify any modifications that may need to be completed prior to implementation of the full scale remedy. Following the pilot test a full scale remedy will be implemented to address the remaining impacted shallow groundwater within the area of concern. Three to four observation wells will be installed as necessary to evaluate the effectiveness of the remedial product. A second injection may be necessary and will be determined based on monitoring. Long term air and groundwater sampling is proposed to monitor soil vapor levels and groundwater contaminant natural attenuation at frequencies described in alternative 2.

3.6 Alternative Number 5: Soil Vapor Extraction System Upgrade with Air Sparge Wells, Shallow Soil Excavation and Deep Groundwater Treatment Using In-Situ Chemical Reduction (ISCR)

This remedial alternative proposes to upgrade the SVE system with air sparge wells and perform shallow soil excavation as described in alternative 3 as well as apply in-situ deep groundwater treatment to enhance PCE plume mitigation using In-Situ Chemical Reduction (ISCR). ISCR technology is described above in **Section 3.5**.

ISCR technology will be implemented using the same process as described in alternative 4 at locations identified in the Shaw 2013 RI to address deep groundwater plume impacts. his alternative involves an initial pilot test injection through permanent injection walls of ISCR amendment at a single (e.g. "Hot Spot") location or as determined by pre-design investigation analytical results. Initial treatment will include the installation of an injection wells at or near MW-6 or MW-24S (known elevated locations of PCE impacts) to ensure adequate EHC-L amendment performance and to identify any modifications that may need to be completed prior to implementation of the full scale remedy. Following the pilot test a full scale remedy will be implemented to address the remaining impacted deep groundwater within the area of concern. A second injection may be necessary and will depend on monitoring results. Three to four observation wells will be installed as necessary to evaluate the effectiveness of the remedial product. Two (2) rounds of full scale injection treatment are anticipated to reduce contaminant levels to the respective chemical specific SCGs. Long term air and groundwater sampling is proposed to monitor soil vapor levels and groundwater contaminant natural attenuation at frequencies described in alternative 2.

3.7 Alternative Number 6: Soil Vapor Extraction System Upgrade, Shallow Soil Excavation and Shallow/Deep Groundwater Treatment Using In-Situ Chemical Reduction (ISCR)

This remedial alternative proposes to upgrade the SVE system as described in alternative 4, perform shallow soil excavation as described in alternative 3, apply in-situ shallow groundwater treatment using ISCR as described in alternative 4 and apply in-situ deep groundwater treatment using ISCR as described in alternative 5. ISCR technology is described above in **Section 3.5**.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

4.1 Introduction

This section provides a detailed analysis of the remedial alternatives outlined in **Section 3** of this document. Each remedy is evaluated to ensure that the alternative can employ a remedy to protect against a threat to public health and/or the environment and is technically suitable at the Site. Each alternative is described in detail and compared on the basis of environmental benefits and costs using criteria established by 6 NYCRR Part 375, NYSDEC and DER-10. A total of five (5) remedial alternatives, (including a "No Action" alternative) are described in this section and compared to the RAOs for groundwater, soil and soil vapor intrusion on this Site.

4.1.1 Detailed Evaluation of Criteria

This section discusses each remedial alternative compared against nine (9) evaluation criteria that were used to select each alternative. These criteria include:

- Overall protection of public health and the environment
- Reduction in toxicity, mobility and volume of hazardous waste (e.g., by thermal destruction, biological or chemical treatments or containment wall construction)
- Long-term effectiveness and permanence
- Short-term effectiveness and potential impacts during remediation
- Implementation and technical reliability
- Compliance with standards, criteria and guidelines (SCGs)
- Community and state acceptance
- Land use
- Cost.

4.1.2 Overall Protection of Human Health and the Environment

This criterion assesses the effect of each proposed alternative on human health and the environment. The assessment is based on a number of factors included in the short and long term effectiveness criteria, and compliance with statutory requirements. This Site specifically includes the effect of contaminated soil, soil vapor intrusion and groundwater on human health and the environment.

4.1.3 Reduction of Toxicity, Mobility and Volume through Treatment

This criterion compares the remedial technology selected for the Site to the technologies effectiveness in reducing the overall toxicity, mobility and quantity of contamination of concern in the treated matrix. It evaluates the degree to which the selected alternative can efficiently reduce the concentrations and volume as well as prevent contaminant migration down gradient of the Site.

4.1.4 Long-Term Impacts Effectiveness and Permanence

This criterion addresses the long-term effectiveness of the selected remedial alternative post completion of the remedial action. It compares and evaluates the effectiveness of the remedial action to remaining contamination on the site as well as the long-term reliability of the alternative to the protection of the environment and human health.

4.1.5 Short-Term Impacts and Effectiveness

This criterion compares how the selected alternative will impact the site during the implementation phase of the project. Considerations include the protection of the surrounding community; construction workers involved the remedial process and the protection of the surrounding environment. It compares and evaluates the effectiveness in meeting the RAOs for the remedial action to remaining contamination on the site as well as the short-term reliability of the alternative.

4.1.6 Implementation and Technical Reliability

This criterion evaluates the overall feasibility of the selected remedial alternative which may include a number of factors including the administrative and technical aspects, and availability of services to conduct the work. Administratively, the remedial alternative must be in compliance with all federal, state and local regulatory requirements and proper permits must be established as necessary. Technically, the remedial alternative must include the site-specific capabilities of being constructed, operated and subsequently maintained. Availability of services includes the means of feasibly establishing and implementing the remedial alternative at the site.

4.1.7 Compliance with Statutory Requirements

This criterion is used to evaluate whether the selected alternative achieve the proposed cleanup goals as described in **Section 2** of this report.

4.1.8 Community and State Acceptance

This criterion evaluates potential feasibility concerns that the public or the state may have regarding each remedial alternative. Typically these criteria are addressed in the Record of Decision (ROD) provided by NYSDEC.

4.1.9 Cost

This criterion provides a cost estimate for the selected alternative which includes design, construction and long-term operation and maintenance at the site. The cost estimates herein reflect remedial alternative costs estimated to an accuracy of +/- 30%.

4.2 Remedial Alternatives

4.2.1 Alternative Number 1: No Action

4.2.1.1 Description

This alternative involves taking no further action to remedy existing contamination on the site. The NCP at 40 CFR §300.430(e) (6) states that a "No Action" alternative be evaluated during Feasibility Studies to use as a baseline for comparison with other remedial alternatives. This alternative relies on the natural processes occurring in the subsurface to provide all and any remedial action. It does not include any design, construction, installation or long-term monitoring of existing monitoring wells on the Site.

4.2.1.2 Detailed Evaluation of Criteria

4.2.1.3 Overall Protection of Human Health and the Environment

This alternative is not protective of human health and the environment. Based on information included in the Shaw 2013 RI, natural attenuation dechlorination processes are occurring at a slow rate. PCE daughter products (including TCE and cis-1,2-DCE) have not significantly been identified in the soil, soil vapor and groundwater therefore dechlorination of impacts in these matrices can be considered minimal at this time. CVOC impacts are expected to remain in the soil, soil vapor and groundwater. The risk to ecological receptors was not evaluated because the site is located in a commercial zoned area and the closest water body is situated greater than 0.3 miles away.

4.2.1.4 Compliance with Statutory Requirements

Applying this alternative as the remedial action for the Site would not significantly reduce contaminant concentrations. The selected chemical specific SCGs for the Site (as discussed in **Section 2)** for groundwater, soil and soil vapor intrusion would not be achieved.

4.2.1.5 Short-Term Impacts and Effectiveness

Short-term impacts for implementing this alternative are considered to be negligible. PCE soil, soil vapor and associated cVOC constituents around and under the existing structure would be expected to remain at or near concentrations indicated in the 2013 Shaw RI and historical RIs. Groundwater cVOC impacts are expected to continue migration with the groundwater flow path. There is no treatment involved with this alternative and there is no short term effectiveness to meet any RAOs.

4.2.1.6 Long-Term Effectiveness and Permanence

Long-term effectiveness of implementing this alternative involves only the natural attenuation processes to degrade existing cVOC contamination. Based on results from the Shaw 2013 and historical RIs, there is no significant evidence of PCE dechlorination with limited detections of TCE and cis-1,2-DCE. The "bulk" of contamination remains as PCE and biodegradation processes appear to be occurring at a slow rate. The risks associated with contaminated soil, soil vapor and groundwater are expected to remain the same because this alternative does not involve the removal or treatment of identified contamination. This alternative is not considered to be a long-term effective remedy.

4.2.1.7 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction or removal of contaminate volume with this alternative. Therefore, the toxicity, mobility, and volume of contamination will not be reduced.

4.2.1.8 Implementability

There is no action to implement by selecting this alternative.

4.2.1.9 Cost

There are no costs associated with this alternative.

4.2.2 Alternative Number 2: Mitigation of Soil Vapor by Sealing Preferential Vapor Pathways, Installation of Sub-Slab Depressurization System(s) and Long Term Air and Groundwater Monitoring

4.2.2.1 Description

The remedial action associated with this alternative involves sealing preferential pathways (cracks in foundation, etc.) within the existing building and the installation of SSDS's under the footprint of the Former Ronhill Cleaners foundation. The system will be powered by an electric blower/fan that discharges to the atmosphere. The blower/fan will be connected to a PVC pipe network that extends below the concrete slab to mitigate soil vapor intrusion. These systems will be designed pursuant to the guidelines included in the *NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006) and *EPA - OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (Subsurface Vapor Intrusion Guidance – November 2002). Air samples will be collected to determine the system's effectiveness. Long term air monitoring includes indoor air (2 samples), outdoor ambient (2 samples), sub-slab (2 samples) and soil vapor sampling (2 samples) annually for the first five (5) years. The same samples will be collected at a frequency of one (1) sampling event every five (5) years from years 6 to 30. Long-term soil vapor sampling (years 6 – 30) has been selected at a one event per five year frequency for anticipated budgetary purposes only. The actual frequency maybe increased or decreased pending sample analytical results from years one through five.

Additionally this alternative proposes a long-term groundwater monitoring program and the installation of up to four (4) groundwater monitoring wells to more adequately identify and delineate groundwater impacts. Long-term monitoring and sampling of existing and new monitoring wells will be conducted to evaluate cVOC contaminant migration both on and offsite at 50-55 locations at an initial frequency of four (4) times per year (quarterly) for the first five (5) years. From years 6 – 30 the sampling frequency would be reduced to one (1) sampling event every five (5) years. Long term groundwater sampling (years 6 – 30) has been selected at a one event per five year frequency for anticipated budgetary purposes only. The actual frequency maybe increased or decreased pending sampling analytical results from years one through five. This alternative is illustrated on **Figure 3**.

4.2.2.2 Detailed Evaluation of Criteria

4.2.2.3 Overall Protection of Human Health and the Environment

Installing SSDS's within the building will reduce risk and provide protection to human health by mitigating soil vapor intrusion. Air monitoring and sampling will be established to verify the effectiveness of these systems. Protection of the environment was not evaluated as the Site is zoned as "commercial" and the nearest surface water body is located further than 0.3 miles from the Site.

4.2.2.4 Compliance with Statutory Requirements

This alternative proposes to mitigate soil vapor to mitigate the risk to human health. The installation of SSDS's will largely prevent soil vapor from entering the structure. Matrix 2 provided in the *NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006) states that mitigation is needed to minimize the risk for PCE soil vapor exposure for sub-slab detected concentrations exceeding 1,000 $\mu g/m^3$. Based on results from the historic RIs, on site sub-slab soil vapor detections for PCE exhibited concentrations significantly greater than 1,000 $\mu g/m^3$. Providing a SSDS and sealing preferential pathways will adequately mitigate the potential for soil vapor intrusion. However, it will not remove/remediate the "mass" of observed soil vapor contamination.

This alternative proposes long term monitoring to evaluate and delineate the migration of groundwater contamination. As discussed in **Section 4.2.1.2** and as indicated by results of data collected during the Shaw 2013 RI, naturally occurring anaerobic biodegradation is occurring at a slow rate and can therefore be eliminated as remedial strategy. Therefore implementing this alternative would not meet the chemical-specific SCGs for the Site.

4.2.2.5 Short-Term Impacts and Effectiveness

Proper installation of an SSDS and sealing of preferential pathways within the building will mitigate or impede soil vapor intrusion into the structure. This will provide short-term protection to employees and customers/visitors that enter the building. Noise, dust and vibration within the structure during construction of the SSDS will cause a short term impact to employees and customers in the store. Annual air sampling will be implemented to evaluate system effectiveness.

4.2.2.6 Long-Term Effectiveness and Permanence

Installation of an SSDS will continue to be effective long-term for the protection of human health if proper operation and maintenance of the blower unit(s) is completed. However, since this alternative does not provide “mass” removal of soil vapor and continuous operation is likely necessary, it is not considered to be a long-term/permanent effective measure for protection of human health and the environment.

4.2.2.7 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative does not target high “mass” removal, treatment of contaminated soil vapor (other than indoor air), or the remediation of groundwater. Therefore, the toxicity, mobility, and volume of contamination is not expected to significantly decrease.

4.2.2.8 Implementability

Implementation of this alternative could begin immediately following technical design of the SSDS and establishing proper administrative controls/permits and related operational requirements. Materials included in the design of the SSDS are readily available and of minimal cost. SSDS’s are not structurally complex and therefore exhibit inexpensive design costs. Structural sealants are readily available and involve mostly labor to identify and seal existing preferential pathways. The structure is currently used as a Payless Shoe store. Operation of the store will be affected over the period of installation due nature of the construction method. Monitoring well installation involves minimal design and could be implemented immediately upon regulatory approval of locations and completion of a utility mark-out.

4.2.2.9 Cost

The 2014 cost to design, implement, operate and maintain this alternative based on a 30-year period is $1,032,300. Quantities, assumptions and unit price information are provided in a cost estimate spreadsheet as **Table 5**. Unit price information was provided by contractor quotes and best engineering judgment.

4.2.3 Alternative Number 3: Soil Vapor Extraction System Upgrade with Air Sparge Wells, Shallow Soil Excavation and Long Term Air/Groundwater Monitoring

4.2.3.1 Description

The remedial action associated with this alternative involves an upgrade of the existing on Site SVE system to an AS/SVE system. The upgrade will include the installation of ASWs to treat shallow groundwater at known impacted areas. The AS/SVE system will include the installation of up to six ASWs at depths ranging up to 100 feet below ground surface. The wells will be installed at or near existing or newly proposed VEWs. A blower/compressor system will be installed in the AS/SVE system to provide a contaminant-free air supply into the subsurface saturated zone. Additional pipe/fittings, valves gauges and appurtenances will be installed with the blower/compressor system as needed to adequately and safely deliver the designed air flow to each installed ASW.

In addition to the ASW installation, up to five VES wells will be installed and tied into the AS/SVE system. VES wells will be placed and screened at locations of known elevated impacts. Pre-design investigation data may be necessary to adequately determine the depth of the VEW screened interval(s). The wells will be constructed of PVC riser pipe and PVC slotted screened pipe. Valves, gauges, sampling ports and appurtenances will be installed to allow for system adjustments, monitoring and maintenance.

Additionally, the existing SVE system components will be upgraded as needed and may include but will not be limited to a demister (knock out) tank, purge water pump, blower unit with filter, lead and lag carbon vessels and full process control system with high level alarms and temperature shut off sensors. Electricity used to run the SVE system will be provided by an electrical “drop” from a utility pole located immediately adjacent to the existing SVE system. The system has been priced to run for five years with bi-weekly operation and maintenance costs. Influent, effluent and equipment blank tedlar bag air samples are proposed for collection to monitor the effectiveness of the system. Following year five of system operation, an evaluation will determine whether or not the system has adequately achieved the RAOs for the Site. If RAOs have been achieved then the system will be decommissioned.

Air samples will be collected annually to determine if the system has adequately remediated the Site. Air monitoring includes indoor air (2 samples), outdoor ambient (2 samples), sub-slab (2 samples) and soil vapor sampling (2 samples) annually for the first five (5) years. From years 6 – 30 the same samples will be collected at a frequency of one (1) sampling event every five (5) years.

Shallow soil excavation will be completed along the northwest corner of the building to address impacted soils (delineated during historical RIs) at depths up to ten feet below ground surface. The anticipated area of concern is approximately 1,500 square feet and the estimated removal volume is approximately 250 cubic yards. Pre-design shallow soil sampling is recommended to confirm the presence of impacted soils exceeding NYSDEC unrestricted RSCOs at this location. Shoring and bracing will be required along the building perimeter to protect the foundation.

This alternative also proposes the implementation of a long-term groundwater monitoring program and installation of up to four (4) groundwater monitoring wells to more adequately identify and delineate the extent of groundwater contamination. Long-term monitoring and sampling of existing and new monitoring wells will be conducted to evaluate cVOC contaminant migration both on and offsite at 50 - 55 locations at an initial frequency of four (4) times per year (quarterly) for the first five (5) years. From years 6 – 30 the sampling frequency would be reduced to one (1) sampling event every five (5) years as described in alternative 2. This alternative is illustrated on **Figure 4.**

4.2.3.2 Detailed Evaluation of Criteria

4.2.3.3 Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment for the remediation of soil, soil vapor and shallow groundwater. It is anticipated that the upgraded AS/SVE system will remove the majority of existing soil vapor contamination (typical AS/SVE system is capable of up to 90% mass reduction) and actively treat the groundwater at ASW locations. As discussed in alternative 1, natural biodegradation processes in groundwater are occurring at a slow rate and post remedial action monitoring well sample data will confirm if cVOC contamination remains in the groundwater. Aerobic remedial activities may promote biodegradation to proceed at a faster rate. This alternative does not address deep groundwater (180 -200ft bgs) impacts. Risk associated with deep groundwater impacts is uncertain given that the closest pumping well (Seaman Road Well N-05261) is greater than 1,200 feet away. Data indicating direction of deep water flow direction is limited. This alternative will provide protection to human health and the environment during AS/SVE system operation. Shallow soil excavation, removal and disposal will address shallow soil impacts at the northwest corner of the building. The risk to ecological receptors was not evaluated because the Site is located in a commercial zoned area and the closest water body is greater than 0.3 miles away.

4.2.3.4 Compliance with Statutory Requirements

Upgrading the existing SVE system with ASWs and additional VEWs will significantly reduce soil and soil vapor contaminant concentrations and potentially meet the guidance provided in the *NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006). Chemical specific SCGs (as discussed in Section 2) for shallow groundwater on this Site will be difficult to achieve as greater than 99.99% mass contaminant reduction of the highest detected concentration (30,000 ppb as indicated in the 2013 RI) will be necessary. Shallow soil impacts will be removed and bottom and sidewall sampling will be conducted to confirm that the excavation meets applicable NYSDEC RSCOs/RAOs, specifically to prevent ingestion/direct contact with contaminated soils and inhalation or exposure from contaminants volatilizing from soil.

4.2.3.5 Short-Term Impacts and Effectiveness

Short-term impacts anticipated during the implementation of this alternative include a potential dust and noise concern to the workers, employees at the building and residents along the adjacent properties during the installation of the ASWs, VEWs and soil excavation. Additional impacts include the short-term impact to traffic on the Site with equipment occupying parking lot space, inhalation of soil dust and soil vapor by workers during the installation process and proper collection of drilling and well development fluids to ensure protection to human health and the environment. Post installation and startup of the AS/SVE system, cVOC soil/soil vapor and groundwater concentrations are expected to decrease immediately (within the first few months of operation). The expectation of the AS/SVE system is to decrease contaminant concentrations to below the NYSDOH recommended guidance criteria and attempt to meet NYSDEC groundwater standards. Shallow soil excavation effectiveness is anticipated to meet NYSDEC RSCOs. This alternative did not evaluate environmental receptors as the nearest surface water body is greater than 0.3 mile from the Site.

4.2.3.6 Long-Term Effectiveness and Permanence

Alternative 3 can be considered to be an effective long-term remedy for the treatment of soil/soil vapor below the footprint of the existing structure as well as for treatment of shallow groundwater. The installation and operation of the AS/SVE system will significantly reduce soil/soil vapor and shallow groundwater concentrations and mitigate soil vapor intrusion into the structure. Shallow groundwater samples collected on site during Shaw's 2013 RI indicate the presence of PCE concentrations ranging from 3.9 ppb to 30,000 ppb. Installation and operation of the AS/SVE system for the highest concentrations will require greater than 99.99% mass reduction to meet NYSDEC groundwater standards and will therefore be difficult to achieve. When the AS/SVE system reaches asymptotic levels of cVOC recovery and system operation loses its cost-effectiveness, a transition to other remedies (such as monitored natural attenuation) should be considered.

Historic soil sample analytical results indicate cVOC concentrations exceeding NYSDEC RSCOs along the northwest corner of the structure. Shallow soil excavation at this location will provide an effective and permanent treatment to meet the applicable RSCO.

Based on the Shaw 2013 RI, there is no evidence of deep groundwater impacts on the Site; deep groundwater impacts have been identified southwest of the Site and are not addressed in this alternative. Therefore, this remedial alternative is not an effective of permanent measure for addressing impacted deep groundwater.

4.2.3.7 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative involves the mass removal or treatment of contaminated soil, soil vapor and groundwater, therefore, the toxicity, mobility, and volume of contamination for these matrices will be significantly reduced.

4.2.3.8 Implementability

Implementation of this alternative could begin immediately following technical design of the AS/SVE system upgrade and establishing proper administrative controls/permits etc. Slotted pipe materials included in the design of the ASWs and VEWs are readily available to meet the requirements of the design. Structurally, the additional pipe network added to the existing SVE system is not complex and the majority of design costs would be incurred during installation of the wells. Achieving the required installation depth(s) of the ASWs will require specific drilling equipment (mud rotary or sonic drilling technologies). Monitoring well installation involves minimal design and could be implemented immediately upon regulatory approval of locations and completion of a utility mark-out.

4.2.3.9 Cost

The 2014 cost to design, implement, operate and maintain this alternative based on a 30-year period is $1,282,000. Quantities, assumptions and unit price information are provided on **Table 6**. Unit price information was provided by contractor quotes and best engineering judgment.

4.2.4 Alternative Number 4: Soil Vapor Extraction System Upgrade with Shallow Soil Excavation and Shallow Groundwater Treatment Using In-Situ Chemical Reduction (ISCR).

4.2.4.1 Description

The remedial action associated with this alternative involves an upgrade of the existing on Site SVE system. The upgrade will include the installation and connection of up to five VEWs into the existing SVE system. VEWs will be placed and screened at locations of known elevated cVOC impacts. Pre-design investigation data may be necessary to adequately determine the horizontal and vertical locations of the VEW screened interval(s). The wells will be constructed of PVC riser pipe and PVC slotted screened pipe. Valves, gauges, sampling ports and appurtenances will be installed to allow for system adjustments, monitoring and maintenance.

Additionally, SVE system component upgrades may include but will not be limited to a demister (knock out) tank, purge water pump, blower unit with filter, lead and lag carbon vessels and full process control system with high level alarms and temperature shut off sensors. Electricity used to run the SVE system will be provided by the electrical "drop" from a utility pole located immediately adjacent to the existing SVE system. The system has been priced to run for five years with bi-weekly operation and maintenance costs. Influent, effluent and equipment blank tedlar bag air samples are proposed for collection to monitor the effectiveness of the system. Following year five of system operation will include an evaluation to determine whether or not the system has adequately achieved the RAOs for the Site. If RAOs have been achieved then the system will be decommissioned.

Additionally, this alternative proposes treating contaminated groundwater using In-situ Chemical Reduction (ISCR) technology. The treatment will involve using a pattern of injection wells to inject EHC-L, a groundwater treatment amendment, that consists of a combination of controlled-release carbon and zero valent iron (ZVI) particles used for stimulating ISCR or otherwise persistent organic compounds in groundwater. The ISCR technology is primarily used for the complete destruction of groundwater contaminants such as PCE/TCE and associated daughter products of reductive dehalogenation. Under typical anaerobic conditions sequential reductive dehalogenation of PCE occurs in a series of "steps" degrading from:

PCE → TCE → cis-1,2-DCE/trans-1,2-DCE/1,1-DCE → VC →Ethene

Under conditions produced by ISCR (typical ORP < - 550 mV), the sequential reductive pathway under typical anaerobic conditions (shown above) can be avoided by a using B-Elimination and Hydrogenolysis Pathways which provides complete destruction of cVOC contaminants. A more in depth description of these processes have been described by *e.g., Dr. John Wilson, US EPA as reported in the AFCEE Technology Transfer Seminar, 2003; Dr. Mark Ferry, MPCAA; J, Szecsody and J. Fruchter et al., Battelle Pacific Northwest National Laboratory*.

Lack of electron donor in groundwater is the primary limiting factor for the complete biological degradation of chlorinated solvents at various sites. Consequently, a combination of an organic carbon-based electron donor and ZVI could successfully stimulate complete degradation of PCE and other cVOCs in groundwater. In addition, ZVI contained in EHC-L has been widely shown to aid both in establishing reducing conditions and in the direct/indirect abiotic dechlorination of cVOCs. Creating reducing conditions of less than -300 mV with only organic carbon electron donors (EOS, HRC, molasses, lactic acid etc.) require a larger amount of amendment compared to when ZVI is present. Oil based electron donors require injection of significant amount of chase water, increasing the ratio of total fluids injection to available pore volume. Once again, this is a disadvantage in silty clayey formations. Longevity of organic carbon electron donors is limited to less than 2 years while EHC-L can provide between three to five years of longevity due to the presence of ZVI.

This alternative will initially involve a pilot test to treat groundwater cVOC contamination at the location surrounding MW-3 because samples collected at this well exhibited the highest PCE concentrations during the Shaw 2013 RI. The pilot test will include the installation of four permanent injection points over an approximate are of 50 ft by 50 ft with an estimated 3,360 lbs of EHC-L mixed and injected per point. The treatment depth interval for each location will extend 20 feet below the groundwater table/soil interface. The depth to water is approximately 80 feet below ground surface therefore the injection points will be installed to a depth of 100 feet below ground surface or as determined by pre-design data. The estimated radius of influence of injection point is 25 feet. The area will be monitored and evaluated for a period of six (6) to nine (9) months prior to mobilization for full scale remedial approach. Additionally, an organic pH buffer ($KHCO_3$) will be injected concurrently with the EHC-L to maintain a neutral pH (approximately 7). A titration test will be conducted on groundwater samples representative of the treatment interval to adequately determine the pH buffer quantity necessary for injection. Based on existing Site information the estimated quantity to be injected per point is approximately 200 lbs. Immediately following the complete injection of EHC-L and pH buffer, a dehalococcoides (DHC) inoculum will be injected at all four points to assist in the biodegradation processes occurring at each location and subsequently down gradient. The estimate injection quantity of DHC inoculum is 15 liters (L) per point.

A full scale remedy will be implemented after an evaluation of the results of the pilot test. The remedy includes the installation of 13 additional injection wells at areas shown on **Figure 5**. The injection wells will be installed as previously described in this section. The injection layout was based on monitoring well sample analytical results included in the Shaw 2013 RI and surficial area feasible for installation of an injection well. All injection wells are located either on the Site or along the road right of way. No injection wells are proposed within buildings or within any main or side street road ways. The EHC-L full-scale injection is estimated to cover a 160 ft by 240 ft area with an estimated 43,680 lbs of EHC-L mixed and injected over a vertical treatment interval of 20 feet (80 – 100 ft bgs). Additionally, an organic pH buffer ($KHCO_3$) and DHC inoculum will be injected at each point as previously described in this section at estimated total quantities of 2,600 lbs and 195 L, respectively. Monitoring analytical results will be used to determine if a second injection is necessary. The pilot test and full scale remedy is illustrated on **Figure 5.**

Shallow soil excavation will be completed along the northwest corner of the building to address impacted shallow soils as previously discussed in alternative 3.

Air samples will be collected annually as described in alternative 2 to determine if the system is adequately remediating and preventing soil vapor intrusion into the structure (See **Section 4.2.2.1**).

Additionally, this alternative proposes long-term groundwater monitoring and the installation of up to four groundwater monitoring/observations wells to more adequately identify and evaluate the effectiveness of the of ISCR groundwater treatment. Long-term monitoring and sampling of existing and new monitoring wells will be conducted as described in alternative 2, **Section 4.2.2.1**.

4.2.4.2 Detailed Evaluation of Criteria

4.2.4.3 Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment for the remediation of soil, soil vapor and groundwater. The upgraded SVE system will more efficiently remove remaining soil vapor contamination. Excavation of shallow soils is anticipated to completely remediate residual impacted areas along the northwest corner of the building as indicated in historic RI. ISCR groundwater treatment will significantly reduce the dissolved cVOC contaminant mass by chemically enhancing dehalogenation processes while also increasing the effect of natural anaerobic biodegradation processes. Addition of DHC inoculum will assist in complete biodegradation of cVOC impacts. This alternative does not propose the treatment of off-site deep groundwater impacts and therefore provides no protection to human health and the environment at these locations. However, risks associated with deep groundwater impacts is uncertain given that the closest pumping well (Seaman Road Well N-05261) is greater than 1,200 feet away. Data indicating direction of deep water flow direction is limited. The risk to ecological receptors was not evaluated because the Site is located in a commercial zoned area and the closest water body is greater than 0.3 miles away.

4.2.4.4 Compliance with Statutory Requirements

Applying this alternative as the remedial action for the Site includes treatment for soil, soil vapor and shallow groundwater. Sampling of shallow soils will be conducted to confirm RSCOs for PCE are achieved post excavation. Installation of SVE system upgrade(s) will significantly reduce soil vapor contaminant concentrations and potentially meet the guidance suggested in Matrix 2 of the *NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006). Using ISCR technology combined with a pH buffer and DHC inoculum is anticipated to provide a sustained shallow groundwater treatment over the injection area and area(s) down gradient. It is anticipated that this technology can meet chemical specific SCGs for PCE and associated daughter products within the shallow groundwater matrix. No deep groundwater treatment is proposed in this alternative and would therefore rely upon monitored natural attenuation to meet chemical specific SCGs. There is no significant indication in historical deep groundwater analytical data of daughter breakdown products associated with PCE; therefore meeting statutory requirements in this matrix is unlikely.

4.2.4.5 Short-Term Impacts and Effectiveness

Short-term impacts anticipated during the implementation of this alternative include a potential dust and noise concern to the workers, employees at the building and residents along the adjacent properties during the installation of the excavation of shallow soils, installation of VEWs and injection/observation wells. Additional impacts include the, short-term impact to traffic with equipment occupying parking lot space, inhalation of soil dust and soil vapor by workers during the construction process and proper collection of drilling and well development fluids to ensure protection to human health and the environment. CVOC concentrations in the soil vapor are expected to decrease within the first few months of operation following installation and startup of the SVE system,. The expectation is that the SVE system will decrease soil vapor contaminant concentrations in the vadose zone below the NYSDOH recommended guidance criteria. Following the application of the in-situ amendment, cVOC concentrations in shallow groundwater are expected to steadily decrease within the first few years. Treatment of deep groundwater is not included in this alternative therefore there is no short-term impact or effectiveness for the matrix. This alternative did not evaluate environmental receptors as the nearest surface water body is greater than 0.3 mile from the Site.

4.2.4.6 Long-Term Effectiveness and Permanence

Alternative 4 is considered to be an effective remedy for the remediation of soil impacts along the northwest corner of the structure, treatment of soil vapor below and around the footprint of the existing structure as well as for the treatment of impacted shallow groundwater. The installation and operation of the SVE system upgrade(s) will significantly reduce soil vapor concentrations and mitigate soil vapor intrusion into the structure providing a long-term permanent effect. Using the EHC-L amendment with additives previously described, treatment of shallow groundwater is expected to significantly enhance contaminant dehalogenation processes while naturally enhancing anaerobic biodegradation processes. This combination will ultimately destroy the bulk of the contaminant mass and yield a sustaining long-term effect. Therefore, this alternative is anticipated to be effective in the long-term. This alternative does not address deep groundwater impacts and does not provide a long term effect or permanent remedy for this matrix.

4.2.4.7 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative involves the mass removal and/or treatment of contaminated soil, soil vapor and shallow groundwater therefore, for these matrices, the toxicity, mobility, and volume of contamination will be significantly reduced. No significant change in toxicity, mobility and volume would be anticipated for impacted deep groundwater.

4.2.4.8 Implementability

Implementation of this alternative could begin immediately following technical design and review of the soil excavation approach, SVE system upgrade(s) and groundwater treatment system. Soil, soil vapor and groundwater treatment construction activities could begin simultaneously upon completion of a utility markout, establishing proper administrative controls/permits, related operational requirements and establishing means and methods for traffic controls. Additionally, Underground Injection Control (UIC) permits will likely be necessary before implementation of injection treatment. Soil excavation could begin immediately following an approved shoring design, coordination with a soil disposal facility and excavation layout. The SVE system upgrade(s) will require drilling and installation of VEWs as well as the standard valves, gauges, pipe & fittings associated with new well installation. Additional SVE components such as an upgrade to blower, knock out tank, carbon vessels, process controls etc are anticipated to be "typical" system components and readily available. Structurally, the pipe network of the SVE system is not complex and therefore design costs would largely be incurred by the VEW drilling, sizing the powered and treatment components of the system. Shallow groundwater treatment using permanent injection wells would largely depend upon obtaining approval for the proposed offsite injection well locations, drilling methodologies, lead times and shipping requirements to obtain the required quantity of EHC-L product. Monitoring well installation involves minimal design and could be implemented immediately upon regulatory approval of locations and completion of a utility mark-out.

4.2.4.9 Cost

The 2014 cost to design, implement, operate and maintain this alternative based on a 30-year period is $1,955,300. Quantities, assumptions and unit price information are provided on **Table 7**. Unit price information was provided by contractor quotes and best engineering judgment.

4.2.5 Alternative Number 5: Soil Vapor Extraction System Upgrade with Air Sparge Wells, Shallow Soil Excavation and Deep Groundwater Treatment Using In-Situ Chemical Reduction (ISCR)

4.2.5.1 Description

The remedial action associated with this alternative involves excavation of shallow soils at the northwest corner of the building as well as treating soil vapor and shallow groundwater impacts by upgrading the existing SVE system with ASWs and additional VEWs as described in alternative 3, **Section 4.2.3.1**.

Additionally, this alternative proposes treating impacted deep groundwater using ISCR. The methodology to implement the treatment is the same as described in alternative 4. This alternative will initially implement a pilot test to treat deep groundwater cVOC contamination at the location surrounding MW-6 or MW-24D. These locations exhibited elevated PCE concentrations in samples collected during the Shaw 2013 RI. The pilot test will include the installation of four permanent injection points over an approximate area of 50 ft by 50 ft with an estimated 3,360 lbs of EHC-L mixed and injected per point. The treatment depth interval for each location is estimated at 20 feet above the identified confining layer (approximately 180 –

200ft bgs). The injection points will be installed to a depth of approximately 200 feet below ground surface or as determined by pre-design data. The estimated radius of influence of injection point is 25 feet. The area will be monitored and evaluated for a period of six (6) to nine (9) months prior to mobilization for full scale remedial approach. Additionally, an organic pH buffer ($KHCO_3$) will be injected concurrently with the EHC-L to maintain a neutral pH (approximately 7). A titration test will be conducted on groundwater samples representative of the treatment interval to adequately determine the pH buffer quantity necessary for injection. Based on existing Site information the estimated quantity to be injected per point is approximately 200 lbs. Immediately following the complete injection of EHC-L and pH buffer, a DHC inoculum will be injected at all four points to assist in the biodegradation processes occurring at each location and subsequently down gradient. The estimate injection quantity of DHC inoculum is 15 liters (L) per point.

A full scale remedy will be implemented after an evaluation of the results of the pilot test. The remedy includes the installation of 21 additional injection wells at areas shown on **Figure 6**. The injection wells will be installed as previously described in this section. The radius of influence at each point is estimated at 25 ft. The injection layout was based on monitoring well sample analytical results included in the Shaw 2013 RI and surficial area feasible for installation of an injection point. All injection points are located off-Site or along the road right of way. No injection points are proposed within buildings or within any main or side street road ways. EHC-L was selected as preferred amendment for use in this application with an estimated injection area of 200 ft by 480 ft. The estimated EHC-L quantity is 70,560 lbs and is to be mixed and injected over a vertical treatment interval of 20 feet (180 – 200 ft bgs). Additionally, an organic pH buffer ($KHCO_3$) and DHC inoculum will be injected at each point as previously described in this section at estimated total quantities of 4,200 pounds and 315 liters, respectively. The pilot test and full scale remedy is illustrated on **Figure 6.**

Air sampling will continue on an annual basis as described in alternative 2 to determine if the system is adequately remediating and preventing soil vapor intrusion into the structure (See **Section 4.2.2.1**).

Additionally, this alternative proposes long-term groundwater monitoring and the installation of up to four (4) groundwater monitoring/observations wells to more adequately identify and evaluate the effectiveness of the of ISCR deep groundwater treatment. Long-term monitoring and sampling of existing and new monitoring wells will be conducted as described in alternative 2, **Section 4.2.2.1**.

4.2.5.2 Detailed Evaluation of Criteria

4.2.5.3 Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment for the remediation of soil, soil vapor and both shallow and deep groundwater. The upgraded AS/SVE system will more efficiently remove remaining soil vapor contamination as well as treat shallow groundwater impacts. Excavation of shallow soils is anticipated to remediate impacted areas along the northwest corner of the building as indicated in historic RIs. ISCR deep groundwater treatment will reduce dissolved cVOC contaminant mass by chemically enhancing dehalogenation processes while also increasing the effect of natural anaerobic biodegradation processes. Addition of pH buffer and DHC inoculum will assist in complete biodegradation of cVOC impacts. The risk to ecological receptors was not evaluated because the Site is located in a commercial zoned area and the closest water body is greater than 0.3 miles away.

4.2.5.4 Compliance with Statutory Requirements

Applying this alternative as the remedial action for the Site includes treatment for soil, soil vapor and shallow/deep groundwater. Post excavation sampling of shallow soils will be conducted to confirm RSCOs for PCE and applicable cVOCs are achieved. Installation of AS/SVE system upgrade(s) with VEWs will significantly reduce soil vapor contaminant concentrations and potentially meet the guidance suggested in Matrix 2 of the *NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006). Additionally, installation of ASWs to treat shallow groundwater impacts is anticipated to significantly reduce cVOC concentrations on Site. Meeting chemical specific SCGs (as discussed in Section 2) for shallow groundwater on this Site will be difficult to achieve as greater than 99.99% mass contaminant reduction of the highest detected concentration (30,000 ppb as indicated in the Shaw 2013 RI) will be necessary. Implementing ISCR technology combined with a pH buffer and DHC inoculum is anticipated to provide sustained deep groundwater treatment over the injection area and area(s) down gradient. It is anticipated that this technology can meet chemical specific SCGs for PCE and associated daughter products.

4.2.5.5 Short-Term Impacts and Effectiveness

Short-term impacts anticipated during the implementation of this alternative potentially include dust and noise concerns to the workers, employees at the building and residents along the adjacent properties during the excavation of shallow soils, installation of ASW/VEW and injection/observation wells. Additional impacts include the short-term impact to traffic with equipment occupying parking lot space, inhalation of soil dust and soil vapor by workers during the construction process and proper collection of drilling and well development fluids to ensure protection to human health and the environment. CVOC concentrations in on Site soil vapor and shallow groundwater are expected to decrease rapidly (within the first few months of operation) following installation and startup of the AS/SVE system. The expectation of the AS/SVE system is to decrease contaminant concentrations to below the NYSDOH recommended guidance criteria and meet NYSDEC groundwater chemical specific SCGs. Following the implementation of the in-situ amendment, cVOC concentrations in deep groundwater are expected to steadily decrease within the first few years. Analytical results will be used to determine if a second injection is necessary. This alternative did not evaluate environmental receptors as the nearest surface water body is greater than 0.3 mile from the Site.

4.2.5.6 Long-Term Effectiveness and Permanence

Alternative 5 is an effective remedy for soil, soil vapor treatment and for the treatment of both on and off Site impacted shallow and deep groundwater. The installation and operation of the AS/SVE system upgrade(s) will significantly reduce soil vapor concentrations and prevent soil vapor intrusion into the structure as well as provide treatment for shallow groundwater yielding a long-term and permanent effect. Utilizing ISCR amendment with additives previously described, treatment of deep groundwater is expected to significantly enhance contaminant dehalogenation processes while naturally enhancing anaerobic biodegradation processes. This combination will ultimately destroy the bulk of the contaminant mass and produce a sustaining long-term effect. Therefore, this alternative is anticipated to be effective in the long-term.

4.2.5.7 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative involves the mass removal and/or treatment of contaminated soil, soil vapor and shallow/deep groundwater therefore, for these matrices, the toxicity, mobility, and volume of contamination will be significantly reduced.

4.2.5.8 Implementability

Implementation of this alternative could begin immediately following technical design of a soil excavation approach, AS/SVE system upgrade(s) and deep groundwater injection treatment system. Soil, soil vapor, shallow and deep groundwater treatment construction activities could begin simultaneously upon completion of a utility mark-out, establishing proper administrative controls/permits, related operational requirements and establishing means and methods for traffic controls. Additionally, Underground Injection Control (UIC) permits will likely be necessary before implementation of injection treatment. Soil excavation could begin immediately following an approved shoring design, soil disposal facility and excavation layout. The AS/SVE system upgrade(s) will require drilling and installation of AS/VEWs as well as the standard valves, gauges, pipe & fittings and appurtenances associated with new well installation. Additional SVE components upgrades such as a blower, knock out tank, carbon vessels, process controls etc. are typical system components and readily available. Structurally, the pipe network of the AS/SVE system is not complex and therefore design costs would largely be incurred by the ASW/VEW drilling, sizing the powered and treatment components of the system. Deep groundwater treatment using permanent injection wells would largely depend upon obtaining approval for proposed off Site injection well locations and lead times and shipping requirements to obtain the required quantity of EHC-L amendment. Drilling options will be limited by the required depths of injection/monitoring wells (200 feet bgs). Monitoring well installation involves minimal design and could be implemented immediately upon regulatory approval of locations and completion of a utility mark-out.

4.2.5.9 Cost

The 2014 cost to design, implement, operate and maintain this alternative based on a 30-year period is $2,447,500. Quantities, assumptions and unit price information are provided on **Table 9**. Unit price information was provided by contractor quotes and best engineering judgment.

4.2.6 Alternative Number 6: Soil Vapor Extraction System Upgrade, Shallow Soil Excavation and Shallow / Deep Groundwater Treatment Using In-Situ Chemical Reduction (ISCR)

4.2.6.1 Description

The remedial action associated with this alternative involves excavation of shallow soils at the northwest corner of the building as described in alternative 3, treatment of soil vapor and shallow groundwater as described in alternative 4 and treatment of deep groundwater as described in alternative 5.

Air sampling will continue on an annual basis as described in alternative 2 to determine if the system is adequately remediating and preventing soil vapor intrusion into the structure (See **Section 4.2.2.1**).

Additionally, this alternative proposes long-term groundwater monitoring and the installation of up to four (4) groundwater monitoring/observations wells to more adequately identify and evaluate the effectiveness of the of ISCR shallow/deep groundwater treatment. Long-term monitoring and sampling of existing and new monitoring wells will be conducted as described in alternative 2, **Section 4.2.2.1**.

4.2.6.2 Detailed Evaluation of Criteria

4.2.6.3 Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment for the remediation of soil, soil vapor and both shallow and deep groundwater. The upgraded SVE system will more efficiently remove remaining soil vapor impacts. Excavation of shallow soils is anticipated to remediate impacted areas along the northwest corner of the building as indicated in historic RIs. ISCR of shallow and deep groundwater treatment will reduce dissolved cVOC contaminant mass by chemically enhancing dehalogenation processes while also increasing the effect of natural anaerobic biodegradation processes. Addition of a pH buffer and DHC inoculum will assist in biodegradation of cVOC impacts. The risk to ecological receptors was not evaluated because the Site is located in a commercial zoned area and the closest water body is greater than 0.3 miles away.

4.2.6.4 Compliance with Statutory Requirements

Applying this alternative as the remedial action for the Site includes treatment for soil, soil vapor and shallow/deep groundwater. Post excavation sampling of shallow soils will be conducted to confirm RSCOs for PCE and applicable cVOCs are achieved. Installation of SVE system upgrade(s) with VEWs will significantly reduce soil vapor contaminant concentrations and potentially meet the guidance suggested in Matrix 2 of the *NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006). Using ISCR technology combined with a pH buffer and DHC inoculum is anticipated to provide a sustained shallow and deep groundwater treatment over the injection area and area(s) down gradient. It is anticipated that this technology can meet chemical specific SCGs for PCE and associated daughter products within the shallow and deep groundwater matrix.

4.2.6.5 Short-Term Impacts and Effectiveness

Short-term impacts anticipated during the implementation of this alternative potentially include dust and noise concerns to the workers, employees at the building and residents along the adjacent properties during the excavation of shallow soils, installation of VEWs and injection/observation wells. Additional impacts include the short-term impact to traffic with equipment occupying parking lot space, inhalation of soil dust and soil vapor by workers during the construction process and proper collection of drilling and well development fluids to ensure protection to human health and the environment. Post installation and startup of the SVE system, cVOC concentrations in on Site soil vapor and shallow groundwater are expected to decrease immediately (within the first few months of operation). The expectation of the SVE system is to decrease contaminant concentrations to below the NYSDOH recommended guidance criteria. Following the implementation of the in-situ amendment, cVOC concentrations in shallow and deep groundwater are expected to steadily decrease within the first few years. Monitoring analytical results will be used to determine if a second injection is necessary. This alternative did not evaluate environmental receptors as the nearest surface water body is greater than 0.3 mile from the Site.

4.2.6.6 Long-Term Effectiveness and Permanence

Alternative 6 can be considered long-term effective remedy for soil, soil vapor treatment and for the treatment of both on and off Site impacted shallow and deep groundwater. The installation and operation of the SVE system upgrade(s) will significantly reduce soil vapor concentrations and prevent soil vapor intrusion into the structure. Utilizing ISCR amendment with additives previously described to treat shallow and deep groundwater is expected to significantly enhance contaminant dehalogenation processes while naturally enhancing anaerobic biodegradation processes. This combination will ultimately destroy the bulk of the contaminant mass and produce a sustaining long-term effect.

4.2.6.7 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative involves the mass removal and/or treatment of contaminated soil, soil vapor and shallow/deep groundwater therefore, for these matrices, the toxicity, mobility, and volume of contamination will be significantly reduced.

4.2.6.8 Implementability

Implementation of this alternative could begin immediately following technical design of a soil excavation approach, SVE system upgrade(s) and shallow/deep groundwater injection treatment system. Soil, soil vapor, shallow and deep groundwater treatment construction activities could begin simultaneously upon completion of a utility mark-out, establishing proper administrative controls/permits, related operational requirements and establishing means and methods for traffic controls. Additionally, Underground Injection Control (UIC) permits will likely be necessary before implementation of injection treatment. Soil excavation could begin immediately following an approved shoring design, soil disposal facility and excavation layout. The SVE system upgrade(s) will require drilling and installation of VEWs as well as the standard valves, gauges, pipe & fittings and appurtenances associated with new well installation. Additional SVE component upgrades such as a blower, knock out tank, carbon vessels, process controls etc. are typical system components and readily available. Structurally, the pipe network of the SVE system is not complex and therefore design costs would largely be incurred by the VEW drilling, sizing the powered and treatment components of the system. Shallow and deep groundwater treatment using permanent injection wells would largely depend on obtaining approval for proposed off site injection well locations and lead times and shipping requirements to obtain the required quantity of EHC-L amendment. Deep injection well drilling options will be limited by the required depths (200 feet bgs). Monitoring well installation involves minimal design and could be implemented immediately upon regulatory approval of locations and completion of a utility mark-out.

4.2.6.9 Cost

The 2014 cost to design, implement, operate and maintain this alternative based on a 30-year period is $3,204,400. Quantities, assumptions and unit price information are provided on **Table 9**. Unit price information was provided by contractor quotes and best engineering judgment.

4.3 Comparative Evaluation of Alternatives

4.3.1 Overall Protection of Human Health and the Environment

Alternative 1 describes no action which means the risk for soil exposure, soil vapor intrusion into the former Ronhill Clearners building and shallow/deep groundwater impacts will remain at the Site and will provide no additional protection of human health and the environment. Alternative 2 provides protection of human health using SSDSs by means of keeping contaminated soil vapor away from building occupants. Proper maintenance is necessary to ensure the SSDSs are properly and continuously functioning to avoid the potential for health risks. Alternative 3 provides an enhanced level of protection of human health over alternative 2 through the upgrade of the existing SVE system with ASWs, additional VEWs and system components. The system will mitigate soil vapor as well as remediate both soil vapor and shallow groundwater on and down gradient of the Site which provides protection to the environment. Alternative 4 is anticipated to provide an enhanced level of protection of human health and the environment over alternative 3 through injection of an in-situ amendment for shallow groundwater treatment versus air sparging. The proposed injection area will most likely treat a larger contaminant mass and have a higher probability of meeting chemical specific SCGs. Alternative 5 provides the same level of protection of human health and the environment for soil, soil vapor and shallow groundwater as alternative 3. Additionally, alternative 5 proposes ISCR treatment of deep groundwater to address off Site impacts. Alternative 6 provides the same level of protection to human health and the environment as alternative 4 and additionally treats deep groundwater with ISCR as described in alternative 5. Risk to human health and the environment for the deep groundwater matrix is uncertain given that the nearest pumping well (N-05261) is greater than 1,500 feet north of the Site. Additional hydrogeologic data may be necessary to confirm the direction of deep groundwater flow. Therefore, based on existing information, alternatives 4 and 5 and 6 are anticipated to provide the highest level of protection of human health and the environment.

4.3.2 Compliance with SCGs

Alternatives 1 and 2 do not comply with chemical specific SCGs because contaminated shallow and deep groundwater would remain at levels above NYSDEC guidance criteria. Alternative 3 provides treatment for shallow groundwater through the installation and operation of ASWs. However, due to the extent of elevated shallow groundwater impacts, meeting chemical specific SCGs will most likely be difficult to achieve. Alternative 4 is anticipated to provide an enhanced level of shallow groundwater treatment over alternative 3 through the use of ISCR technology. Application of this amendment combined with additives previously discussed will provide a sustained treatment over the injected area(s) and down gradient. Through implementation of a pilot test and additional pre-design investigation data, alternative 4 is anticipated to provide the highest probability of meeting chemical specific SCGs for shallow groundwater. Alternative 5 provides the same level of shallow groundwater treatment as described in alternative 3 and additionally provides treatment of deep groundwater using ISCR technology. Alternative 6 provides the greatest possibility of meeting chemical specific SCGs for all matrices as it treats both shallow and deep groundwater with ISCR.

4.3.3 Short Term Impacts and Effectiveness

There are no short-term impacts associated with Alternative 1. Alternatives 2 would incur several short-term impacts that may affect employees and customers residing within the building such as dust and noise during the installation of the SSDS. Alternatives 3 and 4 would incur dust, noise and traffic impacts on the Site during soil excavation, drilling and installation of wells and AS/SVE system upgrades. Additionally, alternatives 3 and 4 may have the potential to cause minimal community disturbance with mobilization and operation of equipment during the installation of off site monitoring/observation wells. Alternative 5 and 6 would incur the greatest short-term impact(s) as it involves construction work using hydraulic equipment for the longest period of time and disturbs the most area both on and off the Site. In terms of short-term effectiveness, Alternative 1 describes no action and therefore provides no additional effective treatment mechanism other than what is naturally biodegrading on the Site. Upon installation and start-up, alternative 2 provides short-term effectiveness for mitigating soil vapor exposure for employees and customers in the building; however since this alternative does not include contaminant “mass” removal, it cannot be considered an effective measure for remediating the Site. Alternatives 3 and 4 provide short-term effectiveness as described in alternative 2 and are effective in the short-term for remediating contaminated soil vapor and shallow groundwater on Site. Alternative 5 and 6 provide the highest means of short-term effectiveness for all matrices as these alternatives additionally include treatment of deep groundwater impacts.

4.3.4 Long-Term Effectiveness and Permanence

Alternative 1 employs no action; therefore soil, soil vapor and shallow/deep groundwater impacts would remain on/off site, providing no long-term effectiveness or permanence. Alternative 2 will not be effective long-term because there are no provisions included for contaminated soil vapor “mass” removal or groundwater treatment. Alternatives 3 and 4 will provide long term effectiveness for soil remediation, soil vapor “mass” removal and shallow groundwater treatment. As previously mentioned, the risk of deep groundwater impacts is unclear. Therefore, based on existing information, alternatives 3 and 4 can be considered long-term effective and permanent remedial alternatives. In addition to providing treatment for the matrices described in alternatives 3 and 4, alternatives 5 and 6 propose deep groundwater treatment. Alternative 6 proposes ISCR treatment for both shallow and deep groundwater and is anticipated to provide the greatest long term effectiveness for both on and off site impacts.

4.3.5 Reduction in Toxicity, Mobility or Volume through Treatment

Alternatives 1 and 2 would not significantly treat contaminated soil vapor or groundwater therefore; toxicity, mobility, and volume would not be reduced. Alternatives 3 and 4 would significantly reduce the toxicity, mobility, and volume of contaminated soil, soil vapor and shallow groundwater at the Site. However, these alternatives do not propose the treatment of deep groundwater and therefore provide no ability to reduce toxicity, mobility and volume of contamination within this matrix. Alternative 5 and 6 provide the highest level of reduction in toxicity, mobility and volume through the additional treatment of deep groundwater impacts.

4.3.6 Implementability

There are no actions to implement for Alternative 1. Alternatives 2 through 6 can be readily implemented using standard construction means and methods. Implementation of alternatives 5 and 6 will be the most difficult implement as this remedy disturbs the greatest area over the longest period of time.

4.3.7 Cost

The cost breakdown for all alternatives is provided in **Table 10**.

4.4 Recommendation

Based on a site wide evaluation of soil, soil vapor and groundwater contamination during the remedial investigation, a remedial action has been determined to be necessary to address chemical specific SCGs for the protection of human health and the environment. Alternatives 3 through 5 provide a remedy to address the majority of on Site impacts. In-situ groundwater remedial technologies described in alternative 3 (Air Sparge), alternative 4 (ISCR) and 5 and 6 (Air Sparge and ISCR) are anticipated to provide effective means for remediation of cVOC contaminants. Application of ISCR amendment using zero valent iron under with combined additives under anaerobic conditions provides an increased treatment sustainability over using the use of air sparge technology. Additionally, this treatment does not involve continuous operation and maintenance of a mechanical system and will only require monitoring and if necessary a second injection treatment. Based on existing information, the level of risk associated with impacted deep groundwater is uncertain and the difficulty of implementing of alternatives 5 and 6 are significantly higher than alternatives 3 and 4. Based on the preliminary cost estimates included in **Tables 5 – 9**, alternative 3 is approximately $673,300 less than alternative 4. However, the cost to implement alternative 4 includes upgrading the SVE system with additional VEWs and operation and maintenance for 5 years. This is highly conservative given that shallow groundwater treatment using ISCR does not rely upon vapor extraction as does air sparging and therefore the SVE system would be primarily used for soil vapor remediation. Additionally included in alternative 4 is a second injection treatment to remediate any additional elevated cVOC impacts that remain after an initial monitoring period. Therefore, the recommended alternative for the Former Ronhill Cleaners Site is alternative 4 assuming that deep groundwater is not of concern in this FS.

5.0 REFERENCES

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Tables

Table 1
Chemical Specific Standards, Criteria, and GuidelinesFormer Ronhill Cleaners
Former Ronhill Cleaners
Glen Cove, NY
Feasibility Study Report

Regulation	Reference	Potential Standard (S) or Guidance (G)	Requirement Summary	Applicability to the Former Ronhill Cleaners Site
Chemical-Specific SCGs				
Federal				
Clean Water Act (CWA) -Ambient Water Quality Criteria	40 CFR Part 131; EPA 440/5-86/001 “Quality Criteria for Water -1986”, superseded by EPA-822-R-02-047 “National Recommended Water Quality Criteria: 2002”	S	Criteria for protection of aquatic life and/or human health depending on designated water use	Not applicable. Previous site investigations support that site constituents are not adversely affecting surface waters or sediments.
CWA Section 136	40 CFR 136	G	Identifies guidelines for test procedures for the analysis of pollutants.	
CWA Section 404	33 USC 1344	S	Regulates discharges to surface water or ocean, indirect discharges to POTWs, and discharge of dredged or fill material into waters of the U.S. (including wetlands).	
RCRA-Regulated Levels for Toxic Characteristics Leaching Procedure (TCLP) Constituents	40 CFR Part 261	S	These regulations specify the TCLP constituent levels for identification of hazardous wastes that exhibit the characteristic of toxicity.	Applicable. Soils will be tested for TCLP and/or other disposal requirements.
Universal Treatment Standards/Land Disposal Restrictions (UTS/LDRs)	40 CFR Part 268	S	Identifies hazardous wastes for which land disposal is restricted and provides a set of numerical constituent concentration criteria at which hazardous waste is restricted from land disposal (without treatment).	Applicable if waste is determined to be hazardous and for remedial alternatives involving off-site land disposal.
New York State				
Environmental Remediation Programs	6 NYCRR Part 375	S	Provides an outline for the development and execution of the groundwater remedial programs. Includes cleanup objective tables.	Applicable for site remediation.
NYSDEC Ambient Water Quality Standards and Guidance Values	Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1 (6/98)	S	Provides ambient water quality standards and guidance values for toxic and non-conventional pollutants for use in the NYSDEC programs.	These standards and guidance values are to be considered in evaluating groundwater and surface water quality.

Table 1
Chemical Specific Standards, Criteria, and GuidelinesFormer Ronhill Cleaners
Former Ronhill Cleaners
Glen Cove, NY
Feasibility Study Report

Regulation	Reference	Potential Standard (S) or Guidance (G)	Requirement Summary	Applicability to the Former Ronhill Cleaners Site
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	S	Criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371-376.	Regulation applicable for determining if soil generated during implementation of remedial activities are hazardous wastes. These regulations do not set cleanup standards, but are considered when developing remedial alternatives.
New York State Surface Water and Groundwater Quality Standards	6 NYCRR Part 703	S	Provided standards for both surface water and groundwater.	Applicable for assessing groundwater quality at the site. The surface water quality standards are not applicable.

Table 2
Location-Specific Standards, Criteria, and Guidelines
Former Ronhill Cleaners
Glen Cove, NY
Feasibility Study Report

Regulation	Reference	Potential Standard (S) or Guidance (G)	Requirement Summary	Applicability to the Former Ronhill Cleaners Site
Location-Specific SCGs				
Local				
Local Building Permits	N/A	S	Local authorities may require a building permit for any permanent or semi-permanent structure, such as an on-site water treatment system building or a retaining wall.	Substantive provisions are potentially applicable to remedial activities that require construction of permanent or semi-permanent structures.
Local Right-of-Way Permits	N/A	S	Local authorities may require permits for remedial work on city owned property, such as sidewalks and roads.	Applicable to remedial work on or near city owned property.
Local Noise Ordinances	City of Albany, NY Code, Chapter 255, Article V.	S	Loud noises which distrub the public shall not occur bewteen 8pm and 6am, and shall be kept to a minimum between 6am and 8pm.	All unnessesary noises shall be kept to a minimum to ensure the welfare of the public is kept to a high standard.

Table 3
Action Specific Standards, Criteria, and Guidelines
Former Ronhill Cleaners
Glen Cove, NY
Feasibility Study Report

Regulation	Reference	Potential Standard (S) or Guidance (G)	Requirement Summary	Applicability to the Former Ronhill Cleaners Site
Action-Specific SCGs				
Federal				
Occupational Safety and Health Act (OSHA) - General Industry Standards	29 CFR Part 1910	S	Specifies the 8-hour time-weighted average concentration for worker exposure to various compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Appropriate training requirements will be met for remedial workers. Air monitoring will be required.
OSHA - Safety and Health Standards	29 CFR Part 1926	S	Specifies types of safety equipment and procedures to be followed during site remediation.	Appropriate safety equipment will be utilized on-site and appropriate procedures will be followed during remedial activities.
OSHA - Record-keeping, Reporting and Related Regulations	29 CFR Part 1904	S	Outlines record-keeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install, operate, and maintain remedial actions at hazardous waste sites.
RCRA - Preparedness and Prevention	40 CFR Part 264.30 - 264.31	S	Outlines requirements for safety equipment and spill control when treating, handling and/or storing hazardous wastes.	Safety and communication equipment will be utilized at the site as necessary. Local authorities will be familiarized with the site.
RCRA - Contingency Plan and Emergency Procedures	40 CFR Part 264.50 - 264.56	S	Provides requirements for outlining emergency procedures to be used following explosions, fires, etc. when storing hazardous wastes.	Emergency and contingency plans will be developed and implemented during remedial design. Copies of the plan will be kept onsite.
CWA - Discharge to Waters of the U.S., and Section 404	40 CFR Parts 403, and 230 Section 404 (b) (1); 33 USC 1344	S	Establishes site-specific pollutant limitations and performance standards which are designed to protect surface water quality. Types of discharges regulated under CWA include: Indirect discharge to a POTW, and discharge of dredged or fill material into U.S. waters.	No dewatering anticipated. Regulation would apply for potential discharge of water generated by excavation dewatering and treated in a temporary onsite water treatment system.
CWA Section 401	33 U.S.C. 1341	S	Requires that 401 Water Quality Certification permit be provided to federal permitting agency (USACE) for any activity including, but not limited to, the construction or operation of facilities which may result in any discharge into jurisdictional waters of the U.S. and/or state.	No excavation anticipated. Regulation would apply for potential discharge of water generated by excavation dewatering and treated in a temporary onsite water treatment system.
90 Day Accumulation Rule for Hazardous Waste	40 CFR Part 262.34	S	Allows generators of hazardous waste to store and treat hazardous waste at the generation site for up to 90 days in tanks, containers and containment buildings without having to obtain a RCRA hazardous waste permit.	Potentially applicable to remedial alternatives that involve the storing or treating of hazardous materials onsite.
RCRA - General Standards	40 CFR Part 264.111	S	General performance standards requiring minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products. Also requires decontamination or disposal of contaminated equipment, structures and soils.	Decontamination actions and facilities will be constructed for remedial activities and disassembled after completion.
Standards Applicable to Transporters of Applicable Hazardous Waste - RCRA Section 3003	40 CFR Parts 170-179, 262, and 263	S	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation and management of the waste. Requires manifesting, recordkeeping and immediate action in the event of a discharge.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
United States Department of Transportation (USDOT) Rules for Transportation of Hazardous Materials	49 CFR Parts 107 and 171.1 - 172.558	S	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous materials.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
Clean Air Act-National Ambient Air Quality Standards	40 CFR Part 50	S	Establishes ambient air quality standards for protection of public health.	Remedial operations will require the use of air monitoring equipment.
USEPA-Administered Permit Program: The Hazardous Waste Permit Program	RCRA Section 3005; 40 CFR Part 270.124	S	Covers the basic permitting, application, monitoring and reporting requirements for off-site hazardous waste management facilities.	Any offsite facility accepting hazardous waste from the site must be properly permitted. Implementation of the site remedy will include consideration of these requirements.

Table 3
Action Specific Standards, Criteria, and Guidelines
Former Ronhill Cleaners
Glen Cove, NY
Feasibility Study Report

Regulation	Reference	Potential Standard (S) or Guidance (G)	Requirement Summary	Applicability to the Former Ronhill Cleaners Site
RCRA Subtitle C	40 U.S.C. Section 6901 et seq.; 40 CFR Part 268	S	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes UTSs to which hazardous wastes must be treated prior to land disposal.	Potentially applicable to remedial activities that include disposal of generated waste material from the site.
New York State				
NYSDEC's Monitoring Well Decommissioning Guidelines	NPL Site Monitoring Well Decommissioning dated May 1995	G	This guidance presents procedure for abandonment of monitoring wells at remediation sites.	This guidance is applicable for soil or groundwater alternatives that require the decommissioning of monitoring wells onsite.
Guidelines for the Control of Toxic Ambient Air Contaminants	DAR-1 (Air Guide 1)	G	Provides guidance for the control of toxic ambient air contaminants in New York State and outlines the procedures for evaluating sources of air pollution .	This guidance may be applicable for soil or groundwater alternatives that result in certain air emissions.
New York Hazardous Waste Management System -General	6 NYCRR Part 370	S	Provides definitions of terms and general instructions for the Part 370 series of hazardous waste management.	Hazardous waste is to be managed according to this regulation.
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	S	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371-376.	Applicable for determining if solid waste generated during implementation of remedial activities are hazardous wastes. These regulations do not set cleanup standards, but are considered when developing remedial alternatives.
Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	6 NYCRR Part 372	S	Provides guidelines relating to the use of the manifest system and its recordkeeping requirements. It applies to generators, transporters and facilities in New York State.	This regulation will be applicable to any company(s) contracted to do treatment work at the site or to transport or manage hazardous material generated at the site.
New York Regulations for Transportation of Hazardous Waste	6 NYCRR Part 372.3 a-d	S	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous waste.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
Waste Transporter Permits	6 NYCRR Part 364	S	Governs the collection, transport and delivery of regulated waste within New York State.	Properly permitted haulers will be used if any waste materials are transported offsite.
NYSDEC Technical and Administrative Guidance Memorandums (TAGMs)	NYSDEC TAGMs	G	TAGMs are NYSDEC guidance that are to be considered during the remedial process.	Appropriate TAGMs will be considered during the remedial process.
New York Regulations for Hazardous Waste Management Facilities	6 NYCRR Part 373.1.1 - 373.1.8	S	Provides requirements and procedures for obtaining a permit to operate a hazardous waste treatment, storage and disposal facility. Also lists contents and conditions of permits.	Any off-site facility accepting waste from the site must be properly permitted.
Land Disposal of a Hazardous Waste	6 NYCRR Part 376	S	Restricts land disposal of hazardous wastes that exceed specific criteria.	New York defers to USEPA for UTS/LDR regulations.
National Pollutant Discharge Elimination System (NPDES) Program Requirements, Administered Under New York State Pollution Discharge Elimination System (SPDES)	40 CFR Parts 122 Subpart B, 125, 301, 303, and 307 (Administered under 6 NYCRR 750-758)	S	Establishes permitting requirements for point source discharges; regulates discharge of water into navigable waters including the quantity and quality of discharge.	Remedial activities may involve treatment/disposal of water. If so, water generated at the site will be managed in accordance with NYSDEC SPDES permit requirements.

Table 4
Summary of Remedial Technologies
Former Ronhill Cleaners
Glen Cove, NY

General Response Actions and Remedial Technology	Description	Preliminary Screening Evaluation	Feasible Technology
No Action			
	No further action to remedy soil conditions at the site.	Ineffective for the protection of human health and environment.	No
Monitored Natural Attenuation (MNA)			
	Ongoing physical, chemical, and/or natural biological processes to reduce the concentrations of contaminants at the site. Includes monitoring of existing groundwater wells to provide documentation that these processes are occurring.	MNA may be appropriate if ongoing physical, chemical, and/or natural processes would achieve the RAOs in a reasonable time frame compared to active remedial measures. However, geochemical and microbiological analyses of groundwater samples at this site indicate that the potential for anaerobic biodegradation is limited and likely not occurring at a significant rate.	No
Long Term Monitoring			
	Monitoring of existing groundwater wells to provide documentation that the remedial measure is reducing contamination at the site.	Provides evidence to verify if a remedial activity is working or not.	Yes
Institutional Controls			
	Includes public notification, deed restrictions, fencing and signs.	Does not reduce contamination concentrations buy can reduce potential exposure to the contamination media.	Yes
In-Situ Treatment			
Thermal			
Thermally Enhances Soil Vapor Extraction (SVE)	Uses electrical resistance/electromagnetic/ radio frequency heating, or hot-air steam injection to facilitate volatilization and extraction of the contaminant vapors.	Based on the current site conditions and limited area (approx. 300 sqft), this technology is likely cost prohibitive.	No
Thermal Desorption (thermal blankets and wells)	Thermal blankets and thermal wells are places on contaminated ground surface. A majority of contaminants vaporize by thermal conduction. Vapors are drawn out by a vacuum system, oxidized, cooled, and passed through activated-carbon beds.	This technique is not effective in the saturated zone, is typically very costly and not effective in or with deeper soil impacts.	No
Physical/Chemical			
Chemical Reduction	Involves the injection of an in-situ amendment (EHC-L) to "destroy" cVOCs. EHC-L is an amendment that consists of controlled release carbon and zero valent iron to stimulate ISCR or other wise persistent organic compounds.	Requires installation of injection and observation wells and associated well head controls. Several rounds of injection will likely be required. Likely effective at source mitigation, UIC permits may been needed.	Yes
SVE	A negative pressure gradient is created by the application of a vacuum to contaminated soils through extraction wells that strips volatile constituents from the soil in the vadose zone, causing movement of vapors toward the wells.	This technique is not effective in the saturated zone and will require O&M similar to existing system onsite. Existing system demonstrates that SVE has been historically effective	Yes
Chemical Oxidation	Commonly used oxidizing agents include ozone, hydrogen peroxide, permanganate, hypochlorite, chlorine, and chlorine dioxide.	Pilot tests will be needed to confirm that the soil is conducive for injection and able to distribute material; cursory review of existing boring logs indicate that it will likely work.	Yes
Pump-and-Treat System	Contaminated groundwater is pumped out of the ground and treated with methods such as granulated activated carbon, chemical reagents, or air stripping.	Requires installation of extraction wells, piping and aboveground equipment. Requires active O&M, relatively expensive for capital and O&M costs.	No
Solidification / Stabilization	Solidification/stabilization treatment systems, sometimes referred to as fixation systems, seek to trap or immobilize contaminants within their "host" medium using chemical reactions instead of removing them through chemical or physical treatment.	Stabilization technologies have not been successfully demonstrated on a full-scale basis for treating organics. Solidified material may hinder future site use. Treatability studies would be required prior to implementing this technology.	No
Biological			
Biological Treatment	Uses indigenous or selectively cultured microorganisms to reduce hazardous organic compounds into water, carbon dioxide, and chlorinated hydrogen chloride.	This technology involves a relatively longer remediation period compared to other treatment technologies, but can enhance natural attenuation. Site does not contain sufficient amount native bacteria. Addition of microorganisms and required electron donor material would be limited due to the low permeability of the site.	Yes - used in combination with chemical reduction

Table 4
Summary of Remedial Technologies
Former Ronhill Cleaners
Glen Cove, NY

General Response Actions and Remedial Technology	Description	Preliminary Screening Evaluation	Feasible Technology
Soil Excavation			
On-Site Disposal	Requires construction of a secure landfill that meets RCRA and state requirements	Containment of the waste material in an on-site landfill is not possible at the small commercial facility.	No
Off-Site Disposal	Involves the excavation and hauling of contaminated material to appropriate commercially licensed disposal facilities. The non-hazardous spoils would go to a non-hazardous/solid waste facility, while the hazardous spoils would go to a RCRA-permitted facility.	Excavation and disposal of contaminated soil at a permitted landfill is an effective method of removing at the source of site contamination. Backfill materials would need to be imported to fill the site.	Yes
Building Soil Vapor Technology			
Sub-slab Depressurization System (SSDS)	A suction pit is created below the concrete floor slabs by drilling a hole through the slab and hand excavating to form a void in the soil. A fan-powered vent draws air beneath the slab to above the surface of the room through a PVC pipe.	Inexpensive; east to install and effectively mitigates vapor intrusion, thereby disrupting this exposure pathway. Can be used in source area for source mass reduction. Not typically intended as sole remedial measure; used as interim mitigation until selected site remedy is implemented.	Yes

TABLE 5

Alternative 2 Feasibility Study Cost Estimate

NYSDEC Ronhill Cleaners, Glen Cove, NY

Mitigation of Soil Vapor by Sealing Preferential Pathways and Installation of Sub-Slab Depressurization System(s) and Long Term Groundwater Monitoring

ITEM	Description	Approximate Quantity	Unit of Measurement	Unit Price Dollars & Cents	Lump Sum Price Dollars & Cents
	REMEDIAL ACTION COSTS				
LS-1	Mobilization/Demobilization (Limit 3% of Total)	1	Lump Sum	$ 5,876.81	$ 5,876.81
LS-2	Site Preparation	1	Lump Sum	$ 7,725.00	$ 7,725.00
LS-3	Soil Vapor Extraction System Decommissioning	1	Lump Sum	$ 30,000.00	$ 30,000.00
LS-4	As-Built Survey	1	Lump Sum	$ 2,500.00	$ 2,500.00
LS-5	Health and Safety	1	Lump Sum	$ 3,233.00	$ 3,233.00
LS-6	Pilot Test Sub-slab Depressurization System	1	Lump Sum	$ 15,000.00	$ 15,000.00
LS-7	Soil Vapor Mitigation - Sealing Existing Structure	1	Lump Sum	$ 10,440.00	$ 10,440.00
LS-8	Sub-surface Slab Depressurization System Installation and Startup	1	Lump Sum	$ 60,487.00	$ 60,487.00
UC-1	Monitoring Well Installation	4	Each	$ 12,175.00	$ 48,700.00
		Subtotal			$ 183,961.81
		Project Administration (15%)			$ 27,594.27
		Design and Legal (15%)			$ 27,594.27
		Contingency (20%)			$ 36,792.36
		Total Capital Cost for RA Design and Installation			**$ 275,942.71**
	OPERATION AND MAINTENANCE COST FOR YEARS 1 - 5				
UC-2	Long Term Groundwater Sampling for VOCs (55 wells Quarterly per year)	1	Year	$ 59,487.80	$ 59,487.80
UC-3	Long Term Air Monitoring and for VOC Analysis (Indoor, Outdoor, Sub-Slab and Soil Vapor Seasonally per year)	1	Year	$ 3,718.50	$ 3,718.50
UC-4	SSDS Maintenance and Operating Costs per year	1	Year	$ 17,000.00	$ 17,000.00
		Subtotal			$ 80,206.30
		Project Administration (5%)			$ 4,010.32
		Contingency (5%)			$ 4,010.32
		Total O&M Yearly Cost (Years 1 - 5)			**$ 88,226.93**
		Total O&M Cost (Years 1 - 5)			**$ 441,134.65**
		Present Value Cost			**$381,976.44**
	OPERATION AND MAINTENANCE COST FOR YEARS 6-30				
UC-5	Long Term Groundwater Sampling for VOCs (All Wells once every 5 years for 25 years)	1	Year	$ 2,957.12	$ 2,957.12
UC-6	Long Term Air Monitoring and for VOC Analysis (Once every 5 years for 25 years)	1	Year	$ 743.70	$ 743.70
UC-7	SSDS Maintenance and Operating Costs	1	Year	$ 7,760.00	$ 7,760.00
		Subtotal			$ 11,460.82
		Project Administration (5%)			$ 573.04
		Contingency (5%)			$ 573.04
		Average Yearly O&M Cost			**$ 12,606.90**
		Total O&M Cost (Years 6 - 30)			**$ 315,172.55**
		Present Value Cost			**$177,680.98**
				Total Capital and Present Value Costs	**$835,700**
				Grand Total	**$1,032,300**

TABLE 6
Alternative 3 Feasibility Study Cost Estimate
NYSDEC Ronhill Cleaners, Glen Cove, NY
Soil Vapor Extraction System Upgrade with Air Sparge Wells, Shallow Soil Excavation and Long Term Air and Groundwater Monitoring

ITEM	Description	Approximate Quantity	Unit of Measurement	Unit Price Dollars & Cents	Lump Sum Price Dollars & Cents
	REMEDIAL ACTION COSTS				
LS-1	Mobilization/Demobilization (Limit 3% of Total)	1	Lump Sum	$ 11,036.70	$ 11,036.70
LS-2	Site Preparation	1	Lump Sum	$ 11,565.00	$ 11,565.00
LS-3	Monitoring Well As-Built Survey	1	Lump Sum	$ 2,500.00	$ 2,500.00
LS-4	Electrical Work and Connections	1	Lump Sum	$ 2,500.00	$ 2,500.00
LS-5	Pilot Test Soil Vapor Extraction System	1	Lump Sum	$ 15,000.00	$ 15,000.00
UC-1	Soil Vapor Extraction System Upgrade With Air Sparge Component	5	Day	$ 23,770.00	$ 118,850.00
UC-2	Health and Safety	1	Each	$ 7,500.00	$ 7,500.00
UC-3	Monitoring/Observation Well Installation	4	Each	$ 12,175.00	$ 48,700.00
UC-4	Shallow Soil Excavation	250	CY	$ 645.10	$ 161,275.00
UC-5	Monitoring Well Decommissioning	1	Each	$ -	$ -
		Subtotal			$ 378,926.70
		Project Administration (15%)			$ 56,839.01
		Design and Legal (15%)			$ 56,839.01
		Contingency (20%)			$ 75,785.34
		Total Capital Cost for RA Design and Installation			**$ 568,390.05**
	OPERATION AND MAINTENANCE COST FOR YEARS 1 - 5				
UC-6	Long Term Groundwater Sampling for VOCs (55 samples Quarterly for 5 Years)	1	Year	$ 59,487.80	$ 59,487.80
UC-7	Long Term Air Monitoring and for VOC Analysis (Indoor, Outdoor, Sub-Slab and Soil Vapor Seasonally for 5 years)	1	Year	$ 3,718.50	$ 3,718.50
UC-8	SVE Maintenance and Operating Costs	1	Year	$ 40,320.00	$ 40,320.00
		Subtotal			$ 103,526.30
		Project Administration (5%)			$ 5,176.32
		Contingency (5%)			$ 5,176.32
		Total Cost O&+M per Year			**$ 113,878.93**
		Total Cost O&M (Years 1 - 5)			**$ 569,394.65**
		Present Value Cost			**$493,036.17**
	OPERATION AND MAINTENANCE COST FOR YEARS 6-30				
UC-9	Long Term Groundwater Sampling for VOCs (All Wells once every 5 years for 25 years)	1	Year	$ 2,957.12	$ 2,957.12
UC-10	Long Term Air Monitoring and for VOC Analysis (Once every 5 years for 25 years)	1	Year	$ 743.70	$ 743.70
		Subtotal			$ 3,700.82
		Project Administration (5%)			$ 185.04
		Contingency (5%)			$ 185.04
		Average Sampling Cost O&M per Year			**$ 4,070.90**
		Total Sampling Cost O&M over 25 Years			**$ 101,772.55**
		Present Value Cost for Sampling			**$ 57,375.07**
UC-11	AS/SVE System Decommissioning (Year 6)	1	Each	$ 38,500.00	$ 38,500.00
		Project Administration (5%)			$ 1,925.00
		Contingency (5%)			$ 1,925.00
		Total Cost			**$ 42,350.00**
		Total Present Value Cost			**$ 99,725.07**
		Total O&M Cost over 25 Years			**$ 144,122.55**
			Total Capital and Present Value Costs		**$ 1,161,200**
				Grand Total	**$ 1,282,000**

TABLE 7

Alternative 4 Feasibility Study Cost Estimate

NYSDEC Ronhill Cleaners, Glen Cove, NY

SVE System Upgrade with Shallow Soil Excavation and Shallow Groundwater Treatment Using In-Situ Chemical Reduction

ITEM	Description	Approximate Quantity	Unit of Measurement	Unit Price Dollars & Cents	Lump Sum Price Dollars & Cents
	REMEDIAL ACTION COSTS				
LS-1	Mobilization/Demobilization (Limit 3% of Total)	1	Lump Sum	$ 24,389.10	$ 24,389.10
LS-2	Site Preparation	1	Lump Sum	$ 6,585.00	$ 6,585.00
LS-3	Monitoring Well/Injection Well As-Built Survey	1	Lump Sum	$ 2,500.00	$ 2,500.00
LS-4	Electrical Work and Connections	1	Lump Sum	$ 2,500.00	$ 2,500.00
UC-1	Soil Vapor Extraction System Upgrade	5	Day	$ 13,340.00	$ 66,700.00
UC-2	Health and Safety	1	Site	$ 8,600.00	$ 8,600.00
UC-3	Monitoring/Observation Well Installation	4	Each	$ 12,175.00	$ 48,700.00
UC-4	Shallow Soil Excavation, T&D and Backfill	250	CY	$ 645.10	$ 161,275.00
UC-5	Monitoring Well Decommissioning	1	Each	$ -	$ -
UC-6	In-Situ Groundwater Treatment Pilot Test at MW-3	1	Each	$ 93,278.72	$ 93,278.72
UC-7	In-Situ Groundwater Treatment INJ.#1	1	Each	$ 279,320.84	$ 279,320.84
UC-8	In-Situ Groundwater Treatment INJ.#2	1	Each	$ 143,510.42	$ 143,510.42
		Subtotal			$ 837,359.08
		Project Administration (15%)			$ 125,603.86
		Design and Legal (15%)			$ 125,603.86
		Contingency (20%)			$ 167,471.82
		Total Capital Cost for RA Design and Installation			**$ 1,256,038.62**
	OPERATION AND MAINTENANCE COST FOR YEARS 1 - 5				
UC-9	Long Term Groundwater Sampling for VOCs (55 samples Quarterly for 5 Years)	1	Year	$ 59,487.80	$ 59,487.80
UC-10	Long Term Air Monitoring and for VOC Analysis (Indoor, Outdoor, Sub-Slab and Soil Vapor Seasonally for 5 years)	1	Year	$ 3,718.50	$ 3,718.50
UC-11	SVE Maintenance and Operating Costs	1	Year	$ 38,820.00	$ 38,820.00
		Subtotal			$ 102,026.30
		Project Administration (5%)			$ 5,101.32
		Contingency (5%)			$ 5,101.32
		Total O&M Cost per Year			**$ 112,228.93**
		Total O&M Cost Years 1 - 5			**$ 561,144.65**
		Present Value Cost			**$485,892.53**
	OPERATION AND MAINTENANCE COST FOR YEARS 6-30				
UC-12	Long Term Groundwater Sampling for VOCs (All Wells once every 5 years for 25 years)	1	Year	$ 2,957.12	$ 2,957.12
UC-13	Long Term Air Monitoring and for VOC Analysis (Once every 5 years for 25 years)	1	Year	$ 743.70	$ 743.70
		Subtotal			$ 3,700.82
		Project Administration (5%)			$ 185.04
		Contingency (5%)			$ 185.04
		Average Yearly O&M Cost			**$ 4,070.90**
		Total Monitoring Cost for Years 5-30 O&M			**$ 101,772.55**
		Present Value Cost			**$57,375.07**
UC-14	SVE System Decommissioning	1	Year	$ 33,000.00	$ 33,000.00
		Project Administration (5%)			$ 1,650.00
		Contingency (5%)			$ 1,650.00
		Subtotal			**$ 36,300.00**
		Total O&M Cost for Years 6 - 30			**$ 138,072.55**
		Total Present Value Cost			**$ 93,675.07**
			Total Capital and Present Value Costs		**$ 1,835,700**
			Grand Total		**$ 1,955,300**

TABLE 8
Alternative 5 Feasibility Study Cost Estimate
NYSDEC Ronhill Cleaners, Glen Cove, NY
SVE System Upgrade with Air Sparge Wells, Shallow Soil Excavation and Deep Groundwater Treatment Using In-Situ Chemical Reduction

ITEM	Description	Approximate Quantity	Unit of Measurement	Unit Price Dollars & Cents	Lump Sum Price Dollars & Cents
	REMEDIAL ACTION COSTS				
LS-1	Mobilization/Demobilization (Limit 3% of Total)	1	Lump Sum	$ 33,669.45	$ 33,669.45
LS-2	Site Preparation	1	Lump Sum	$ 6,585.00	$ 6,585.00
LS-3	Monitoring Well/Injection Well As-Built Survey	1	Lump Sum	$ 2,500.00	$ 2,500.00
LS-4	Electrical Work and Connections	1	Lump Sum	$ 2,500.00	$ 2,500.00
UC-1	Soil Vapor Extraction System Upgrade With Air Sparge Component	1	Each	$ 121,050.00	$ 121,050.00
UC-2	Health and Safety	1	Each	$ 7,500.00	$ 7,500.00
UC-3	Monitoring/Observation Well Installation	4	Each	$ 16,575.00	$ 66,300.00
UC-4	Shallow Soil Excavation, T&D and Backfill	250	CY	$ 584.86	$ 146,213.80
UC-5	Monitoring Well Decommissioning	1	Each	$ -	$ -
UC-6	In-Situ Deep Groundwater Treatment Pilot Test at MW-6/24D	1	Each	$ 100,538.72	$ 100,538.72
UC-7	In-Situ Deep Groundwater Treatment INJ.#1	1	Each	$ 443,518.28	$ 443,518.28
UC-8	In-Situ Deep Groundwater Treatment INJ#2	1	Each	$ 225,609.14	$ 225,609.14
		Subtotal			$ 1,155,984.39
		Project Administration (15%)			$ 173,397.66
		Design and Legal (15%)			$ 173,397.66
		Contingency (20%)			$ 231,196.88
		Total Capital Cost for RA Design and Installation			**$ 1,733,976.58**
	OPERATION AND MAINTENANCE COST FOR YEARS 1 - 5				
UC-9	Long Term Groundwater Sampling for VOCs (55 samples Quarterly for 5 Years)	1	Year	$ 59,487.80	$ 59,487.80
UC-10	Long Term Air Monitoring and for VOC Analysis (Indoor, Outdoor, Sub-Slab and Soil Vapor Seasonally for 5 years)	1	Year	$ 3,718.50	$ 3,718.50
UC-11	SVE Maintenance and Operating Costs	1	Year	$ 40,320.00	$ 40,320.00
		Subtotal			$ 103,526.30
		Project Administration (5%)			$ 5,176.32
		Contingency (5%)			$ 5,176.32
		Total O&M Cost Per Year			**$ 113,878.93**
		Total O&M Cost for Years 1-5			**$ 569,394.65**
		Present Value Cost			**$493,036.17**
	OPERATION AND MAINTENANCE COST FOR YEARS 6-30				
UC-12	Long Term Groundwater Sampling for VOCs (All Wells once every 5 years for 25 years)	1	Year	$ 2,957.12	$ 2,957.12
UC-13	Long Term Air Monitoring and for VOC Analysis (Once every 5 years for 25 years)	1	Year	$ 743.70	$ 743.70
		Subtotal			$ 3,700.82
		Project Administration (5%)			$ 185.04
		Contingency (5%)			$ 185.04
		Total O&M Cost Per Year			**$ 4,070.90**
		Total Monitoring O&M Cost for Years 6-30			**$ 101,772.55**
		Present Value Cost			**$57,375.07**
UC-14	SVE System Decommissioning	1	Each	$ 38,500.00	**$ 38,500.00**
		Project Administration (5%)			$ 1,925.00
		Contingency (5%)			$ 1,925.00
		Subtotal			$ 42,350.00
		Total O&M Cost for Years 6-30			**$ 144,122.55**
		Total Present Value Cost			**$99,725.07**
				Total Capital and Present Value Costs	**$2,326,800**
				Grand Total	**$2,447,500**

TABLE 9

Alternative 6 Feasibility Study Cost Estimate

NYSDEC Ronhill Cleaners, Glen Cove, NY

Soil Vapor Extraction System Upgrade, Shallow Soil Excavation and Shallow/Deep Groundwater Treatment Using In-Situ Chemical Reduction.

ITEM	Description	Approximate Quantity	Unit of Measurement	Unit Price Dollars & Cents	Lump Sum Price Dollars & Cents
	REMEDIAL ACTION COSTS				
LS-1	Mobilization/Demobilization (Limit 3% of Total)	1	Lump Sum	$ 50,376.38	$ 50,376.38
LS-2	Site Preparation	1	Lump Sum	$ 6,585.00	$ 6,585.00
LS-3	Monitoring Well/Injection Well As-Built Survey	1	Lump Sum	$ 2,500.00	$ 2,500.00
LS-4	Electrical Work and Connections	1	Lump Sum	$ 2,500.00	$ 2,500.00
UC-1	Soil Vapor Extraction System Upgrade	1	EA	$ 64,950.00	$ 64,950.00
UC-2	Health and Safety	1	Each	$ 7,500.00	$ 7,500.00
UC-3	Monitoring/Observation Well Installation	4	Each	$ 25,925.00	$ 103,700.00
UC-4	Shallow Soil Excavation, T&D and Backfill	250	CY	$ 584.86	$ 146,213.80
UC-5	Monitoring Well Decommissioning	1	Each	$ -	$ -
UC-6	In-Situ Shallow Groundwater Treatment Pilot Test at MW-3	1	Each	$ 93,278.72	$ 93,278.72
UC-7	In-Situ Shallow Groundwater Treatment INJ.#1	1	Each	$ 279,320.84	$ 279,320.84
UC-8	In-Situ Shallow Groundwater Treatment INJ.#2	1	Each	$ 143,510.42	$ 143,510.42
UC-9	In-Situ Deep Groundwater Treatment Pilot Test at MW-6/24D	1	Each	$ 100,538.72	$ 100,538.72
UC-10	In-Situ Deep Groundwater Treatment INJ.#1	1	Each	$ 443,518.28	$ 443,518.28
UC-11	In-Situ Deep Groundwater Treatment INJ#2	1	Each	$ 225,609.14	$ 225,609.14
		Subtotal			$ 1,670,101.30
		Project Administration (15%)			$ 250,515.20
		Design and Legal (15%)			$ 250,515.20
		Contingency (20%)			$ 334,020.26
		Total Capital Cost for RA Design and Installation			**$ 2,505,151.95**
	OPERATION AND MAINTENANCE COST FOR YEARS 1 - 5				
UC-12	Long Term Groundwater Sampling for VOCs (55 samples Quarterly for 5 Years)	1	Year	$ 59,487.80	$ 59,487.80
UC-13	Long Term Air Monitoring and for VOC Analysis (Indoor, Outdoor, Sub-Slab and Soil Vapor Seasonally for 5 years)	1	Year	$ 3,718.50	$ 3,718.50
UC-14	SVE Maintenance and Operating Costs	1	Year	$ 38,820.00	$ 38,820.00
		Subtotal			$ 102,026.30
		Project Administration (5%)			$ 5,101.32
		Contingency (5%)			$ 5,101.32
		Total O&M Cost per Year			**$ 112,228.93**
		Total O&M Cost for Years 1-5			**$ 561,144.65**
		Present Value Cost			**$485,892.53**
	OPERATION AND MAINTENANCE COST FOR YEARS 6-30				
UC-15	Long Term Groundwater Sampling for VOCs (All Wells once every 5 years for 25 years)	1	Year	$ 2,957.12	$ 2,957.12
UC-16	Long Term Air Monitoring and for VOC Analysis (Once every 5 years for 25 years)	1	Year	$ 743.70	$ 743.70
		Subtotal			$ 3,700.82
		Project Administration (5%)			$ 185.04
		Contingency (5%)			$ 185.04
		Average Monitoring O&M Cost per Year			**$ 4,070.90**
		Total Monitoring O&M Cost Years 6 - 30			**$ 101,772.55**
		Present Value Cost			**$57,375.07**
UC-17	SVE System Decommissioning	1	Year	$ 33,000.00	$ 33,000.00
		Project Administration (5%)			$ 1,650.00
		Contingency (5%)			$ 1,650.00
		Subtotal			$ 36,300.00
		Total O&M Cost Years 6 - 30			**$ 138,072.55**
		Total Present Value Cost			**$93,675.07**
			Total Capital and Present Value Costs		**$ 3,084,800**
				Grand Total	**$ 3,204,400**

TABLE 10
Cost Comparison of Alternatives
NYSDEC Ronhill Cleaners, Glen Cove, NY

	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**	**Alternative 6**
Description	No Action	Mitigation of Soil Vapor by Sealing Preferential Vapor Pathways and Installation of Sub-Slab Depressurization System(s) and Long Term Groundwater Monitoring	Soil Vapor Extraction System Upgrade with Air Sparge Wells, Shallow Soil Excavation and Long Term Air and Groundwater Monitoring	Soil Vapor Extraction System Upgrade with Shallow Soil Excavation and Shallow Groundwater Treatment Using In-Situ Chemical Reduction (ISCR)	Soil Vapor Extraction System Upgrade with Air Sparge Wells, Shallow Soil Excavation and Deep Groundwater Treatment Using In-Situ Chemical Reduction (ISCR)	Soil Vapor Extraction System Upgrade, Shallow Soil Excavation and Shallow/Deep Groundwater Treatment Using In-Situ Chemical Reduction (ISCR)
Project Duration						
Capital Cost	$ -	**$ 275,942.71**	**$ 568,390.05**	**$ 1,256,038.62**	**$ 1,733,976.58**	**$ 2,505,151.95**
Present Value (Years 1-5)		**$ 381,976.44**	**$ 493,036.72**	**$ 485,892.53**	**$ 493,063.17**	**$ 485,892.53**
Annual O&M Year 1		$ 88,226.93	$ 113,878.93	$ 112,228.93	$ 113,878.93	$ 112,228.93
Annual O&M Year 2		$ 88,226.93	$ 113,878.93	$ 112,228.93	$ 113,878.93	$ 112,228.93
Annual O&M Year 3		$ 88,226.93	$ 113,878.93	$ 112,228.93	$ 113,878.93	$ 112,228.93
Annual O&M Year 4		$ 88,226.93	$ 113,878.93	$ 112,228.93	$ 113,878.93	$ 112,228.93
Annual O&M Year 5		$ 88,226.93	$ 113,878.93	$ 112,228.93	$ 113,878.93	$ 112,228.93
Total Annual O&M - Years 1-5	**$ -**	**$ 441,134.65**	**$ 569,394.65**	**$ 561,144.65**	**$ 569,394.65**	**$ 561,144.65**
Present Value (Years 6-30)		**$ 177,680.98**	**$ 99,725.07**	**$ 57,375.07**	**$ 57,375.07**	**$ 93,675.07**
Annual O&M Year 6		$ -	$ 42,350.00	$36,300.00	$ 42,350.00	$ 36,300.00
Annual O&M Year 10		$ 63,034.55	$ 20,354.50	$ 20,354.50	$ 20,354.50	$ 20,354.50
Annual O&M Year 15		$ 63,034.50	$ 20,354.50	$ 20,354.50	$ 20,354.50	$ 20,354.50
Annual O&M Year 20		$ 63,034.50	$ 20,354.50	$ 20,354.50	$ 20,354.50	$ 20,354.50
Annual O&M Year 25		$ 63,034.50	$ 20,354.50	$ 20,354.50	$ 20,354.50	$ 20,354.50
Annual O&M Year 30		$ 63,034.50	$ 20,354.50	$ 20,354.50	$ 20,354.50	$ 20,354.50
Total Annual O&M - Years 6-30	**$ -**	**$ 315,172.55**	**$ 144,122.50**	**$138,072.50**	**$ 144,122.50**	**$ 138,072.50**
Total Capital and Present Value Cost		**$ 835,700**	**$ 1,161,200**	**$ 1,835,700**	**$ 2,326,800**	**$ 3,084,800**
Grand Total	**$ -**	**$ 1,032,300**	**$ 1,282,000**	**$ 1,955,300**	**$ 2,447,500**	**$ 3,204,400**

Figures

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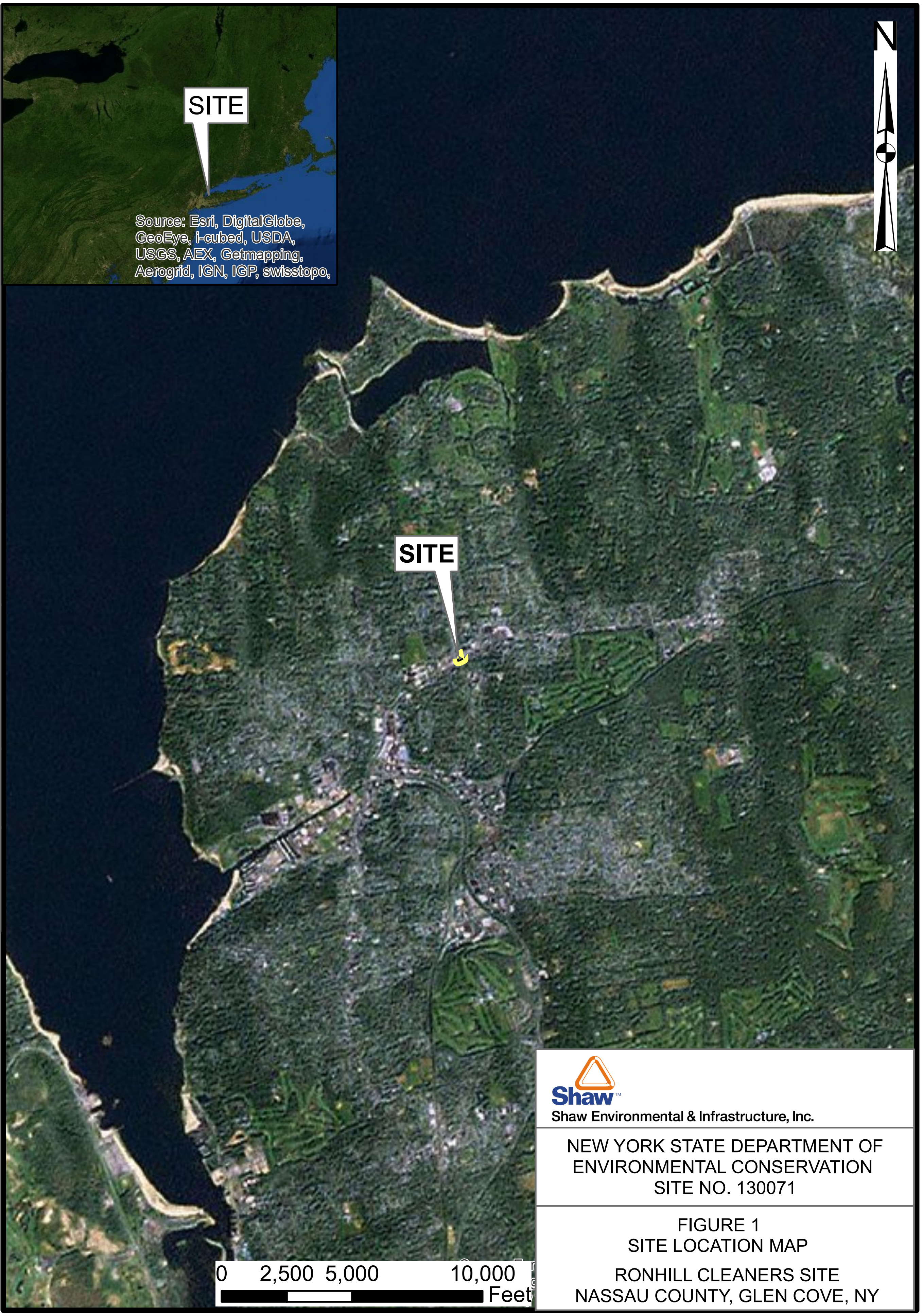
APPROVED BY	MJS
DRAWING NUMBER	134685-29A1



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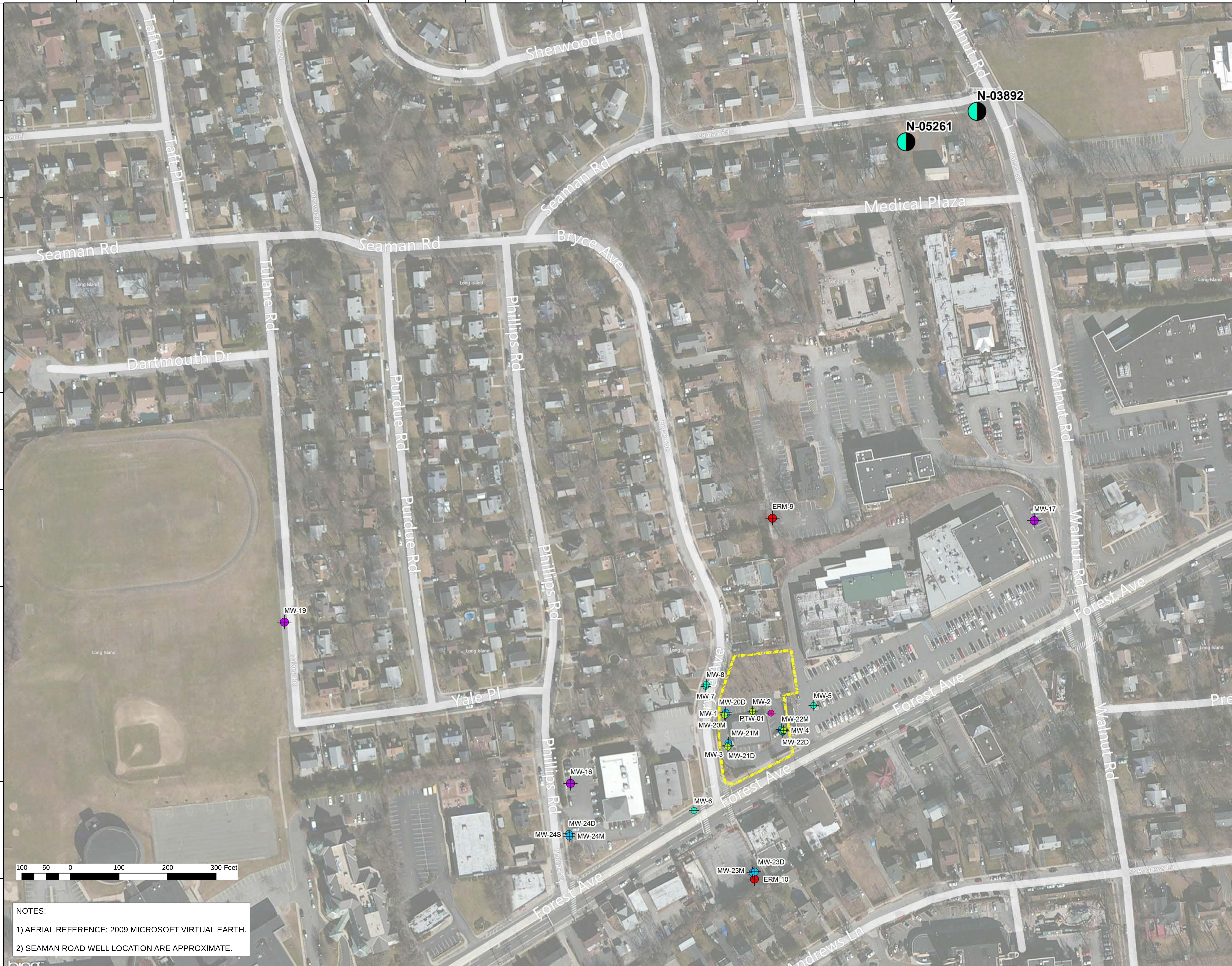

NOTES:

1) AERIAL REFERENCE: 2009 MICROSOFT VIRTUAL EARTH.

2) SEAMAN ROAD WELL LOCATION ARE APPROXIMATE.

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RONHILL CLEANERS SITE

FIGURE 2

SITE FEATURES MAP

NASSAU COUNTY, GLEN COVE, NEW YORK

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RONHILL CLEANERS SITE

FIGURE 3 - ALTERNATIVE 2 - MITIGATION OF SOIL VAPOR BY SEALING PREFERENTIAL PATHWAYS AND INSTALLATION OF SUB-SLAB DEPRESSURIZATION SYSTEM(S) AND LONG TERM AIR AND GROUNDWATER MONITORING
NASSAU COUNTY, GLEN COVE, NEW YORK

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134685-29D22

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FIGURE 6 - ALTERNATIVE 5 - SOIL VAPOR EXTRACTION SYSTEM UPGRADE WITH AIR SPARGE WELLS, SHALLOW SOIL EXCAVATION AND DEEP GROUNDWATER TREATMENT USING IN-SITU CHEMICAL REDUCTION

NASSAU COUNTY, GLEN COVE, NEW YORK

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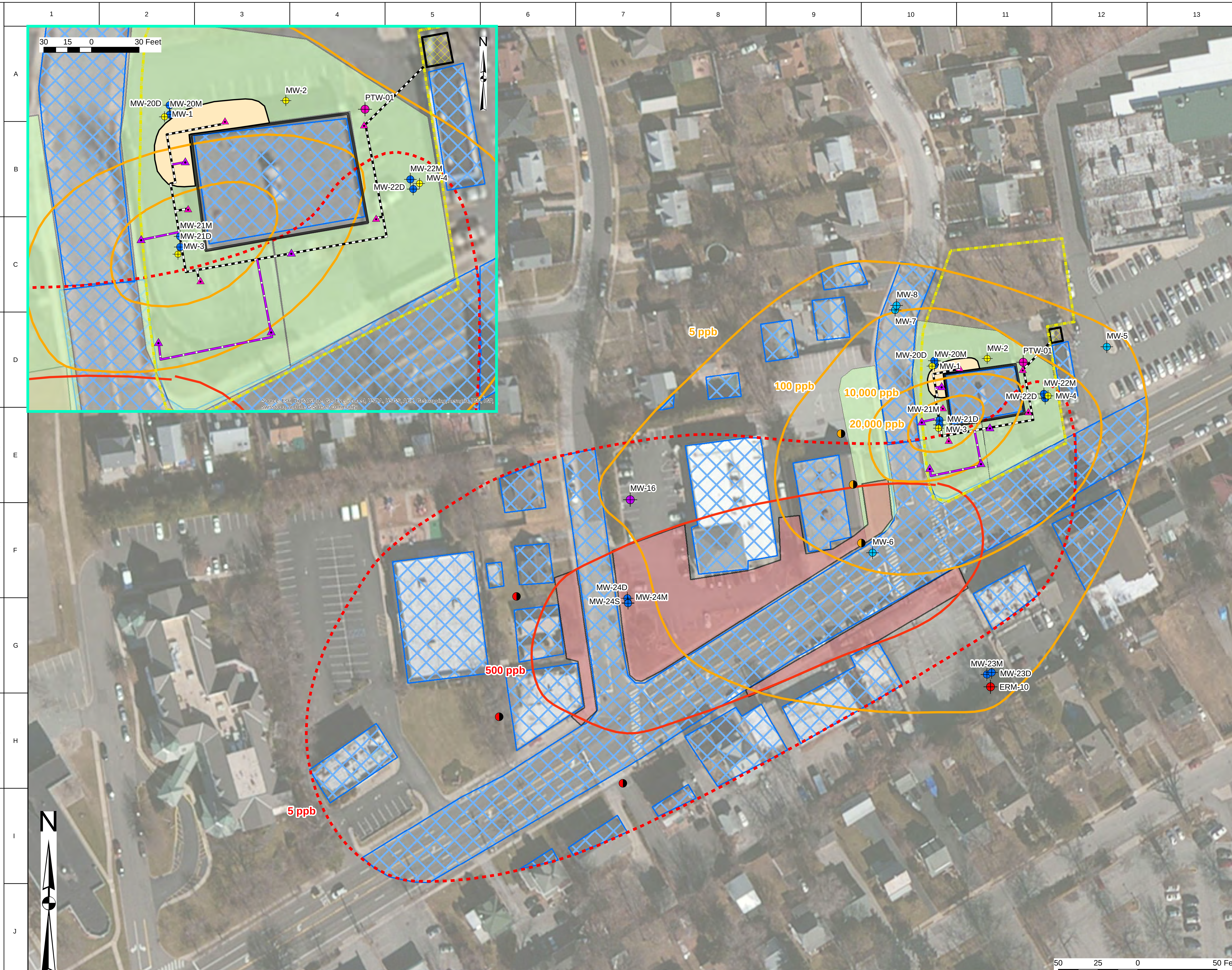

Legend

- PROPOSED DEEP INJECTION MONITORING WELL
- PROPOSED SHALLOW INJECTION MONITORING WELL
- SOIL VAPOR EXTRACTION WELL LOCATIONS
- ERM 2005-2006 MONITORING WELL LOCATION
- TYREE 1994 MONITORING WELL LOCATION
- MONITORING WELL-PTW LOCATION
- PROPOSED VEW WELLS
- SHAW MONITORING WELL LOCATION
- CDM 2009 MULTI-CHANNEL MONITORING WELL LOCATION
- HISTORIC MONITORING WELL LOCATION
- PROPOSED VEW PIPE NETWORK
- SHALLOW PCE CONTOUR (SHAW 2013 RI)
- VES PIPE NETWORK
- SITE BOUNDARY
- BUILDING PERIMETER
- DEEP PCE CONTOUR (SHAW 2013 RI)
- DEEP PCE CONTOUR (INFERRED) (SHAW 2013 RI)
- SVE SYSTEM BOUNDARY
- PROPOSED SOIL EXCAVATION AREA
- PROPOSED DEEP GROUNDWATER INJECTION AREA
- PROPOSED SHALLOW GROUDWATER INJECTION AREA
- AREA UNAVAILABLE FOR INJECTION

NOTES:

1) AERIAL REFERENCE: ESRI WORLD IMAGERY.LYR.

2) CONTOUR NUMBERS ARE SHOWN IN PARTS PER BILLION (PPB). NUMBERING INDICATES ISO-CONTOUR VALUE.

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RONHILL CLEANERS SITE

FIGURE 7 - ALTERNATIVE 6 - SOIL VAPOR EXTRACTION SYSTEM UPGRADE, SHALLOW SOIL EXCAVATION AND SHALLOW/DEEP GROUNDWATER TREATMENT USING IN-SITU CHEMICAL REDUCTION

NASSAU COUNTY, GLEN COVE, NEW YORK

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