FINAL
FEASIBILITY STUDY REPORT
GABRIEL MANUFACTURING CO.

SITE # 344041

WORK ASSIGNMENT NO. D009809-22

Prepared for:

New York State Department of Environmental Conservation

Albany, New York

Prepared by:
Earth Environment Engineering and Geology, P.C.
Two Monument Square
Portland, Maine 04101

EEEG: 3616206129

November 2024

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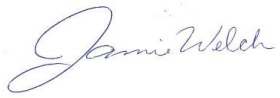
Submitted by:

Amberlee Clark
Project Manager



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CERTIFICATION STATEMENT

I, MARK STELMACK, certify that I am currently a New York State (NYS) licensed professional engineer as in defined in 6 NYCRR Part 375 and that this Feasibility Study Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10). and that all activities were performed in full accordance with the DER-approved scope of work and any DER-approved modifications.

Mark Stelmack

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Mark Stelmack, P.E.
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11/10/2024 DATE

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
CO_2	Carbon Dioxide
CFC	chlorofluorocarbons
COC	contaminant of concern
CVOC	chlorinated volatile organic compound
DER	Department of Environmental Remediation
°F	degrees Fahrenheit
FS	Feasibility Study
EEEG	Earth Environment Engineering and Geology, P.C.
GRAs	general response action
LTM	Long Term Monitoring
MACTEC	MACTEC Engineering and Geology, P.C.
MNA	monitored natural attenuation
NRC	National Response Corporation
NYCRR	New York Codes, Rules, and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	operation and maintenance
OM&M	operation, maintenance, and monitoring
OMB	Office of Management and Budget

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

PCB	polychlorinated biphenyls
PCE	tetrachloroethene
PFAs	per- and polyfluoroalkyl substances
PVC	polyvinyl chloride
PW	present worth
QC	quality control
QHHEA	Qualitative Human Health Exposure Assessment
RAs	remedial alternatives
RAOs	remedial action objectives
Report	Remedial Investigation/Feasibility Study Report
RG	remediation goal
RI	Remedial Investigation
SCGs	standards, criteria, and guidance values
SCOs	soil cleanup objectives
SF	square foot
Site	Gabriel Manufacturing Co, Inc Site
SIM	Selected Ion Method
SMP	Site Management Plan
SSDS	Sub-Slab Depressurization System
SVI	soil vapor intrusion
SVOC	semi-volatile organic compound
TCE	trichloroethene
TOC	total organic carbon
µg/L	microgram(s) per liter

USEPA United States Environmental Protection Agency

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

VC vinyl chloride

VISL vapor intrusion screening level

VOC volatile organic compound

WA Work Assignment

EXECUTIVE SUMMARY

The Gabriel Manufacturing Co., Inc. (Gabriel) site (Site) is in the village of Stony Point, Rockland County, New York. The Site is listed as a Class 2 Inactive hazardous waste site; Site No. 344041 in the New York State Registry of Hazardous Waste Sites. The Site is an approximately 3-acre property consisting of an open lot containing a one story 16,000 square foot building which is currently used as a metal fabrication facility.

The Site was developed in the 1960s as a manufacturing facility for producing metal and plastic parts for office furniture. As part of their manufacturing process, Gabriel repackaged silicon-based "mold release" lubricants into smaller containers with the addition of chlorofluorocarbons (CFCs) as a propellant. The facility reportedly used an approximately 300-foot-deep bedrock well (supply well) for non-contact cooling water during manufacturing operations, producing approximately 10,000 gallons per day which was discharged to the on-site leach field type septic system. In 1988, volatile organic compounds (VOCs) were found in the Site's water supply well by the Rockland County Department of Health (RCDOH). A State Pollutant Discharge Elimination System (SPDES) permit No. NY-0214591 was issued by the NYSDEC in 1993 to allow treatment of manufacturing process water by air stripping and discharge to the adjacent storm sewer off-site.

This Feasibility Study (FS) was completed for the Site to develop remedial objectives and evaluate potential remedial alternatives (RAs) from an engineering, environmental, public health, and economic perspective.

Potential exposure to contaminants of concern (COCs) at concentrations above guidance values could result at the Site from contact with:

- contaminated groundwater via construction, excavation, or withdrawal; and
- soil vapor via migration into on- and off-Site buildings from groundwater.

RAs designed to reduce or eliminate exposure pathways and/or migration of contamination in groundwater have been evaluated. RAs evaluated included:

Alternative 1: No Further Action
Alternative 2: In Situ Thermal Remediation with Engineering Controls
Alternative 3: Enhanced Bioremediation with Engineering Controls

Alternative 4: Groundwater Containment with Engineering Controls
Alternative 5: Long Term Monitoring with Engineering Controls

The active RAs focus on targeting areas with higher groundwater concentrations and preventing off-site migration with the intent that the downgradient groundwater will eventually reach applicable quality standards once the higher groundwater contamination is addressed through Monitored Natural Attenuation (MNA).

1.0 INTRODUCTION

Earth Environment Engineering and Geology, P.C. (EEEG), previously MACTEC Engineering and Geology, P.C. (MACTEC), prepared this Feasibility Study (FS) Report (Report) for the New York State Department of Environmental Conservation (NYSDEC). This Report develops and evaluates remedial action alternatives for the Gabriel Manufacturing Co. Site (Site) in Stony Point, New York (Site 344041) (Figure 1.1). This Report was prepared in response to Work Assignment (WA) No. D009809-22.

The FS has been conducted in accordance with the WA, as well as with applicable portions of the following documents:

- 6 New York Codes, Rules, and Regulations Part 375 "Environmental Remediation Programs"
- DER Technical Guidance for Site Investigation and Remediation (DER-10)
- United States Environmental Protection Agency (USEPA) "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (USEPA, 1988)

1.1 PURPOSE

The purpose of this FS Report is to develop and evaluate remedial action alternatives for the Site. Site COCs include volatile organic compounds (VOC) and CFC contaminants detected in soil vapor and groundwater on- and off-site. The approach to the FS involves integration of data and conclusions presented in the RI Report (MACTEC, 2022), with development, screening, and evaluation of proposed remedial alternatives from engineering, environmental, public health, and economic perspectives. This FS Report is organized into the following sections.

- Section 1.0 – Introduction
- Section 2.0 – Summary and Conclusions of the Remedial Investigation
- Section 3.0 – Development of Remedial Action Goals and Objectives, and General Response Actions for Contamination Requiring Remediation
- Section 4.0 – Identification and Screening of Technologies and Development of Alternatives

- Section 5.0 – Development and Detailed Description of Alternatives
- Section 6.0 – Detailed Analysis and Comparison of Alternatives
- Section 7.0 – References

2.0 SUMMARY AND CONCLUSIONS OF THE REMEDIAL INVESTIGATION

2.1 SUMMARY

The Site is an approximately 3-acre property located at 125 South Liberty Drive (Routes 202 and 9W) in the Town of Stony Point, Rockland County, New York (Figure 1.1). The Site consists of an open lot containing a one story 16,000 square foot building which is currently used as a metal fabrication facility.

The Site was developed in the 1960s as a manufacturing facility for producing metal and plastic parts for office furniture. As part of their manufacturing process, CFCs were used as a propellant and sold as a standalone product. During manufacturing operations, the facility used an on-Site bedrock well for non-contact cooling (approximately 10,000 gallons per day).

RI field investigations were completed at the Site between July 2018 and April 2022, and consisted of:

- Soil sampling (surface and subsurface);
- Monitoring well installation;
- Groundwater sampling and groundwater elevation measurements from monitoring wells;
- Bedrock Sampling and downhole geophysics;
- SVI sampling on Site and from three structures located in the vicinity of the Site;
- Pore water sampling at the ravine northeast of the Site, the presumed groundwater discharge; and,
- Evaluation of on-Site and off-Site hydrogeology.

2.2 CONCLUSIONS

Results of the investigations show:

- Site contaminants of concern (COCs) are determined to exist primarily in groundwater. It is likely there are multiple sources contributing to groundwater contamination, including the septic leach-field area north of the Site building, floor drains and sub-slab coolant piping within the building, and the on-Site deep bedrock supply well.

- A soil source for CFCs was not identified at the leachfield or beneath the site buildings or for chlorinated volatile organic compound (CVOCs) in the loading dock area and the soil piles on the western side of the site. Other CVOCs (TCE and PCE) were sporadically detected below NYSDEC SCGs primarily in the western portion of the site.
- Results from three sinks sampled within the Site building show concentrations of CFC 12 above GA Standards.
- CFC concentrations in overburden and bedrock groundwater exceed the NYS groundwater criteria (5 µg/L) on the Site, and extend approximately 500 feet downgradient of the Site;
- CFCs and CVOCs in residential sub-slab soil vapor and indoor air are below the NYSDOH recommended guidance values;
- The Fish and Wildlife Resources Impact Analysis indicates that ecological receptors may exist down gradient of the Site at or near Cedar Pond Brook; and
- A Qualitative Human Health Exposure Assessment (QHHEA) indicated complete exposure pathways exist for on-Site groundwater via the deep bedrock supply well and soil vapor intrusion into the on-Site structures.

3.0 DEVELOPMENT OF REMEDIAL ACTION GOALS AND OBJECTIVES, AND GENERAL RESPONSE ACTIONS FOR CONTAMINATION REQUIRING REMEDIATION

Remedial Action Objectives (RAOs) form the basis for identifying remedial technologies and developing RAs. This section identifies RAOs for the contaminated Site media, general response actions to address these RAOs, and the nature and extent of contamination requiring remedial action.

Site-specific remedial objectives for the impacted media were developed with consideration for the frequency of contaminant detection, background concentrations, the chemical and toxicological properties of the COCs, existing or potential exposure pathways, and the present or projected Site use.

3.1 IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES

RAOs consist of medium-specific or operable unit-specific goals for protecting human health and the environment (NYSDEC, 2010). RAOs specify the COCs, exposure pathway(s) and receptor(s), and acceptable contaminant levels or range of levels for each exposure route. Site-specific COCs were determined by comparison of contaminant levels to Chemical-Specific SCG values but did not consider Site-specific exposure pathways.

RAOs presented in the following subsections were developed for the specific media and receptors identified in the QHHEA. Acceptable contaminant levels or range of levels for each media are referred to as remediation goals (RGs). The RGs developed for the Site consider both the identified COCs and the potential exposure pathways and receptors. The Chemical-Specific SCGs generally provide both exposure pathway- and receptor-specific criteria and were used in the development of Site-specific RGs.

3.1.1 Remedial Action Objectives for Soil

Samples taken during the RI identified metals concentrations greater than SCOs that were reflective of background conditions at the Site. Otherwise, all analytical results for metals, VOCs/SVOCs, PCBS,

and PFAs compounds indicated that analytes were only detected at levels beneath SCOs. Therefore, no remedial action is required, and no Remedial Action Objectives were developed for soil.

3.1.2 Remedial Action Objectives for Groundwater

Groundwater at the Site is classified as GA and depth to groundwater is between 30 and 50 feet below ground surface (bgs). Concentrations of chlorinated fluorocarbons, trichloroethene, and dichloroethene were all observed above water quality standards in samples taken during the RI. The area in the vicinity of the Site is supplied by municipal water and a survey of registered wells in the area has not identified use of impacted groundwater for potable or non-potable use outside of the on-Site well used to supply non-potable water to the Site building. As a result, generally the risk posed by groundwater is to act as a source of soil vapor contamination that may result in vapor intrusion both on- and off-site, although the supply well creates the potential for direct exposure to contaminated groundwater on-site.. The groundwater plume has been sufficiently horizontally and vertically delineated for the purposes of determining a remedy. Groundwater ultimately discharges in a forested upland ravine of the Cedar Pond Brook. Discharge of contaminants to surface water was evaluated by sampling of porewater. The porewater sampling data did not establish a complete exposure pathway. Therefore, the RAOs for groundwater are:

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with or inhalation of VOCs from contaminated groundwater.
- To the extent practicable, restore groundwater aquifer to pre-disposal/pre-release conditions.
- Prevent the discharge of contaminants to surface water.
- Remove the source of groundwater or surface water contamination.

3.1.3 Remedial Action Objectives for Surface Water

No surface water present on-site. Surface water appears seasonally in the nearby forested upland ravine which feeds into Cedar Pond Brook and ultimately the Hudson River. Porewater samples were taken from the ravine during the RI. CFC 11 was observed in two locations within the ravine at concentrations below Class GA SGVs, and no other Site COCs were detected in the porewater samples. To be conservative, RAOs were developed for surface water to address the potential for exposure although no data collected during the RI suggests that remedial action or RAOs for surface water are required. RAOs for surface water are:

- Prevent ingestion of water impacted by contaminants
- Prevent contact or inhalation of contaminants from impacted water bodies
- Prevent surface water contamination which may result in fish advisories
- Restore surface water to ambient water quality criteria for the contaminant of concern
- Prevent impacts to biota from ingestion/direct contact with surface water causing toxicity and impacts from bioaccumulation through the marine or aquatic food chain

3.1.4 Remedial Action Objectives for Soil Vapor/Indoor Air

Chlorinated fluorocarbons present in groundwater have been observed in soil vapor and sub-slab soil vapor samples taken both on- and off-site, as well as in associated indoor air samples. The NYSDOH has not established guidelines for concentrations of CFCs in indoor air, although the USEPA has developed vapor intrusion screening level (VISLs) for CFC-12 via a VISL calculator for volatile chemicals (USEPA 2012). Screening levels for CFC-11 have not been calculated because no inhalation toxicity data for CFC-11 is available. Additionally, no indoor air standard is explicitly calculated for CFC-11 or CFC-12, but a risk-based standard can be calculated using toxicity data for CFC-12 and hypothetical exposure conditions in accordance with USEPA Risk Assessment Guidance for Superfund (RAGS). CFCs and CVOCs in residential sub-slab soil vapor and indoor air are below the NYSDOH recommended guidance values no RAOs for soil vapor/ indoor air are required. Soil vapor samples taken at the western edge of the site showed concentrations of VOCs that have the potential to exceed the DOH soil vapor decision matrix. Similarly located groundwater samples showed concentrations of contaminants of VOCs marginally above groundwater cleanup levels, and the presence of elevated soil vapor concentrations warrants RAOs for soil vapor and indoor air. Therefore, the RAOs for soil vapor / indoor air are:

- Mitigate potential impacts to public health resulting from existing vapor intrusion into buildings

3.1.5 Remediation Goals

The RGs for the Site include attaining, to the extent practicable, the following chemical specific SCGs:

- GA Groundwater Quality Standards (NYS, 1999)
- Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (NYSDEC, 1998).

3.2 EXTENT OF CONTAMINATION REQUIRING REMEDIAL ACTION

The following paragraphs summarize the current extent of site contamination based on sampling performed during the RI. Additional information is described in Section 4.0 of the RI report.

Soil. Soil samples taken during the RI did not identify contaminants present above SCOs, therefore there is no anticipated need for soil remediation on site.

Groundwater. VOC and CFC concentrations exceed SCGs in overburden and bedrock groundwater on Site. Contaminants are believed to have originated in the on-site septic field from the discharge of non-contact cooling water used in operation of the facility and to have subsequently migrated off-site. Offsite sampling has delineated the plume to the south, east, and west to groundwater standards, and to the north and northeast to within an order of magnitude of groundwater standards. RI sampling identified upward hydraulic gradients restricting offsite contamination to primarily overburden groundwater, and contaminants have been observed as far downgradient as 100 feet from the site. Additional information is available in Subsection 4.4 of the RI report.

Soil Vapor Intrusion (SVI). The RI included soil vapor, subslab vapor, indoor air, and ambient air sampling both on-site and at downgradient buildings located to the north and northeast of the Site. Onsite subslab soil vapor samples showed concentrations of CFCs well above both commercial and residential USEPA VISLs; however, indoor air sampling at the site did not identify concentrations of CFCs or VOCs above risk-based criteria. Although downgradient subslab vapor samples had elevated concentrations of CFCs, they were below the USEPA VISL for residential use, and associated indoor air samples had concentrations of CFC11 and CFC12 similar to those in offsite ambient air samples. These results suggest that offsite vapor intrusion is unlikely to be occurring at downgradient buildings, as the samples were taken above areas where contaminants were at the highest concentrations in groundwater and would be the most likely to suffer from SVI issues.

Several soil vapor samples taken at the western edge of the site showed concentrations of CFCs and VOCs that exceed the VISL values for residential use.The presence of elevated soil vapor concentrations warrants supplemental investigation of subslab and indoor air concentrations in the

residences immediately to the west of the site. Additional information is available in Subsection 4.4 of the RI report.

3.3 IDENTIFICATION OF GENERAL RESPONSE ACTIONS

General response actions (GRAs) describe those actions that will satisfy the RAOs (NYSDEC, 2010). GRAs may include treatment, containment, excavation, disposal, institutional actions, or a combination of these. Like RAOs, GRAs are medium-specific. Based upon the current Site conditions and the RAOs identified for the Site, the potential threat related to the Site is limited to exposure to contaminated groundwater and soil vapor intrusion.

3.3.1 General Response Actions – Groundwater

The following GRAs would address the RAOs identified for groundwater at the Site.

- Institutional Controls
- Natural Attenuation
- Containment
- In-Situ Treatment
- Ex-Situ Treatment

3.3.2 General Response Actions – Soil Vapor/Indoor Air

The following GRAs would address the RAOs identified for soil vapor and indoor air at the Site and surrounding properties.

- Engineering Controls
- In-Situ Treatment
- Ex-Situ Treatment

4.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES AND DEVELOPMENT OF ALTERNATIVES

This section identifies and screens potential remedial technologies. Technologies are identified for the purpose of attaining the RAOs established in Subsection 3.1 and the GRAs also described in Subsection 3.3.

Following identification, candidate technologies are screened based on their applicability to Site- and contaminant-limiting characteristics. The purpose of the screening is to produce an inventory of suitable technologies that can be assembled into RAs capable of mitigating actual or potential risks at the Site. Potential technologies representing a range of GRAs (i.e., no further action, Site management, treatment, etc.) are considered. Technology screening results in a list of potential remedial technologies that may be developed into candidate remedial action alternatives.

4.1 IDENTIFICATION AND INITIAL SCREENING OF TREATMENT TECHNOLOGIES

Preliminary review of remedial technologies and specific process options applicable to the Site summarized in Table 4.1 was conducted in general accordance with the USEPA's Guidance for Conducting RI/FS (USEPA, 1988). The screening focuses on technology types capable of remediating the COCs present in Site groundwater and soil vapor and evaluates the effectiveness and implementability of the technology. Based on this evaluation, technologies retained are determined to be potentially viable treatment options for the contaminated Site media. These technologies will undergo a more detailed evaluation in the following report subsections.

4.2 DETAILED SCREENING OF TECHNOLOGIES

Consistent with DER-10, the remedial action technologies retained from the initial screening process (Table 4.1) were screened based on whether they can meet the RAOs (Effectiveness) and whether they are technically implementable (Implementability). Additionally, based upon available information, the relative cost of each remedial alternative is also evaluated. The rationale for either retaining or

eliminating treatment options is presented and summarized in Table 4.2. The remedial action options retained from the detailed screening process were used to develop the proposed remedial alternatives (RAs) discussed below in Subsection 4.3, and further described in Section 6.0.

4.3 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Media-specific remedial components retained in Table 4.2 were compiled into five remedial alternatives which address contaminated media. The remedial alternatives are summarized in Table 4.3 below, followed by a brief description of each alternative in the following sub-sections.

Table 4.3 Development of Alternatives

	Proposed Alternatives				
Alternative Components	**1**	**2**	**3**	**4**	**5**
No Action	X				
Pre-Design Investigation		X	X	X	X
Abandon On-Site Supply Well		X	X	X	X
In-Situ Thermal Remediation		X			
Enhanced Bioremediation			X		
Groundwater Containment				X	
Institutional/Engineering Controls and Site Management Plan		X	X	X	X
Monitored Natural Attenuation		X	X	X	X

4.3.1 Alternative 1: No Further Action

This alternative will be used as a baseline for comparison to other RAs. No further action would be taken to address contaminated soil or groundwater at the Site.

4.3.2 Alternative 2: In-Situ Thermal Remediation with Engineering Controls

Alternative 2 includes a pre-design investigation to determine the extent of offsite vapor intrusion. Additionally, Alternative 2 includes abandonment of the on-site supply well. Onsite overburden and bedrock groundwater is addressed with an in-situ thermal remedy. Any offsite soil vapor intrusion discovered during the pre-design investigation will also be addressed with the installation of sub-slab depressurization systems (SSDS). The objective of the Site work would be to reach as close to pre-disposal/unrestricted use conditions as is practicable. Following implementation, long term monitoring would be conducted to evaluate the natural attenuation of any remaining offsite contaminants and to assess groundwater and indoor air quality for up to 30 years off-site.

4.3.3 Alternative 3: Enhanced Bioremediation with Engineering Controls

Alternative 3 includes a pre-design investigation to determine the extent of offsite vapor intrusion. Additionally, groundwater samples would be taken to evaluate natural attenuation parameters and the most viable bio-augmentation amendment selection and dosing. The on-site supply well would be evaluated for its potential use as an injection well for amendment media and either incorporated for use as part of the remedy or abandoned to eliminate the potential for direct exposure to groundwater. Onsite overburden and bedrock groundwater is addressed with in-situ enhanced bioremediation..Any offsite soil vapor intrusion discovered during the pre-design investigation will be addressed with the installation of sub-slab depressurization systems. The objective of the Site work would be to achieve protection of human health in the short term and to reduce contaminant concentrations to drinking water standards. Following implementation, long term monitoring would be conducted to evaluate the natural attenuation of any remaining on- and off-site contaminants and to assess groundwater and indoor air quality for up to 30 years.

4.3.4 Alternative 4: Groundwater Containment with Engineering Controls

Alternative 4 includes a pre-design investigation to determine the extent of offsite vapor intrusion. The on-site supply well would be abandoned to eliminate the potential for direct exposure to groundwater. Onsite overburden and bedrock groundwater is prevented from migrating offsite with a groundwater extraction and treatment system. Any offsite soil vapor intrusion discovered during the pre-design investigation will be addressed with the installation of sub-slab depressurization systems. The objective of the Site work would be to achieve protection of human health in the short term. Following implementation, long term monitoring would be conducted to evaluate the natural attenuation of any remaining on- and off-site contaminants and to assess groundwater and indoor air quality for up to 30 years.

4.3.5 Alternative 5: Monitored Natural Attenuation with Engineering Controls

Alternative 5 includes a pre-design investigation to determine the extent of offsite vapor intrusion. The on-site supply well would be abandoned to eliminate the potential for direct exposure to groundwater. Offsite soil vapor intrusion discovered during the pre-design investigation will be addressed with the installation of sub-slab depressurization systems. A site management plan would be prepared, and institutional controls would be implemented in the form of a deed restriction to prevent installation of drinking water wells and future residential use of the Site. Long term monitoring would be conducted to evaluate the natural attenuation of on- and off-site contaminants and to assess groundwater and indoor air quality for up to 30 years.

5.0 DEVELOPMENT AND DETAILED DESCRIPTION OF ALTERNATIVES

This section provides a detailed description of the alternatives retained in Section 4.0. These conceptual designs were used to estimate the associated costs for each alternative.

5.1 ALTERNATIVE 1: NO FURTHER ACTION

This alternative does not include any actions to address Site contamination and does not meet the requirements of the National Contingency Plan or Climate Leadership and Community Protection Act. This alternative will be used as a baseline for comparison to other remedial alternatives.

5.2 ALTERNATIVE 2: IN-SITU THERMAL REMEDIATION WITH ENGINEERING CONTROLS

Alternative 2, in-situ thermal remediation with engineering controls, consists of the following components (which are subsequently described in detail):

- Pre-design investigation
- Abandonment of the Site supply well
- On-Site thermal remediation and soil vapor extraction
- On- and off-site installation of sub-slab depressurization systems (SSDSs)
- Institutional controls including preparation of an SMP
- Monitored natural attenuation and reporting

Pre-Design Investigation: Prior to implementation, a pre-design investigation will be conducted to support remedial design of Alternative 2, including: offsite indoor air and ambient air sampling to identify the extent of indoor air intrusion; and baseline sampling of all groundwater wells. Prior to implementation, onsite PVC wells will need to be abandoned; a total of 15 wells will need to be abandoned, and a proposed 9 stainless steel wells (5 overburden wells and 4 bedrock) will be installed to monitor treatment effectiveness. Groundwater samples taken at the new wells will be tested for CFCs and CVOCs, and a select number of samples will be tested for MNA parameters including TOC,

chloride, nitrate, nitrite, sulfate, sulfide, methane, ethane, ethene, carbon dioxide (CO_2), alkalinity, iron, and manganese (in addition to field parameters for pH, redox potential, and oxygen). To further delineate the nature and extent of 1,4-Dioxane to the NYSDEC guidance value of 0.35 ug/L, groundwater samples will also be collected at a subset of monitoring wells for 1,4-Dioxane using USEPA Method 8720 Selected Ion Monitoring (SIM).

Site Supply Well Abandonment: Municipal water service in the Site building will be expanded to eliminate the need for the onsite supply well, which will subsequently be abandoned. The site building fire suppression system is already supplied by municipal water, so any work to expand the existing service will be limited to plumbing within the building. The supply well is a 300-foot-deep open borehole bedrock well; abandonment is assumed to include tremie pipe placement of grout for the entire length of the well with a bentonite cap and subsequent removal of subsurface piping and surface restoration.

On-Site Thermal Remediation and Soil Vapor Extraction: The proposed thermal treatment area is presented in Figure 5.1. Dual heater/soil vapor extraction wells will be spaced as needed over an approximately 61,500 square foot area where CFC-11 concentrations exceed 5 ug/L in overburden and bedrock groundwater and will heat to depths between 30 and 140 feet below ground surface, as appropriate, to treat groundwater to GA drinking water criteria. Based on a contaminant concentration reduction of 99.9 percent, it has been assumed that the treatment zone will be heated, and vapors will be extracted for approximately 6 months.

Off-Site Installation of Sub-Slab Depressurization Systems: SSD systems would be installed at nearby offsite properties based on the results of indoor air sampling performed during the predesign investigation. Up to 6 off-site systems may be installed; this alternative includes all 6 systems to be conservative and prevent potential vapor intrusion as a result of higher vapor pressure associated with thermal treatment. The 4 residences abutting the property directly to the west are each approximately 1,600 square feet with slab on grade construction. Two additional downgradient properties are approximately 2000 and 4700 square feet and appear to be slab on grade construction.

Institutional Controls Including Preparation of an SMP: Successful implementation of the remedy will eliminate the need for ICs that restrict the use of the property to prevent contaminant exposure.

However, a SMP detailing the ongoing monitoring and maintenance of the offsite SSDSs will still be required.

Monitored Natural Attenuation and Reporting: It is assumed that after Site work is complete and IC/ECs are in place, on- and off-Site monitoring will be carried out for up to 30 years. Semi-annual groundwater sampling will be conducted from 20 existing monitoring wells for VOCs and CFCs and from 10 wells for MNA parameters for five years, and indoor air samples would be taken semi-annually from the Site building and up to 6 off-Site buildings equipped with sub-slab depressurization systems. Annually thereafter, groundwater sampling would occur at 10 wells for MNA parameters, and indoor air sampling would occur at the Site building and up to 6 off-Site buildings. Monitoring and inspection results will be presented in an annual report.

5.3 ALTERNATIVE 3: ENHANCED BIOREMEDIATION WITH ENGINEERING CONTROLS

Alternative 3, enhanced bioremediation with engineering controls, consists of the following components which are subsequently described in detail:

- Pre-Design Investigation
- Abandonment of the Site supply well
- Onsite bio-augmentation
- On- and off-site installation of sub-slab depressurization systems (SSDSs)
- Institutional controls including preparation of an SMP
- Monitored natural attenuation and reporting

Pre-Design Investigation: Prior to implementation, a pre-design investigation will be conducted to support remedial design of Alternative 3, including offsite indoor air and ambient air sampling to identify the extent of indoor air intrusion; and baseline sampling of all groundwater wells. Groundwater samples will be tested for CFCs and CVOCs, and a select number of samples will be tested for MNA parameters and those affecting biological growth, including TOC, chloride, nitrate, nitrite, sulfate, sulfide, methane, ethane, ethene, CO_2, alkalinity, iron, manganese, and phosphorus (in addition to field parameters for pH, redox potential, and oxygen). To further delineate the nature and extent of 1,4-Dioxane to the NYSDEC guidance value of 0.35 ug/L, groundwater samples will also be

collected at a subset of monitoring wells for 1,4-Dioxane using USEPA Method 8720 SIM. Additionally, a microbial study will be performed to evaluate the presence of bacteria onsite using bio-trap sampling or equivalent.

Site Supply Well Abandonment: Municipal water service in the Site building will be expanded to eliminate the need for the onsite supply well. The site building fire suppression system is already supplied by municipal water, so any work to expand the existing service will be limited to plumbing within the building. The on-site supply well would be evaluated for its potential use as an injection well for amendment media and either incorporated for use as part of the remedy or abandoned to eliminate the potential for direct exposure to groundwater; for costing purposes, it is assumed that the supply well will be abandoned. The supply well is a 300-feet deep open borehole bedrock well; abandonment is assumed to include tremie pipe placement of grout for the entire length of the well with a bentonite cap and subsequent removal of subsurface piping and surface restoration.

Onsite Bio-Augmentation: Injection of bio-amendments will be implemented to address on- and off-Site groundwater contamination. Injection wells and supporting monitoring points will be installed for use during amendment injection. For costing purposes, it is assumed that injection activities will be performed with temporary equipment and facilities and that no other permanent equipment will be required. Figure 5.2 shows the proposed treatment area of approximately 8,000 square feet in the overburden and a 200-foot-long bedrock fence. Injection well spacing of 20 feet over the treatment area was assumed for costing purposes, resulting in a total of 20 new overburden wells and 25 new bedrock wells, with the assumption that additional injections would be made with temporary wells to ensure sufficient distribution. Injections will be performed at the property boundary to reach as much contamination as possible. A budgetary estimate was obtained from a specialized vendor for the cost of the amendments and injection services based on the area and depth of the treatment zone and the associated contaminants. Final decisions regarding well layout, use of permanent or temporary wells, and injection frequency will be made during remedy design, but for costing purposes a second round of amendment injection was included 6 months after the initial application.

Off-Site Installation of Sub-Slab Depressurization Systems: SSD systems would be installed at nearby offsite properties contingent on the results of soil vapor intrusion sampling performed during the pre-design investigation. Up to four off-site systems may be installed; this alternative includes all

four systems to be conservative. The four residences abutting the property directly to the west are each approximately 1,600 square feet with slab on grade construction.

Institutional Controls Including Preparation of an SMP: ICs will likely include implementation of land-use restrictions to control on-Site subsurface activity to minimize contaminant exposure. Land-use restrictions will be implemented through legal instruments such as deeds and/or permitting processes, and a SMP will be required.

Monitored Natural Attenuations and Reporting: It is assumed that after Site work is complete and IC/ECs are in place, on- and off-Site monitoring will be carried out for up to 30 years. Semi-annual groundwater sampling will be conducted from 20 existing monitoring wells for VOCs and CFCs and from 10 wells for MNA parameters for five years, and indoor air samples would be taken semi-annually from the Site building and up to 4 off-Site buildings equipped with sub-slab depressurization systems. Annually thereafter, groundwater sampling would occur at 10 wells with 5 samples for MNA parameters, and indoor air sampling would occur at the Site building and up to 4 off-Site buildings. Monitoring and inspection results will be presented in an annual report.

5.4 ALTERNATIVE 4: GROUNDWATER CONTAINMENT WITH ENGINEERING CONTROLS

Alternative 4, pump and treat with engineering controls, consists of the following components, which are subsequently described in detail:

- Pre-design Investigation
- Abandonment of the Site supply well
- Installation of groundwater extraction wells and associated treatment system
- Off-site installation of sub-slab depressurization systems (SSDSs)
- Institutional controls including preparation of an SMP
- Monitored natural attenuation and reporting

Pre-Design Investigation: Prior to implementation, a pre-design investigation will be conducted to support remedial design of Alternative 4, including: offsite indoor air and ambient air sampling to identify the extent of indoor air intrusion; and baseline sampling of all groundwater wells.

Groundwater samples will be tested for CFCs and CVOCs, and a select number of samples will be tested for MNA parameters and those affecting biological growth, including TOC, chloride, nitrate, nitrite, sulfate, sulfide, methane, ethane, ethene, CO_2, alkalinity, iron, manganese, and phosphorus (in addition to field parameters for pH, redox potential, and oxygen). To further delineate the nature and extent of 1,4-Dioxane to the NYSDEC guidance value of 0.35 ug/L, groundwater samples will also be collected at a subset of monitoring wells for 1,4-Dioxane using USEPA Method 8720 SIM. Additionally, hydraulic conductivity tests will be performed at several existing monitoring wells and production well located near the site boundaries to attempt to identify preferential flow pathways within the media and better position extraction wells.

Site Supply Well Abandonment: Municipal water service in the Site building will be expanded to eliminate the need for the onsite supply well, which will subsequently be abandoned. The site building fire suppression system is already supplied by municipal water, so any work to expand the existing service will be limited to plumbing within the building. The supply well is a 300-foot deep open borehole bedrock well; abandonment is assumed to include tremie pipe placement of grout for the entire length of the well with a bentonite cap and subsequent removal of subsurface piping and surface restoration.

Installation of Groundwater Extraction Wells and Associated Treatment System: Groundwater extraction wells will be installed along the northern and eastern boundaries of the Site in order to capture the groundwater plume and prevent offsite migration of contaminants. The nature of the overburden geology makes predicting the capture radius of an extraction well difficult; as part of the design of the extraction system, a pilot study would be performed to attempt to locate existing preferential pathways for groundwater within the overburden soils and estimate the radius of influence of extraction wells and anisotropy of groundwater flow; for pricing purposes, it is assumed that wells will be spaced 100 feet apart along the Site boundary for a total of 6 wells. The depth and screened intervals of the extraction wells would be informed by borehole geophysical analysis performed after drilling, but for the purpose of this FS, wells are assumed to be 55 feet deep and screened between 40 and 55 feet bgs and to pump at 20 gpm.

Extracted groundwater will be pumped to a new treatment building located onsite. For pricing purposes, the system is assumed to include an equalization tank, bag filters, and an air stripper that discharges directly to the atmosphere, although the exact components of the system would be

determined during the design phase. Capital costs include construction of the building, procurement and installation of the equipment, and associated reporting.

Off-Site Installation of Sub-Slab Depressurization Systems: SSD systems would be installed at nearby offsite properties contingent on the results of soil vapor intrusion sampling performed during the predesign investigation. Up to () four off-site systems may be installed; this alternative includes all () four systems to be conservative. The () four residences abutting the property directly to the west are each approximately 1,600 square feet with slab on grade construction.

Institutional Controls Including Preparation of an SMP: ICs will likely include implementation of land-use restrictions to control on-Site subsurface activity to minimize contaminant exposure. Land-use restrictions will be implemented through legal instruments such as deeds and/or permitting processes, and a SMP will be required.

Monitored Natural Attenuation and Reporting: It is assumed that after Site work is complete and IC/ECs are in place, on- and off-Site monitoring will be carried out for up to 30 years. Quarterly sampling will occur for the groundwater extraction system, including one influent sample from each well and one effluent sample for the system. Semi-annual groundwater sampling will be conducted from 20 existing monitoring wells for VOCs and CFCs and from 10 wells for MNA parameters for five years., and indoor air samples would be taken semi-annually from the Site building and up to 4 off-Site buildings equipped with sub-slab depressurization systems. Annually thereafter, groundwater sampling would occur at 10 wells with 5 samples for MNA parameters., and indoor air sampling would occur at the Site building and up to 4 off-Site buildings. Monitoring and inspection results will be presented in an annual report.

5.5 ALTERNATIVE 5: MONITORED NATURAL ATTENUATION WITH ENGINEERING CONTROLS

Alternative 5, Monitored Natural Attenuation with Engineering Controls, consists of the following components, which are subsequently described in detail:

- Pre-Design Investigation

- Abandonment of the Site supply well
- On- and off-site installation of sub-slab depressurization systems (SSDSs)
- Institutional controls including preparation of an SMP
- Monitored natural attenuation and reporting

Pre-Design Investigation: Prior to implementation, a pre-design investigation will be conducted to support remedial design of Alternative 5, including: offsite indoor air and ambient air sampling to identify the extent of indoor air intrusion; and baseline sampling of all groundwater wells. Groundwater samples will be tested for CFCs and CVOCs, and a select number of samples will be tested for MNA parameters and those affecting biological growth, including TOC, chloride, nitrate, nitrite, sulfate, sulfide, methane, ethane, ethene, CO_2, alkalinity, iron, manganese, and phosphorus (in addition to field parameters for pH, redox potential, and oxygen). To further delineate the nature and extent of 1,4-Dioxane to the NYSDEC guidance value of 0.35 ug/L, groundwater samples will also be collected at a subset of monitoring wells for 1,4-Dioxane using USEPA Method 8720 SIM.

Site Supply Well Abandonment: Municipal water service in the Site building will be expanded to eliminate the need for the onsite supply well, which will subsequently be abandoned. The site building fire suppression system is already supplied by municipal water, so any work to expand the existing service will be limited to plumbing within the building. The supply well is a 300-foot-deep open borehole bedrock well; abandonment is assumed to include tremie pipe placement of grout for the entire length of the well with a bentonite cap and subsequent removal of subsurface piping and surface restoration.

Off-Site Installation of Sub-Slab Depressurization Systems: SSD systems would be installed at nearby offsite properties contingent on the results of soil vapor intrusion sampling performed during the predesign investigation. Up to four off-site systems may be installed; this alternative includes all four systems to be conservative. The four residences abutting the property directly to the west are each approximately 1,600 square feet with slab on grade construction.

Institutional Controls Including Preparation of an SMP: ICs will likely include implementation of land-use restrictions to control on-Site subsurface activity to minimize contaminant exposure. Land-

use restrictions will be implemented through legal instruments such as deeds and/or permitting processes, and a SMP will be required.

Monitored Natural Attenuation and Reporting: It is assumed that after Site work is complete and IC/ECs are in place, on- and off-Site monitoring will be carried out for up to 30 years. Semi-annual groundwater sampling will be conducted from 20 existing monitoring wells for VOCs and CFCs and from 10 wells for MNA parameters for five years., and indoor air samples would be taken semi-annually from the Site building and up to 4 off-Site buildings equipped with sub-slab depressurization systems. Annually thereafter, groundwater sampling would occur at 10 wells with 5 samples for MNA parameters, and indoor air sampling would occur at the Site building and up to 4 off-Site buildings. Monitoring and inspection results will be presented in an annual report.

6.0 DETAILED ANALYSIS AND COMPARISON OF ALTERNATIVES

6.1 DETAILED ANALYSIS EVALUATION CRITERIA

The detailed analysis of each remedial action alternative for surface soil and subsurface media was performed using the evaluation criteria identified in DER-10 (NYSDEC, 2010) and Subpart 375-1.8(f) (NYS, 2006), as well as the Green Remediation criteria in DER-31 (NYSDEC, 2011). Table 6.1 includes a comparison of alternatives to the following criteria:

- Compliance with SCGs
- Overall Protection of Public Health and the Environment
- Short-term Impacts and Effectiveness
- Long-term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume with Treatment
- Implementability
- Land Use
- Sustainability / Green Remediation (DER-31)
- Cost-Effectiveness

Compliance with Standards, Criteria, and Guidance. Compliance with SCGs addresses whether a remedy will meet applicable environmental laws, regulations, standards, and guidance. Chemical-specific SCGs were discussed in Section 3,0. Table 6.1 indicates whether each RA meets, partially meets, or does not meet compliance with the Site-specific SCGs. Table 6.2 summarizes the list of applicable SCGs used in the evaluation of alternatives against this criterion.

Overall Protection of Public Health and the Environment. This criterion is an evaluation of the remedy's ability to protect public health and the environment, assessing how risks posed through each existing or potential exposure pathway are eliminated, reduced, or controlled through removal, treatment, ECs or ICs. The remedy's ability to achieve each of the RAOs is evaluated.

Short-term Impacts and Effectiveness. The potential short-term adverse impacts and risks of the remedy upon the community, the workers, and the environment during the construction and/or

implementation are evaluated. For the RAs discussed herein, the Site work will be conducted to reduce potential of short-term impacts by use of perimeter air monitoring; designated decontamination locations; erosion and sediment controls; temporary fencing around work areas, and personal protective equipment. Additionally, remedial action contractors will prepare and adhere to a construction work plan and health and safety plan. The potential for short term impacts increases with the duration of intrusive Site work. The duration the remedial activities, along with indication as to whether the remedy will result in short-term effectiveness is included in Table 6.1.

Long-term Effectiveness and Permanence. This criterion evaluates the long-term effectiveness of the remedy after implementation. If wastes or treated residuals remain on-Site after the selected remedy has been implemented, the following items are evaluated:

1. magnitude of remaining risks
2. adequacy of the engineering and ICs intended to limit the risk
3. reliability of these controls
4. ability of the remedy to continue to meet RAOs in the future

This includes an evaluation of the permanence of the alternative, the magnitude of residual risk, and the adequacy and reliability of controls required to manage wastes or residuals remaining at the Site.

Reduction of Toxicity, Mobility, or Volume with Treatment. The remedy's ability to reduce the toxicity, mobility or volume of Site contamination is evaluated. Preference is given to remedies that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the Site.

Implementability. The technical and administrative feasibility of implementing the remedy is evaluated. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. For administrative feasibility, the availability of the necessary personnel and material is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, or other issues.

Land Use. The current, intended, and reasonably anticipated future land uses of the Site and its surroundings is considered in the evaluation of RAs.

Sustainability / Green Remediation (DER-31). Evaluating compliance with DER-31 (NYSDEC, 2011) was conducted. This includes applying green remediation concepts, such as minimizing energy consumption; reducing greenhouse gas emissions; maximizing the reuse of land and the recycling of materials; and conserving natural resources such as soil, water, and habitat to the extent possible, while still implementing remedies that are protective of public health and the environment. Additionally, an assessment of the operational and embodied energy (converted to metric tons of emissions of CO_2) associated with remedial activities was performed to quantitatively compare the environmental impacts of each alternative.

Cost-Effectiveness. Capital and Site Management costs, including operation, maintenance, and monitoring (OM&M) costs, were estimated based on the conceptual designs described in Section 5.0 for each RA and are compared on a present worth (PW) basis.

6.2 COST ANALYSIS PROCEDURES

Estimated costs presented in this FS Report are intended to be within the target accuracy range of minus 30 to plus 50 percent of actual cost (USEPA, 1988). Costs are presented as a PW and as a total cost for up to a 30-year period.

A summary of the costs for each alternative identifying capital and PW costs are included in each alternative's cost description. Each cost estimate includes a PW analysis to evaluate expenditures that occur over different time periods. The analysis discounts future costs to a PW and allows the cost of RAs to be compared on an equal basis. PW represents the amount of money that, if invested now and disbursed as needed, will be sufficient to cover costs associated with the remedial action over its planned life cycle. A discount rate of 2.6 percent, as published by the Office of Management and Budget (OMB), was used to prepare the cost estimates (OMB, 2022).

Consistent with USEPA FS cost estimating guidance (USEPA, 2000), the RA cost estimates include costs for project management, remedial design, construction management, technical support, and scope contingency.

Project management includes planning and reporting, community relations support during construction or OM&M, bid or contract administration, permitting (not already provided by the construction or OM&M contractor), and legal services outside of ICs. Project management costs are generally between 5 and 10 percent of total direct costs.

Remedial design cost includes cost for collection and analysis of pre-design field data, engineering survey for design, treatability study/pilot-scale testing, and the various design components such as design analysis, plans, specifications, cost estimate, and schedule. Remedial design cost is generally between 6 and 10 percent of total direct costs.

Construction management cost includes cost associated with services to manage construction or installation of the remedial action, except any similar services provided as part of regular construction activities. Activities include review of submittals, design modifications, engineering survey for construction, preparation of operation and maintenance (O&M) manual, documentation of QC/quality assurance, and record drawings. Construction management cost is generally between 6 and 15 percent of total direct costs.

Technical support during O&M includes services to monitor, evaluate, and report progress of the remedial action. This includes oversight of O&M activities, update of O&M manual, and progress reporting and is generally between 10 percent and 20 percent of total annual O&M costs depending on complexity of the remedial action (USEPA, 2000).

Scope contingency represents project risks associated with the feasibility-level of design presented in this FS Report. This type of contingency represents costs, unforeseeable at the time of estimate preparation, which are likely to become known as the remedial design proceeds. Scope contingency ranges from 10 to 25 percent, with higher values appropriate for alternatives with greater levels of cost growth potential (USEPA, 2000). A contingency of 20% for capital costs and 25% for annual and periodic costs was added to each of the alternatives described herein.

Project management, remedial design, and construction management costs, related to implementation of the chosen RA, presented in this FS Report are based upon the following matrix presented in the USEPA FS cost estimating guidance (USEPA, 2000).

Professional and Technical Costs as Percentage of Direct Costs					
Indirect Cost	< $100K (%)	$100K-$500K (%)	$500K-$2M (%)	$2M-$10M (%)	>$10M (%)
Project Management	10	8	6	5	5
Remedial Design	20	15	12	8	6
Construction Management	15	10	8	6	6

A comparison of alternatives against this criterion is discussed in detail in Subsection 6.3.

6.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

The comparative analysis evaluates the relative performance of each alternative using the same criteria by which the detailed analysis of each alternative was conducted. The purpose of the comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another to aid in selecting an overall remedy for the Site. In addition to the comparison provided in Table 6.1, a detailed narrative for the comparative analysis of remedial alternatives using the evaluation criteria identified in DER-10 (NYSDEC, 2010) and Subpart 375-1.8(f) (NYS, 2006) is presented below.

The comparative analysis presented in this document uses a qualitative approach to comparison, with the exceptions of comparing alternative costs and the required time to implement each alternative. A comparison of the capital and long-term costs associated with the RAs is presented in Table 6.3, with costs for each alternative summarized in Tables 6.4 to 6.7. Detailed cost analysis backup is provided in Appendix A.

Compliance with Standards, Criteria and Guidance. Alternatives 1, 4, and 5 do not include actions to address contamination at the Site. These remedies are not compliant with Site specific and chemical specific SCGs.

Alternative 2 will result in compliance with Site-specific SCGs. Alternative 3 will result in partial compliance with Site-specific and chemical-specific SCGs. Each of the alternatives will leave

contaminated groundwater present off-Site at concentrations greater than SCGs. However, Alternatives 2 and 3 have the greatest potential to reduce offsite groundwater concentrations and may meet SCGs at some future time due to natural attenuation processes. Therefore Alternative 2 ranks highest for meeting Site-specific and chemical-specific SCGs, followed in decreasing rating by Alternatives 3, 4, and 5.

Overall Protection of Public Health and the Environment. The comparative analysis of alternatives relative to Overall Protection of Public Health and the Environment takes into consideration current exposure pathways. Groundwater in the vicinity of the Site is not used as a source of drinking water, and the New York State well registry does not indicate the presence of any wells located within the suspected bounds of the offsite plume. There is no complete exposure pathway to groundwater except for a construction or utility worker that may be required to conduct work in the subsurface. Based on offsite ambient and indoor air sampling, soil vapor intrusion does not currently appear to be a complete exposure pathway for contaminant concentrations above ambient conditions at properties downgradient of the Site; however, due to the potential of contaminants to migrate to soil vapor from groundwater it is possible that this exposure pathway may develop in the future. Alternative 1 rates lowest at overall protection of public health and the environment since it does not address the potential soil vapor intrusion exposure pathway. Each of the other alternatives includes installation of SSDSs as necessary to prevent soil vapor intrusion, although Alternative 2 creates a greater potential for soil vapor intrusion during active remediation. Therefore, Alternatives 2, 3, 4, and 5 are all considered protective of public health and the environments, although Alternatives 3, 4, and 5 rate slightly higher than Alternative 2 for this criterion.

Short-Term Impacts and Effectiveness. Although ECs will be used and a health and safety plan will be prepared and followed, there is potential for short-term adverse impacts and risks upon the community, the workers, and the environment during the construction and implementation of Alternatives 2, 3, 4, and 5. Alternative 5 ranks lowest regarding short term impacts based on the duration of the remedy implementation and degree of the remedy's intrusiveness. Alternative 3 is next lowest, followed by Alternative 4, which both have a similar scope of intrusive work (installation of SSDS, well abandonment, and well installation) but Alternative 4 also includes long term operation of a GWETS for plume containment, creating a new possible exposure pathway to onsite contaminants. Alternative 2 has the most short-term impacts, requiring significantly more staging and longer

construction duration than the other alternatives. Additionally, the execution of the thermal remedy may create additional threats via exposure to volatilized contaminants or energized equipment.
Alternative 2 ranks highest for short term effectiveness because it eliminates potential risk to public health and will reduce contaminant concentrations in the short term. Alternatives 3 and 4 rank second and third respectively for short term effectiveness as they both eliminate potential risk to public health in the short term, but Alternative 3 may have an impact on offsite groundwater contamination, accelerating the time to achieve SCGs. Alternative 5 ranks last for short-term effectiveness, as its only short-term components are ECs and ICs.

Long-Term Effectiveness and Permanence. Alternatives 1 and 5 rate equally low with regards to long-term effectiveness and permanence since little to no active remediation will occur; although Alternative 5 includes engineering controls to mitigate risks on- and off-site, if the ECs are discontinued then the residual risks remain the same as Alternative 1. Alternative 2 rates highest for long-term effectiveness and permanence because its objective is to achieve onsite unrestricted use conditions. Alternative 3 rates next highest due to its active remediation which should accelerate achieving on- and off-site SCGs. Alternative 4 rates third for long-term effectiveness and permanence; although operation of a GWETS reduces onsite contaminant mass, the hydrology of the site suggests that the GWETS will not achieve significant mass removal. If the GWETS and ECs are discontinued, then the residual risks will be similar to those present in Alternative 1 and 5.

Reduction of Toxicity, Mobility, or Volume with Treatment. Alternatives 1, 4, and 5 rate equally low with regards to reduction of toxicity, mobility, or volume with treatment since little to no active remediation will occur. Alternative 2 rates highest for these criteria as it would reduce toxicity, mobility, and volume of impacted groundwater to the greatest extent. Alternative 3 would reduce the toxicity, mobility, and volume of impacted groundwater on- and off-site over time, but the overall reduction would be less than Alternative 2.

Implementability. There would be few to no technical difficulties to implement Alternatives 1 or 5; administrative difficulties would include implementing deed restrictions to limit potential future use. Alternative 2 would have slight technical difficulties because it would require the greatest number of new wells to be installed in both overburden and bedrock, which has historically been challenging. Alternatives 3 would have moderate technical difficulties because injection of substrate to spur biological activity will be challenging in the dense till overburden. Similarly, Alternative 4 will have

technical difficulties in achieving plume capture through extraction in the tight overburden till. Implementing SSDSs on- and off-site is not anticipated to pose any technical challenges.

Land Use. As established in Section 6.0, exposure pathways at the Site include potential vapor intrusion to indoor air. Alternatives 2, 3, 4, and 5 address the potential exposure pathway by installing SSDSs in locations where indoor air infiltration may impact human health and safety, preventing future exposure and eliminating the source of soil vapor and groundwater contamination. Alternatives 1, 4, and 5, however, do not address the onsite groundwater contamination, and therefore restrictions to current or foreseeable land use may be needed.

Sustainability / Green Remediation (DER-31). An assessment of the operational and embodied energy associated with remedial activities was performed to quantitatively compare the environmental impacts of each alternative. The use of fuels (such as gasoline or diesel) and electricity in production, transportation, and remedial action was estimated using published CO_2 factors were and converted to equivalent greenhouse gas emissions as metric tons of CO_2. Table 6.8 presents a summary of the emissions of each component of the alternatives, and the supporting calculations are in Appendix B. The results of the emissions assessment are as follows:

Remedial Alternatives	Total Emissions (Metric Tons of CO_2)
Alternative 1: No Further Action	0
Alternative 2: In-Situ Thermal Remediation with Engineering Controls	8301.75
Alternative 3: Enhanced Bioremediation with Engineering Controls	112.68
Alternative 4: Groundwater Containment with Engineering Controls	1174.44
Alternative 5: Long Term Monitoring with Engineering Controls	72.53

Alternative 5 rates highest on sustainability, as very few resources would be required for implementation; the primary source of emissions is the ongoing operation of the on- and off-site SSDSs. Alternative 3 rates third because the addition of enhanced biological results in a relatively small increase in remedial action-based emissions (an approximate 55% increase) compared to Alternatives 2 and 4, in which the ongoing operation of the groundwater extraction system and the

application of electrical resistance heating result in an over 4000% increase in emissions. Alternative 2 rates last based on emissions as a result of the amount of energy used to operate the remedy.

Cost. The estimated capital cost and present worth of the remedial alternatives (as summarized from Table 6.3) are as follows:

Remedial Alternatives	Capital Cost	Present Worth
Alternative 1: No Further Action	$ 0	$ 0
Alternative 2: In-Situ Thermal Remediation with Engineering Controls	$ 27,077,000	$ 27,881,000
Alternative 3: Enhanced Bioremediation with Engineering Controls	$ 2,122,000	$ 2,926,000
Alternative 4: Groundwater Containment with Engineering Controls	$ 1,751,000	$ 5,985,000
Alternative 5: Long Term Monitoring with Engineering Controls	$ 153,000	$ 957,000

A summary of the costs associated with these alternatives are presented in Tables 6.3 through 6.7. Detailed cost analysis backup is provided in Appendix A.

7.0 REFERENCES

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FIGURES

NYSDEC Site # 344041
Gabriel Manufacturing
Stony Point, New York

MACTEC

Site Location

Project 3616206129 Figure 1.1

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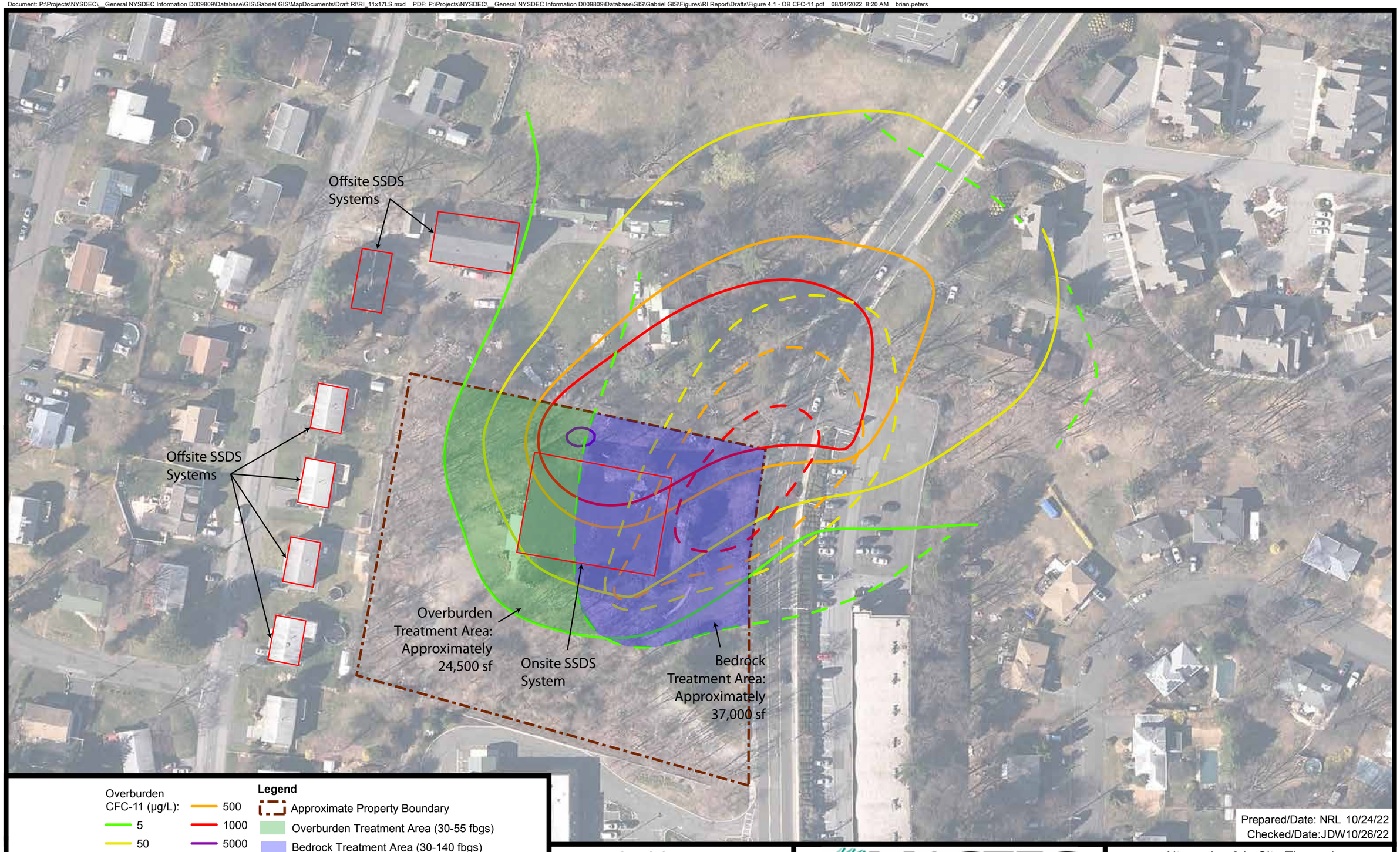
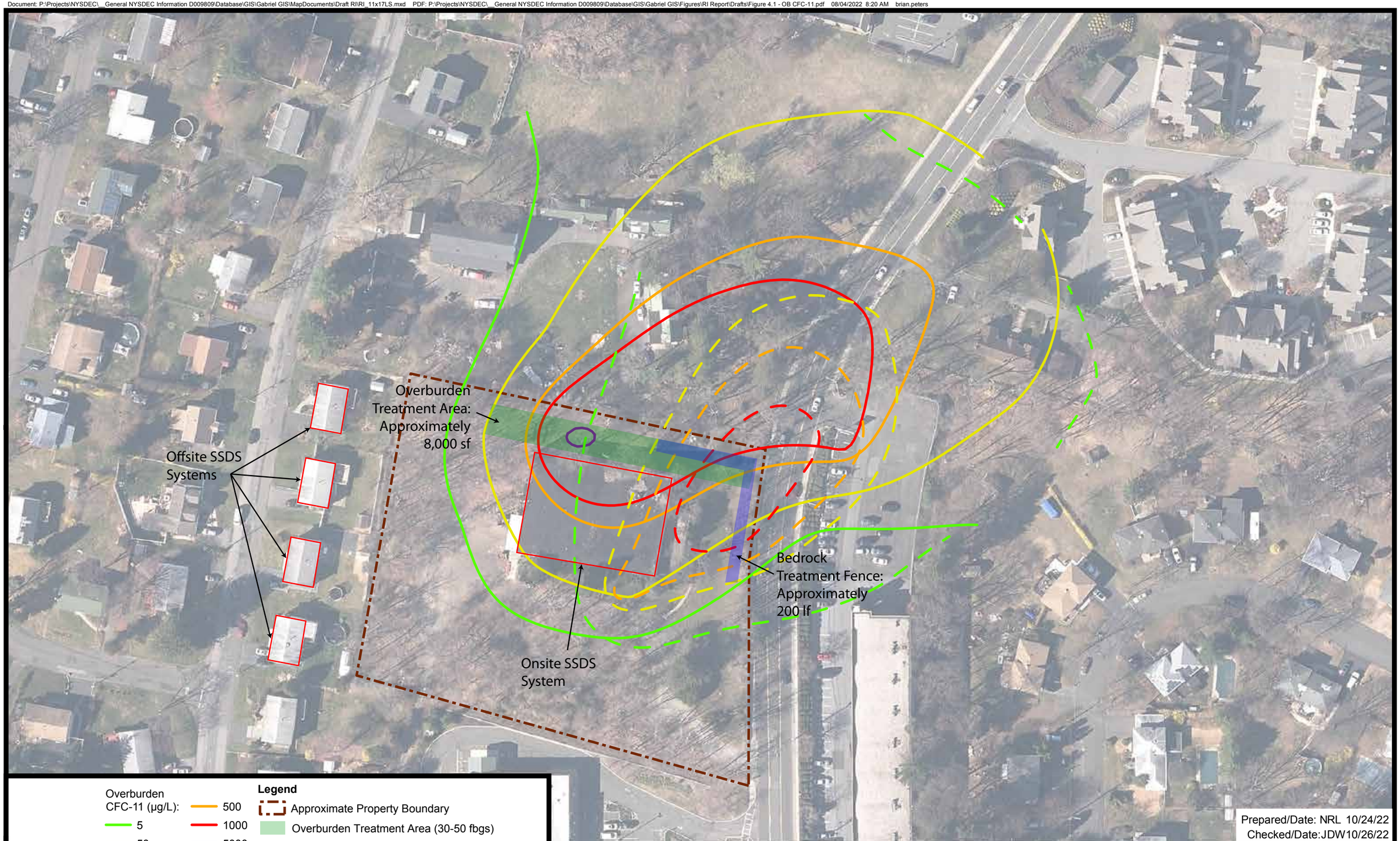


NYSDEC Site # 344041
Gabriel Manufacturing
Stony Point, New York

MACTEC

Alternative 2 In Situ Thermal Treatment Area
Project 3616206129 Figure 5.1



NYSDEC Site # 344041
Gabriel Manufacturing
Stony Point, New York

MACTEC

Alternative 3 Enhanced Bioremediation Treatment Area
Project 3616206129 Figure 5.2

TABLES

Table 4.1: Identification and Screening of Potential Remedial Technologies

Environmental Media	General Response Action	Remedial Technology	Process Option	Applicability to		Screening Status	Comments
				Site-Limiting Characteristics	Waste-Limiting Characteristics		
Groundwater	No Action	Not Applicable	Not Applicable	None.	Would not reduce toxicity, mobility, or volume of COCs	Retained.	Retained to be carried through as a baseline comparison to other alternatives.
	Institutional Controls	Groundwater Use Restrictions	Restrict use/drilling of production wells	Groundwater is not currently used as a drinking water source in the vicinity of the site. Would need to ensure that future supply wells are not installed.	Would not reduce toxicity, mobility, or volume of contaminants, but would ensure that groundwater is not used as a drinking water source in the future.	Retained.	Viable as a component of remedial actions which do not involve remediation allowing for unrestricted use.
	Natural Attenuation	Groundwater Monitoring	Long-term Monitoring	None.	Would not reduce toxicity, mobility, or volume of contaminants in a reasonable time frame.	Retained.	Viable as a component of remedial actions to monitor the effectiveness of treatment.
	Containment	Capping	Low Permeability Cover System	Infiltration is not understood to be the primary source of ongoing groundwater contamination, therefore a cover system has little impact beyond potentially decreasing off-site migration of contaminants by reducing groundwater recharge on site.	May decrease mobility but would not reduce toxicity or volume of contaminants.	Eliminated.	
		Vertical Barriers	Slurry wall, sheet piling	Depth to competent bedrock and the presence of transmissive fractures in bedrock containing impacted groundwater.	Would decrease mobility, but would not reduce toxicity or volume of contaminants.	Eliminated.	
		Extraction	Groundwater Extraction Wells	The geology of the overburden till and fractured bedrock make it difficult to ensure complete capture of migrating groundwater. In addition, the impacted plume extends past the area where the remedy can be implemented (i.e. the site boundary).	Although potentially effective in the short term, requires long-term operation and maintenance to meet RGs.	Retained	
	In-Situ Treatment	Biological Treatment	Enhanced Biodegradation	Injecting biological amendments into overburden till and fractured bedrock may result in unpredictable distribution of amendments and unreliable contact with contaminants. The impacted plume also extends past the area where the remedy can be implemented (i.e. the site boundary).	CFCs may have limited response to biological remediation.	Retained.	Viable option in conjunction with other technologies that will eliminate off-site exposure pathways.
		Physical Treatment	Permeable Reactive Barrier	It will be difficult to ensure that the barrier is present in all of the preferential pathways groundwater travels through in overburden till and fractured bedrock, and there is a potential to clog or foul existing pathways and change contaminant distribution by creating new preferential pathways. Additionally, the barrier would have to be implemented down to competent bedrock and within transmissive bedrock fractures.	None.	Eliminated.	
			Air Sparging	The geology of the overburden till and fractured bedrock will make it difficult to inject air, to predict the pathway that volatilized contaminants will take travelling to the surface, and to implement the soil vapor extraction system necessary to capture and treat volatilized contaminants. In addition, the impacted plume extends past the area where the remedy can be implemented (i.e. the site boundary).	None	Eliminated.	
			Dual-Phase Extraction	The geology of the overburden till and fractured bedrock will likely restrict the radius of influence of extraction wells and make it difficult to ensure complete capture of groundwater. In addition, the groundwater plume is located in areas where the remedy cannot be implemented (i.e. past the site boundary).	None	Eliminated.	
		Thermal Treatment	Electrical Resistance Heating or Other Thermal Technology	The geology of the overburden till and fractured bedrock will make it difficult to implement the soil vapor extraction system necessary to capture and treat volatilized contaminants. In addition, the impacted plume extends past the area where the remedy can be implemented (i.e. the site boundary).	None	Retained.	
		Chemical Treatment	Oxidation	Injecting chemical oxidants into overburden till and fractured bedrock may result in unpredictable distribution of amendments and unreliable contact with contaminants. The impacted plume also extends past the area where the remedy can be implemented (i.e. the site boundary).	Not effective for CFCs.	Eliminated.	
	Ex-Situ Treatment	Physical Treatment	Granular Activated Carbon	The plume extends beyond the area where groundwater can be captured (i.e. beyond the site boundary).	Ultimately would decrease mobility of contaminants, but would not reduce toxicity or volume of contaminants.	Retained.	
			Air Stripping	The plume extends beyond the area where groundwater can be captured (i.e. beyond the site boundary).	Requires additional treatment of off-gasses captured during air stripping.	Retained	
Soil Vapor	No Action	Not Applicable	Not Applicable	Not Applicable	Will not reduce toxicity, mobility, or volume of site related contaminants.	Retained	Retained to be carried through as a baseline comparison to other alternatives.
	Engineering Controls	Sub-Slab Depressurization	Sub-Slab Depressurization	This would be conducted in on- and off-site structures as applicable. Limiting characteristics would be structure specific and could include condition of the structure floor and space restrictions.	None	Retained	

Table 4.1: Identification and Screening of Potential Remedial Technologies

Environmental Media	General Response Action	Remedial Technology	Process Option	Applicability to		Screening Status	Comments
				Site-Limiting Characteristics	Waste-Limiting Characteristics		
	In-Situ Treatment	Physical Treatment	Soil Vapor Extraction	The geology of the overburden till and fractured bedrock will likely restrict the radius of influence of extraction wells and make it difficult to ensure complete capture of soil vapor. In addition, the impacted soil vapor is located in areas where the remedy cannot be implemented (i.e.. past the site boundary).	None.	Retained	
			Dual Phase Extraction	The geology of the overburden till and fractured bedrock will likely restrict the radius of influence of extraction wells and make it difficult to ensure complete capture of soil vapor. In addition, the impacted soil vapor is located in areas where the remedy cannot be implemented (i.e.. past the site boundary).	None	Eliminated.	
	Ex-Situ Treatment	Physical Treatment	Vapor Phase Carbon Adsorption	Impacted vapor is located beyond the area where it can be captured (i.e. beyond the site boundary).	Ultimately would decrease mobility of contaminants and eliminate exposure pathways, but would not reduce toxicity or volume of contaminants.	Retained	

Table 4.2: Detailed Technology Screening

Environmental Media	General Response	Remedial Technology	Process Option	Effectievness	Implementability	Relative Cost	Screening Status	Comments
Groundwater	No Action	Not Applicale	Not Applicable	Not effective for reducing contamination concentrations or addressing the identified exposure pathways.	There are no technical issues with implementing this alternative.	No cost	Retained.	Retained to be carried through as a baseline comparison to other alternatives.
	Institutional Controls	Groundwater Use Restrictions	Restrict use/drilling of production wells	Institutional controls will not reduce contaminant concentrations but does eliminate potential exposure pathways resulting from extraction of and direct contact with groundwater	There are no technical issues with implementing this alternative. Institutional controls are relatively easy to implement and are typically captured in a Site Management Plan (SMP).	Relative costs are low	Retained.	Viable as a component of remedial actions which do not involve remediation allowing for unrestricted use.
	Natural Attenuation	Groundwater Monitoring	Longterm Monitoring	The limited evidence of degradation products at the site and the persistence of contamination throughout the history of the site both suggest that MNA will not be effective in the short term or in ultimately achieving SCGs.	There are no technical issues with implementing this alternative.	Relative costs are low	Retained.	Viable as a component of remedial actions to monitor the effectiveness of treatment.
	Containment	Extraction	Groundwater Extraction Wells	Groundwater Extraction will reduce contaminants present in on-site groundwater but does not ultimately reduce their toxicity, nor does it directly address contamination present in off-site groundwater. Additionally, Groundwater Extraction is more effective as a containment measure than as a remedy, as continued operation typically yields decreasing contaminant removal while approaching SCGs.	Extraction wells can be productive on site, as evidenced by the existing production well, but correctly locating wells for maximum impact will be difficult due to overburden and bedrock geology. Similarly, it will be difficult to ensure that a network of extraction wells is capturing sufficient groundwater to prevent offsite migration. Extraction may also create the potential to draw contaminants into previously clean soil or rock.	Relative costs are low but accumulate over time	Retained	

Table 4.2: Detailed Technology Screening

Environmental Media	General Response	Remedial Technology	Process Option	Effectievness	Implementability	Relative Cost	Screening Status	Comments
	In-Situ Treatment	Biological Treatment	Enhanced Biodegradation	Enhanced Biodegradation of CFCs and CVOCs is potentially effective in reducing the volume and toxicity of contaminants at the site, although the amount of time necessary to achieve SCGs (99.97% reduction to 5 ug/L) may make this technology ineffective in the short term. While biodegradation is likely to have some downgradient impact, it would not address the entirety of the off-site plume.	Overburden and bedrock geology would make it difficult to evenly distribute amendments and ensure good contact with contaminated media. Additionally, existing site conditions are mildly oxidative and would need to be altered to reducing conditions to be conducive to anaerobic bidegradation.	Relative costs are low to medium	Retained.	Viable option in conjunction with other technologies that will eliminate off-site exposure pathways.
		Thermal Treatment	Electrical Resistance Heating or Other Thermal Technology	Thermal Remediation would reduce contaminants present in on-site groundwater but does not ultimately reduce their toxicity, nor does it directly address contamination present in off-site groundwater.	Overburden and bedrock geology may be ideal for certain applications of thermal but would make it difficult effectively implement the necessary soil vapor extraction system to capture volitilized contaminants.	Relative costs are high	Retained.	
	Ex-Situ Treatment	Physical Treatment	Granular Activated Carbon	Granular Activated Carbon would reduce contaminants present in on-site groundwater but does not ultimately reduce their toxicity, only changes what media they exist in (adsorbed onto carbon).	There are no technical issues with implementing this alternative.	Relative costs are low but accumulate over time	Retained.	
			Air Stripping	Air Stripping would reduce contaminants present in on-site groundwater but does not ultimately reduce their toxicity, only changes what media they exist in (effluent vapor/discharged to atmosphere).	There are no technical issues with implementing this alternative.	Relative costs are low to medium	Retained	

Table 4.2: Detailed Technology Screening

Environmental Media	General Response	Remedial Technology	Process Option	Effectievness	Implementability	Relative Cost	Screening Status	Comments
Soil Vapor	No Action	Not Applicable	Not Applicable	Not effective for reducing contamination concentrations or addressing the identified exposure pathways.	There are no technical issues with implementing this alternative.	No cost	Retained	Retained to be carried through as a baseline comparison to other alternatives.
	Engineering Controls	Sub-Slab Depressurization	Sub-Slab Depressurization	Sub-Slab Depressurization would reduce contaminants present in sub-slab soil vapor but does not ultimately reduce their toxicity, only changes what media they exist in (effluent vapor/discharged to atmosphere).	Installing off-site SSDSs requires obtaining access to private properties to perform assessment of existing conditions and eventual installation. Site overburden geology may make it difficult to achieve sufficient radius of influence from extraction points, but soils are typically disturbed during construction and it is unlikely that conditions immediately beneath foundation slabs are characteristic of the overburden.	Relative costs are low to medium	Retained	
	In-Situ Treatment	Physical Treatment	Soil Vapor Extraction	Soil Vapor Extraction will reduce contaminants present in on-site soil vapor but does not ultimately reduce their toxicity, nor does it directly address contamination present in off-site soil vapor.	Overburden geology may make it difficult to exert vaccuum over a sufficient radius to effectively capture volitilized contaminants.	Relative costs are low to medium	Retained	
	Ex-Situ Treatment	Physical Treatment	Vapor Phase Carbon Adsorption	Granular Activated Carbon would reduce contaminants present in on-site soil vapor but does not ultimately reduce their toxicity, only changes what media they exist in (adsorbed onto carbon).	There are no technical issues with implementing this alternative.	Relative costs are low but accumulate over time	Retained	

Table 6.1: Detailed Analysis and Comparison of Remedial Alternatives

Remedial Alternative	Breakdown of Remedy Components[1]	Compliance with Standards, Criteria and Guidance[2] (Meets / Partially Meets / Does Not Meet)	Overall Protection of Public Health and the Environment (Is / Partially / Is Not Protective)	Short-term Impacts[3] (Will / Will Not Result)	Short-term Effectiveness[3] (Not/ Partially/ Effective)	Long-term Effectiveness and Permanence (Not/ Partially /Effective)	Reduction of Toxicity, Mobility, or Volume with Treatment (Will Not / Will Partially / Will Reduce)	Implementability (No / Some Technical Difficulties)	Land Use (Compatible / Not Compatible)	Sustainability / Green Remediation (DER-31) (High / Medium / Low Compliance)	Cost (Numerically Ranked, 1=Lowest cost)
Alternative 1: No Action	**No Action for all Media**	Does not meet	Is not protective	Will not result	Not Effective	Not effective or permanent	Will not reduce	No technical difficulties	Not compatible	High	There are no costs associated with Alternative 1.
Alternative 2: In-Situ Thermal Remediation with Engineering Controls	**ISTT for on-site soil and bedrock**	Partially meets	Is protective	Will result	Effective	Effective	Will reduce	Some technical difficulties	Compatible	Low	5
	Off-Site Engineering Controls (SSDS)	Meets	Is protective	Will result	Effective	Partially Effective	Will partially reduce	Some technical difficulties	Compatible	High	
Alternative 3: Enhanced Bioremediation with Engineering Controls	**In-situ Bioremediation for On- and Off-Site GW**	Partially meets	Is protective	Will result	Partially Effective	Effective	Will partially reduce	Some technical difficulties	Compatible	High	3
	On- and Off-Site Engineering Controls (SSDS)	Meets	Is protective	Will result	Effective	Partially Effective	Will partially reduce	Some technical difficulties	Compatible	High	
Alternative 4: Groundwater Containment with Engineering Controls	**Groundwater Extraction and Treatment**	Partially meets	Is protective	Will result	Partially Effective	Partially Effective	Will partially reduce	Some technical difficulties	Compatible	Medium	4
	On- and Off-Site Engineering Controls (SSDS)	Meets	Is protective	Will result	Effective	Partially Effective	Will partially reduce	Some technical difficulties	Compatible	High	
Alternative 5: Monitored Natural Attenuation with Engineering Controls	**MNA and LTM for On- and Off-Site GW**	Does not meet	Is protective	Will not result	Not Effective	Not effective or permanent	Will not reduce	No technical difficulties	Not compatible	High	2
	On- and Off-Site Engineering Controls (SSDS)	Meets	Is protective	Will result	Effective	Partially Effective	Will partially reduce	Some technical difficulties	Compatible	High	

Color indicates relative ranking of the remedial option based on the evaluation criteria.
Green indicates the most desirable result;
Orange indicates a less desirable result;
Pink indicates a negative result for the evaluation criteria.

Notes:

(1) A narrative discussion of the strengths and weaknesses of the remedial action alternatives relative to one another with respect to these evaluation criteria are included in Section 6.3 of the Feasibility Study.

(2) In alternatives where standards, criteria, and guidance values (SCGs) will not be met, contamination in excess of SCG values will remain onsite, leading to potential adverse human health and environmental impacts. It is possible that SCGs may be met at some time in the future due to natural attenuation processes.

(3) Adverse short-term impacts and health risks will be managed using temporary controls to prepare the Site for remedial action implementation, including but not limited to installation of an equipment decontamination area, implementation of erosion and sediment control measures, and the placement of temporary fencing around work areas. Implementation will also include preparation of and adherence to a construction work plan and a health and safety plan.

Table 6.2: Applicable Location- and Action-Specific Standards, Criteria, and Guidance

Requirement	Consideration in the Remedial Response Process
29 CFR Part 1910.120 - Hazardous Waste Operations and Emergency Response	Applicable to Health and Safety implementation, enforcement, and emergency response.
6 NYCRR Part 700-705 Water Quality Regulations Surface Water and Groundwater Classifications and Standards	Applicable to the development and implementation of remedial programs.
6 NYCRR Part 371 - Identification and Listing of Hazardous Wastes (November 1998)	Applicable to the characterization, handling, transportation, and treatment/disposal of investigative derived waste and other soils/liquids generated that require removal from the Site.
6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities (November 1998)	Applicable to the handling, transportation, and treatment/disposal of investigative derived waste and other soils/liquids generated that require removal from the Site.
6 NYCRR Part 375 - Environmental Remediation Programs (as amended December 2006)	Applicable to the development and implementation of remedial programs.
6 NYCRR Part 376 - Land Disposal Restrictions	Applicable to disposal of hazardous wastes. Identifies those wastes that are restricted from land disposal.
6 NYCRR Part 750 through 758 - Implementation of NPDES Program in NYS (“SPDES Regulations”)	Applicable to construction that requires discharge of treated wastewater, such as discharge for treatment groundwater treatment systems.
DER-10 Technical Guidance for Site Investigation and Remediation	Applicable to the development and implementation of remedial programs.
Citizen Participation in New York’s Hazardous Waste Site Remediation Program: A Guidebook (June 1998)	Applicable to the development and implementation of remedial programs.
Solidification/Stabilization and its Application to Waste Materials	May be applicable to disposal of wastes generated during implementation of remedial program.
DER-31 - Green Remediation (Revised January 2011)	Applicable to the development and implementation of remedial programs.
NYSDOH Final Guidance for Evaluation of Soil Vapor Intrusion in the State of New York (Amended 2017)	Applicable to the development and implementation of remedial programs.

Table 6.3 Summary of Estimated Remedial Alternative Costs

Item	Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
1	Total Capital Costs	$ -	$ 27,077,000	$ 2,122,000	$ 1,751,000	$ 153,000
2	Average Annual Cost (Present Worth)	$ -	$ 26,800	$ 26,800	$ 141,100	$ 26,800
3	Present Worth of Annual and Periodic Costs	$ -	$ 804,000	$ 804,000	$ 4,234,000	$ 804,000
4	Total Present Worth (Item 1 plus item 3)	$ -	$ 27,881,000	$ 2,926,000	$ 5,985,000	$ 957,000
5	Total Non-Discounted Cost	$ -	$ 28,207,000	$ 3,252,000	$ 7,873,000	$ 1,283,000

Notes:
1. Alternative 1: No Further Action
2. Alternative 2: In-Situ Thermal Remediation with Engineering Controls
3. Alternative 3: Enhanced Bioremediation with Engineering Controls
4. Alternative 4: Groundwater Containment with Engineering Controls
5. Alternative 5: Monitored Natural Attenuation with Engineering Controls
6. Costs in this summary table have been rounded to three significant figures.

Table 6.4: Cost Summary for Alternative 2
In-Situ Thermal Remediation with Engineering Controls

Item No.	Item Description		COST
DIRECT CAPITAL COSTS			
Pre-design Investigation			
1A	Pre-Design Investigation for Thermal	$	177,000
1C	Baseline Sampling	$	37,000
1D	Indoor Air Intrusion Sampling	$	32,000
Implementation			
2A	Site Supply Well Abandonment	$	22,000
2B	Implement In Situ Thermal	$	19,006,000
2D	Institute ICs/EC & Site Management Plan	$	25,000
2G	Offsite SSDS Implementation for Thermal Remediation	$	180,000
	Direct Cost Subtotal	$	19,479,000
INDIRECT CAPITAL COSTS			
	Project Management (@ 5 Percent)	$	974,000
	Remedial Design (@ 8 Percent)	$	1,559,000
	Construction Management (@ 6 Percent)	$	1,169,000
	Contingency (@ 20 Percent)	$	3,896,000
	Indirect Cost Subtotal	$	7,598,000
TOTAL CAPITAL COSTS		**$**	**27,077,000**
Long-Term Annual Costs*			
3A	Long-term Monitoring & Reporting (Years 1 through 5)	$	42,000
3B	Long-Term Monitoring (Years 6 through 30)	$	20,000
3C	Long Term IC/EC Inspections, Certifications and Reporting	$	6,000
3F	Operation/Maintenance of SSD Systems for Thermal Remediation	$	8,000
PRESENT WORTH OF ANNUAL AND PERIODIC COSTS (30 yrs)		**$**	**804,000**
TOTAL PRESENT WORTH OF ALTERNATIVE (30 yrs)		**$**	**27,881,000**
TOTAL NON-DISCOUNTED COST OF ALTERNATIVE (30 yrs)		**$**	**28,207,000**

NOTES:

1. Costs have been rounded to the nearest thousand.
2. * - Costs include additional 10 percent for technical support and 25 percent contingency for unforeseen project complexities, including insurance, taxes, and licensing costs.

Table 6.5: Cost Summary for Alternative 3
Enhanced Bioremediation with Engineering Controls

Item No.	Item Description		COST
DIRECT CAPITAL COSTS			
Pre-design Investigation			
1B	Pre-Design Investigation for Enhanced Bio	$	18,000
1C	Baseline Sampling	$	37,000
1D	Indoor Air Intrusion Sampling	$	32,000
Implementation			
2A	Site Supply Well Abandonment	$	22,000
2C	Implement Enhanced Biodegradation	$	1,158,000
2D	Institute ICs/EC & Site Management Plan	$	25,000
2F	Onsite SSDS Implementation	$	41,000
2H	Offsite SSDS Implementation	$	118,000
	Direct Cost Subtotal	$	1,451,000
INDIRECT CAPITAL COSTS			
	Project Management (@ 6 Percent)	$	88,000
	Remedial Design (@ 12 Percent)	$	175,000
	Construction Management (@ 8 Percent)	$	117,000
	Contingency (@ 20 Percent)	$	291,000
	Indirect Cost Subtotal	$	671,000
TOTAL CAPITAL COSTS		**$**	**2,122,000**
Long-Term Annual Costs*			
3A	Long-term Monitoring & Reporting (Years 1 through 5)	$	42,000
3B	Long-Term Monitoring (Years 6 through 30)	$	20,000
3C	Long Term IC/EC Inspections, Certifications and Reporting	$	6,000
3G	Operation/Maintenance of SSD Systems	$	8,000
PRESENT WORTH OF ANNUAL AND PERIODIC COSTS (30 yrs)		**$**	**804,000**
TOTAL PRESENT WORTH OF ALTERNATIVE (30 yrs)		**$**	**2,926,000**
TOTAL NON-DISCOUNTED COST OF ALTERNATIVE (30 yrs)		**$**	**3,252,000**

NOTES:

1. Costs have been rounded to the nearest thousand.
2. * - Costs include additional 10 percent for technical support and 25 percent contingency for unforeseen project complexities, including insurance, taxes, and licensing costs. Costs assume annual inspection and reporting.

Table 6.6: Cost Summary for Alternative 4
Groundwater Containment with Engineering Controls

Item No.	Item Description		COST
DIRECT CAPITAL COSTS			
Pre-design Investigation			
1C	Baseline Sampling	$	37,000
1D	Indoor Air Intrusion Sampling	$	32,000
Implementation			
2A	Site Supply Well Abandonment	$	22,000
2D	Institute ICs/EC & Site Management Plan	$	25,000
2E	Install GW Extraction System	$	924,000
2F	Onsite SSDS Implementation	$	41,000
2H	Offsite SSDS Implementation	$	118,000
	Direct Cost Subtotal	$	1,199,000
INDIRECT CAPITAL COSTS			
	Project Management (@ 6 Percent)	$	72,000
	Remedial Design (@ 12 Percent)	$	144,000
	Construction Management (@ 8 Percent)	$	96,000
	Contingency (@ 20 Percent)	$	240,000
	Indirect Cost Subtotal	$	552,000
TOTAL CAPITAL COSTS		**$**	**1,751,000**
Long-Term Annual Costs*			
3A	Long-term Monitoring & Reporting (Years 1 through 5)	$	42,000
3B	Long-Term Monitoring (Years 6 through 30)	$	20,000
3C	Long Term IC/EC Inspections, Certifications and Reporting	$	6,000
3D	GWTP Operation and Maintenance	$	160,000
3E	Extraction Well Pump Maintenance (per 5 years)	$	32,000
3G	Operation/Maintenance of SSD Systems	$	8,000
PRESENT WORTH OF ANNUAL AND PERIODIC COSTS (30 yrs)		**$**	**4,234,000**
TOTAL PRESENT WORTH OF ALTERNATIVE (30 yrs)		**$**	**5,985,000**
TOTAL NON-DISCOUNTED COST OF ALTERNATIVE (30 yrs)		**$**	**7,873,000**

NOTES:

1. Costs have been rounded to the nearest thousand.
2. * - Costs include additional 10 percent for technical support and 25 percent contingency for unforeseen project complexities, including insurance, taxes, and licensing costs. Costs assume annual inspection and reporting.

Table 6.7: Cost Summary for Alternative 5
Monitored Natural Attenuation with Engineering Controls

Item No.	Item Description		COST
DIRECT CAPITAL COSTS			
Pre-design Investigation			
1C	Baseline Sampling	$	37,000
1D	Indoor Air Intrusion Sampling	$	32,000
Implementation			
2A	Site Supply Well Abandonment	$	22,000
2D	Institute ICs/EC & Site Management Plan	$	25,000
2F	Onsite SSDS Implementation	$	41,000
2H	Offsite SSDS Implementation	$	118,000
	Direct Cost Subtotal	$	91,000
INDIRECT CAPITAL COSTS			
	Project Management (@ 10 Percent)	$	10,000
	Remedial Design (@ 20 Percent)	$	19,000
	Construction Management (@ 15 Percent)	$	14,000
	Contingency (@ 20 Percent)	$	19,000
	Indirect Cost Subtotal	$	62,000
TOTAL CAPITAL COSTS		**$**	**153,000**
Long-Term Annual Costs*			
3A	Long-term Monitoring & Reporting (Years 1 through 5)	$	42,000
3B	Long-Term Monitoring (Years 6 through 30)	$	20,000
3C	Long Term IC/EC Inspections, Certifications and Reporting	$	6,000
3G	Operation/Maintenance of SSD Systems	$	8,000
PRESENT WORTH OF ANNUAL AND PERIODIC COSTS (30 yrs)		**$**	**804,000**
TOTAL PRESENT WORTH OF ALTERNATIVE (30 yrs)		**$**	**957,000**
TOTAL NON-DISCOUNTED COST OF ALTERNATIVE (30 yrs)		**$**	**1,283,000**

NOTES:
1. Costs have been rounded to the nearest thousand.
2. * - Costs include additional 10 percent for technical support and 25 percent contingency for unforeseen project complexities, including insurance, taxes, and licensing costs. Costs assume annual inspection and reporting.

Table 6.8: Remedial Activity Greenhouse Gas Emissions as CO_2

Alternative Components and Associated Metric Tons CO2	Alternatives				
	1 - No Further Action	2 - In-Situ Thermal Remediation with Engineering Controls	3 - Enhanced Bioremediation with Engineering Controls	4 - Groundwater Containment with Engineering Controls	5 - Monitored Natural Attenuation with Engineering Controls
Pre-Design Investigation	0	7.06	0.09	0.09	0.09
Abandonment of Site Supply Well	0	2.80	2.80	2.80	2.80
In-Situ Thermal Remediation	0	8245.87	0.00	0.00	0.00
Enhanced Biodegradation	0	0.00	40.15	0.00	0.00
Groundwater Extraction System	0	0.00	0.00	156.61	0.00
On- and Off-Site SSDS Installation	0	0.09	0.09	0.09	0.09
Long Term Operation and Monitoring	0	45.94	69.55	1014.85	69.55
Total Metric Tons CO2	0	8301.75	112.68	1174.44	72.53

APPENDIX A

DETAILED COST ANALYSIS BACKUP

APPENDIX A - PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 2

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 5-Year Periods	5-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Capital (Year 0)	$ 27,077,000	1	0.000	NA	NA	NA	NA	$ 27,077,000	$ 27,077,000
Long-term Monitoring & Reporting (Years 1 through 5)	$ 42,000	5	0.026	NA	NA	NA	NA	$ 210,000	$195,000.00
Long-Term Monitoring (Years 6 through 30)	$ 20,000	25	0.026	NA	NA	NA	NA	$ 500,000	$320,000.00
Long Term IC/EC Inspections, Certifications and Reporti	$ 6,000	30	0.026	NA	NA	NA	NA	$ 180,000	$124,000.00
Operation/Maintenance of SSD Systems for Thermal Ren	$ 8,000	30	0.026	NA	NA	NA	NA	$ 240,000	$165,000.00
Total Annual Costs								**$ 1,130,000**	**$ 804,000**
Total Capital and Annual Costs								**$ 28,207,000**	**$ 27,881,000**

Note:
1. Discount rate of 1.3% was used, as published by the Office of Management and Budget (OMB) in March 2022.

APPENDIX A - PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 3

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 5-Year Periods	5-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Capital (Year 0)	$ 2,122,000	1	0.000	NA	NA	NA	NA	$ 2,122,000	$ 2,122,000
Long-term Monitoring & Reporting (Years 1 through 5)	$ 42,000	5	0.026	NA	NA	NA	NA	$ 210,000	$ 195,000
Long-Term Monitoring (Years 6 through 30)	$ 20,000	25	0.026	NA	NA	NA	NA	$ 500,000	$ 320,000
Long Term IC/EC Inspections, Certifications and Reporting	$ 6,000	30	0.026	NA	NA	NA	NA	$ 180,000	$ 124,000
Operation/Maintenance of SSD Systems	$ 8,000	30	0.026	NA	NA	NA	NA	$ 240,000	$ 165,000
Total Annual Costs								**$ 1,130,000**	**$ 804,000**
Total Capital and Annual Costs								**$ 3,252,000**	**$ 2,926,000**

Note:
1. Discount rate of 1.3% was used, as published by the Office of Management and Budget (OMB) in March 2022.

APPENDIX A - PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 4

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 5-Year Periods	5-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Capital (Year 0)	$ 1,751,000	1	0.000	NA	NA	NA	NA	$ 1,751,000	$ 1,751,000
Long-term Monitoring & Reporting (Years 1 through 5)	$ 42,000	5	0.026	NA	NA	NA	NA	$ 210,000	$ 195,000
Long-Term Monitoring (Years 6 through 30)	$ 20,000	25	0.026	NA	NA	NA	NA	$ 500,000	$ 320,000
Long Term IC/EC Inspections, Certifications and Reporti	$ 6,000	30	0.026	NA	NA	NA	NA	$ 180,000	$ 124,000.00
GWTP Operation and Maintenance	$ 160,000	30	0.026	NA	NA	NA	NA	$ 4,800,000	$ 3,305,000.00
Extraction Well Pump Maintenance (per 5 years)	$ 32,000	NA	0.026	6	0.14	NA	NA	$ 192,000	$125,000.00
Operation/Maintenance of SSD Systems	$ 8,000	30	0.026	NA	NA	NA	NA	$ 240,000	$ 165,000
Total Annual Costs								**$ 6,122,000**	**$ 4,234,000**
Total Capital and Annual Costs								**$ 7,873,000**	**$ 5,985,000**

Note:

1. Discount rate of 1.3% was used, as published by the Office of Management and Budget (OMB) in March 2022.

APPENDIX A - PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 5

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 5-Year Periods	5-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Capital (Year 0)	$ 153,000	1	0.000	NA	NA	NA	NA	$ 153,000	$ 153,000
Long-term Monitoring & Reporting (Years 1 through 5)	$ 42,000	5	0.026	NA	NA	NA	NA	$ 210,000	$ 195,000
Long-Term Monitoring (Years 6 through 30)	$ 20,000	25	0.026	NA	NA	NA	NA	$ 500,000	$ 320,000
Long Term IC/EC Inspections, Certifications and Reporti	$ 6,000	30	0.026	NA	NA	NA	NA	$ 180,000	$ 124,000
Operation/Maintenance of SSD Systems	$ 8,000	30	0.026	NA	NA	NA	NA	$ 240,000	$ 165,000
Total Annual Costs								**$ 1,130,000**	**$ 804,000**
Total Capital and Annual Costs								**$ 1,283,000**	**$ 957,000**

Note:

1. Discount rate of 1.3% was used, as published by the Office of Management and Budget (OMB) in March 2022.

Appendix A - OMB Circular A-94 Interest Rates

OMB Circular No. A-94

APPENDIX C
(Revised March 15, 2022)

DISCOUNT RATES FOR COST-EFFECTIVENESS, LEASE PURCHASE, AND RELATED ANALYSES

Effective Dates. This appendix is updated annually. This version of the appendix is valid for calendar year 2022. A copy of the updated appendix can be obtained in electronic form through the OMB home page at https://www.whitehouse.gov/wp-content/uploads/2022/05/Appendix-C.pdf. The text of the Circular is found at www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/circulars/A94/a094.pdf, and a table of past years' rates is located at https://www.whitehouse.gov/wp-content/uploads/2022/05/discount-history.pdf. Updates of the appendix are also available upon request from OMB's Office of Economic Policy (202-395-3585).

Nominal Discount Rates. A forecast of nominal or market interest rates for calendar year 2022 based on the economic assumptions for the 2023 Budget is presented below. These nominal rates are to be used for discounting nominal flows, which are often encountered in lease-purchase analysis.

Nominal Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
1.3	1.6	1.9	2.1	2.5	2.6

Real Discount Rates. A forecast of real interest rates from which the inflation premium has been removed and based on the economic assumptions from the 2023 Budget is presented below. These real rates are to be used for discounting constant-dollar flows, as is often required in cost-effectiveness analysis.

Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
-1.2	-0.6	-0.3	0.0	0.4	0.5

Analyses of programs with terms different from those presented above may use a linear interpolation. For example, a four-year project can be evaluated with a rate equal to the average of the three-year and five-year rates. Programs with durations longer than 30 years may use the 30-year interest rate.

Account Name	Wood E&I	Bid Date	09/27/2022
Address	511 Congress Street, Suite 200 Portland, Maine 04101	Quote Number Quote Revision Date	
		Opportunity/Project Name	Wood - 22.09.27 Stony Point
Contact Name	Nathan Lewis	Work Site Address	
Email	nathan.lewis@woodplc.com	City	Stony Point
Phone	207-210-0512	State	NY
Bill To Account Number		Zip	

Cascade Rep Contact Information

Prepared By: Shawn Tibbetts Email stibbetts@cascade-env.com

Scope of Work

Abandon nine (9) overburden wells.

Option 1 - Install five (5) overburden wells to a depth of 55' BG and four (4) bedrock wells to a depth of 145' BG. Wells will consist of 2" stainless steel screen and riser.

Description	Quantity	Unit	Sales Price	Optional	Subtotal
Mobilization/Demobilization	1	Lump Sum	$ 3,500.00	$	3,500.00
Per Diem	13	Days	$ 550.00	$	7,150.00
Sonic Rig w/Two (2) Man Crew	10	Days	$ 4,900.00	$	49,000.00
Air Package - Hammer & Compressor	8	Days	$ 650.00	$	5,200.00
2" Stainless Steel Well Installation	855	Feet	$ 75.00	$	64,125.00
Flush Mount/Stickup Well Protector	9	Each	$ 275.00	$	2,475.00
Well Abandonment Crew & Equipment	3	Days	$ 2,850.00	$	8,550.00
2" Well Abandonment Materials	800	Feet	$ 8.00	$	6,400.00
4" Well Abandonment Materials	0	Feet	$ 12.00	$	-
6" Well Abandonment Materials	0	Feet	$ 16.00	$	-
Drums	10	Each	$ 90.00	$	900.00
Asphalt/Concrete	10	Bags	$ 30.00	$	300.00
Overtime, After 8 Hours On Site - Sonic Rig & Crew	0	Hours	$ 775.00	$	-
Overtime, After 8 Hours On Site - Abandonment Crew & Equipment	0	Hours	$ 475.00	$	-
Well Development, If Performed Separately	0	Days	$ 1,950.00	$	-
Rockland County Well Permit	1	Each	$ 675.00	$	675.00

Tax will be charged unless a tax exampt cert is provided

Pre-Tax Total	$148,275.00
Tax Percentage	8.375%
Taxes	$12,418.03
Quote Total	$160,693.03

Account Name	Wood E&I	Bid Date	09/27/2022
Address	511 Congress Street, Suite 200 Portland, Maine 04101	Quote Number Quote Revision Date	
		Opportunity/Project Name	Wood - 22.09.27 Stony Point
Contact Name	Nathan Lewis	Work Site Address	
Email	nathan.lewis@woodplc.com	City	Stony Point
Phone	207-210-0512	State	NY
Bill To Account Number		Zip	

Cascade Rep Contact Information

Prepared By: Shawn Tibbetts Email stibbetts@cascade-env.com

Client acknowledges that Cascade's bid was based on current and market costs of supplies and materials. Should work on the project not commence within 45 days after [the date of the acceptance of Cascade's bid] as a result of Client failing to schedule the project, an act of God or similar force majeure circumstance, or other reason outside Cascade's control, Cascade reserves the right to increase pricing to reflect increased cost of supplies and materials.

This quote is based on information provided by you and is valid for 45 days from the bid date. Unless previously agreed, Cascade requires a 2-week notice prior to mobilization. Your firm is responsible for 1) Obtaining any site specific permits, 2) Locating and clearly marking underground installations or utilities, 3) Furnishing dig Alert numbers at least three working days prior to scheduled start date and proof of private locating services, 4) Obtaining access to site with no overhead wires within 20' of the holes. Cascade Drilling shall not be responsible for damages to underground improvements not clearly and accurately marked. If bedrock, cobbles, flowing sands or other adverse or unsafe drilling conditions are encountered, drilling may continue on a time and materials basis or be terminated at the discretion of Cascade. Additional costs may apply if scope is significantly changed. Well development by others may void some or all of Cascade warranties of workmanship and materials. Prices assume standard labor rates and no work hour restrictions. Signature of Client/Owner Authorized Representative Cascade will perform the Work as described in this proposal subject to the terms and conditions posted at https://cascade-env.com/resources/others/terms-and-conditions/ unless MSA is already established between Cascade and Client in which case MSA takes precedence over the aforementioned terms and conditions. By signing this proposal, Client agrees that this proposal together with the terms and conditions referenced above constitute a Subcontract. Client acknowledges that Client has received and agrees with all such documents in the form provided by Cascade. Terms and Conditions are posted and accessible at the website location set forth above.

Signature of Client/Owner Authorized Representative	Signature of Authorized ADT Representative
Name & Title of Authorized Representative and Company	Name & Title of Authorized ADT Representative
Date	Date

Cascade provides management of investigation derived waste. Call us today for information on a full range of additional options to meet your drilling needs.

Appendix A
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Notes
		PRE-DESIGN INVESTIGATIONS					
1A	***Alt 2***	***Pre-Design Investigation for Thermal***				***$ 176,871***	
		Monitoring Well Installation & Abandonment					
		Survey new locations	1	LS	$ 2,000.00	$ 2,000	Labor plus equipment
		Drill Rig mob/demob	1	LS	$ 3,500.00	$ 3,500	
		Drill Rig & Crew (Drive/Wash)	10	Days	$ 4,900.00	$ 49,000	
		Air Package - Hammer & Compressor	8	Days	$ 650.00	$ 5,200	
		Per Diem	13	Days	$ 550.00	$ 7,150	
		2" Stainless Steel Well Installation	835	ft	$ 75.00	$ 62,625	Assumes five new overburden wells to 55 fbgs and four bedrock wells to 145 fbgs
		Flush Mount/Stickup Well Protector	9	Each	$ 275.00	$ 2,475	
		Well Abandonment Crew & Equipment	3	Days	$ 2,850.00	$ 8,550	
		2" Well Abandonment Materials	800	lf	$ 8.00	$ 6,400	
		Asphalt/Concrete	10	Bags	$ 30.00	$ 300	
		Drill Waste Disposal	10	Drums	$ 90.00	$ 900	Assume two locations per drum for soil, plus 4 drums for development water
		Rockland County Well Permit	1	Each	$ 675.00	$ 675	
		Tax	1	LS	$ 12,292.41	$ 12,292	
		Baseline Sampling Round					
		Field Technician	15	Days	$ 1,000.00	$ 15,000	Oversight 2 weeks, plus one week develop and sample wells.
		GW sampling Equipment	1	weeks	$ 219.00	$ 219	
		Lab Analysis - VOCs / Groundwater	9	EA	$ 65.00	$ 585	
1B	***Alt 3***	***Pre-Design Investigation for Enhanced Bio***				***$ 17,824***	
		GW Sampling					
		Labor and Per Diem	5	Days	$ 1,000.00	$ 5,000	One person, 5 days, one event
		GW sampling Equipment	1	weeks	$ 219.00	$ 219	
		Lab Analysis - MNA Parameters / Groundwater	10	EA	$ 258.00	$ 2,580	
		In Situ Microcosm Study	3	EA	$ 2,000.00	$ 6,000	Bio trap in situ microcosm study
		Pilot Injection Test					
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	Use geoprobe to conduct injections in existing monitoring wells to estimate potential injection rates/radius of influence
		Geoprobe, Crew & Equipment	2	DAYS	$ 1,500.00	$ 3,000	
		Pump / Equipment for injection	2	DAYS	$ 250.00	$ 500	
1C	***Alt 2, 3, 4, 5***	***Baseline Sampling***				***$ 36,029***	
		Baseline Sampling					
		Labor and Per Diem	4	Days	$ 1,000.00	$ 4,000	One person, 4 days, one event
		GW sampling Equipment	1	weeks	$ 219.00	$ 219	
		Lab Analysis - VOCs / Groundwater	42	EA	$ 65.00	$ 2,730	Assumes samples and duplicates from 38 existing on- and off-site monitoring wells
		Lab Analysis - MNA Parameters / Groundwater	10	EA	$ 258.00	$ 2,580	
		Microbial Sampling	3	EA	$ 500.00	$ 1,500	Bio trap -microbe analysis only.
		Findings Report	1	LS	$ 25,000	$ 25,000	
1D	***Alt 2, 3, 4, 5***	***Indoor Air Intrusion Sampling***				***$ 31,100***	
		Field Technician	10	Days	$ 1,000.00	$ 10,000	2 people, 1 week
		Driller Mob/Demob	1	Week	$ 1,000.00	$ 1,000	Small geoprobe and/or hand tools for coring.
		Drill Rig & Crew	1	Week	$ 17,000.00	$ 17,000	Small geoprobe and/or hand tools for coring.
		Core through Concrete Slabs	4	Each	$ 250.00	$ 1,000	
		Air Samples - TO-15	12	Each	$ 175.00	$ 2,100	Sub slab, Indoor Air, and Ambient Air samples

Appendix A
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Notes
FULL SCALE IMPLEMENTATION FOR ALL ALTERNATIVES							
2A	***Alt. 2, 3, 4, 5***	***Site Supply Well Abandonment***				***$ 21,880***	
		Drill Rig mob/demob	1	LS	$ 3,500.00	$ 3,500	
		Well Abandonment Crew & Equipment	3	Days	$ 2,850.00	$ 8,550	
		6" Well Abandonment Materials	300	lf	$ 16.00	$ 4,800	
		Asphalt/Concrete	1	Bags	$ 30.00	$ 30	
		Oversight/Reporting	5	Days	$ 1,000.00	$ 5,000	Oversight - one person plus two days for reporting (and per-diem)
2B	***Alt. 2***	***Implement In Situ Thermal***				***$ 19,005,869***	
		Work Plans, Schedules and Permits				***$ 516,000***	Includes Design, Work Plan, HASP, Permit Assistance - lump sum provided by TRS (9/12/22)
		Detailed Construction Plan	0	LS	$ 7,500.00	$ -	Included as part of lump sum provided by TRS (9/12/22)
		Health & Safety Plan	0	LS	$ 5,000.00	$ -	Included as part of lump sum provided by TRS (9/12/22)
		QA/QC Plan	0	LS	$ 5,000.00	$ -	Included as part of lump sum provided by TRS (9/12/22)
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	14	MO	$ 2,000.00	$ 28,000	TRS, drilling, construction, operations, demobe - estimated 14 months
		Portable Toilets	14	MO	$ 360.00	$ 5,040	TRS, drilling, construction, operations, demobe - estimated 14 months
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	26	WK	$ 420.00	$ 10,920	TRS, drilling, construction - estimated 6 months
		Thermal and SVE Systems					
		Equipment/Materials Mobilization	1	LS	$ 3,908,700.00	$ 3,908,700	Lump sum provided by TRS (9/12/22)
		Subsurface Installation	1	LS	$ 5,215,470.00	$ 5,215,470	Lump sum provided by TRS (9/12/22)
		Surface Installation and Start-up	1	LS	$ 1,950,480.00	$ 1,950,480	Lump sum provided by TRS (9/12/22)
		System Operation	1	LS	$ 2,835,940.00	$ 2,835,940	Lump sum provided by TRS (9/12/22)
		Drill Waste Disposal	1075	Tons	$ 200.00	$ 215,090	Includes roll-off container
		Operation Labor	13	Days	$ 1,000.00	$ 13,000	Assume on site one day every other week for 6 months
		Demobilization and Reporting	1	LS	$ 1,353,210.00	$ 1,353,210	
		Construction Oversight					
		Labor & Per Diem	35	Week	$ 10,000.00	$ 350,000	TRS, drilling, construction, operations, demobe - estimated 8 months, assume 10 hour days, office support and per diem
		Payment and Performance Bonds				$ 141,911	Assume 1% of cost
		Soil Confirmatory Sampling					
		Drill Rig mob/demob	1	LS	$ 3,500.00	$ 3,500	
		Drill Rig & Crew (Drive/Wash)	45	Days	$ 4,900.00	$ 220,500	25 borings to 150 ft; 3750 ft
		Air Package - Hammer & Compressor	43	Days	$ 650.00	$ 27,950	
		Per Diem	45	Days	$ 550.00	$ 24,750	
		Field Technician	45	Days	$ 1,000.00	$ 45,000	Oversight during construction, plus one week develop and sample wells.
		Sampling Equipment	9	Weeks	$ 200.00	$ 1,800	
		Soil Analysis Delineation (VOC - 8260)	320	Each	$ 80.00	$ 25,600	Estimate from thermal vendor
		Drill Waste Disposal	45	Drums	$ 350.00	$ 15,750	Assume two locations per drum for soil, plus 4 drums for development water
		Electrical Energy Usage					
		Utilities	18420000	KWH	$ 0.11	$ 2,088,828	Energy usage provided by TRS
2C	***Alt. 3***	***Implement Enhanced Biodegradation***				***$ 1,157,418***	
		Bio Well Installation					treatment over 8,000 square feet, assume 20' injection grid, and 200' long bedrock fence
		Drill Rig mob/demob	1	LS	$ 3,500.00	$ 3,500	
		Drill Rig & Crew (Drive/Wash)	57	Days	$ 4,900.00	$ 279,300	
		Air Package - Hammer & Compressor	55	Days	$ 650.00	$ 35,750	Assume ~85 ft/day based on vendor quote for sonic drilling
		Per Diem	57	Days	$ 550.00	$ 31,350	
		Well Construction - 2" Sch 80 CPVC Riser	3725	ft	$ 4.28	$ 15,943	See included Quantity Calculations for quantities of well construction materials
		Well Construction - 2" Sch 80 CPVC Screen	900	ft	$ 3.03	$ 2,727	See included Quantity Calculations for quantities of well construction materials
		Well Cap - 2"	45	each	$ 13.60	$ 612	See included Quantity Calculations for quantities of well construction materials
		Grout	3725	bag	$ 12.08	$ 44,998	See included Quantity Calculations for quantities of well construction materials
		Bentonite	23	bag	$ 23.05	$ 530	See included Quantity Calculations for quantities of well construction materials
		Sand	630	bag	$ 7.88	$ 4,964	See included Quantity Calculations for quantities of well construction materials
		Well Finish (Manhole)	45	each	$ 1,500.00	$ 67,500	See included Quantity Calculations for quantities of well construction materials
		Oversight/Reporting	59	Days	$ 1,000.00	$ 59,000	Oversight - one person plus two days for reporting (and per-diem)
		T&D of Drill Cuttings	90	tons	$ 75.00	$ 6,723	See included Quantity Calculations for quantities of well construction materials
		Performance Bonds and Payments				$ 5,529	Assume 1% of cost

Appendix A
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Notes
		Injection Services and Materials					
		Geoprobe mob/demob	1	LS	$ 525	$ 525	
		Labor and Per Diem	12	Days	$ 2,000.00	$ 24,000	Two people, 12 days, one event
		3-D Microemulsion®	14,800	lbs	$ 6.04	$ 89,392	Regenesis quote, 9/19/22
		S-MZVI®	11,000	lbs	$ 11.31	$ 124,410	Regenesis quote, 9/19/22
		Tax and Freight - Material	1	LS	$ 32,070.30	$ 32,070	15%, Regenesis quote, 9/19/22
		Amendment Injection - Second Round					
		Geoprobe mob/demob	1	LS	$ 525	$ 525	
		Labor and Per Diem	12	Days	$ 2,000.00	$ 24,000	Two people, 12 days, one event
		3-D Microemulsion®	14,800	lbs	$ 6.04	$ 89,392	Regenesis quote, 9/19/22
		S-MZVI®	11,000	lbs	$ 11.31	$ 124,410	Regenesis quote, 9/19/22
		Tax and Freight - Material	1	LS	$ 42,760.40	$ 42,760	15%, Regenesis quote, 9/19/22
		Post-Treatment Sampling					
		Labor and Per Diem	12	Days	$ 1,000.00	$ 12,000	One person, 6 days, two events
		Monitoring well sampling equipment	2	ea/wk	$ 219.00	$ 438	One week per event
		Lab Analysis - Multiple Analysis GW	44	EA	$ 322.00	$ 14,168	20 GW samples plus QAQC samples per event. VOC, Iron, Manganese, TC, Nitrate/Nitrite, Sulfate/Sulfide, Cos, Alkalinity, Chloride.
		Purge Water Disposal	2	Drum	$ 450.00	$ 900	For disposal of purge water
		Construction Oversight	20	Days	$ 1,000.00	$ 20,000	Oversight - one person plus two days for reporting (and per-diem) per injection event
2D	***Alt 2, 3, 4, 5***	***Institute ICs/EC & Site Management Plan***				***$ 25,000***	
		Site Management Plan	1	LS	$ 25,000.00	$ 25,000	
2E	***Alt 4***	***Install GW Extraction System***				***$ 923,993***	
		INSTALL EXTRACTION WELLS AND CONVEYANCE LINES					
		Extraction Wells					
		Drill Rig & Crew Mob	1	LS	$ 8,000.00	$ 8,000	Assume 1 Air Hammer rig
		Regular Drill per foot	330	ft	$ 80.00	$ 26,400	4 wells, 125' per well
		Well Construction - 6" Sch 80 PVC Riser	240	ft	$ 27.50	$ 6,600	
		Well Construction - 6" Sch 80 PVC Screen	90	ft	$ 30.00	$ 2,700	
		Grout	240	bag	$ 12.08	$ 2,899	
		Bentonite	3	bag	$ 23.05	$ 69	
		Sand	63	bag	$ 7.88	$ 496	
		Manhole & Controls	6	Each	$ 2,500.00	$ 15,000	
		Disposal of Drill Cuttings	6	tons	$ 200.00	$ 1,279	
		Borehole Geophysics					
		Mob	1	LS	$ 2,000.00	$ 2,000	
		Open Borehole Logging ($3,000 ea.)	6	Each	$ 3,000.00	$ 18,000	
		Reporting/Design ($2,000 ea.)	6	Each	$ 2,000.00	$ 12,000	
		Well Equipment					
		Pump	6	Each	$ 4,500.00	$ 27,000	
		VFD for Pump Control	6	Each	$ 3,500.00	$ 21,000	
		Pitless/Piping	6	Each	$ 1,500.00	$ 9,000	
		Transducer	6	Each	$ 2,000.00	$ 12,000	

Appendix A
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Notes
		Conveyance Lines					
		Trenching	535	ft	$ 35.00	$ 18,725	Equip/Labor
		Poly pipes (1.5")	1510	ft	$ 7.00	$ 10,570	HDPE
		Wire (4#10)	1510	ft	$ 3.00	$ 4,530	THHN
		Wire (TWSP)	1510	ft	$ 2.00	$ 3,020	For level Transmitter
		Conduit (2)	1510	ft	$ 4.00	$ 6,040	PVC
		Reseeding/Mulch	535	ft	$ 3.00	$ 1,605	
		Discharge Line					
		Trenching	1,000	lf	$ 35.00	$ 35,000	Assume trench is 4 feet deep, no excavation support.
		Piping	1,000	lf	$ 15.00	$ 15,000	Sch 40 Installed, assume discharge to Cedar Pond Brook
		Reseeding/Mulch	1,000	lf	$ 3.00	$ 3,000	
		GROUNDWATER TREATMENT PLANT					
		Equipment					
		Equalization Tank (500 Gal)	1	Each	$ 3,000	$ 3,000	Cone Bottom with Stand
		Process Pumps (1.5 HP)	2	Each	$ 2,000	$ 4,000	SS Centrifugal
		Flowmeters (1.5 inch)	7	Each	$ 2,500	$ 17,500	Mag flux, one for each well and one for combined process (7 total)
		Filters (2 inch)	1	Each	$ 7,500	$ 7,500	Multi (10) cartridge, duplex system (includes automated valving from manufacturer)
		Pressure Transmitter (50 PSI)	1	Each	$ 2,000	$ 2,000	Monitor filter inlet pressure
		Air Stripper (120 GPM)	1	Each	$ 85,000	$ 85,000	SS Shallow Tray System (including 10 hp blower and controls), gravity discharge, assume ~20 gpm per well
		Building					
		Pre-engineered metal building	600	SF	$ 350	$ 210,000	Frost wall/slab, includes insulation and heat.
		Allowances					
		Piping Allowance (20%):	1	LS	$ 23,800	$ 23,800	Based on Equipment Sub Total
		Valving Allowance (20%):	1	LS	$ 23,800	23800	Based on Equipment Sub Total
		Electrical Allowance (20%):	1	LS	$ 65,800	65800	Based on Treatment System Total (includes building service)
		Controls Allowance (20%):	1	LS	$ 23,800	23800	Based on Equipment Sub Total
		Drawings and Reporting	1	LS	$ 93,240	$ 93,240	Assumed 20% of Total GW Treatment Plant costs
		Construction Oversight	10	Weeks	$ 10,000.00	$ 100,000	includes per diem and office support
		Performance Bonds and Payments				$ 2,619	Assume 1% of cost
2F	***Alt. 3, 4, 5***	***Onsite SSDS Implementation***				***$ 40,603***	
		Testing and Design					
		Communication Diagnostic Testing and SSDS Design	1	LS	$ 4,500.00	$ 4,500	Vendor quote from Keystone Environmental Services for comparable system obtained for another NYSDEC Site (Site 360175)
		SSDS Construction					
		Materials and Labor	1	LS	$ 14,000.00	$ 14,000	Vendor quote from Keystone Environmental Services for comparable system obtained for another NYSDEC Site (Site 360175)
		Electrician	1	day	$ 2,500	$ 2,500	Vendor quote from Keystone Environmental Services for comparable system obtained for another NYSDEC Site (Site 360175)
		Monitoring Point Installation					
		Core through Concrete Slabs	6	ea	$ 250.00	$ 1,500	
		Install sample port	6	ea	$ 1,200.00	$ 7,200	
		Reporting					
		Construction Completion Report	1	ea	$ 600.00	$ 600	Vendor quote from Keystone Environmental Services for comparable system obtained for another NYSDEC Site (Site 360175)
		Construction Oversight					
		Oversight	1	Weeks	$ 10,000.00	$ 10,000	Assume 10 hour days, office support and per diem
		Payment and Performance Bonds				$ 303	Assume 1% of cost

Appendix A
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Notes
2G	***Alt. 2***	***Offsite SSDS Implementation for Thermal Remediation***				***$ 179,478***	
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	6	LS	$ 2,000.00	$ 12,000	
		Health & Safety Plan	6	LS	$ 2,000.00	$ 12,000	
		QA/QC Plan	6	LS	$ 2,000.00	$ 12,000	
		Equipment Mobilization/Demobilization	6	LS	$ 2,000.00	$ 12,000	
		Install SSDS System					
		Core through Concrete	20	Each	$ 500.00	$ 10,000	
		Controls	14	ea	$ 150	$ 2,100	magnahelic and sample port.
		Blower / Fan	6	ea	$ 4,000	$ 24,000	Weather resistant, install on roof.
		Conveyance System	435	LF	$ 7.00	$ 3,045	See hypothetical system layout
		Monitoring Point Installation					
		Core through Concrete Slabs	19	ea	$ 250.00	$ 4,750	
		Install sample port	19	ea	$ 1,200.00	$ 22,800	
		Reporting					
		Construction Completion Report	6	ea	$ 600.00	$ 3,600	
		Construction Oversight					
		Oversight	6	Weeks	$ 10,000.00	$ 60,000	Assume 10 hour days, office support and per diem
		Payment and Performance Bonds				$ 1,183	Assume 1% of cost
2H	***Alt. 3, 4, 5***	***Offsite SSDS Implementation***				***$ 117,447***	
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	4	LS	$ 2,000.00	$ 8,000	
		Health & Safety Plan	4	LS	$ 2,000.00	$ 8,000	
		QA/QC Plan	4	LS	$ 2,000.00	$ 8,000	
		Equipment Mobilization/Demobilization	4	LS	$ 2,000.00	$ 8,000	
		Install SSDS System					
		Core through Concrete	12	Each	$ 500.00	$ 6,000	
		Controls	8	ea	$ 150	$ 1,200	magnahelic and sample port.
		Blower / Fan	4	ea	$ 4,000	$ 16,000	Weather resistant, install on roof.
		Conveyance System	240	LF	$ 7.00	$ 1,680	See hypothetical system layout
		Monitoring Point Installation					
		Core through Concrete Slabs	12	ea	$ 250.00	$ 3,000	
		Install sample port	12	ea	$ 1,200.00	$ 14,400	
		Reporting					
		Construction Completion Report	4	ea	$ 600.00	$ 2,400	
		Construction Oversight					
		Oversight	4	Weeks	$ 10,000.00	$ 40,000	Assume 10 hour days, office support and per diem
		Payment and Performance Bonds				$ 767	Assume 1% of cost
		PERIODIC AND ANNUAL COSTS FOR ALL ALTERNATIVES					
3A	***Alt 2, 3, 4, 5***	***Long-term Monitoring & Reporting (Years 1 through 5)***				***$ 30,778***	
		Groundwater Sampling (20 wells, every 6 months)					
		Labor and Per Diem	8	Days	$ 2,000.00	$ 16,000	2 people, 4 days, two events
		Monitoring well sampling equipment	2	ea/wk	$ 219.00	$ 438	One week per event
		Lab Analysis - VOCs / Groundwater	44	EA	$ 65.00	$ 2,860	20 GW samples plus QAQC samples per event.
		Lab Analysis - MNA Parameters / Groundwater	10	EA	$ 258.00	$ 2,580	5 GW samples per event. Iron, Manganese, TC, Nitrate/Nitrite, Sulfate/Sulfide, Cos, Alkalinity, Chloride.
		Purge Water Disposal	2	Drum	$ 450.00	$ 900	For disposal of purge water
		Annual Report	1	LS	$ 8,000.00	$ 8,000	
3B	***Alt 2, 3, 4, 5***	***Long-Term Monitoring (Years 6 through 30)***				***$ 14,674***	
		Groundwater Sampling (10 wells, every 12 months)					
		Labor and Per Diem	5	Days	$ 1,000.00	$ 5,000	One person, 5 days, one event
		Monitoring well sampling equipment	1	ea/wk	$ 219.00	$ 219	One week per event
		Lab Analysis - VOCs / Groundwater	11	EA	$ 65.00	$ 715	10 GW samples plus QAQC.
		Lab Analysis - MNA Parameters / Groundwater	5	EA	$ 258.00	$ 1,290	5 GW samples- Iron, Manganese, TC, Nitrate/Nitrite, Sulfate/Sulfide, Cos, Alkalinity, Chloride.
		Purge Water Disposal	1	Drum	$ 450.00	$ 450	For disposal of purge water
		Annual Report	1	LS	$ 7,000.00	$ 7,000	

Appendix A
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Notes
3C	***Alt 2, 3, 4, 5***	***Long Term IC/EC Inspections, Certifications and Reporting***				***$ 4,000***	
		Annual Inspection - ICs/ECs					
		Labor and Per Diem	1	Days	$ 1,000.00	$ 1,000	Site Visit and Inspection
		Annual Report/Certifications	1	LS	$ 3,000.00	$ 3,000	
3D	***Alt 4***	***GWTP Operation and Maintenance***				***$ 116,144***	
		Technician Labor	416	hrs	$ 85.00	$ 35,360	8 hrs/wk - Filter replacements/check system
		Office Support	104	Hour	$ 100.00	$ 10,400	2 hrs/wk
		Influent and Effluent Sampling	28	Each	$ 300.00	$ 8,400	Assume 1 per well and 1 effluent sample per quarter
		Filters	520	Each	$ 10.00	$ 5,200	Assume 10/wk
		Waste	12	Drums	$ 485.00	$ 5,820	Drums of spent filters - Cost of drum and disposal as non-hazardous
		Quarterly OM&M Reports	4	Each	$ 5,000.00	$ 20,000	
		Utilities	153300	KWH	$ 0.11	$ 17,384	Assume 0.5 KW/well, 10 HP (8.5KW) blower, and 1.5 hp (1 KW) process pump, 100% duty cycle. Heat assumed 10 KW, 50% of the year.
		Annual Pump Maintenance	48	hrs	$ 85.00	$ 4,080	(8 Hr per well @ $85/Hr)
		Misc. Parts	1	LS	$ 2,000.00	$ 2,000	
		Conveyance Line Cleaning (Contracted)	1	LS	$ 7,500.00	$ 7,500	
3E	***Alt 4***	***Extraction Well Pump Maintenance (per 5 years)***				***$ 23,000***	
		Pump replacement	1	LS	$ 8,000.00	$ 8,000	Assume 2 every 5 years, includes labor
		Well redevelopment (Contracted)	1	LS	$ 15,000.00	$ 15,000	Assume 1 well every 5 years
3F	***Alt 2***	***Operation/Maintenance of SSD Systems for Thermal Remediation***				***$ 6,160***	
		Technician	2	Days	$ 1,000.00	$ 2,000	Two People - one day
		Lab Coordination, Data Tracking	8	hr	$ 120.00	$ 960	One annual event
		Equipment - PID	1	Days	$ 150.00	$ 150	
		Air Samples	6	EA	$ 175.00	$ 1,050	One in breathing area near each system
		Miscellaneous O&M	1	ea	$ 2,000.00	$ 2,000	Possible replacement of a fan and/or magnehelic
		Annual Report	1	LS	$ -	$ -	Included in Annual GW Monitoring Report
3G	***Alt 3, 4, 5***	***Operation/Maintenance of SSD Systems***				***$ 5,985***	
		Technician	2	Days	$ 1,000.00	$ 2,000	Two People - one day
		Lab Coordination, Data Tracking	8	hr	$ 120.00	$ 960	One annual event
		Equipment - PID	1	Days	$ 150.00	$ 150	
		Air Samples	5	EA	$ 175.00	$ 875	One in breathing area near each system
		Miscellaneous O&M	1	ea	$ 2,000.00	$ 2,000	Possible replacement of a fan and/or magnehelic
		Annual Report	1	LS	$ -	$ -	Included in Annual GW Monitoring Report

KEYSTONE
ENVIRONMENTAL SERVICES

A Division of Keystone Material Testing, LLC

Kenneth D. Ellsworth, P.E.
Managing Member

Richard J. Tarnowski, CEP, CEI
Member

October 14, 2021

Quote received for another NYSDEC Site; costs utilized for Gabriel Manufacturing due to similarity in project scope.

Mr. Charles Staples
Wood Environmental and Infrastructure Solutions, Inc.
22 Gildner Road
Central Square, New York 13036

RE: Soil Vapor Remediation
Field Diagnostic Testing and ASD Design
Commercial Structure
49 Main Street
Irvington, New York
KES Proposal No. P11621

Dear Mr. Staples:

Keystone Environmental Services (Consultant) is pleased to be given this opportunity to submit this preliminary proposal to Wood Environmental and Infrastructure Solutions, Inc. (Client) for the above noted project site.

PROJECT UNDERSTANDING

It is our understanding the project involves the remediation of VOC soil vapors at a commercial structure located at 49 Main Street, Irvington, New York. Consultant's Scope of Work would involve providing the manpower and equipment necessary to perform sub-slab vacuum testing in order to determine feasibility of installing Active Soil Depressurization (ASD) systems to remediate the estimated 15,000 square foot commercial structure.

DIAGNOSTIC TESTING

In order to determine blower requirements and preliminary suction point spacing for depressurizing the soil at the 49 Main Street commercial structure, suction test holes will be installed and sub slab soil permeability tests will be conducted. A performance rated shop vacuum will be used to draw air from suction holes. Smaller diagnostic test holes will be drilled through the slabs at various locations around the suction test holes. Existing soil vapor sampling points will be utilized if possible. Static vacuum measurements will be conducted at each diagnostic test hole location. A micro manometer will be used to measure pressure differentials at the remote diagnostic test hole locations and an ExTech "Thermo Anemometer" will be used to measure air flow. The results of the pressure and air flow tests will be shown in tabular form and in drawings.

GENERAL SYSTEM DESIGN INFORMATION

1. **Pressure Field Extension Determination**

   Pressure fields will be determined by evaluating the results of the pressure field testing. The objective of the ASD systems are to create a negative vacuum field of at least negative 0.004 to negative 0.010 inches of water column (W.C.) under the slab throughout the 15,000 square foot commercial structure.

Corporate Office
58 Exchange Street
Binghamton, New York 13901
Phone: 607.723.5117 / 607.770.9098
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2. Suction Point Location Verification

Preliminary suction point locations will be selected by Consultant and if present, the Client's on-site representative. Those locations will correspond to possible pipe routes to the exterior and will be tested and volume of air and static pressure readings will be recorded from the diagnostics testing. The design objective is to create a negative pressure field between negative 0.004" and 0.10" W.C. with a minimum performance of 0.004" W.C. Based on this, preliminary suction point locations will be confirmed or relocated to best meet pressure field extension objectives and pipe routing.

Consultant will take every reasonable precaution to avoid any damage to existing utilities located anywhere in the building or those located in or below the slab floor. Preliminary drawings of the lower basement slab on grade areas have not been provided by the Client. Consultant assumes the Client representatives will be present on-site to assist in identifying sub-slab utilities prior to drilling through the slab.

Worker's Health and Safety shall comply with all OSHA, state and local standards or regulations relating to worker safety. Consultant will be responsible for preparing an in house "Project Site Health and Safety Plan" (HASP) prior to beginning work.

A Contractor's Daily Report shall be completed providing a brief description of daily work performed, manpower used and equipment used.

Consultant's employees' wages on this project are not NYS Prevailing Wage.

3. ASD Design

With the diagnostic test results, Consultant will develop designs for ASD systems to preemptively mitigate VOC soil vapors at the 15,000 sq. ft. commercial structure located at 49 Main Street, Irvington, New York. The design services will include development of written plans, specifications, and system layout for the installation of proposed ASD systems.

The proposed ASD systems will be designed to create a negative pressure field under the entire lower level basement concrete slab on grade throughout the commercial structure so that the sub-slab VOC vapors in the structure will be unlikely to migrate upwards into the occupied areas under reasonably anticipated building conditions.

Consultant's proposed design will consist of specifications and diagrams that provide details for construction of the proposed ASD systems. If installed, operated and maintained per specifications, the ASD systems should be able to maintain negative sub-slab pressures under reasonably anticipated conditions and prevent upward migration of sub-slab vapors into the occupied areas of the building. Consultant's ASD system design specifications will be submitted to Client for approval.

Consultant is familiar with and will adhere to the following USEPA and ASTM technical guidance documents: OSWER Publication 9200.2-154 "OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air" and ASTM Standard E2121-03" Standard Practice for Installing Radon Mitigation Systems in Existing Low Rise Residential Buildings. Consultant is certified by the National Environmental Health Association as a proficient radon mitigation contractor.

QUALIFICATIONS

Consultant shall assume the following terms to form a basis of this contract:

Client's October 5, 2021, e-mail request for proposal for Diagnostic Communication Testing and Sub-Slab Ventilation System Design, ASD installation and final close out reports.

STAFFING

Our Member-in-Charge, Richard J. Tarnowski will manage the project and will assign additional experienced personnel as necessary to assure that quality work is accomplished within the project schedule. Based upon our current understanding of project requirements, our proposed project team includes the following individuals:

- Richard J. Tarnowski – Mr. Tarnowski will provide project management, data review, report preparation, and project supervision.
- Christian Tarnowski – Mr. Tarnowski will provide in field diagnostic testing, field supervision and design preparation.
- Paul Kovich – Mr. Kovich will provide in field diagnostic testing and design preparation.
- Anthony Polovick – Mr. Polovick will provide in field diagnostic testing and design preparation.

TIME SCHEDULE

Consultant shall provide all sub-slab diagnostic testing and ASD design services in accordance with Client's schedule requirements and can begin work immediately after notification of award.

COMPENSATION

Consultant will perform the following tasks:

1) Perform in field sub-slab diagnostic communication testing and Active Soil Depressurization (ASD) system design for the estimated 15,000 sq. ft. commercial structure located at 49 Main Street, Irvington, New York.
2) Provide estimated costs for standard commercial grade two suction point Active Soil Depressurization (ASD) system with special high suction exhaust fan. (Total number of ASD Systems needed will not be known until diagnostic testing is completed.)
3) Prepare costs for project closeout documents.

The cost to complete the above noted tasks will be performed on an estimated Lump Sum basis and is broken down and contained in the attached Estimated Lump Sum Project Costs section.

REIMBURSABLE EXPENSES

Direct and reimbursable expenses are included in the estimated lump sum fee as detailed above.

EXTRA WORK REQUESTS

If work on this project is believed by Consultant to be beyond, or in addition to, the base Scope of Services we will notify you immediately. Upon your approval we will proceed with this additional work and bill based on the provided unit pricing found in attached fee schedule.

AGREEMENT TERMS

This Proposal, along with the attached Schedule A (Standard Terms and Conditions) and the Fee Schedule represents the entire understanding between the Client and Consultant with respect to this project and may only be modified in writing signed by both parties.

We trust that we have responded to your request and if you have any questions or need additional information, please contact our office. This proposal is valid for thirty (30) days from date of this letter and pricing shall be in effect until December 1, 2021. Please execute this proposal along with initialing the attached Schedule A and returning it to our office acknowledging receipt and acceptance of the terms and conditions of this proposal.

This executed proposal will serve as the agreement between Client and Consultant.

Thank you for your consideration of this proposal. Please contact our office if you have any questions or comments.

Respectfully,

KEYSTONE ENVIRONMENTAL SERVICES

Richard J. Tarnowski, C.E.P., C.E.I.
Member/Director of Environmental Service

Enclosures

RJT:las

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Signature Resolution:

A. <u>Company Representative Signature:</u>

Be it hereby resolved that I, _____(Your Name),

am a _____ of
(CHOOSE ONE - Member, Partner, Officer, Director or Shareholder)

_____(Company) and have been

given the authority by its _____ to execute this
(CHOOSE ONE - Members, Partners or Shareholders)

agreement between Keystone Material Testing, LLC dba Keystone Environmental Services dba Enviro Testing and
_____(Company)
(LLC, Partnership or Corporation)

This agreement will therefore obligate _____(Company)
(LLC, Partnership or Corporation)

and all of its_____ to be obligated to honor all of the
(CHOOSE ONE - Members, Partners or Shareholders)

terms of this agreement.

_____
Company Name

_____
Client Authorized Signature Date

Along with this Signature Resolution, please <u>review and initial</u> where indicated on the following pages indicated below and return with signed contract:

- **SCHEDULE A** - STANDARD TERMS AND CONDITIONS

ATTACHMENT A

ESTIMATED LUMP SUM PROJECT COSTS

Estimated Lump Sum Project Costs
ASD Design and Installation Costs
Commercial Structure
49 Main Street
Irvington, New York
KES Proposal No. P11621

Consultant proposes to provide the manpower and equipment necessary to perform sub-slab vacuum communication diagnostic testing, prepare ASD design documents, install a two suction point commercial grade ASD system and prepare project closeout documents.

Consultant proposes to provide these services on an estimated Lump Sum (LS) basis and provides the following project breakdown for review purposes.

1) Preform Sub-Slab Communication Diagnostic Testing Data and Prepare ASD Design Documents

Project Manager	18 hours at $90.00 per hour	$ 1,620.00
Discount Travel	6 hours at $55.00 per hour	$ 330.00
ASD Foreman	8 hours at $75.00 per hour	$ 600.00
Discount Travel	6 hours at $55.00 per hour	$ 330.00
CADD Tech	6 hours at $55.00 per hour	$ 330.00
Administrative	8 hours at $50.00 per hour	$ 400.00
Construction Vehicle	1 day at $195.00 per day	$ 195.00
Lodging/Meals	1 night at $250.00/ per night/person	$ 500.00
Mileage	340 Miles @ .60 per mile	$ 204.00

Lump Sum Cost for Sub-Slab Diagnostic Testing and ASD Design Documents: **$ 4,509.00**

2) Two Suction Point Commercial Grade ASD System Installation Costs

Project Manager	24 hours at $90.00 per hour	$ 2,160.00
Discount Travel	6 hours at $55.00 per hour	$ 330.00
ASD Foreman	24 hours at $75.00 per hour	$ 1,800.00
Discount Travel	6 hours at $55.00 per hour	$ 330.00
ADS Installer	24 hours at $65.00 per hour	$ 1,560.00
Discount Travel	6 hours at $55.00 per hour	$ 330.00
Licensed Electrician	1 at $2,500.00 per day	$ 2,500.00
Construction Vehicle	3 days at $195.00 per day	$ 585.00
Lodging/Meals	3 Nights at $250/night/person (3 men)	$ 2,250.00
Mileage	680 miles at $0.60 per mile (2 vehicles)	$ 408.00

Materials for Two Suction Point Commercial Grade ASD System with High Suction Exhaust Fan
3" Schedule 40 PVC pipe, PVC Fittings, OBAR GBR 76 Exhaust Fan,
Vacuum Gauges, Balancing Valves, Fan Housing, Labels, Etc. $ 4,650.00

One (1) Two Suction Point Commercial Grade ASD System with
High Suction Exhaust Fan Installation Cost: **$ 16,903.00**

CORPORATE OFFICE 58 Exchange Street, Binghamton, NY 13901 | Tel: (607) 723-5117 | Fax: (607) 729-5154 | Email: info@KECompanies.com | www.KECompanies.com

Estimated Lump Sum Project Costs
ASD Design and Installation Costs
Commercial Structure
49 Main Street
Irvington, New York
KES Proposal No. P11621

3) Project Closeout Documentation

Post-Mitigation Sub Slab Testing, As-Built Sketches, Operation & Maintenance Manual and Final Report Preparation

Foreman / Project Manager	4 hours at $85.00 per hour	$340.00
CADD Tech	2 hours at $55.00 per hour	$110.00
Administrative	4 hours at $50.00 per hour	$200.00
	Lump Sum for Project Closeout Documentation:	**$650.00**

Total Lump Sum Project Cost

1)	ASD System Design	$ 4,509.00
2)	One (1) Two Suction Point Commercial Grade ASD System with High Suction Exhaust Fan Installation	$ 16,903.00
3)	Project Closeout Documentation	$ 650.00
	TOTAL LUMP SUM PROJECT COST:	**$22,062.00**

Limitations

1) Lump sum ASD installation costs are based on installing one (1) two suction point commercial grade ASD system with special high suction exhaust fan. Final ASD Design and existing on-site conditions could alter ASD installation costs. Any additional cost above Consultants "Total Lump Sum Project Costs" will be invoiced per the attached 2021 Fee Schedule or a revised ASD install cost will be prepared after the ASD Design is completed.
2) Preparation of CADD / Shop Drawings will be prepared if drawings are provided by the Client.
3) Consultant is assuming that asbestos testing of all floor, wall and ceiling surfaces has been completed and that all surfaces are non-asbestos containing. KES can provide environmental testing services if needed.
4) Consultant costs do not include slab sealing due to unknown conditions. If slab sealing is necessary, it will be invoiced as time and material charges above and beyond Consultant's estimated lump sum costs.

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STANDARD TERMS AND CONDITIONS

SCHEDULE A

This offer of services, including these terms and conditions and any attachment hereto, contains the complete and final agreement between Keystone Material Testing, LLC dba Keystone Environmental Services (CONSULTANT/TESTING AGENCY) and CLIENT.

GENERAL TERMS & CONDITIONS

Standard Day
If applicable and/or used on the attached Hourly Testing Proposal, a standard day is defined as time on-site during a 4- to 8-hour period and a half-day is defined as time on-site up to a 4-hour period, Monday through Friday, within the hours of 6:00 a.m. and 6:00 p.m. The overtime rate applies to time in excess of 8 hours per day or to time outside the hours of 6:00 a.m. to 6:00 p.m.

Right of Entry
The CLIENT shall provide for the TESTING AGENCY's right to enter the property owned by the CLIENT and/or others in order for the TESTING AGENCY to fulfill the Scope of Services included hereunder. Although the TESTING AGENCY will exercise reasonable care in performing its services, the CLIENT understands that use of testing or other equipment may unavoidably cause some damage, the correction of which is not part of this Agreement. The CLIENT agrees, to the fullest extent permitted by law, to indemnify and hold harmless the TESTING AGENCY, its officers, directors, employees, and professional associates (collectively, TESTING AGENCY) against any damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising or allegedly arising from procedures associated with testing or investigative activities or connected in any way with the discovery of hazardous materials or suspected hazardous materials on the property.

Health and Safety
The OWNER, or CLIENT, as the OWNER's Representative, is responsible for providing safe access to and on the project site in accordance with all applicable federal and state safety laws and regulations, including, but not limited to, relevant provisions of the OSHA standards. The more stringent of those or any site specific health and safety programs and procedures shall prevail. In addition to the laws, standards, and regulations above, the OWNER, or CLIENT, as the OWNER's representative, and any agents thereof, including contractors and subcontractors, shall adhere to TESTING AGENCY safety requirements while within the exclusion zone work area established by the TESTING AGENCY.

Ownership and Reuse of Documents
All data compilation, reports, photographs, and/or drawings produced by Consultant as instruments of service, in accordance with this AGREEMENT, shall not be used or reused for unrelated extrinsic purposes by either CLIENT or TESTING AGENCY, without the prior written consent of the other party. CLIENT agrees to compensate TESTING AGENCY, in accordance with the terms of the agreement, for all documents and other work produced by TESTING AGENCY as instruments of service. Failure to compensate TESTING AGENCY for services rendered under this AGREEMENT forfeits CLIENT's right to ownership and use of TESTING AGENCY's instruments of service for any purpose. TESTING AGENCY will retain all pertinent records relating to the services performed in accordance with TESTING AGENCY's record retention policy. The records will be made available to CLIENT at all reasonable times upon request and for the cost of retrieval and reproduction.

Standard of Care
Services provided by TESTING AGENCY under this AGREEMENT will be performed in a manner consistent with the level of care and skill ordinarily exercised by members of the industry performing similar services using recognized methodologies in the same or comparable locality. In accepting reports of observations, tests, photographs, and opinions provided pursuant to this AGREEMENT, CLIENT acknowledges that the extent of TESTING AGENCY's obligation with respect thereto is limited to furnishing of such data, which shall not be solely used by others to determine acceptance of any construction work, nor shall it relieve the contractor in any way from his obligations and responsibilities to conduct the work in conformance with the project plans and specifications.

PAYMENT AND TERMINATION

Payment Due
Invoices shall be submitted by the TESTING AGENCY are due upon presentation and shall be considered past due if not paid within thirty (30) calendar days of the invoice date.

Interest
If payment in full is not received by the TESTING AGENCY within thirty (30) calendar days of the invoice date, invoices shall bear interest at one-and-one-half (1.5) percent (or the maximum rate allowable by law, whichever is less) of the PAST DUE amount per month, which shall be calculated from the invoice due date. Payment thereafter shall first be applied to accrued interest and then to the unpaid principal.

Collection Costs
If the CLIENT fails to make payments when due and the TESTING AGENCY incurs any costs in order to collect overdue sums from the CLIENT, the CLIENT agrees that all such collection costs incurred shall immediately become due and payable to the TESTING AGENCY. Collection costs shall include, without limitation, legal fees, collection agency fees and expenses, court costs, collection bonds, and reasonable TESTING AGENCY staff costs at standard billing rates for the TESTING AGENCY's time spent in efforts to collect. This obligation of the CLIENT to pay the TESTING AGENCY's collection costs shall survive the term of this Agreement or any earlier termination by either party.

Suspension of Services
If the CLIENT fails to make payments when due or otherwise is in breach of this Agreement, the TESTING AGENCY may suspend performance of services upon seven (7) calendar days' written notice to the CLIENT. The TESTING AGENCY shall have no liability whatsoever to the CLIENT for any costs or damages as a result of such suspension caused by any breach of this Agreement by the CLIENT. Upon payment in full by the CLIENT, the TESTING AGENCY shall resume services under this Agreement, and the time schedule and compensation shall be equitably adjusted to compensate for the period of suspension plus any other reasonable time and expense necessary for the TESTING AGENCY to resume performance.

Client Initials: _____

Termination of Services
This Agreement may be terminated by either party upon not less than seven (7) days' written notice should the other party fail substantially to perform in accordance with the terms of this agreement through no fault of the party initiating the termination.

This Agreement may be terminated by the CLIENT upon not less than seven (7) days' written notice to the TESTING AGENCY for the CLIENT's convenience and without cause.

If the CLIENT fails to make payment to the TESTING AGENCY in accordance with the payment terms herein, this shall constitute a material breach of this Agreement and shall be cause for termination of this Agreement by the TESTING AGENCY.

Set-offs, Backcharges, Discounts
Payment of invoices shall not be subject to any discounts or set-offs by the CLIENT, unless agreed to in writing by the TESTING AGENCY. Payment to the TESTING AGENCY for the services rendered and expenses incurred shall be due and payable regardless of any subsequent suspension or termination of this Agreement by either party.

Satisfaction with Services
Payment of any invoice by the CLIENT to the TESTING AGENCY shall be taken to mean that the CLIENT is satisfied with the TESTING AGENCY's services to the date of payment and is not aware of any deficiencies in those services.

Disputed Invoices
If the CLIENT objects to any portion of an invoice, the CLIENT shall so notify the TESTING AGENCY in writing within seven (7) calendar days of receipt of the invoice. The CLIENT shall identify in writing the specific cause of the disagreement and the amount in dispute and shall pay that portion of the invoice not in dispute in accordance with the other payment terms of this Agreement. Any dispute over invoiced amounts due which cannot be resolved within ten (10) calendar days after presentation of invoice by direct negotiation between the parties shall be resolved by court having jurisdiction. If such matter relates to or is the subject of a lien arising out of the TESTING AGENCY's services, the TESTING AGENCY may proceed in accordance with applicable law to comply with the lien notice or filing deadlines prior to the resolution of the matter. Interest as stated above shall be paid by the CLIENT on all disputed invoice amounts that are subsequently resolved in the TESTING AGENCY's favor and shall be calculated on the unpaid balance from the due date of the invoice.

ALLOCATION OF RISK

Limitation of TESTING AGENCY's Liability
To the fullest extent permitted by law, total liability to CLIENT for any and all injuries, claims, losses, expenses, or damages whatsoever arising out of or in any way related to the project or this Agreement from any cause or causes included but not limited to TESTING AGENCY's negligence, errors, omissions, strict liability, breach of contract, or breach of warranty shall not exceed the total reimbursement received by TESTING AGENCY from CLIENT on this Project or five thousand dollars ($5,000), whichever is less.

TESTING AGENCY will be responsible only for the instruments of service furnished by it but shall not be responsible for the interpretation and/or misuse by others of the information developed. CLIENT agrees to indemnify and hold TESTING AGENCY harmless from and against all claims, damages, losses, and expenses arising from the interpretation and/or misuse by others of instruments of service provided by TESTING AGENCY.

Consequential Damages
Notwithstanding any other provision of this Agreement, and to the fullest extent permitted by law, neither the CLIENT nor the TESTING AGENCY, their respective officers, directors, partners, employees, contractors, or professional associates shall be liable to the other or shall make any claim for any incidental, indirect, or consequential damages arising out of or connected in any way to the Project or to this Agreement. This mutual waiver of consequential damages shall include, but is not limited to, loss of use, loss of profit, loss of business, loss of income, loss of reputation, or any other consequential damages that either party may have incurred from any cause or action including negligence, strict liability, breach of contract, and breach of strict or implied warranty. Both the CLIENT and the TESTING AGENCY shall require similar waivers of consequential damages protecting all the entities or persons named herein in all contracts and subcontracts with others involved in this project.

Third Party Beneficiaries
Nothing contained in this Agreement shall create a contractual relationship with or a cause of action in favor of a third party against either the CLIENT of the TESTING AGENCY. The TESTING AGENCY's services under this Agreement are being performed solely for the CLEINT's benefit, and no other party or entity shall have any claim against the TESTING AGENCY because of this Agreement or the performance or nonperformance of services hereunder. The CLIENT and the TESTING AGENCY agree to require a similar provision in all contracts with contractors, subcontractors, professional associates, vendors, and other entities involved in this Project to carry out intent of this provision.

Information Provided by Others
The CLIENT shall furnish, at the CLIENT's expense, copies of the project plans and specifications prior to project initiation. The TESTING AGENCY may use the above information in performing its services and is entitled to rely upon the accuracy and completeness thereof.

Client Initials: _____

KEYSTONE
ENVIRONMENTAL SERVICES

A Division of Keystone Material Testing, LLC

SOIL VAPOR INTRUSION CONSULTING/REMEDIATION
2021 FEE SCHEDULE

SERVICE		UNIT FEE
PERSONNEL		
Member/Director		$ 120.00/Hour
Professional Engineer		$ 120.00/Hour
Project Manager		$ 90.00/Hour
Project Foreman		$ 75.00/Hour
Installer		$ 65.00/Hour
Laborer		$ 45.00/Hour
Mason/Concrete Finisher		$ 75.00/Hour
CADD Technician		$ 55.00/Hour
Administration		$ 50.00/Hour
Light Duty Field Sampling Vehicle Fully Equipped		$ 175.00/Day
REIMBURSABLE EXPENSES		
Laboratory Fees		
Sample Analysis		Cost +
Reproduction/Prints/Scans/Photocopies		
In-House Prints	24x36	$ 2.50/Each
	30x42	$ 3.00/Each
In-House Mylars	24x36	$ 10.00/Each
	30x42	$ 15.00/Each
In-House Copy Services	8½x11	$ 0.20/Each
	11x17	$ 0.30/Each
Outside Copy Services		Cost + 10%
Travel		
Mileage		$ 0.60/Mile
Meals/Lodging		Cost + 10%
Vehicle Rental/Fuel		Cost + 10%
Postage/Courier		
Bulk Postage, Express Mail, UPS, FedEx, DHL, etc.		Cost + 10%
Miscellaneous		
Subcontracted Services		Per Quote (Cost +)
Consumable Supplies		Cost + 10%

The above hourly rates include compensation for professional, technical and non-technical personnel time, equipment, materials, and overhead, which ordinarily would be incurred during the performance of our work. Services are normally billed monthly. A finance charge of 1.5% per month will be billed on all accounts not paid within 30 days of the invoice date. Rates will be revised on January 1 of every year.

PREFERRED ENVIRONMENTAL SERVICES
323 Merrick Avenue - North Merrick, New York 11566 Tel: (516) 546-1100 Fax : (516) 213-8156

May 14, 2021

Mr. Charles Staples, CG, PG
Senior Scientist
Wood, PLC

Re: Sub-slab Depressurization System Installation
Budgetary Cost Estimate
49 Main Street
Irvington, NY

Dear Mr. Staples:

Preferred Environmental Services (Preferred) is pleased to provide a budgetary cost estimate for the installation of a Sub-Slab Depressurization System (SSDS) at the above-referenced property (Subject Property). This estimate has been prepared based on the limited information provided, including pictures and a site sketch. As per our conversations this estimate is summarized into the following tasks:

- ***Task 1*** - Prior to installation of the SSDS Preferred with a Professional Engineer will prepare a design for the system. The design will be submitted and verified by the client prior to installation. One (1) site visit with the client will be included within this task - **$5,000.00**

- ***Task 2 –*** Conduct of a Pilot Test and installation of initial three (3) extraction points for the SSDS System. – Three (3) extraction points shall be installed through the concrete slab floor of the building, along with an estimated five vacuum monitoring points. A pilot test will be conducted to evaluate the vacuum beneath the entire footprint of the building. A summary report will be prepared with the findings of the pilot test. - **$15,000.00**

- ***Task*** 3 –It is assumed that three (3) extraction points previously installed during the Pilot Test will be utilized in the final design/operation of the SSDS system and no additional extraction points will be required. The extraction points will be completed and exhausted through vertical piping routed interior to the building and eventually through the roof of the building. In-line fans (assumed Radon away RP-265 models with u-tube manometers) will be installed on each of the extraction vent piping above the roof line - **$10,000.00**

    - **Note: ROOF PENETRATIONS TO BE SEALED AND ELECTRICAL OUTLETS TO BE PROVIDED BY OTHERS. WOOD FRAME AND SHEETROCK ENCLOSURES TO BE BUILT AROUND VERTICAL VENT PIPING ARE THE RESPONSIBILITY OF THE OWNER AND ARE NOT INCLUDED IN THIS ESTIMATE.**

- ***Task 4*** **-** System Start-up and Reporting - 48-hours after installation, Preferred's technicians will conduct a start-up check of the system. The start-up process will visually verify that the system will operate as designed and that vacuum is being generated beneath

the slab of the basement. Preferred will prepare a summary report documenting the installation of the SSDS. **$2,000.00**

TOTAL ESTIMATE - $32,000.00

ASSUMPTIONS

1. Estimate assumes that groundwater will not present an issue. Handling of groundwater is not included with this estimate.
2. Assumes all vertical piping can be run inside the building to the roof (and through);
3. Assumes no auto dialer;
4. Does not include monitoring or sampling of the SSDS and/or indoor air after installation;
5. Does not include any permitting costs;
6. Assumes all piping can be PVC;
7. Assumes labor is non-union, non-prevailing wage;
8. Normal work hours Monday through Friday 8 am to 4 pm;

BUDGET AND SCHEDULE

Please note that this has been prepared for budgetary purposes only. Actual costs will be provided after additional information is provided and a site-walk through is completed. It is assumed that a Preferred will enter into a Subcontractor Agreement with Wood and that our existing insurance limits are adequate for this project. A sample insurance certificate is provided.

Thank you very much for this opportunity to be of service.

PREFERRED ENVIRONMENTAL SERVICES

Dan Prisco-Buxbaum

Dan Prisco-Buxbaum
Technical Director

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 7/14/2017

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:	
SterlingRisk 135 Crossways Park Drive P.O. Box 9017 Woodbury NY 11797	PHONE (A/C, No, Ext): 800-767-7837	FAX (A/C, No): 516-487-0372
	E-MAIL ADDRESS: request@sterlingrisk.com	

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : Great Divide Insurance Company	25224
INSURER B : Utica National Ins. of Texas	43478
INSURER C :	
INSURER D :	
INSURER E :	
INSURER F :	

INSURED

SPECCOV-01

Spectrum Coverage Corpration dba Preferred Environmental Services
323 Merrick Avenue
North Merrick NY 11566

COVERAGES **CERTIFICATE NUMBER:** 1259983231 **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	**GENERAL LIABILITY** X COMMERCIAL GENERAL LIABILITY [ ] CLAIMS-MADE [X] OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: [ ] POLICY [X] PRO-JECT [ ] LOC	Y	Y	ECP	6/26/2020	6/26/2021	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG Deductible	$2,000,000 $100,000 $5,000 $2,000,000 $4,000,000 $4,000,000 $5,000
B	**AUTOMOBILE LIABILITY** ANY AUTO ALL OWNED AUTOS [X] SCHEDULED AUTOS X HIRED AUTOS [X] NON-OWNED AUTOS				6/26/2020	6/26/2021	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ 1,000,000 $ $ $
	UMBRELLA LIAB [ ] OCCUR **EXCESS LIAB** [ ] CLAIMS-MADE DED [ ] RETENTION $						EACH OCCURRENCE AGGREGATE	$ $
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y / N ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? [ ] **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below	N / A					[ ] WC STATU-TORY LIMITS [ ] OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	 $ $ $
A	Professional Liability Contractor's Pollution Liability	Y Y	Y Y	ECP20	6/26/2020	6/26/2021	Each Claim Aggregate Limit	$2,000,000 $4,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

CERTIFICATE HOLDER

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

REGENESIS

Project Information		
Gabriel Manufacturing		
Stony point NY		
bedrock		
Prepared For:		
Wood		
Target Treatment Zone (TTZ) Info	**Unit**	**Value**
Barrier Length	ft	200
Top Treat Depth	ft	50.0
Bot Treat Depth	ft	70.0
Vertical Treatment Interval	ft	20.0
Treatment Zone Volume	ft^3	80,000
Treatment Zone Volume	cy	2,963
Soil Type	---	bedrock
Porosity	cm^3/cm^3	0.20
Effective Porosity	cm^3/cm^3	0.15
Treatment Zone Pore Volume	gals	119,688
Treatment Zone Effective Pore Volume	gals	89,766
Fraction Organic Carbon (foc)	g/g	0.005
Soil Density	g/cm^3	1.67
Soil Density	lb/ft^3	104
Soil Weight	lbs	8.3E+06
Hydraulic Conductivity	ft/day	25.0
Hydraulic Conductivity	cm/sec	8.82E-03
Hydraulic Gradient	ft/ft	0.005
GW Velocity	ft/day	0.83
GW Velocity	ft/yr	304
Contaminant Mass	**Unit**	**Value**
Dissolved Phase Contaminant Mass	lbs	5
Sorbed Phase Contaminant Mass	lbs	0
Competing Electron Acceptor Mass	lbs	90
Total Mass Contributing to H2 Demand	**lbs**	**95**
Mass Flux and 3DME Demand	**Unit**	**Value**
Groundwater Flux	L/day	14,158
Stoichiometric 3DME Demand	lbs	372
Total Mass Flux 3DME Demand	lbs	3,188
Total 3DME Demand	**lbs**	**3,560**
Application Dosing		
3-D Microemulsion to be Applied	**lbs**	**3,600**
S-MZVI to be Applied	**lbs**	**3,000**
BDI Plus to be Applied	**liters**	**34**

3-D Microemulsion®, S-MZVI®, BDI® Plus Application Design Summary

bedrock		
Treatment Type	**Barrier**	
Distance Perpendicular to Flow (ft)	200	**Input special application instructions here as needed.**
Spacing Within Rows (ft)	8	
Number of Rows	1	
Injection Wells	25	
Top Application Depth (ft bgs)	50	**Field Mixing Ratios**
Bottom Application Depth (ft bgs)	70	3DME Concentrate per Pt (gals)
3DME to be Applied (lbs)	**3,600**	17
3DME to be Applied (gals)	431	Mix Water per Pt (gals)
3DME Mix %	6%	296
Volume Water (gals)	**7,412**	3DME Mix Volume per Pt (gals)
3DME Mix Volume (gals)	7,844	314
S-MZVI to be Applied (lbs)	**3,000**	S-MZVI Volume per Pt (gals)
S-MZVI Volume (gals)	199	8
BDI Plus to be Applied (L)	**34**	BDI Volume per Pt (L)
BDI Plus Mix Water Volume (gals)	340	1.4
	0	
	0	
Total Application Volume (gals)	**8,391**	Volume per pt (gals)
Estimated Radius of Injection (ft)	#N/A	336
Prepared by: Name - Title		Volume per vertical ft (gals)
Date: 9/19/2022		17

Technical Notes/Discussion

REGENESIS

Purchasing Information

Gabriel Manufacturing	--	**bedrock**
3-D Microemulsion to be Applied	**lbs**	**3,600**
S-MZVI to be Applied	**lbs**	**3,000**
BDI Plus to be Applied	**liters**	**34**
3-D Microemulsion Cost	$	$21,276
S-MZVI Cost	$	$33,930
BDI Plus Cost	$	$6,732
Subtotal Product Cost	**$**	**$61,938**
Estimated Tax and Freight %	%	15%
Estimated Tax and Freight Cost*	$	$9,291
Estimated Total Product Cost	**$**	**$71,229**
Estimated RRS Application Cost	**$**	**$18,071**
Total Estimated Project Cost**	**$**	**$89,299**
Estimated RRS Days to Apply	**---**	**3**
Total Estimated Project Cost Range**	**Min** **Max**	**$89,000** **$107,000**
Estimated RRS Days to Apply	**--**	**3**

***Note that the combined tax and freight costs are preliminary estimates only. Please contact your local sales manager or Customer Service at 949-366-8000 to obtain a shipping quote. You will be asked to provide a ship-to address and estimated time of delivery.**

Currently Available Packaging Options

Package Type**	# of packages	lbs required
3DME-400 lb poly drums	9	3,600
3DME-2,000 lb reinforced plastic totes	2	4,000
S-MZVI-2,000 lb reinforced plastic totes	2	4,000
S-MZVI-500 lb poly drums	6	3,000
S-MZVI-50 lb HDPE Pails	60	3,000
BDI-18 Liter kegs	2	--

****Total Project cost is only an estimate; actual project cost may change as the final scope and/or RRS proposal are developed.**

*****Available Package Types are subject to change.**

REGENESIS

Project Information

Gabriel Manufacturing
Stony point NY
source
Prepared For:
Wood

Target Treatment Zone (TTZ) Info	Unit	Value
Areal Extent	sq ft	6,000
Top Treat Depth	ft	30.0
Bot Treat Depth	ft	50.0
Vertical Treatment Interval	ft	20.0
Treatment Zone Volume	ft^3	120,000
Treatment Zone Volume	cy	4,444
Soil Type	---	silty sand
Porosity	cm^3/cm^3	0.40
Effective Porosity	cm^3/cm^3	0.20
Treatment Zone Pore Volume	gals	359,065
Treatment Zone Effective Pore Volume	gals	179,532
Fraction Organic Carbon (foc)	g/g	0.003
Soil Density	g/cm^3	1.6
Soil Density	lb/ft^3	100
Soil Weight	lbs	1.2E+07
Hydraulic Conductivity	ft/day	10.0
Hydraulic Conductivity	cm/sec	3.53E-03
Hydraulic Gradient	ft/ft	0.005
GW Velocity	ft/day	0.25
GW Velocity	ft/yr	91

Contaminant Mass	Unit	Value
Dissolved Phase Contaminant Mass	lbs	15
Sorbed Phase Contaminant Mass	lbs	0
Competing Electron Acceptor Mass	lbs	270
Total Mass Contributing to H2 Demand	**lbs**	**285**

Mass Flux and 3DME Demand	Unit	Value
Groundwater Flux	L/day	850
Stoichiometric 3DME Demand	lbs	1,117
Total Mass Flux 3DME Demand	lbs	191
Total 3DME Demand	**lbs**	**1,308**

Application Dosing		
3-D Microemulsion to be Applied	**lbs**	**8,400**
S-MZVI to be Applied	**lbs**	**6,500**
BDI Plus to be Applied	**liters**	**68**

3-D Microemulsion®, S-MZVI®, BDI® Plus Application Design Summary

source		
Treatment Type	**Grid**	
Treatment Areal Extent (sq ft)	6,000	
Spacing Within Rows (ft)	20	**Input special application instructions here as needed.**
Spacing Between Rows (ft)	20	
Injection Wells	15	
Top Application Depth (ft bgs)	30	**Field Mixing Ratios**
Bottom Application Depth (ft bgs)	50	3DME Concentrate per Pt (gals)
3DME to be Applied (lbs)	**8,400**	67
3DME to be Applied (gals)	1,007	Mix Water per Pt (gals)
3DME Mix %	6%	1153
Volume Water (gals)	**17,295**	3DME Mix Volume per Pt (gals)
3DME Mix Volume (gals)	18,302	1220
S-MZVI to be Applied (lbs)	**6,500**	S-MZVI Volume per Pt (gals)
S-MZVI Volume (gals)	430	29
BDI Plus to be Applied (L)	**68**	BDI Volume per Pt (L)
BDI Plus Mix Water Volume (gals)	680	4.5
	0	
	0	
Total Application Volume (gals)	**19,430**	Volume per pt (gals)
Estimated Radius of Injection (ft)	4.9	1295
Prepared by: Name - Title		Volume per vertical ft (gals)
Date: 9/19/2022		65

Technical Notes/Discussion

REGENESIS

Purchasing Information

Gabriel Manufacturing	--	source
3-D Microemulsion to be Applied	**lbs**	**8,400**
S-MZVI to be Applied	**lbs**	**6,500**
BDI Plus to be Applied	**liters**	**68**
3-D Microemulsion Cost	$	$49,644
S-MZVI Cost	$	$73,515
BDI Plus Cost	$	$13,464
Subtotal Product Cost	**$**	**$136,623**
Estimated Tax and Freight %	%	15%
Estimated Tax and Freight Cost*	$	$20,493
Estimated Total Product Cost	**$**	**$157,116**
Estimated RRS Application Cost	**$**	**$26,343**
Total Estimated Project Cost**	**$**	**$183,459**
Estimated RRS Days to Apply	**---**	**5**
Total Estimated Project Cost Range**	**Min** **Max**	**$183,000** **$220,000**
Estimated RRS Days to Apply	**--**	**5**

***Note that the combined tax and freight costs are preliminary estimates only. Please contact your local sales manager or Customer Service at 949-366-8000 to obtain a shipping quote. You will be asked to provide a ship-to address and estimated time of delivery.**

Currently Available Packaging Options

Package Type**	# of packages	lbs required
3DME-400 lb poly drums	21	8,400
3DME-2,000 lb reinforced plastic totes	5	10,000
S-MZVI-2,000 lb reinforced plastic totes	4	8,000
S-MZVI-500 lb poly drums	13	6,500
S-MZVI-50 lb HDPE Pails	130	6,500
BDI-18 Liter kegs	4	--

****Total Project cost is only an estimate; actual project cost may change as the final scope and/or RRS proposal are developed.**

*****Available Package Types are subject to change.**

Gabriel Manufacturing Remediation Parameters

www.thermalrs.com

			Area 1	Area 2
Treatment Volume:				
Electrical Resistance Heating Treatment Area:	61,500 sq. ft		37,000	24,500
Average Shallow Extent of Heating:	30 ft		30	30
Average Deep Extent of Heating:	106.1 ft		140	55
Typical Depth to Groundwater:	35 ft			
Treatment Volume:	173,400 cu. yd		150,700	22,700
Assumed Total Organic Carbon Content of Soil:	0.25%		0.25%	0.25%
Is a New Surface Cap Required?	no			
Subsurface Components:				
Number of Electrodes:	232		140	92
Electrode Boring Diameter (in.):			12.0	12.0
Average Distance Between Electrodes:	17.5 ft		17.5	17.5
Avg. Total Depth of Electrodes:	107.3 ft		141	56
Avg. Depth to Top of Electrode Conductive Zone:	30 ft		30	30
Number of Co-located Vapor Recovery Wells:	232		140	92
Number of Temperature Monitoring Points:	25 (avg. 16 sensors each)			
Contaminant Information:				
Controlling Contaminant:	Freon 113			
Average Clean-up Percent:	99.9%		100%	100%
Assumed VOC Mass:	470 lb	This VOC mass is based on an assumed average conc. of 1 mg/kg.		
Vapor Recovery and Condensate Streams:				
Vapor Recovery Air Flow Rate:	2160 scfm using a 100-hp vapor recovery blower			
Vapor Treatment Method:	carbon			
Assumed Activated Carbon Required:	12,000 lb			
Condensate Production Rate:	5 gpm			
Electrical Information:				
Power Control Unit (PCU) Capacity:	6000 kW			
Average Electrical Heating Power Input:	4118 kW			
Total Heating Treatment Time:	164 - 219 days			
Design Remediation Energy (kWh):	18,030,000	An additional 390,000 kWh is used by surface equipment.		
Confirmatory Soil Sampling:				
Number of Confirmatory Soil Borings Included:	25	With 8 soil samples per boring. Budget for 320 total confirmatory samples.		

The above remediation parameters are estimated -5%/+ 20%. Final parameters will be determined during system design.

Standard Fixed Price for Gabriel Manufacturing

Price Charged by TRS Group	Price Range Low End	High End
Design, Work Plan, HASP, Permit Assistance:	$456,000	$576,000
Materials Mobilization:	$3,454,200	$4,363,200
Subsurface Installation:	$4,609,020	$5,821,920
Surface Installation and Start-up:	$1,723,680	$2,177,280
Remediation System Operation:	$2,948,040	$3,723,840
Demobilization and Final Report:	$1,195,860	$1,510,560
Total TRS Price	**$14,386,800**	**$18,172,800**

Several factors will impact the final TRS price, including the scope split between the parties, contract terms, subcontractor quotes, and a more detailed design. The above cost estimate is valid for 30 days.Payment for materials is due before starting field work. Pricing is based on net 30 day payment. Add 1% for net 60 days.

Suggested Scope by Others:

Site Preparatory Work		
Drill Cuttings and Waste Disposal		
Electrical Permit and Utility Connection to System		
Electrical Energy Usage		
Carbon Usage, Transportation & Regeneration		
Condensate Disposal		
Other Operational Costs		
Total Estimated Costs by Others	**$2,800,600**	**$3,832,400**

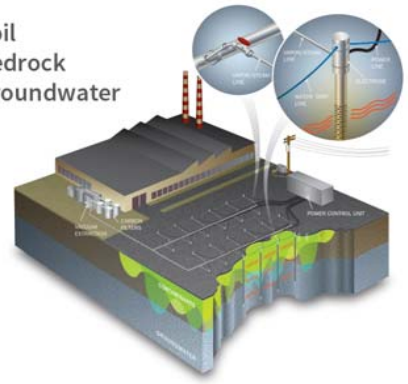
TRS recommends getting quotes to verify Costs by Others. Due to economies of scale, costs do not scale linearly with changes in treatment volume. Please request a revised cost estimate, when there are changes to the treatment parameters listed above.

Total Estimated Remediation Cost:	**$17,187,400**	**$22,005,200**

Prepared for Dorottya Kelemen, 207.776.4938, dorottya.kelemen@woodplc.com
Prepared by C.Blundy on 09/12/2022

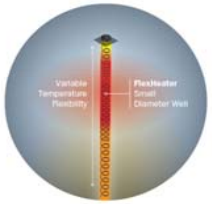
Electrical Resistance Heating

- Soil
- Bedrock
- Groundwater

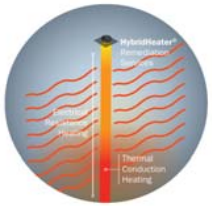


Thermal Conduction Heating

FlexHeater®
Remediation
Services
Variable Vertical
Temperatures



HybridHeater®
Remediation
Services
Combining
TCH and ERH



HEPA® Remediation
Sub-steaming Temperatures for a Plume-wide Solution

Heat Enhanced:

- Bioremediation
- Chemical Oxidation
- Hydrolysis
- Multi-phase Extraction

TRS Group

Appendix A
Quantity Calculations

Alt 2 - SS Monitoring Well Construction

	No.Wells	Depth of Drill (ft)	Screen length (ft)	Riser Length (ft)
Overburden Monitoring Wells	5	55	15	40
Bedrock Monitoring Wells	4	140	15	125
Totals	9	835	135	700

Grout (bags)	700	1 bag per foot of riser	
Bentonite (bags)	5	1/2 bag per well	
Sand (bags)	95	0.7 bags per foot of screen	
Debris:	12	Inch Boring Diameter	
	835	feet depth of drill	
	655	CF	
	24	CY	
	36.4	Tons	Assume 1.5 Ton/CY

Alt 2 - Existing Monitoring Well Abandonment

Name of Abandoned Well	Depth of Well (ft)
MW-200	54.61
MW-201	49.67
MW-207	50.14
MW-101	55.16
MW-102	64.29
MW-103	34.62
MWT-4	46.11
MW-203B	NM
MW-101B	104.19
MWB-2	121.98
MW-102B	102.6
MW-206B	90.11
MW-204B	85.75
MW-204D	137.01
MW-302B	104.9
Totals (feet)	1101.14
Total Number of Wells	15

Alt 2 - Thermal Construction

Overburden Treatment Area

Treatment Area (sf)	24,500
Well Grid Spacing (ft)	16
Well AOE (sf)	267.3225

	No.Wells	Depth of Drill (ft)	Screen length (ft)	Riser Length (ft)
Injection Wells	92	55	20	35
Monitoring Points	0	55	20	35
Totals (Feet)	92	5060	1840	3220

Grout (bags)	3220	1 bag per foot of riser	
Bentonite (bags)	46	1/2 bag per well	
Sand (bags)	1288	0.7 bags per foot of screen	
Debris:	12	Inch Boring Diameter	
	5060	feet depth of drill	
	3972	CF	
	147	CY	
	221	Tons	Assume 1.5 Ton/CY

Appendix A
Quantity Calculations

Bedrock Treatment Area

Treatment Area (sf)	37,000
Well Grid Spacing (ft)	16
Well AOE (sf)	265.69

	No.Wells	Depth of Drill (ft)	Screen length (ft)	Riser Length (ft)
Injection Wells	140	140	20	120
Monitoring Points	0	140	20	120
Totals (Feet)	140	19600	2800	16800

Grout (bags)	16800	1 bag per foot of riser	
Bentonite (bags)	70	1/2 bag per well	
Sand (bags)	1960	0.7 bags per foot of screen	
Debris:	12	Inch Boring Diameter	
	19600	feet depth of drill	
	15386	CF	
	570	CY	
	855	Tons	Assume 1.5 Ton/CY

Alt 3 - Bio Well Construction

Overburden Treatment Area

Treatment Area (sf)	8,000
Well Grid Spacing (ft)	20
Well AOE (sf)	400

	No.Wells	Depth of Drill (ft)	Screen length (ft)	Riser Length (ft)
Injection Wells	20	50	20	30
Monitoring Points	0	50	20	30
Totals (Feet)	20	1000	400	600

Grout (bags)	600	1 bag per foot of riser	
Bentonite (bags)	10	1/2 bag per well	
Sand (bags)	280	0.7 bags per foot of screen	
Debris:	8	Inch Boring Diameter	
	1000	feet depth of drill	
	349	CF	
	13	CY	
	19	Tons	Assume 1.5 Ton/CY

Bedrock Treatment Area

Barrier Length (ft)	200
Well Spacing (ft)	8

	No.Wells	Depth of Drill (ft)	Screen length (ft)	Riser Length (ft)
Injection Wells	25	145	20	125
Monitoring Points	0	145	20	125
Totals (Feet)	25	3625	500	3125

Grout (bags)	3125	1 bag per foot of riser	
Bentonite (bags)	13	1/2 bag per well	
Sand (bags)	350	0.7 bags per foot of screen	
Debris:	8	Inch Boring Diameter	
	3625	feet depth of drill	
	1265	CF	
	47	CY	
	70	Tons	Assume 1.5 Ton/CY

Appendix A
Quantity Calculations

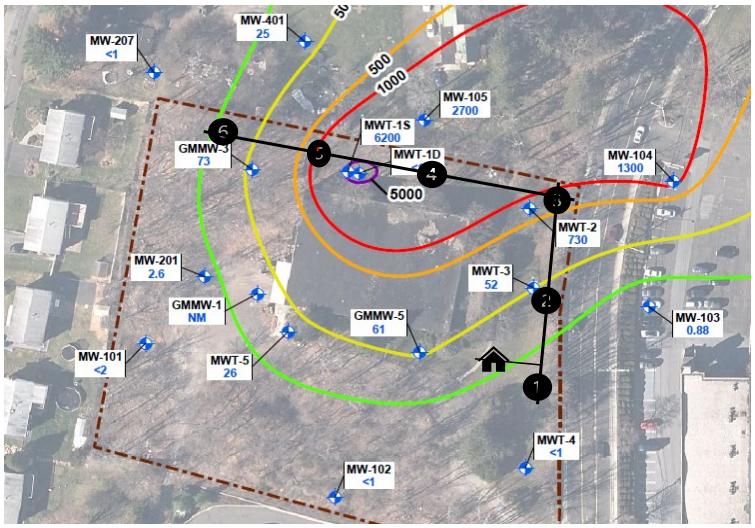
Alt 4 - Groundwater Extraction Well Construction

	No.Wells	Depth of Drill (ft)	Screen length (ft)	Riser Length (ft)
Extraction Wells	6	55	15	40
Totals (Feet)	6	330	90	240

Grout (bags)	240	1 bag per foot of riser	
Bentonite (bags)	3	1/2 bag per well	
Sand (bags)	63	0.7 bags per foot of screen	
Debris:	8	Inch Boring Diameter	
	330	feet depth of drill	
	115	CF	
	4	CY	
	6	Tons	Assume 1.5 Ton/CY

Groundwater Extraction System Conveyance and Discharge Lines

Hypothetical System Layout

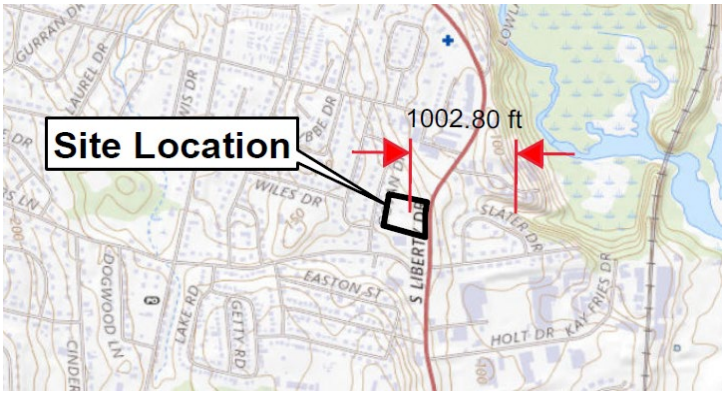


Conveyance Lines

Proposed Well	Trench Run (ft)	Pipe Run (ft)
EW-1	85	85
EW-2	85	85
EW-3	185	185
EW-4	285	285
EW-5	385	385
EW-6	485	485
Totals	535	1510

Appendix A
Quantity Calculations

Discharge Lines

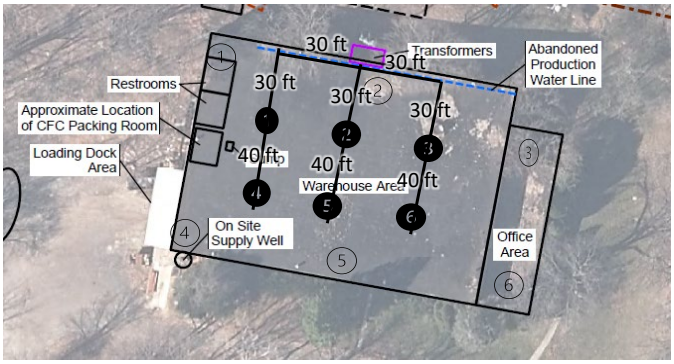


Distance to brook discharge, est. (ft)	1000

Alt 2, 3, 4, 5 - Install Onsite SSDS System

Treatment Area (sf)	16,000
Extraction Point Radius of Influence (ft)	30
Well AOE (sf)	2827.4

Hypothetical System Layout



	No.Wells
Extraction Points	6
Monitoring Points	6
Totals	12

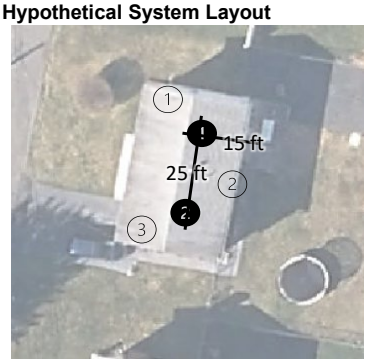
Conveyance Lines

Proposed Extraction Point	Pipe Run (ft)	Shared Run (ft)
1	30	0
2	60	0
3	90	30
4	70	30
5	100	60
6	130	90
Total Pipe Run	290	*Assumes 20' rise outside of the building*

Appendix A
Quantity Calculations

Alt 2 - Install Offsite SSDS Systems (Thermal Remediation)

Hypothetical System Layout



Property Address	Footprint (sf)	Extraction Well ROI (ft)	Well AOE (sf)	Extraction Points	Monitoring Points
8 Govan Drive	1600	20	1256.6	2	3
10 Govan Drive	1600	20	1256.6	2	3
12 Govan Drive	1600	20	1256.6	2	3
14 Govan Drive	1600	20	1256.6	2	3
Former Ramapo Tool Company	4700	20	1256.6	4	4
16 Govan Drive	2000	20	1256.6	2	3
Number of Systems	6		TOTALS	14	19

Conveyance Lines

Proposed SSDS	Pipe Run (ft)
8 Govan Drive	60
10 Govan Drive	60
12 Govan Drive	60
14 Govan Drive	60
Former Ramapo Tool Company	130
16 Govan Drive	65
Total Pipe Run	435

Assumes 20' rise outside of each building

Alt 3, 4, 5 - Install Offsite SSDS Systems

Property Address	Footprint (sf)	Extraction Well ROI (ft)	Well AOE (sf)	Extraction Points	Monitoring Points
8 Govan Drive	1600	20	1256.6	2	3
10 Govan Drive	1600	20	1256.6	2	3
12 Govan Drive	1600	20	1256.6	2	3
14 Govan Drive	1600	20	1256.6	2	3
Number of Systems	4		TOTALS	8	12

Conveyance Lines

Proposed SSDS	Pipe Run (ft)
8 Govan Drive	60
10 Govan Drive	60
12 Govan Drive	60
14 Govan Drive	60
Total Pipe Run	240

Assumes 20' rise outside of each building

Appendix A
Quantity Calculations

Bio Amendment Calculation

Overburden Area	
Treatment Area (sf)	8,000
Top of Treatment Depth (fbgs)	35
Bottom of Treatment Depth (fbgs)	55
Treatment Interval (ft)	20
Treatment Volume (cf)	160000
3-D Microemulsion required (lb)	11200
SMZVI required (lb)	8000
Bedrock Fence	
Fence Length (ft)	200
Top of Treatment Depth (fbgs)	125
Bottom of Treatment Depth (fbgs)	145
Treatment Interval (ft)	20
3-D Microemulsion required (lb)	3600
SMZVI required (lb)	3000

APPENDIX B

DETAILED C02 EMISSIONS CALCULATIONS

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 2			
Alternative 2: In-Situ Thermal Remediation with Engineering Controls			
Treatment area assumptions (thermal treatment to 5 ug/L CFC-11 in groundwater)			
Overburden only treatment area			
Areal extent of thermal treatment area	24500	square feet	
Depth to top of treatment zone	30	fbgs	
Depth to bottom of treatment zone	55	fbgs	
Treatment volume	612500	cubic feet	
Overbuden/bedrock treatment area			
Areal extent of thermal treatment area	37000	square feet	
Depth to top of treatment zone	30	fbgs	
Depth to bottom of treatment zone	140	fbgs	
Treatment volume	4070000	cubic feet	
Thermal Predesign Investigation			
New well installation			
Drill rig operation time	10	days	*Estimate provided by drilling subcontractor*
Drill rig fuel consumption rate	50	gal/day	*Estimate provided by drilling subcontractor*
Drill rig fuel consumption	500	gallons	
Metric tons CO2 per gallon (diesel)	0.01018	tons/gal	
Metric Tons CO2	5.09	tons	
Abandonment of existing wells			
Drill rig operation time	3	days	*Estimate provided by drilling subcontractor*
Drill rig fuel consumption rate	50	gal/day	*Estimate provided by drilling subcontractor*
Drill Rig Fuel Consumption	150	gallons	
Metric tons CO2 per gallon (diesel)	0.01018	tons/gal	
Metric Tons CO2	1.53	tons	
Disposal of IDW			
Drums of waste	10	drums	*Estimate provided by drilling subcontractor*
Truck Capacity	80	drums	
Trips	1		
Distance to Disposal Facility	100	miles	*Assume 100 miles to nearest disposal facility*
Active Truck Fuel Consumption Rate	6	mpg	
Disposal Fuel Consumption	34	gallons	
Metric tons CO2 per gallon (diesel)	0.01018	tons/gal	
Metric Tons CO2	0.35	tons	
Baseline Sampling			
Trips	1		*One round of sampling*
Distance to Office	120	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	10	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	0.09	tons	

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 2

Groundwater Samples	52		
Volume of Groundwater Samples	6240	ml	*Assume 120 ml each*
Mass of Sample Bottles	8840	g	*Assume empty sample bottle is roughly 6 ounces (170 grams)*
Mass of Groundwater Samples	15.08	kg	
Mass of Groundwater Samples	0.016622575	ton	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.001		
Vapor Samples	12		
Mass of Sample Bottles	31.32	kg	*Assume 6-L Summa canister, 2.61 kg/each*
Mass of Sample Bottles	0.03452381	tons	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.002		
Site Supply Well Abandonment			
Shipping/freight of grout			
Volume to be grouted	59	cubic feet	*Assume 6" open borehole to 300 fbgs*
Wet density of grout	1.5	g/cc	
Mass of wet grout	2,502.0	kg	
Ratio of water/grout	0.8		
Necessary mass of Dry Grout	1.53	tons	
Distance from generator	50	miles	*Assumes supply by Lehigh Cement on Long Island*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.02	tons	
Embodied energy of grout			
Volume to be grouted	1.67	m^3	
Embodied energy of dry grout (kg CO2 pe	1624	kg CO2	*From Kien T. Tong 2020 IOP Conf. Ser: Mater. Sci. Eng. 869 032048*
Metric Tons CO2	2.71	tons	
Plumbing to municipal water			
Mass of piping	0.07	tons	*Assume 100 ft of 3" Sch 40 PVC @ 1.41 lb/ft*
Distance from supplier	5	miles	*Assume from Ferguson Plumbing Supply (local wholesaler)*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.07		
In-situ Thermal Installation and Operation			
Install heating wells			
Drill rig operation time	300	days	*Based on estimate provided by drilling subcontractor*
Drill rig fuel consumption rate	50	gal/day	*Estimate provided by drilling subcontractor*
Drill rig fuel consumption	15,000	gallons	
Metric tons CO2 per gallon (diesel)	0.01018	tons/gal	
Metric Tons CO2	152.70	tons	

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 2			
Disposal of Drill Cuttings			
Drums of waste	2152	drums	*Assume approx. 0.5 tons per drum*
Truck Capacity	80	drums	
Trips	27		
Distance to Disposal Facility	100	miles	*Assume 100 miles to nearest disposal facility*
Active Truck Fuel Consumption Rate	6	mpg	
Disposal Fuel Consumption	900	gallons	
Metric tons CO2 per gallon (diesel)	0.01018	tons/gal	
Metric Tons CO2	9.16	tons	
Heating			
Average heating power input	4118	kw	*Estimate provided by thermal vendor*
Duration of heating	4680	hours	*164-219 days, assume 195 days*
Heating kwh	19,272,240	kwh	
Metric tons CO2/kwh (natural gas)	0.000412	tons/kwh	
Metric Tons CO2	7,940.16	tons	
SVE Operation			
SVE blower HP	100	HP	
SVE blower energy consumption rate	74.6	kw	
Duration of pumping	4680	hours	*164-219 days, assume 195 days*
SVE energy consumption	349128	kwh	
Metric tons CO2/kwh (natural gas)	0.000412	tons/kwh	
Metric Tons CO2	143.84	tons	
On- and Off-Site SSDS Installation			
Materials shipping			
Mass of offsite fans	46	lb	*6 RP 145 fans @ 7.7 lbs each*
Distance from supplier	240	miles	*Assume from Haverhill, MA*
Mass of Piping	1,022	lb	*Assume 725 ft of 3" Sch 40 PVC @ 1.41 lb/ft*
Distance from supplier	5	miles	*Assume from Ferguson Plumbing Supply (local wholesaler)*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.002		
Installation			
Trips	1		
Distance to Office	120	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	10	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	0.09	tons	

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 2			
Long Term Operation and Monitoring			
Offsite SSDS Operation			
Exhaust fan energy consumption rate	0.396	kw	*Assume 6 RP145 fans @ 0.066 kw*
Duration of operation	262980	hours	*365 days/year, 30 years*
Fan energy consumption	104140.08	kwh	
Metric tons CO2/kwh (natural gas)	0.000412	tons/kwh	
Metric Tons CO2	42.91	tons	
Travel and sampling events, years 1 through 5			
Trips	10		*Sampling every 6 months*
Distance to Office	120	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	96	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	0.85	tons	
Travel and sampling events, years 6 through 30			
Trips	25		*Sampling every 12 months*
Distance to Office	120	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	240	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	2.13	tons	
Shipping/Freight			
Groundwater Samples	670		*54 samples years 1-5, 16 samples years 6-30*
Volume of Groundwater Samples	80400	ml	*Assume 120 ml each*
Mass of Sample Bottles	113900	g	*Assume empty sample bottle is roughly 6 ounces (170 grams)*
Mass of Groundwater Samples	194.3	kg	
Mass of Groundwater Samples	0.21	ton	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.01		
Vapor Samples	180		*6 samples years 1-30*
Mass of Sample Bottles	469.8	kg	*Assume 6-L Summa canister, 2.61 kg/each*
Mass of Sample Bottles	0.52	tons	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.03		
Total tons CO2	8,301.75	tons CO2	

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 3			
Alternative 3: Enhanced Bioremediation with Engineering Controls			
Treatment area assumptions (enhanced bio to 5 ug/L CFC-11 in groundwater)			
Overburden only treatment area			
Areal extent of treatment area	8000	square feet	
Depth to top of treatment zone	30	fbgs	
Depth to bottom of treatment zone	50	fbgs	
Treatment volume	160000	cubic feet	
Bedrock treatment fence			
Fence lenth	200	feet	
Depth to top of treatment zone	125	fbgs	
Depth to bottom of treatment zone	145	fbgs	
Predesign Investigation			
Baseline Sampling			
Trips	1		*One round of sampling*
Distance to Office	120	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	10	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	0.09	tons	
Groundwater Samples	52		
Volume of Groundwater Samples	6240	ml	*Assume 120 ml each*
Mass of Sample Bottles	8840	g	*Assume empty sample bottle is roughly 6 ounces (170 grams)*
Mass of Groundwater Samples	15.08	kg	
Mass of Groundwater Samples	0.0166226	ton	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.001		
Vapor Samples	12		
Mass of Sample Bottles	31.32	kg	*Assume 6-L Summa canister, 2.61 kg/each*
Mass of Sample Bottles	0.0345238	tons	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.002		
Site Supply Well Abandonment			
Shipping/freight of grout			
Volume to be grouted	59	cubic feet	*Assume 6" open borehole to 300 fbgs*
Wet density of grout	1.5	g/cc	
Mass of wet grout	2,502.0	kg	
Ratio of water/grout	0.8		
Necessary mass of Dry Grout	1.53	tons	
Distance from generator	50	miles	*Assumes supply by Lehigh Cement on Long Island*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.02	tons	

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 3			
Embodied energy of grout			
Volume to be grouted	1.67	m^3	
Embodied energy of dry grout (kg CO2 pe	1624	kg CO2	*From Kien T. Tong 2020 IOP Conf. Ser: Mater. Sci. Eng. 869 032048*
Metric Tons CO2	2.71	tons	
Plumbing to municipal water			
Mass of piping	0.07	tons	*Assume 100 ft of 3" Sch 40 PVC @ 1.41 lb/ft*
Distance from supplier	5	miles	*Assume from Ferguson Plumbing Supply (local wholesaler)*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.07		
Enhanced Bio			
Install injection wells			
Drill rig operation time	55	days	*Based on estimate provided by drilling subcontractor*
Drill rig fuel consumption rate	50	gal/day	*Estimate provided by drilling subcontractor*
Drill rig fuel consumption	2,750	gallons	
Metric tons CO2 per gallon (diesel)	0.01018	tons/gal	
Metric Tons CO2	28.00	tons	
Disposal of Drill Cuttings			
Drums of waste	178	drums	*Assume approx. 0.5 tons per drum*
Truck Capacity	80	drums	
Trips	3		
Distance to Disposal Facility	100	miles	*Assume 100 miles to nearest disposal facility*
Active Truck Fuel Consumption Rate	6	mpg	
Disposal Fuel Consumption	100	gallons	
Metric tons CO2 per gallon (diesel)	0.01018	tons/gal	
Metric Tons CO2	1.02	tons	
Transport of material to site			
Amendment 1 (two rounds)	14.8	tons	*14,800 lbs per round, 2 rounds*
Distance from generator	2600	miles	*From Anaheim, CA*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Amendment 2 (two rounds)	11.0	tons	*11,000 lbs per round, 2 rounds*
Distance from generator	750	miles	*From Gallatin, TN*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	9.77	tons	
Injection			
Drill rig operation time	180	hours	*Assume 2 events, 12 days each, 10 hour days, 75% active injection*
Drill rig fuel consumption rate	0.75	gal/hr	*Assume 7822DT Geoprobe or equivalent*
Drill Rig Fuel Consumption	135	gallons	
Metric tons CO2 per gallon (diesel)	0.01018	tons/gal	
Metric Tons CO2	1.37	tons	

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 3			
On- and Off-Site SSDS Installation			
Materials shipping			
Mass of onsite fan	22	lb	*1 GBR76 SOE @ 22 lbs each*
Distance from supplier	45	miles	*Assume from West Milford, NJ*
Mass of offsite fans	31	lb	*4 RP 145 fans @ 7.7 lbs each*
Distance from supplier	240	miles	*Assume from Haverhill, MA*
Mass of Piping	747	lb	*Assume 530 ft of 3" Sch 40 PVC @ 1.41 lb/ft*
Distance from supplier	5	miles	*Assume from Ferguson Plumbing Supply (local wholesaler)*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.001		
Installation			
Trips	1		
Distance to Office	120	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	10	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	0.09	tons	
Long Term Operation and Monitoring			
Onsite SSDS Operation			
Exhaust fan energy consumption rate	0.32	kw	*Assume 1 GBR76 SOE16 blower @ 0.32 kw*
Duration of operation	262980	hours	*365 days/year, 30 years*
Fan energy consumption	84153.6	kwh	
Metric tons CO2/kwh (natural gas)	0.000412	tons/kwh	
Metric Tons CO2	34.67	tons	
Offsite SSDS Operation			
Exhaust fan energy consumption rate	0.264	kw	*Assume 4 RP145 fans @ 0.066 kw*
Duration of operation	262980	hours	*365 days/year, 30 years*
Fan energy consumption	69426.72	kwh	
Metric tons CO2/kwh (natural gas)	0.000412	tons/kwh	
Metric Tons CO2	28.60	tons	
Travel and sampling events, years 1 through 5			
Trips	10		*Sampling every 6 months*
Distance to Disposal Facility	250	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	200	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	1.78	tons	
Travel and sampling events, years 6 through 30			
Trips	25		*Sampling every 12 months*
Distance to Disposal Facility	250	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	500	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	4.44	tons	

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 3			
Shipping/Freight			
Groundwater Samples	670		*54 samples years 1-5, 16 samples years 6-30*
Volume of Groundwater Samples	80400	ml	*Assume 120 ml each*
Mass of Sample Bottles	113900	g	*Assume empty sample bottle is roughly 6 ounces (170 grams)*
Mass of Groundwater Samples	194.3	kg	
Mass of Groundwater Samples	0.2141755	ton	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.01		
Vapor Samples	210		*7 samples years 1-30*
Mass of Sample Bottles	548.1	kg	*Assume 6-L Summa canister, 2.61 kg/each*
Mass of Sample Bottles	0.6041667	tons	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.04		
Total tons CO2	112.68	tons CO2	

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 4			
Alternative 4: Groundwater Containment with Engineering Controls			
Predesign Investigation			
Baseline Sampling			
Trips	1		*One round of sampling*
Distance to Office	120	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	10	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	0.09	tons	
Groundwater Samples	52		
Volume of Groundwater Samples	6240	ml	*Assume 120 ml each*
Mass of Sample Bottles	8840	g	*Assume empty sample bottle is roughly 6 ounces (170 grams)*
Mass of Groundwater Samples	15.08	kg	
Mass of Groundwater Samples	0.0166226	ton	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.001		
Vapor Samples	12		
Mass of Sample Bottles	31.32	kg	*Assume 6-L Summa canister, 2.61 kg/each*
Mass of Sample Bottles	0.0345238	tons	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.002		
Site Supply Well Abandonment			
Shipping/freight of grout			
Volume to be grouted	59	cubic feet	*Assume 6" open borehole to 300 fbgs*
Wet density of grout	1.5	g/cc	
Mass of wet grout	2,502.0	kg	
Ratio of water/grout	0.8		
Necessary mass of Dry Grout	1.53	tons	
Distance from generator	50	miles	*Assumes supply by Lehigh Cement on Long Island*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.02	tons	
Embodied energy of grout			
Volume to be grouted	1.67	m^3	
Embodied energy of dry grout (kg CO2 pe	1624	kg CO2	*From Kien T. Tong 2020 IOP Conf. Ser: Mater. Sci. Eng. 869 032048*
Metric Tons CO2	2.71	tons	
Plumbing to municipal water			
Mass of piping	0.07	tons	*Assume 100 ft of 3" Sch 40 PVC @ 1.41 lb/ft*
Distance from supplier	5	miles	*Assume from Ferguson Plumbing Supply (local wholesaler)*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.07		

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 4			
GWETS Installation			
Install extraction wells			
Drill rig operation time	4	days	*Based on estimate provided by drilling subcontractor*
Drill rig fuel consumption rate	50	gal/day	*Estimate provided by drilling subcontractor*
Drill rig fuel consumption	200	gallons	
Metric tons CO2 per gallon (diesel)	0.01018	tons/gal	
Metric Tons CO2	2.04	tons	
Disposal of Drill Cuttings			
Drums of waste	12	drums	*Assume approx. 0.5 tons per drum*
Truck Capacity	80	drums	
Trips	1		
Distance to Disposal Facility	100	miles	*Assume 100 miles to nearest disposal facility*
Active Truck Fuel Consumption Rate	6	mpg	
Disposal Fuel Consumption	34	gallons	
Metric tons CO2 per gallon (diesel)	0.01018	tons/gal	
Metric Tons CO2	0.35	tons	
Construction of Treatment Building			
Embodied energy	17.00	metric tons	*Estimate from buildcarbonneutral.org*
Metric Tons CO2	17.00	tons	
Materials shipping			
Mass of pump	270	lb	*6 submersible 20 GPM pumps @ 45 lbs/each*
Distance from supplier	2400	miles	*Assume from Mexico*
Mass of air stripper	1,000	lb	*Air stripper capable of handling 120 GPM, assume ~1000 lbs*
Distance from supplier	650	miles	*Assume from Dexter, MI*
Mass of Piping	3,035	lb	*Assume 1510 ft of 4" Sch 40 PVC @ 2.01 lb/ft*
Distance from supplier	5	miles	*Assume from Ferguson Plumbing Supply (local wholesaler)*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	137.23	tons	
On- and Off-Site SSDS Installation			
Materials shipping			
Mass of onsite fan	22	lb	*1 GBR76 SOE @ 22 lbs each*
Distance from supplier	45	miles	*Assume from West Milford, NJ*
Mass of offsite fans	31	lb	*4 RP 145 fans @ 7.7 lbs each*
Distance from supplier	240	miles	*Assume from Haverhill, MA*
Mass of Piping	747	lb	*Assume 530 ft of 3" Sch 40 PVC @ 1.41 lb/ft*
Distance from supplier	5	miles	*Assume from Ferguson Plumbing Supply (local wholesaler)*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.001		
Installation			
Trips	1		
Distance to Office	120	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	10	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	0.09	tons	

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 4			
Long Term Operation and Monitoring			
GWETS Operation			
Pump consumption rate	2.2371	kw	*Assume two 1.5 hp process pumps*
Duration of operation	236682	hours	*365 days/year, 30 years, 90% uptime*
Pump energy consumption	529481.3	kwh	
Blower consumption rate	7.457	kw	*Assume one 10 hp blower*
Duration of operation	236682	hours	*365 days/year, 30 years, 90% uptime*
Blower energy consumption	1764937.7	kwh	
Metric tons CO2/kwh (natural gas)	0.000412	tons/kwh	
Metric Tons CO2	945.30	tons	
Onsite SSDS Operation			
Exhaust fan energy consumption rate	0.32	kw	*Assume 1 GBR76 SOE16 blower @ 0.32 kw*
Duration of operation	262980	hours	*365 days/year, 30 years*
Fan energy consumption	84153.6	kwh	
Metric tons CO2/kwh (natural gas)	0.000412	tons/kwh	
Metric Tons CO2	34.67	tons	
Offsite SSDS Operation			
Exhaust fan energy consumption rate	0.264	kw	*Assume 4 RP145 fans @ 0.066 kw*
Duration of operation	262980	hours	*365 days/year, 30 years*
Fan energy consumption	69426.72	kwh	
Metric tons CO2/kwh (natural gas)	0.000412	tons/kwh	
Metric Tons CO2	28.60	tons	
Travel and sampling events, years 1 through 5			
Trips	10		*Sampling every 6 months*
Distance to Disposal Facility	250	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	200	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	1.78	tons	
Travel and sampling events, years 6 through 30			
Trips	25		*Sampling every 12 months*
Distance to Disposal Facility	250	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	500	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	4.44	tons	
Shipping/Freight			
Groundwater Samples	670		*54 samples years 1-5, 16 samples years 6-30*
Volume of Groundwater Samples	80400	ml	*Assume 120 ml each*
Mass of Sample Bottles	113900	g	*Assume empty sample bottle is roughly 6 ounces (170 grams)*
Mass of Groundwater Samples	194.3	kg	
Mass of Groundwater Samples	0.2141755	ton	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.01		

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 4			
Vapor Samples	210		*7 samples years 1-30*
Mass of Sample Bottles	548.1	kg	*Assume 6-L Summa canister, 2.61 kg/each*
Mass of Sample Bottles	0.6041667	tons	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.04		
Total tons CO2	1,174.44	tons CO2	

Appendix B Remedial Activity Greenhouse Gas Emissions - Alternative 5

Alternative 5: Monitored Natural Attenuation with Engineering Controls			
Predesign Investigation			
Baseline Sampling			
Trips	1		*One round of sampling*
Distance to Office	120	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	10	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	0.09	tons	
Groundwater Samples	52		
Volume of Groundwater Samples	6240	ml	*Assume 120 ml each*
Mass of Sample Bottles	8840	g	*Assume empty sample bottle is roughly 6 ounces (170 grams)*
Mass of Groundwater Samples	15.08	kg	
Mass of Groundwater Samples	0.0166226	ton	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.001		
Vapor Samples	12		
Mass of Sample Bottles	31.32	kg	*Assume 6-L Summa canister, 2.61 kg/each*
Mass of Sample Bottles	0.0345238	tons	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.002		
Site Supply Well Abandonment			
Shipping/freight of grout			
Volume to be grouted	59	cubic feet	*Assume 6" open borehole to 300 fbgs*
Wet density of grout	1.5	g/cc	
Mass of wet grout	2,502.0	kg	
Ratio of water/grout	0.8		
Necessary mass of Dry Grout	1.53	tons	
Distance from generator	50	miles	*Assumes supply by Lehigh Cement on Long Island*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.02	tons	
Embodied energy of grout			
Volume to be grouted	1.67	m^3	
Embodied energy of dry grout (kg CO2 p	1624	kg CO2	*From Kien T. Tong 2020 IOP Conf. Ser: Mater. Sci. Eng. 869 032048*
Metric Tons CO2	2.71	tons	
Plumbing to municipal water			
Mass of piping	0.07	tons	*Assume 100 ft of 3" Sch 40 PVC @ 1.41 lb/ft*
Distance from supplier	5	miles	*Assume from Ferguson Plumbing Supply (local wholesaler)*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.07		

On- and Off-Site SSDS Installation			
Materials shipping			
Mass of onsite fan	22	lb	*1 GBR76 SOE @ 22 lbs each*
Distance from supplier	45	miles	*Assume from West Milford, NJ*
Mass of offsite fans	31	lb	*4 RP 145 fans @ 7.7 lbs each*
Distance from supplier	240	miles	*Assume from Haverhill, MA*
Mass of Piping	747	lb	*Assume 530 ft of 3" Sch 40 PVC @ 1.41 lb/ft*
Distance from supplier	5	miles	*Assume from Ferguson Plumbing Supply (local wholesaler)*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.001		
Installation			
Trips	1		
Distance to Office	120	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	10	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	0.09	tons	
Long Term Operation and Monitoring			
Onsite SSDS Operation			
Exhaust fan energy consumption rate	0.32	kw	*Assume 1 GBR76 SOE16 blower @ 0.32 kw*
Duration of operation	262980	hours	*365 days/year, 30 years*
Fan energy consumption	84153.6	kwh	
Metric tons CO2/kwh (natural gas)	0.000412	tons/kwh	
Metric Tons CO2	34.67	tons	
Offsite SSDS Operation			
Exhaust fan energy consumption rate	0.264	kw	*Assume 4 RP145 fans @ 0.066 kw*
Duration of operation	262980	hours	*365 days/year, 30 years*
Fan energy consumption	69426.72	kwh	
Metric tons CO2/kwh (natural gas)	0.000412	tons/kwh	
Metric Tons CO2	28.60	tons	
Travel and sampling events, years 1 through 5			
Trips	10		*Sampling every 6 months*
Distance to Disposal Facility	250	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	200	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	1.78	tons	
Travel and sampling events, years 6 through 30			
Trips	25		*Sampling every 12 months*
Distance to Disposal Facility	250	miles	*Assume from Albany*
Active Car Fuel Consumption Rate	25	mpg	
Travel Fuel Consumption	500	gallons	
Metric tons CO2 per gallon (gasoline)	0.00889	tons/gal	
Metric Tons CO2	4.44	tons	

Shipping/Freight			
Groundwater Samples	670		*54 samples years 1-5, 16 samples years 6-30*
Volume of Groundwater Samples	80400	ml	*Assume 120 ml each*
Mass of Sample Bottles	113900	g	*Assume empty sample bottle is roughly 6 ounces (170 grams)*
Mass of Groundwater Samples	194.3	kg	
Mass of Groundwater Samples	0.2141755	ton	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.01		
Vapor Samples	210		*7 samples years 1-30*
Mass of Sample Bottles	548.1	kg	*Assume 6-L Summa canister, 2.61 kg/each*
Mass of Sample Bottles	0.6041667	tons	
Distance to Lab	315	miles	*Assume ground freight to Rochester*
Shipping emissions factor	0.209	kg/ton-mile	*air - 1.278, truck - 0.209, train - 0.021, sea - 0.0409*
Metric Tons CO2	0.04		
Total tons CO2	72.53	tons CO2	