Partial Massachusetts Contingency Plan, Phase IV Remedy Implementation Plan, Part 2

Version: Draft for Public Comment

Former Varian Facility Site, 150 Sohier Road, Beverly, Massachusetts 01915
MassDEP Site # 3-0485

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Acronyms and abbreviations

°C	degree(s) Celsius
AUL	activity use limitation
bgs	below ground surface
CAC	colloidal activated carbon
cis-1,2-DCE	cis-1,2-dichloroethene
CMR	Code of Massachusetts Regulations
CPI	Communications & Power Industries, Inc.
CSA	Comprehensive Site Assessment
CVOC	chlorinated volatile organic compound
DNAPL	dense nonaqueous phase liquid
DO	dissolved oxygen
DOC	dissolved organic carbon
ERD	enhanced reductive dechlorination
EVO	emulsified vegetable oil
FLUTe	Flexible Linear Underground Technologies
ft^2	square foot (feet)
ft/ft	foot per foot
GAC	granular activated carbon
GPR	ground-penetrating radar
HASP	Health and Safety Plan
ISB	in situ bioremediation
ISCO	in situ chemical oxidation
ISCR	in situ chemical reduction
ISTR	in situ thermal remediation
KBr	potassium bromide
lb	pound(s)
LSP	Licensed Site Professional
MassDEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
mL	milliliter
mV	millivolt(s)
NA	not available
$NaMnO_4$	sodium permanganate
NAPL	nonaqueous phase liquid
NMR	nuclear magnetic resonance
OHM	oil and/or hazardous material
OMM	operation, maintenance, and/or monitoring
ORP	oxidation-reduction potential
PAZ	permeable absorptive zone

PCE	tetrachloroethene
PDB	passive-diffusion bag
PID	photo ionization detector
PIP	Public Involvement Plan
PSL	Potential Source Location
ppb-V	parts per billion by volume
PPE	personal protective equipment
PSL	Potential Source Location
PVC	polyvinyl chloride
RAA	remedial action alternative
RAM	Release Abatement Measure
RAP	Remediation Action Plan
RCM	reactive core mat
ROI	radius of influence
RP	responsible party
S mZVI PRZ	sulfidated micro zero-valent iron permeable reactive zone
SBGR	subgrade biogeochemical reactor
SPCC	spill prevention control and countermeasures
SSDS	subslab depressurization system
SVE	soil vapor extraction
TAT	turnaround time
TBD	to be determined
TCE	trichloroethene
TOC	total organic carbon
TTZ	target treatment zone
USEPA	United States Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound
ZOI	zone of influence
ZVI	zero-valent iron

1. Introduction

Jacobs has prepared this Phase IV Implementation of the Selected Remedial Alternative Report (Phase IV Plan) on behalf of Varian Medical Systems, Inc. (Varian) in accordance with the Massachusetts Contingency Plan (MCP) (Section 310 Code of Massachusetts Regulations [CMR] 40.0870) for the Former Varian Facility located at 150 Sohier Road, in Beverly, Massachusetts (Site). Within this report, the term "Site" is used in accordance with the MCP, being any place or area where oil and/or hazardous material (OHM) from Varian's former facility have come to be located. The "facility" refers to Varian's former facility property. The Site location is shown on Figure 1-1. The Site has been the subject of multiple assessment activities, which have indicated that release of OHM has occurred at the Former Varian Facility. The Site is listed as a Disposal Site under the MCP and was assigned Release Tracking Number (RTN) 3-0485 by the Massachusetts Department of Environmental Protection (MassDEP).

The purpose of this Phase IV Plan is to present plans for the implementation of the selected remedial action alternatives (RAAs) for the Building 5 overburden, bedrock, and Potential Source Location (PSL) 10 areas. Specifically, this plan is referred to as the Phase IV Plan, Part 2. The Phase IV Plan, Part 1, submitted in March 2023, presented plans for the implementation of the RAAs for addressing the Building 3 source area and two downgradient areas of the Site, one along the groundwater flow pathway at Tozer Road and the other at two identified groundwater seeps along Stream A.

As required by the MCP, this Phase IV Plan, Part 2, is being submitted electronically to MassDEP concurrently with a completed Comprehensive Response Action Transmittal Form (BWSC-108). A copy of the BWSC-108 form is provided as Appendix A. The Site is an active Public Involvement Plan (PIP) site under the MCP. Therefore, a copy of this report will also be sent to the information repository established for the Former Varian Facility Site and to the City of Beverly. In addition, this report will be presented at a public meeting and will undergo a 20-day public comment period.

1.1 Disposal Site Name, Location, and Locus Map

Varian's former facility was located at 150 Sohier Road in Beverly, Essex County, Massachusetts. The property at 150 Sohier Road has the Universal Transverse Mercator coordinates of North 4,715,075 meters and East 345,475 meters, Longitude 70° 52′ 57″ West: Latitude 42° 34′ 28″ North. Figure 1-2, the Expanded Site Plan, identifies the location of 150 Sohier Road and the surrounding area.

The facility is located on approximately 24 acres of land and contains four large complexes of buildings covering approximately 250,000 square feet. The facility's southern portion includes an open field and a paved parking area. The central portion of the facility includes a building complex (Buildings 5, 5A, 8, and 10) (referred to as the Building 5 complex). North of the Building 5 complex is a paved parking area and to the northwest is another building complex (Buildings 1, 2, 3, 4, and 6) (referred to as the Building 3 complex). Northeast of the Building 3 complex is a wastewater treatment plant in Building 9. West of the Building 3 complex is former Building 7, which is now operated as Kelly Classics and Restoration.

Presently, Communications & Power Industries, Inc. (CPI) maintains the use of Buildings 1 through 6, 8, 9, and 10 and other structures at the 150 Sohier Road property (Aptim 2023).

1.2 Regulatory Reporting

On October 7, 2022, a Public Comment Draft Phase II Comprehensive Site Assessment (CSA) Addendum was submitted to MassDEP. The October 2022 Phase II CSA comprehensively assessed current Site conditions, including the nature and extent of chlorinated volatile organic compounds (CVOCs), which

were identified as the primary compounds released at the Site, and provided an updated evaluation of risk based on these current Site conditions. A public meeting to present the October 2022 Phase II CSA took place on November 9, 2022. Comments were received during the public comment period, which ended on November 29, 2022, and responses to comments were provided on December 7, 2022. The Final Phase II CSA Addendum was submitted to MassDEP on March 10, 2023.

On December 7, 2022, a Public Comment Draft Phase III Remedial Action Plan (RAP) was submitted to MassDEP. A public meeting to present the Phase III RAP was held on January 24, 2023. Comments were received during the public comment period, which ended on February 14, 2023, and responses to comments were provided on March 16, 2023.

A Revised Phase III RAP was submitted to MassDEP on March 17, 2023. This report was presented at a public meeting on June 7, 2023. Comments were received during the public comment period, which ended on June 27, 2023, and responses to comments were provided on July 27, 2023. No changes to the Revised Phase III RAP were made as a result of the comments, and the document is considered final.

The Final Phase III RAP included the selected RAAs shown in Table 1-1.

Table 1-1. Selected Remedial Action Alternatives

Area	Selected Remedial Action Alternative
Building 3 Overburden Source Area	In situ thermal remediation (ISTR), In Situ Bioremediation (ISB) Polish, and Continued Soil Vapor Extraction (SVE) System Operation
Building 5 Overburden Source Area	ISB and Continued SVE System Operation
Bedrock	In Situ Chemical Oxidation (ISCO)
PSL10 Source Area	Colloidal Activated Carbon (CAC) Permeable Adsorptive Zone (PAZ) or ISCO
Downgradient Plume	Sulfidated Micro Zero-Valent Iron Permeable Reactive Zone (S mZVI PRZ) for Tozer Road and Granular Activated Carbon Reactive Core Mat (GAC RCM) for the Seep Areas

Along with the Revised Phase III RAP, a Public Comment Draft for the Phase IV Plan, Part 1 (*Partial Massachusetts Contingency Plan Phase IV Remedy Implementation Plan*), was submitted to MassDEP on March 17, 2023. This report included remedy implementation plans for the Building 3 Overburden Source Area (ISTR/ISB Polish/Continued SVE System Operation) and the Downgradient Plume (Tozer Road S mZVI PRZ and Stream A Seep GAC RCM). The public meeting to present the Phase IV Plan, Part 1, was also held on June 7, 2023. Comments were received during the public comment period, which ended on June 27, 2023, and responses to comments were provided on July 27, 2023. No changes to the Phase IV Plan, Part 1, were made as a result of the comments, and the document was considered final.

This Phase IV Plan, Part 2, includes remedy implementation plans for the Building 5 Overburden Source Area (ISB/Continued SVE System Operation), and the bedrock (ISCO). Note that the remedy implementation plan for the PSL10 Source Area will be submitted as a separate document, pending additional investigation (see Section 5).

1.3 Statement of Purpose

Per the MCP (310 CMR 40.0872), the purpose of the Phase IV Plan is to:

1. Sufficiently develop the information, plans, and reports related to the design, construction, and implementation of the selected remedial alternative and provide documentation to support the implementation of the Comprehensive Remedial Alternative.
2. Confirm that, following initial implementation, the Comprehensive Remedial Alternative meets design and performance specifications.
3. Meet the Response Action Performance Standard for the design, construction, and implementation of the Comprehensive Remedial Action, as described in 310 CMR 40.0191.

1.4 Report Organization

The report has been developed in accordance with 310 CMR 40.0874(3) of the MCP to present the design, construction, and monitoring associated with the implementation of selected RAAs. The report organization is shown in Table 1-2.

Table 1-2. Report Organization

310 CMR 40.0874 (3)	Description of Section	Building 5 – ISB	Bedrock – ISCO	PSL10 Area
(a)	Relevant Project Contacts	Section 2.0		
(b)(1)	Remedial Action Goals	Section 3.2	Section 4.2	TBD (to be determined)
(b)(2)	Significant Changes/New Information	None	None	Section 5.1
(b)(3)	Disposal Site Maps	Section 3.1	Section 4.1	Section 5.1
(b)(4)	Environmental Media/Materials to be Treated or Otherwise Managed	Section 3.1	Section 4.1	Section 5.1
(b)(5)	Conceptual Plan of Remedial Activities	Section 3.3	Section 4.3	TBD
(b)(6)	Design & Operation Parameters	Section 3.5	Section 4.5	TBD
(b)(7)	Spill, Accidental Discharge or System Malfunction Control	Section 3.6	Section 4.6	TBD
(b)(8)	Waste Material Management-Disposal Methods	Section 3.7	Section 4.7	TBD
(b)(9)	Site-Specific Characteristics	Section 3.4	Section 4.4	TBD
(b)(10)	Adverse Impact Mitigation	Section 3.8	Section 4.8	TBD
(b)(11)	RAA Inspections-Monitoring	Section 3.9	Section 4.9	TBD
(c)(1)	Construction Plans-Specifications	Section 6.1 Figures 3-1 to 3-3	Section 6.2 Figure 4-7	TBD
(c)(2)	Schedule	Section 3.12	Section 4.12	TBD
(d)	Operation, Maintenance, and/or Monitoring (OMM) Plan	Section 3.9	Section 4.9	TBD
(e)	Health & Safety Plan	Section 7.0		
(f)	Permits, Licenses & Approvals	Section 3.10	Section 4.10	TBD
(g)	Property Access Issues	Section 3.11	Section 4.11	TBD
Not applicable	Public Involvement	Section 8.0		

2. Project Contacts

Per 310 CMR 40.0874(3)(a), the Phase IV Plan must include a list of contacts, including the responsible party (RP), the licensed site professional (LSP), and the party that will own, operate, and/or maintain the selected RAA during and following construction.

2.1 Responsible Party

Matthew Gillis
Environmental Affairs Program Manager
Varian Medical Systems, Inc.
801 Pennsylvania Avenue NW
Washington, DC, 20004
Phone: 410-459-1710

2.2 Licensed Site Professional

Matthew E. Hackman, P.E.
LSP No. 9456
CHMM, Inc.
97 Asylum Rd
Warwick, Rhode Island, 02886-8001
Office Phone: 401-737-9211

2.3 Owner/Operator of the Selected Remedial Action Alternative

Matthew Gillis
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801 Pennsylvania Avenue NW
Washington, DC, 20004
Phone: 410-459-1710

3. Building 5 – In Situ Bioremediation and Continued Soil Vapor Extraction System Operation

This section addresses the design, construction, and implementation of ISB with continued SVE system operation at Building 5.

3.1 Nature and Extent of Contamination (310 CMR 40.0874(3)(b)(4))

The target treatment zone associated with the Building 5 Source Area identified in the Phase III RAP is shown on Figure 3-1 (Aptim 2023). The treatment zone is approximately 7,000 square feet (ft^2) and extends to the top of bedrock (55 to 65 feet deep). A mass estimate of 1,000 pounds (lb) of total chloroethenes (700 lb adsorbed and 300 lb dissolved) was presented in the Phase III RAP (Aptim 2023). This estimate was based on an average soil concentration of 20 milligrams per kilogram (mg/kg) and an average groundwater concentration of 40 milligrams per liter (mg/L) over a 7,000 ft^2 area and depth of 55 feet.

Overburden soil CVOC concentration data are summarized in Table 3-1. ISCO (from 2004 until 2017) and ISB (from 2015 to 2020) have been conducted in the Building 5 Source Area. Therefore, data listed in Table 3-1 that were collected before these activities are likely not representative of current conditions. May 2023 groundwater concentrations in overburden monitoring wells at Building 5 are summarized in Table 3-2. Figure 3-1 includes a depiction of the approximate lateral extent of trichloroethene (TCE) in groundwater. The estimated area of CVOCs in soil at levels greater than 10 mg/kg is also illustrated on Figure 3-1. Figures 3-2 and 3-3 provide cross sections of the approximate extent of TCE in groundwater.

To assess the potential presence of dense nonaqueous phase liquid (DNAPL), it is common to compare groundwater concentrations to the solubility values of the CVOCs detected. Even if DNAPL is not physically observed in a monitoring well or sample, groundwater concentrations above 1% of the solubility value may be considered potentially indicative of DNAPL being present in an area as a "rule of thumb" (Kueper and Davies 2009). Table 3-2 summarizes the solubility limits and 1% solubility values for key CVOCs. May 2023 groundwater samples from monitoring wells OB-60-S and OB-35-DO had concentrations exceeding the 1% solubility rule of thumb.

Table 3-1. Overburden Soil CVOC Concentrations at Building 5

Boring	Depth (feet bgs)	Date	PCE	TCE	cis-1,2-DCE	VC
AP-36-S	16 to 16.9	July 26, 2018	0.1	0.4	0.2	<0.1
AP-37-S	6 to 6.8	July 26, 2018	1.8	0.3	0.4	<0.1
AP-38-S	6 to 6.8	July 25, 2018	0.1	<0.1	<0.1	<0.1
AP-39-S	16 to 17	July 24, 2018	13	2.5	0.3	<0.1
BLD5-SHIP	11 to 13	April 1, 1995	1	3.5	<0.56	<1.1
BLDG5-SV4	6 to 7.5	December 30, 2013	<0.052	<0.052	<0.052	<0.052
OB-44-S	9 to 10	December 30, 2013	10 D	0.23	<0.039	<0.039
OB-44-S	17 to 18	December 30, 2013	14 D	6.2	0.057	<0.038
OB-53-BR	19.5	March 31, 2022	11 J	<0.35	<0.35	<0.35
OB-53-BR	41.5	March 31, 2022	11 J	35 J	0.46 J	<0.39
OB-53-BR	64	April 1, 2022	<0.09	<0.09	<0.09	<0.09
OB-60-S	7	August 13, 2022	0.58	<0.068	0.091	<0.068
OB-60-S	16	August 13, 2022	13	1.4	0.13	<0.067

Note: Concentrations in mg/kg

< = less than
bgs = below ground surface
cis-1,2-DCE = cis-1,2-dichloroethene
D = result from a diluted sample
J = concentration is estimated
PCE = tetrachloroethene
VC = vinyl chloride

Table 3-2. May 2023 Groundwater Concentrations in Building 5 Overburden Monitoring Wells

Well	Unit	PCE	TCE	cis-1,2-DCE	VC
OB-44-S	Shallow	<0.1	<0.1	33	1.6
OB-47-S	Shallow	0.017	0.012	<0.002	<0.002
OB-60-S	Shallow	14	16	71	1
OB-35-DO	Deep	41	7.2	6.5	0.47
OB-38-DO	Deep	0.004	0.077	0.059	<0.002
Aqueous Solubility (@ 25°C, mg/L)[a]		200	1,100	3,500	2,760
1% of Solubility Limit (mg/L)		2.0	11	35	27.6

[a] Solubility values are from MassDEP soil-to-groundwater leaching calculations found in the MCP Numerical Standards Development Spreadsheets (MassDEP, 2014), which are based on United States Environmental Protection Agency's (USEPA) 1996 Soil Screening Guidance (USEPA 1996).

Note: Concentrations in mg/L.

°C = degree(s) Celsius

3.2 Remedial Goals (310 CMR 40.0874(3)(b)(1))

The general remedial objectives for the Site are: (1) source elimination/control; (2) migration control of groundwater and vapor; (3) DNAPL removal; and (4) groundwater concentration reduction. Regarding these objectives for the Building 5 Source Area, the following are noted:

1. Source Elimination/Control – The Building 5 Source Area ISB and SVE are designed to eliminate/ reduce sources of contamination.

2. Migration Control – The Building 5 Area ISB will be designed to control the potential migration of dissolved-phase CVOCs by focusing treatment on the reduction of the residual contaminant sources that remain. The SVE system will control potential vapor migration into Building 5.

3. DNAPL Removal – Although the presence of DNAPL has not been observed in the Building 5 Source Area, CVOC groundwater concentrations indicate it potentially may be present. The Building 5 Source Area ISB will reduce groundwater concentrations, which, through equilibrium processes, will enhance dissolution of potential residual DNAPL. In addition, ISB produces biosurfactants that enhance DNAPL dissolution, transferring CVOCs from the DNAPL to groundwater, where they are biologically degraded. Therefore, ISB will contribute to remediation of residual DNAPL, if present, to the extent feasible.

4. Groundwater Concentration Reduction – The Building 5 Source Area ISB will be designed to reduce CVOC concentrations in groundwater. The goal is to reduce the levels of CVOCs such that the Building 5 Source Area is not a continuing source of CVOCs to groundwater.

Per 310 CMR 40.0874(3)(b)(1), the Phase IV Plan must document the goals of the remedial action, including performance requirements of the remedial systems, the requirements for achieving a Permanent or Temporary Solution (whichever is applicable) under 310 CMR 40.1000, and the projected timeframe, based on available information, for achieving the Permanent or Temporary Solution.

3.2.1 Performance Standards for Building 5 ISB and Continued Operation of SVE System

The following performance standards apply to the Building 5 RAA:

1. A decrease in CVOC groundwater concentrations within the target treatment area, as measured in samples from monitoring wells, after potential initial increases caused by the agitation and pressure during injections.

2. Soil vapor control must be maintained such that volatile organic compound (VOC) concentrations in indoor air remain below the MassDEP Threshold Values and the remediation target for TCE (MassDEP 2016).

ISB is a remediation technique that uses microbial ecology to degrade, including dechlorinating, the various parent and daughter CVOCs, ultimately to ethene/ethane. It is expected that total "parent" CVOC concentrations may temporarily increase due to construction activities disturbing the soil matrix and formation of biosurfactants, both of which tend to desorb CVOCs from soil particles and dissolve into groundwater. Once dissolved, the CVOCs are then available to be degraded by indigenous microbes by being transported across the cell wall and metabolized. It is also expected that concentrations of interim daughter products will likely temporarily increase as parent CVOCs are degraded, creating daughter

products, which continue having chlorine atoms removed until these ultimately degrade to chloride, ethene/ethane, and carbon dioxide.

3.2.2 Requirements for Achieving a Permanent or Temporary Solution

To achieve a Temporary or Permanent Solution at Building 5, the requirements defined in 310 CMR 40.1000 must be met (Table 3-3).

Table 3-3. Requirements for Achieving a Temporary or Permanent Solution at Building 5

Item	Permanent Solution Requirement	Temporary Solution Requirement	Current Status	Expected Post-ISB Status
No Substantial Hazard	Documented	Documented	Achieved (see Phase II Addendum) with SVE operation	Achieved with SVE operation
No Significant Risk	Documented	Documented	Achieved (see Phase II Addendum) with SVE operation	Achieved with SVE operation
Solution Statement Submitted	Permanent Solution Statement Submitted	Temporary Solution Statement Submitted	Not submitted	Will be submitted once Permanent Solution requirements met
Unpermitted releases of OHM contamination	Eliminated	Eliminated	Achieved	Achieved
OHM Contaminant Sources	Eliminated or eliminated to the extent feasible and controlled	Eliminated or controlled to the extent feasible	Not Achieved	Sources eliminated to the extent feasible and controlled
Plumes of dissolved OHM in groundwater and vapor-phase OHM in the Vadose Zone	Stable or contracting	Stable or contracting, or otherwise controlled or mitigated to the extent feasible	Stability of dissolved-phase plume at Building 5 not established; Vapor-phase OHM at Building 5 controlled by SVE as demonstrated by subslab vapor and indoor air monitoring	Dissolved and vapor-phase plumes stable or contracting; continued operation of SVE as a subslab depressurization system may be required (activity use limitation [AUL] may be needed)
Non-stable nonaqueous phase liquid (NAPL) not present	Not present under current site conditions and for the foreseeable future	Removed and/or controlled to the extent feasible if present	Non-stable NAPL not observed	Monitoring data shows non-stable NAPL not present
NAPL with micro-scale mobility	Removed to the extent feasible if present	Removed and/or controlled to the extent feasible if present	NAPL with micro-scale mobility not observed but may be present	NAPL with micro-scale mobility removed to the extent feasible if present

The treatment goal for the Building 5 Overburden Source Area is to reduce concentrations in the source area to eliminate, to the extent feasible, the potential for DNAPL (if present) to act as a continuing source of CVOC migration in groundwater. In consideration of the 1% solubility rule of thumb and to provide a safety factor, treatment goals for PCE, TCE, and cis-1,2-DCE groundwater concentrations (the most likely CVOCs to be present in DNAPL form) set at half of the 1% solubility (that is, 0.5% solubility) are proposed (Table 3-4).

Table 3-4. Proposed Treatment Goals for Building 5 Groundwater

Unit	PCE	TCE	cis-1,2-DCE
Aqueous Solubility (@25°C, mg/L)[a]	200	1,100	3,500
0.5% of Solubility Limit (Treatment Goal) (mg/L)	1.0	5.5	17.5

[a] Solubility values are from MassDEP soil-to-groundwater leaching calculations found in the MCP Numerical Standards Development Spreadsheets (MassDEP 2014), which are based on USEPA's 1996 Soil Screening Guidance (USEPA 1996).

As discussed herein, further reduction in CVOC concentrations in groundwater via natural attenuation will likely be needed after ISB injections.

Based on the May 2023 groundwater concentrations in Building 5 overburden wells (Table 3-2), concentrations are above the treatment goals at monitoring wells OB-44-S (cis-1,2-DCE), OB-60-S (PCE, TCE, and cis-1,2-DCE), and OB-35-DO (PCE and TCE).

3.2.3 Timeframe to Achieve Permanent or Temporary Solution

A Temporary Solution requires the implementation of measures that will eliminate substantial hazards presented by the Site until a Permanent Solution is achieved. The Varian site is expected to achieve a Temporary Solution by February 18, 2024, as specified by the MassDEP.

The selected remedial action alternative is designed to achieve a Permanent Solution at Building 5. An AUL and Permanent Solution with Conditions may be required if it is decided that continued operation of the SVE system as a subslab depressurization system (SSDS) is required to mitigate possible vapor intrusion into indoor air. The SSDS would then constitute an Active Exposure Pathway Mitigation Measure under the MCP (310 CMR 40.1025).

3.3 Conceptual Plan (310 CMR 40.0874(3)(b)(5))

The proposed remedial alternative for the Building 5 Source Area is ISB via enhanced reductive dechlorination (ERD). ERD is used to promote anaerobic biological dechlorination of CVOCs through the delivery of carbon amendments that microbes use as a food source. The microbial populations required to promote ERD may be naturally occurring or added via bioaugmentation (addition of a specialized culture). ERD is typically carried out in source areas through injection wells or a grid of injection points (depending on accessibility), allowing for overlap in amendment from each point to establish a treatment zone. Additional amendments may be added along with the carbon substrate to provide pH buffering, nutrients, and/or promote abiotic treatment of CVOCs (zero-valent iron [ZVI]). Per the Phase III RAP, it is assumed that ISB will result in considerable CVOC mass reduction; however, natural attenuation will be used following active treatment via ISB to achieve the treatment goals required for a Permanent Solution.

ISB has been implemented previously within the shallow overburden at Building 5 from 2015 through 2020. Previous ISB injections included the addition of approximately 22,700 gallons of remedial additives

(emulsified vegetable oil [EVO], microbial culture, and water) into four shallow overburden wells located within the footprint of Building 5 (AP36-S, AP37-S, AP38-S, and AP39-S), as shown on Figure 3-1 (Aptim 2021). As a result of the work completed to date, PCE and TCE concentrations at monitoring well OB-44-S, near injection wells AP36-S and AP38-S, have decreased from 47 mg/L and 24 mg/L in January 2014, respectively, to below reporting limits in May 2023 (Jacobs 2023). However, the previous ISB efforts were limited by the spatial and vertical placement of the wells as well as the limited volume of remedial additives that were injected based on the geological setting. In some cases, complete dechlorination was not observed (that is, cis-1,2-DCE and VC are still present). In May 2023, a groundwater sample from recently installed monitoring well OB60-S, located south and upgradient of the previous injection area, had 14 mg/L of PCE, 16 mg/L of TCE, and 71 mg/L of cis-1,2-DCE. This indicates that source mass exists outside of the area previously treated.

Remedial activities at Building 5 will include the following:

- An investigation is planned to provide a better understanding of the vertical and horizontal distribution of CVOCs in the Building 5 area, including beneath Building 5. Data from the investigation will be used to refine the design for ISB, including finalization of the target treatment zone (TTZ) based on CVOC distribution, injection method and the need for specialized emplacement methods based on the geology (for example, fracturing or wave pulsing), and amendment dosing and volume. The investigation will include installation of soil borings (with soil sampling and groundwater grab sampling) and completion of selected soil borings as monitoring/injection wells. Angled (directional) drilling will be considered to allow access below Building 5 without disrupting current building occupants or operations.
- Baseline groundwater sampling at existing and planned monitoring and injection wells will be conducted to provide a baseline for remedy performance.
- Injection of treatment amendments to promote ERD, including a carbon substrate (biostimulation), is anticipated. The treatment amendments may also include a bioaugmentation culture, nutrients, pH buffer, and/or ZVI (to promote combined biotic/abiotic treatment). Injections will be carried out via injection wells and/or open boreholes with a packer system. Details on open borehole injections are discussed in Section 3.5.3.3. Emplacement technologies, such as fracturing and WaveFront pulsed injections, may be used to help amendment distribution.
- Monitoring during injection will be performed to confirm amendment distribution, injection pressures, and limit the potential for daylighting (surfacing). If fracturing technologies are used, surface deflection and structural monitoring may be used to monitor existing facilities.
- Post-remediation monitoring will be conducted at new and existing monitoring wells to assess the performance of the treatment. Injection wells may be monitored for pH and total organic carbon (TOC), but not CVOCs. CVOC data from injection wells are not representative of CVOC concentrations in the groundwater plume and, thus, cannot be used to evaluate CVOC removal in the groundwater plume.
- Continued operation of the current SVE system is planned during investigations. The SVE system consists of four horizontal SVE wells (BLDG5-SVE1, BLDG5-SVE2, BLDG5-SVE3, and BLDG4-SVE4). The SVE system has been shown to reduce the amount of VOCs in soil vapor beneath the building and thus mitigate vapor migration/intrusion into the building. Investigation results will be evaluated to confirm whether additional SVE wells may be necessary.

3.4 Site-specific Characteristics (310 CMR 40.0874(3)(b)(9))

This section provides information on Site-specific characteristics that may affect or be affected by the design, construction, or operation of the selected RA.

3.4.1 Building Use During Treatment

The Building 5 Source Area is below an occupied commercial manufacturing operation (Figure 3-4). Building operations will continue during injection and monitoring well installation and injections. Angled (directional) drilling will be used to access areas beneath Building 5 from the exterior perimeter of Building 5, thus avoiding disturbing current occupants. If fracturing is required to enhance amendment distribution in the target soil strata during injections, monitoring for surface deflection may be required. Throughout the investigation, injection, and monitoring period, the existing SVE system will remain operational as an SSDS to mitigate vapor intrusion.

3.4.2 Drainage Features

The Building 5 Source Area is below Building 5. There is a subsurface, 24-inch-diameter stormwater drain line for the unnamed stream located northeast of Building 5 (Figure 1-2). This stormwater drain line flows west and daylights above ground west of the facility. Underground pipes that run along the east side of Building 5 connect Building 5 roof drains to this stormwater line. There are utility trenches within Building 5 with active facility lines/piping, and a non-contact cooling water tank is also located beneath Building 5. Visual observation of the storm sewer and utility trenches will be performed during and after injections to determine whether any injectate reached these structures (Figure 3-4).

3.4.3 Natural Resource Areas and Local Planning and Development Issues

No natural resources or local planning and development issues have been identified in the Building 5 Source Area.

3.4.4 Soil and Groundwater Characteristics

Soil and groundwater characteristics that may affect remedy implementation are summarized in this section.

Soils at OB-38-BR, located just east of Building 5, were described as gravel with some clay from 0 to 5 feet bgs, underlain by a medium dense to very dense glacial till composed generally of a silty sand to clayey gravel. The bottom of the overburden consisted of approximately 10 feet of a fat (that is, highly plastic) clay and approximately 2 feet of poorly graded sand. Weathered granitic bedrock was observed from 50 feet bgs to a depth of 75 feet bgs.

The depth to groundwater in the TTZ is shallow, generally approximately 2 to 5 feet bgs (Jacobs 2023). The vertical gradient from deep overburden to bedrock is strongly downward (−0.05 to −0.56 foot per foot [ft/ft] at OB-38-DO/OB-38-BR in 2022 and 2023). In addition to the strongly downward vertical gradient, potentiometric maps indicate groundwater flow in overburden is to the west-northwest. The depth to bedrock is approximately 50 to 60 feet bgs. Bedrock groundwater flow in the immediate vicinity of the Building 5 area is generally northerly, with westerly flow to the west and north of the building.

The most recent depth to water and geochemical information available for monitoring wells in the area of Building 5 are summarized in Table 3-5. The data suggests there are some areas with some biological activity that may be related to the amendment applications last conducted in 2020; however, geochemical conditions are no longer conducive to sustained biological degradation. Additional geochemical data will be collected as part of the investigation prior to remedy implementation.

Table 3-5. Groundwater Geochemical Data at Building 5

Well	Unit	Depth to water (feet)	Date	DO (mg/L)	ORP (mV)	pH	TOC (mg/L)	Methane (mg/L)	Ethane (mg/L)	Ethene (mg/L)	DHC (cells/mL)
OB-44-S	Shallow	5.01 to 9.1	11/10/2021	1.87	−107.8	7.33	5.6	0.035	<0.02	0.19	38,600
OB-46-S	Shallow	0.1 to 1.63	1/30/2020	6.39	−15.9	8.27	NA	NA	NA	NA	NA
OB-47-S	Shallow	13.41 to 17.03	11/10/2021	1.86	48.8	6.52	NA	NA	NA	NA	NA
OB-60-S	Shallow	4.73 to 6.3	5/24/2023	NA	NA	NA	6.3	0.020	0.072	0.45	NA
OB-35-DO	Deep	10.25 to 14.00	11/9/2021	1.11	−53.5	7.88	3.1	0.310	<0.02	0.037	145
OB-38-DO	Deep	3.4 to 10.22	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: Depth to water from 2019 to 2023

DHC = *Dehalococcoides* sp.
DO = dissolved oxygen
mL = milliliter
mV = millivolt(s)
NA = not available
ORP = oxidation-reduction potential

3.5 Design and Operation Parameters (310 CMR 40.0874(3)(b)(6))

3.5.1 Target Treatment Zone

As shown on Figure 3-1, the area of the TTZ is estimated to be approximately 100 feet by 70 feet on the ground surface and up to 65 feet deep. The dimensions of the TTZ (both laterally and vertically) will be refined to focus on areas of high concentration identified during the investigation prior to remedial amendment injection.

3.5.2 Remediation Amendments and Treatment Mechanisms

ISB relies on establishing reducing and anaerobic conditions in the subsurface to help promote growth of a robust biological community that treats CVOCs through removal of chlorine atoms until the parent and less-chlorinated daughter products are reduced to ethane/ethene, carbon dioxide, and chloride ions. Anaerobic biodegradation of PCE often proceeds sequentially via reductive dechlorination to its daughter product TCE, then cis-1,2-DCE, and then VC before degrading to ethane or ethene. However, sometimes PCE may degrade right to cis-1,2-DCE without degrading first to TCE. The injection of a carbon substrate provides an organic carbon source to promote anaerobic biological growth to facilitate reductive dechlorination. The microbes responsible for reductive dechlorination (for example, *Dehalococcoides* and *Dehalobacter*) may be naturally occurring or may be introduced to the aquifer via bioaugmentation. While there are specific organisms that perform the reductive dechlorination steps, a diverse microbial community is necessary to support the entire process.

To promote ISB in the Building 5 Source Area, remediation amendments will include, at a minimum, a carbon substrate to promote biological stimulation. Two separate types of carbon substrate will be used, including both slow-release/longer-lasting substrates (EVO) and water-soluble substrates (for example, lactate), which provide a readily available carbon source to help establish robust reducing conditions. Additional additives to the carbon substrate may include a pH buffer to counteract fatty acids formed during bioremediation (too low of a pH will inhibit dechlorinating bacteria) and/or nutrients to help promote biological growth. Some commercially available carbon substrate products contain a mixture of fast- and slow-release carbon sources, nutrients, and a pH buffer.

In addition to the carbon substrate, a microbial culture specifically designed to promote ERD of CVOCs may be added, if needed, based on monitoring results. Previous microbial analysis of groundwater at the Site has demonstrated that, following carbon substrate injections, sufficient microbial populations have developed to support successful biological reduction of CVOCs.

Additionally, micro-scale ZVI may be added to the carbon substrate to help promote abiotic treatment of CVOCs alongside the ISB. Micro-scale ZVI can be added directly to the carbon substrate in suspension, with particles less than 5 micrometers at up to 10% by volume. ZVI degrades CVOCs primarily by abiotic (electrochemical reduction) degradation that degrades PCE, TCE, and cis-1,2-DCE to dichloroacetylene, chloroacetylene, and acetylene, respectively, without intermediate products. VC that may already be present would also be degraded by ZVI.

The selection of the final remedial amendment dosing will be completed following the investigation and prior to remedy implementation. CVOC and geochemical data collected during the investigation will be used to identify final locations and/or dosing of amendments.

3.5.3 Investigation Prior to Remedial Amendment Injection

Prior to injection, an investigation will be conducted to provide the data to implement ISB effectively. The goals of the investigation will include the following:

1. Assess the horizontal and vertical distribution and concentration of CVOCs.
2. Evaluate aquifer characteristics that affect injectability and remedial amendment behavior.
3. Monitor the geochemical characteristics of the groundwater to establish baseline conditions.

Prior to the subsurface investigation, a utility location program, including ground-penetrating radar (GPR), will be performed to identify utilities that may conflict with proposed drilling locations. Drilling locations will be adjusted to avoid conflicts with utilities. If there are known or suspected utilities within 5 feet of a proposed location, hand-clearance by hand auger or air knifing will be performed to below the depth of the utility.

Data collected during the investigation will be summarized in a Phase IV Status Report submitted before remedy implementation.

3.5.3.1 Soil Boring Advancement and Well Installation

Vertical soil borings will be advanced to the top of bedrock at up to five locations inside and outside the Building 5 footprint using sonic, hollow-stem auger, or drive-and-wash drilling techniques. Potential locations are shown on Figure 3-1. Additionally, there will be up to 6 locations where up to three non-vertical (directional drilling) borings will be advanced, for a total of up to 18 non-vertical borings. These will be advanced using sonic (rotosonic) drilling methods and/or directional drilling (see Sections 3.5.3.1.1 and 3.5.3.1.2) to improve delineation of the western and northern extents of the plume (Figures 3-1 through 3-3). The non-vertical borings will target shallow overburden (less than 25 feet bgs, requiring directional drilling techniques), the middle of the overburden (25 to 40 feet bgs, requiring angled rotosonic techniques) and deep overburden (greater than 40 feet bgs, requiring angled rotosonic techniques). These non-vertical borings will be advanced from the east or south under Building 5; potential locations are shown on Figures 3-1 through 3-3. The borings closest to the TTZ boundaries will be advanced first, and results will be used to decide whether the contingency borings to the north or west will be advanced. As discussed in the following, some of these non-vertical borings may be completed as injection wells or as dedicated monitoring wells.

3.5.3.1.1 Borings Advanced with Rotosonic, Hollow-stem, or Drive-and-wash Drilling

During advancement of soil borings via rotosonic, hollow-stem auger, or drive-and-wash drilling methods, cores will be recovered, lithology logged, and soil screened for VOCs to better understand the geology and extent of CVOC impacts. For rotosonic borings, continuous cores will be retrieved from the core barrels. For hollow-stem auger or drive-and-wash borings, split-spoon samplers will be advanced ahead of the augers/casing to retrieve cores. The soil cores will be screened using a photoionization detector (PID) to identify the areas of highest response. Sudan IV dye-shaker tests also may be used to help identify if DNAPL is present at locations with elevated PID readings. At each location, soil samples will be collected for laboratory analysis of VOCs from up to five intervals, including those with the highest PID readings and intervals that will bracket the zones of highest impacts. The soil sample results will provide information on the total contaminant mass present in the subsurface and the degree of contaminant partitioning between soils and groundwater.

Additionally, groundwater grab samples will be collected at 10-foot intervals through the full saturated depth from each soil boring for laboratory analysis of VOCs. Groundwater grab samples will be submitted

on a 24-hour turnaround time (TAT) so that the results can be used to finalize the depth of the well screen placement within the boring. Soil borings will remain open via casing pending results of the groundwater grab samples.

Wells may be installed within some of the soil borings based on the results of the groundwater grab samples. Additionally, well placement will be selected so that the monitoring network includes wells located upgradient, within, and downgradient of the TTZ to monitor changes in groundwater concentrations and geochemistry. The wells may be constructed with wire-wrapped screens so that they can be used as either monitoring wells or injection wells (note that wells used as injection wells will not subsequently be used as monitoring wells except for monitoring pH and TOC). Screen placement will be selected based on the depths where the highest concentrations of contaminants are present.

Borings not completed as wells will be abandoned by grouting in accordance with MassDEP requirements (WSC-310-91).

3.5.3.1.2 Borings Advanced Using Directional Drilling Techniques

For the shallow, non-vertical borings, directional drilling techniques will be used to install borings in the shallowest portions of the aquifer that are not accessible by vertical drilling. Discrete soil samples will be collected every 10 to 20 feet for logging, PID screening, and laboratory analysis for VOCs (on a 24-hour TAT). Based on soil sample screening and VOC results, a well screen (or well screens, up to three nested wells) may be installed within the borehole and groundwater samples collected for VOC analysis. Wells may be constructed so that they can be used as either monitoring or injection wells. Additionally, well placement will be selected so that the monitoring network includes wells located upgradient, within, and downgradient of the TTZ to monitor changes in groundwater concentrations and geochemistry.

3.5.3.2 Baseline Groundwater Sampling

Baseline groundwater sampling will be performed at new and existing overburden monitoring wells near Building 5 prior to performing injections. These groundwater data will provide information on the groundwater geochemistry and CVOC concentration distribution prior to completing injections. Groundwater samples will be collected using low-flow sampling procedures and field parameters, including pH, ORP, and DO will be collected. Groundwater samples at all locations will be analyzed by a laboratory for VOCs, dissolved gases (methane, ethane, and ethene) and TOC. Additionally, geochemical and microbial data will be collected at select locations (up to 10 locations), including total and dissolved iron and manganese, sulfate, nitrate, alkalinity, chloride, and microbial populations.

Once baseline groundwater sample results are available, the monitoring and injection network will be reassessed to decide if additional well locations are required. If additional wells are required, they may be installed prior to injections.

3.5.4 Remedial Amendment Injection

Based on the current understanding of the TTZ, a subset of the angled and vertical borings proposed for site assessment may be used for ISB injections (Figures 3-1 through 3-3). Existing, alternative, or additional injection locations may be used based on the results of the site assessment. If needed based on the findings of the investigation, injections may also be carried out near or under Building 5 using open boreholes at locations advanced specifically for injection. Injection depths will be decided based on the results of the site assessment; however, it is assumed injections will be carried out in 10-foot intervals at wells or over the full saturated interval at open boreholes using packers. The use of angled boreholes or wells will also be considered based on the findings of the investigation.

Given the known geology and limited observed radius of influence (ROI) during past injections, an ROI of 10 feet may be difficult to achieve at Building 5. Injection using traditional injection methods (through injection wells, open boreholes, or both) will be attempted first. If traditional injection methods are deemed insufficient, fracturing methods may be used to improve amendment emplacement. Prior to fracturing beneath or adjacent to the building, an assessment will be conducted to evaluate whether fracturing can be conducted without impacting the building. Information regarding the building foundation, subsurface geology, and targeted fracturing intervals would be evaluated as part of this assessment. Fracturing is performed by injecting either fluid (hydraulic) or gases (pneumatic) at a high pressure to propagate fractures within the subsurface. Once these fractures are opened, the remedial amendments are injected into the fractures, allowing for better distribution within tight geologies. Fracturing can only be carried out through open boreholes and would not be implemented in screened wells. Fracturing would be completed at borings purposed for injection in 2- to 5-foot vertical intervals. Locations would be selected based on assessment data collected from existing and proposed wells. Each vertical interval would be hydraulically separated from intervals above or below using packers or other means. The total volume for each vertical interval would be placed prior to moving to the next injection interval.

Fracturing cannot be carried out at depths shallower than 8 feet bgs, as there is not enough hydrostatic pressure to prevent fractures from propagating to ground surface and creating a conduit for daylighting.

The carbon substrate dose, additional amendments (pH buffer, nutrients, and ZVI), and/or bioaugmentation approach will be selected based on the findings of the investigation and the final injection layout.

Prior to subsurface work, DigSafe notification and a third-party utility locate will be performed to identify utilities that may conflict with proposed injection locations.

The injections will be carried out by an injection contractor. The injection contractor will prepare a work plan prior to implementation, providing details on how the work will be carried out and the equipment to be used; the work plan will be included in a Phase IV Status Report. The final equipment used for injection will be verified prior to mobilization. However, a standard injection setup typically includes a trailer-mounted mobile injection system. The system will include mixing tanks for batch mixing, pumps, pressure gauges, flowmeters, valves, and hoses/piping. An injection manifold may be used to inject multiple injection points simultaneously. Before injection, the mixing tank will be filled with potable water. The calculated amount of amendments will be added to the mixing tank and mechanically mixed to create a solution at the appropriate concentration. Volumes of amendments applied to each location will be documented.

For open borehole injections, the boring will be advanced to the target depth, and a packer will be inflated to isolate the depth interval for injection. The maximum injection pressure will be calculated so that the aquifer materials can safely accommodate the injection without uncontrolled fracturing (unless fracturing is intended), excessive groundwater mounding, or otherwise damaging the aquifer formation. Borings will be grouted after injection so that they do not serve as preferential pathways for subsequent injections. The ground surface will be restored to a similar condition as before drilling (that is, an asphalt patch will be installed where drilling through asphalt).

For injection through wells, a wellhead adapter will be placed on the injection well, and amendments will be pumped from the injection trailer down the well. The maximum injection pressure will be calculated so that the aquifer materials can safely accommodate the injection without uncontrolled fracturing, excessive groundwater mounding, or otherwise damaging the aquifer formation. If injections are carried out at wells,

the use of a pulsed injection system, such as WaveFront, may be considered to possibly help improve distribution.

Monitoring data will be collected during the injection. The data will include fracture pressures, as applicable, injection pressures, injection volumes, injection flow rates, water levels in nearby monitoring wells, the injected mass and volume of the amendments, and pertinent observations (such as surfacing, intrusion into the storm sewer or utility trenches, or other abnormal conditions). If fracturing is used, surface deflection and structural monitoring may be performed throughout the injection period. During injections, the ROI will be verified at selected injection locations, where monitoring wells are present within the expected ROI, via observation of changes in geochemical field parameters and visual confirmation.

3.6 Spill, Accidental Discharge, and System Malfunction Controls (310 CMR 40.0874 (3)(b)(7))

The remediation amendments will be delivered to the Site in concentrated liquid or colloidal suspension form and stored on pallets with secondary containment in a secure area in their original, tightly closed containers until used. The EVO will be protected from freezing, while the ZVI will be stored at temperatures below 95 degrees Fahrenheit in accordance with manufacturer guidance. The ZVI will be stored separately from potentially incompatible materials, such as oxidants or acids, which could react with the ZVI and generate hydrogen sulfide gas.

If the volume of carbon substrate required for the reinjections exceeds 1,320 gallons, a Spill Prevention, Control, and Countermeasures (SPCC) Plan will be developed and implemented prior to delivery of substrate to the Site. The SPCC plan will include specific actions to contain and control spills during injection activities and storage and secondary-containment requirements for the carbon substrate. During implementation, spill control materials will be maintained near the injection sites, substrate storage area, and at the waste storage area.

The remediation media, mixing tank, associated hoses, and carbon substrate storage area are the primary items that require design features to control accidental spills or discharges of the remediation media. Secondary containment will be constructed around the injection system trailer and substrate storage area to contain spills. Spill response equipment, including sorbents and a shop vacuum, will be kept onsite near the injection system. Because the work will be conducted in the vicinity of a building and parking lot in active use, traffic control measures will be implemented. Temporary work zones will be established around the remediation areas to allow access only to authorized personnel. These exclusion zones will be clearly marked with cones and/or caution tape. Spill control will be set up around each injection point to contain potential spills or surfacing, including protection of nearby storm sewer grates if present. Prior to injection, areas around the injection point will be visually inspected for potential preferential pathways, such as utility corridors or old borings, where surfacing could occur. These areas will be visually monitored during injection for potential surfacing.

3.7 Waste Material Management-Disposal Methods (310 CMR 40.0874(3)(b)(8))

Efforts will be made to limit the amount of waste generated during remedy implementation. Material disposal and waste generation will be conducted in accordance with the general procedures described in this section. Remedial wastes, if generated, will be characterized prior to final disposition. Remediation additives will be mixed and applied such that no waste remediation amendment is anticipated. If there are

remaining remediation additives, these will be disposed of as a D001 (ignitable) hazardous waste at a licensed, offsite facility.

Soil, water, daylighted injection fluids (if generated), and personal protective equipment (PPE) waste will be managed and disposed of in accordance with state and federal regulations.

3.8 Deleterious Impact Mitigation (310 CMR 40.0874(3)(b)(10))

Environmental impact mitigation measures will be implemented to avoid deleterious impact on environmental receptors. The carbon substrate, as well as the additives and the bioaugmentation culture, are nontoxic and biodegradable. While not anticipated to occur, injections will be stopped if the remediation amendment surfaces or appears in storm sewers or utility trenches during the injection. Surfaced solution will be cleaned up with water, adsorbent pads, or a shop vacuum as needed. Injection locations will be sequenced such that initial injections are not near potential receptors. If amendment surfacing occurs, adjustments such as reducing injection pressures and flow rates will be made.

3.9 Inspections and Monitoring

This section provides a general description of inspections and monitoring to document adequate construction and performance of the RAA. It also provides the basis of the OMM Plan that will be further developed once the design is complete.

3.9.1 Inspections and Monitoring During Injections

The number and condition of containers of remediation amendment will be inspected when delivered to the Site. The source and amount of potable water used will be documented. During batch mixing, the amount of amendment(s) and potable water added to each batch will be recorded to document that the prepared injection solution is consistent with the design specifications. The injection locations where the batch was placed will also be documented. Equipment such as pressure gauges, flow gauges, and pressure-relief valves will be inspected prior to use to confirm proper function.

During the injection of the remediation amendment, injection pressures and flow rates at each injection point/depth will be monitored and recorded. The volume of the remedial amendment mixture will also be monitored and recorded and compared to the design. The volume injected, as measured by a flow totalizer, will be compared to the changes in volume observed in the injection system tank.

To assess injection volume and ROI relationships, select monitoring wells will be used, based on the final injection layout, to assess distribution during injection. Immediately prior to injections, groundwater parameters and groundwater elevations will be collected to provide a pre-injection baseline. Groundwater in select monitoring wells will be sampled periodically when injections are carried out nearby for evidence that the remediation media has been distributed to the well. The groundwater samples will be visually monitored for the presence of carbon substrate (milky, white) and ZVI (black), and field parameters will also be measured (pH, ORP, DO, and specific conductivity). Air monitoring with a PID or multi-gas meter will also be conducted prior to and during injection activities. SVE system operation will continue during injections to maintain a negative pressure underneath the building. If fracturing is used, tiltmeters may be used to monitor surface deflection, and structural monitoring may be performed. Field monitoring equipment, including groundwater field parameter monitoring equipment and air monitoring equipment, will be calibrated daily, and calibration data will be recorded in a field book. Photographs will be taken before, during, and after injection activities.

3.9.2 Groundwater Performance Monitoring

Groundwater performance monitoring will consist of baseline sampling prior to injections and periodic post-injection monitoring.

3.9.2.1 Baseline

A round of baseline groundwater sampling and water level measurements will be collected before injections from a selected network of monitoring wells, as detailed in Section 3.5.3.2. These wells will include locations upgradient, within, and downgradient of the injection locations. Depending on monitoring location, groundwater samples may be analyzed for VOCs, dissolved gases, TOC, total and dissolved iron and manganese, sulfate, nitrate, alkalinity, chloride, and microbial populations. Additionally, photographs of purged water may be collected at selected locations, by filling a clear container, to visually compare changes over time.

3.9.2.2 Post-injection Monitoring

Periodic groundwater monitoring will be performed following the injections to monitor the changes in groundwater elevation and concentrations and decide if/when reinjection may be required. At a minimum, this will include quarterly sampling for VOCs to assess the degradation VOCs in compliance with requirements in the MCP.

Initially following injections, groundwater monitoring is proposed monthly for 3 months at select locations believed to be within the ROI of the injections. These locations will be sampled for TOC and/or dissolved organic carbon (DOC), and field parameters will be collected. TOC results should remain above 100 mg/L during the first 100 days at a neutral pH.

Groundwater monitoring is proposed quarterly between the first and second injections and quarterly for up to 18 months post-final injection, followed by 2.5 years of semiannual monitoring and 1 year of annual monitoring. Each monitoring event will include synoptic groundwater elevation measurements to evaluate groundwater flow patterns and calculate hydraulic gradients. Groundwater samples will be collected from monitoring wells and analyzed for VOCs, dissolved gases, and TOC, but other parameters may be added as needed, and the frequencies may vary at select locations. Optimization of the sampling network may be recommended after the first 2 years of monitoring, based on sampling results. Similarly, additional data may be collected, as needed, for troubleshooting or assessment. After 5 years of post-final injection monitoring, ISB-related sampling will be integrated into the sitewide monitoring program. Groundwater monitoring data will be evaluated as follows:

- Upgradient monitoring well data will be assessed for potential changes in CVOC concentrations that may not be related to the remediation activities in the Building 5 Source Area.
- As needed, groundwater data within the treatment zone will be evaluated for changes in groundwater concentrations, both temporally and spatially, as well as changes in geochemistry, such as pH, ORP, TOC/DOC, and dissolved gases, indicating favorable conditions for ERD. These data also will be used to identify if the efficacy of the treatment is waning, indicating reinjection may be required.
- As required by the MCP, groundwater data downgradient of the treatment zone will be evaluated for changes in CVOC concentrations and geochemical conditions.

Groundwater data also will be evaluated graphically and statistically, once sufficient data is collected, to verify the overall stability of the Building 5 overburden plume.

The monitoring results will be reported in semiannual Phase IV or Phase V Status Reports and include an evaluation of overall remedial performance and any recommendations for remedy optimization, such as supplemental injections, if warranted.

3.10 Permits, Licenses, and Approvals (310 CMR 40.0874(3)(f))

A Massachusetts-certified well driller will be required to install monitoring wells.

Injections proposed under this plan are not anticipated near the sensitive receptors listed in the MCP under 310 CMR 40.0046(3). Therefore, prior approval from MassDEP is not required for these injections.

3.11 Property Access Issues (310 CMR 40.0874(3)(g))

An access agreement is already in place that will cover the ISB injections, including staging of the injection system equipment, and performance monitoring at Building 5. A portion of the Building 5 Source Area is below an occupied industrial building. As shown on Figure 3-1, some of the proposed injection locations are located inside Building 5 and will require building access. Building access will be coordinated with the property owner.

Building operations will continue during drilling, ISB injections, and performance monitoring. Injection equipment will be staged so that ingress/egress to buildings is not blocked. If access to a building does need to be blocked, this will be negotiated with the property owners, and strategies such as night or weekend injections may be used.

3.12 Design/Construction Schedule (310 CMR 40.0874(3)(c)(2))

The anticipated schedule for the Building 5 overburden activities includes the following:

- Phase IV Comment Period and Responses: November and December 2023
- Investigation, installation of performance monitoring and injection well network, baseline sampling, and data evaluation: winter to spring 2024
- Phase IV Status Report: January 27, 2024
- Installation and baseline sampling of additional performance monitoring well or injection well network (if needed): spring to summer 2024
- Phase IV Status Report: July 27, 2024
- First round of ISB injections: summer to fall 2024
- Post-injection performance monitoring: Monthly (fall 2024 to winter 2025), Quarterly (winter 2025 to summer 2026), then semiannually for 2.5 years (2027 through 2028), then annually (starting in 2029)
- Second round of ISB injections (if necessary): TBD
- Continued post-injection performance monitoring: TBD, quarterly monitoring for 18 months, followed by 2.5 years of semiannual monitoring, and 1 year of annual monitoring

4. Bedrock – In Situ Chemical Oxidation

This section addresses the design, construction, and implementation of ISCO in bedrock.

4.1 Nature and Extent of Contamination (310 CMR 40.0874(3)(b)(4))

The treatment zone for bedrock is proximate to Building 5 and is characterized by CVOC concentrations in groundwater at OB-54-BR and OB-45-BR to the southeast, OB-28-BR to the northeast, and OB-52-BR to the northwest (Figure 4-1). The surface area of the zone depicted in Figure 4-1 is approximately 40,000 ft^2 and, based on analytical data, may be limited to the upper 50 feet of the bedrock aquifer. Bedrock is encountered at approximately 25 to 100 feet bgs across the Site and approximately 45 to 60 feet bgs in this area (Figures 4-2 through 4-6). Based on the bedrock geology (granite), groundwater is primarily present in bedrock fractures. Additionally, contaminant diffusion into this type or rock is not expected to be significant, and adsorption of contaminants is also expected to be low due to the low organic carbon content of the matrix. Therefore, contaminant mass resides primarily in the interconnected fractures within the rock matrix in separate phase (DNAPL) and dissolved in groundwater. Based on an approximate average groundwater concentration of 100 mg/L total CVOCs in the upper 50 feet of bedrock aquifer, the contaminant mass was estimated in the Phase III RAP (Aptim 2023) to range from 125 to 1,250 lb, assuming a fracture porosity of 0.01 to 0.1. The treatment objective is to eliminate DNAPL that is potentially present within fractures.

Bedrock cross sections C-C′ through F-F′, and overburden TCE plume maps are provided on Figures 4-2 through 4-6. As shown in Figures 4-3 through 4-6, the depth to bedrock varies across the Site. Prior to remedy implementation, additional investigation, as discussed in Section 4.5, will be performed to refine the target depths and intervals for ISCO treatment and refine the ISCO delivery approach. Recent groundwater CVOC concentrations are summarized in Table 4-1. CVOC concentrations at OB-45-BR in Table 4-1 reflect a significant decrease from a maximum of 3.9 mg/L of PCE, 600 mg/L of TCE, and 6.7 mg/L of cis-1,2-DCE reported in a November 2021 sample. CVOC concentrations at the remaining wells have remained relatively consistent between sampling events. As noted in Section 3.1, even if DNAPL is not physically observed in a monitoring well or sample, groundwater concentrations above 1% of the solubility value may be considered potentially indicative of DNAPL being present. Three of the four bedrock monitoring wells had concentrations of at least one CVOC that exceeded the 1% solubility rule of thumb, suggesting that DNAPL may be present. However, previous samples from all four wells have exceeded this value.

Table 4-1. May 2023 Groundwater Concentrations in Bedrock Monitoring Wells within Target Treatment Zone

Well	Unit	PCE	TCE	cis-1,2-DCE	VC
OB-28-BR	Bedrock	0.44	14	7.5	<0.1
OB-45-BR	Bedrock	0.019	0.81	0.21	<0.002
OB-52-BR	Bedrock	2.8	9.1	8.9	1.6
OB-54-BR	Bedrock	1.4	39	21	<0.4

Well	Unit	PCE	TCE	cis-1,2-DCE	VC
Aqueous Solubility (@25°C, mg/L)[a]		200	1,100	3,500	2,760
1% of Solubility Limit (mg/L)		2.0	11	35	27.6

[a] Solubility values are from MassDEP soil-to-groundwater leaching calculations found in the MCP Numerical Standards Development Spreadsheets (MassDEP, 2014), which are based on USEPA's 1996 Soil Screening Guidance (USEPA, 1996).

Notes: Concentrations in mg/L. OB-54-BR data from December 2022.

4.2 Remedial Goals (310 CMR 40.0874(3)(b)(1))

The general remedial objectives for the Site are: (1) source elimination/control; (2) migration control; (3) DNAPL removal; and (4) groundwater concentration reduction, specifically:

1. Source Elimination/Control – The bedrock ISCO is designed to eliminate/reduce sources of contamination.
2. Migration Control – The bedrock ISCO will be designed to control the potential migration of dissolved-phase CVOCs by focusing treatment on the reduction of the residual contaminant sources that remain in bedrock.
3. DNAPL Removal – Although the presence of DNAPL has not been observed in bedrock, CVOC concentrations indicate it may potentially be present. The bedrock ISCO will be designed to decrease CVOC concentrations in the source areas, thereby reducing the potential for DNAPL to act as a continuing source of CVOCs to downgradient groundwater.
4. Groundwater Concentration Reduction – The bedrock ISCO will be designed to decrease CVOC concentrations in groundwater. The goal is to reduce the levels of CVOCs such that DNAPL, if present, is not a continuing source of CVOCs to downgradient groundwater.

Per 310 CMR 40.0874(3)(b)(1), the Phase IV Plan must document the goals of the remedial action, including performance requirements of the remedial systems, the requirements for achieving a Permanent or Temporary Solution (whichever is applicable) under 310 CMR 40.1000, and the projected timeframe, based on available information, for achieving such Permanent or Temporary Solution.

4.2.1 Performance Standards for Bedrock ISCO

The following performance standards are applicable to bedrock ISCO:

1. Existing Site operations must be maintained and interruptions limited during remedy implementation.
2. VOC concentration decrease should be observed after potential initial increases caused by the agitation and pressure during injections; evidence of decreases will be obtained by observing lower VOC concentrations in nearby monitoring wells.

4.2.2 Requirements for Achieving a Permanent or Temporary Solution

Requirements for achieving a Temporary or Permanent Solution for the bedrock treatment zone, along with the current status, are presented in Table 4-2.

Table 4-2. Requirements for Achieving a Temporary or Permanent Solution in Bedrock

Item	Permanent Solution Requirement	Temporary Solution Requirement	Current Status	Expected Post-ISCO Status
No Substantial Hazard	Documented	Documented	Achieved	Achieved
No Significant Risk	Documented	Documented	Achieved	Achieved
Solution Statement Submitted	Permanent Solution Statement Submitted	Temporary Solution Statement Submitted	Not submitted	Will be submitted once Temporary or Permanent Solution requirements met
Unpermitted releases of OHM contamination	Eliminated	Eliminated	Achieved	Achieved
OHM Contaminant Sources	Eliminated or eliminated to the extent feasible and controlled	Eliminated or controlled to the extent feasible	Not Achieved	Sources eliminated to the extent feasible and controlled
Plumes of dissolved OHM in groundwater and vapor-phase OHM in the Vadose Zone	Stable or contracting	Stable or contracting, or otherwise controlled or mitigated to the extent feasible	Stability of dissolved-phase plume in bedrock not established; vadose zone goals not applicable	Dissolved-phase plume stable or contracting; vadose zone goals not applicable
Non-stable NAPL not present	Not present under current site conditions and for the foreseeable future	Removed and/or controlled to the extent feasible if present	Non-stable NAPL not observed	Monitoring data shows non-stable NAPL not present
NAPL with micro-scale mobility	Removed to the extent feasible if present	Removed and/or controlled to the extent feasible if present	NAPL with micro-scale mobility not observed but may be present	NAPL with micro-scale mobility removed to extent feasible if present

The treatment goal for the bedrock is to reduce concentrations in the source area to eliminate, to the extent feasible, the potential for DNAPL (if present) to act as a continuing source of CVOC migration in groundwater. In light of the 1% solubility rule of thumb, and to provide a safety factor, treatment goals for PCE, TCE, and cis-1,2-DCE groundwater concentrations (the most likely CVOCs to be present in DNAPL form) set at half of the 1% solubility (that is, 0.5% solubility) are proposed (Table 4-3).

Table 4-3. Proposed Treatment Goals for Bedrock

Unit	PCE	TCE	cis-1,2-DCE
Aqueous Solubility (@25°C, mg/L)[a]	200	1,100	3,500
0.5% of Solubility Limit (Treatment Goal) (mg/L)	1.0	5.5	17.5

[a] Solubility values are from MassDEP soil-to-groundwater leaching calculations found in the MCP Numerical Standards Development Spreadsheets (MassDEP 2014), which are based on USEPA's 1996 Soil Screening Guidance (USEPA 1996).

4.2.3 Timeframe to Achieve Permanent or Temporary Solution

A Temporary Solution requires the implementation of measures that will eliminate substantial hazards presented by the Site until a Permanent Solution is achieved. The Varian site is expected to achieve a Temporary Solution by February 18, 2024, as specified by MassDEP.

The selected alternative has the potential to achieve a Permanent Solution in bedrock.

4.3 Conceptual Plan (310 CMR 40.0874(3)(b)(5))

The proposed remedial alternative for bedrock is ISCO. Chemical oxidation refers to the use of oxidants to convert contaminants to nonhazardous or less-toxic compounds. Oxidants are able to achieve high treatment efficiencies with very fast reaction rates for certain CVOCs (for example, PCE and TCE) (FRTR 2022). The oxidant proposed for bedrock, sodium permanganate ($NaMnO_4$), is a stable oxidant and can persist in the subsurface for months (SERDP-ESTCP 2010) to a few years.

As outlined in the Phase III RAP, ISCO in bedrock will involve multiple rounds of $NaMnO_4$ injections. Injection of $NaMNO_4$ has previously been used in six areas at the Site, with injections conducted at 76 locations. Approximately 215,000 gallons of 20% permanganate solution by volume has been applied to the subsurface (Aptim 2021). Within the bedrock TTZ (see Section 4.5.1), OB-28-BR was treated with 2,921 gallons of permanganate solution in 2003.

Remedial activities in bedrock will include:

- An investigation to provide additional high-resolution data in bedrock. Data from this investigation will be used to refine the design by identifying areas of higher and lower concentrations that will inform the final TTZ, amendment dosing, volume and spacing for injections, and the need for specialized injection methods, that is, oxidant delivery approaches (for example, recirculation). The investigation will include:
  - Advancing borings with analytical bedrock sampling and groundwater grab sampling
  - Aquifer characterization, including fracture network characterization
  - Completion of select borings as monitoring or injection wells
- Baseline groundwater sampling at existing and new monitoring wells to provide a baseline for remedy performance.
- Injection of $NaMnO_4$, which will provide treatment by chemical oxidation of CVOCs. Recirculation may be used to distribute the oxidant more uniformly and improve contact between the oxidant and CVOCs for enhanced treatment delivery.

- Monitoring during injection will be performed to confirm amendment distribution in groundwater and adjust injectate dosing, if needed, and to assess injection pressures and injection rates and minimize daylighting (surfacing).
- Post-remediation monitoring will be conducted at planned and existing monitoring wells to assess the performance of the treatment zone.

4.4 Site-specific Characteristics (310 CMR 40.0874(3)(b)(9))

4.4.1 Site Activities and Operations During Treatment

The TTZ is located west of CPI buildings along Bomac Road, which is used primarily to access CPI buildings and former Building 7 (Kelly Classics and Restoration). As discussed in Section 4.5.3, some investigation may occur in other areas of the Former Varian Facility or offsite. Disruptions to Site activities will be minimized to the extent possible; investigation and injection activities are not expected to impact Site operations significantly.

4.4.2 Drainage Features

The area along Bomac Road is approximately 75 feet in elevation. West of the TTZ is a wooded area, with the topography steeply dipping to the west toward Tozer Road. The unnamed stream flows east to west through the TTZ, within a subsurface culvert at an elevation of about 50 feet above mean sea level. West of the TTZ, where the surface elevation is approximately 20 feet lower, the stream flows above ground for approximately 100 feet before entering another subsurface culvert. The ISCO application in bedrock will be much deeper than this culvert and is not expected to impact these drainage features. However, the stream will be visually monitored for daylighting of injection fluids (permanganate is purple in color).

4.4.3 Nature Resource Areas, Local Planning, and Development Issues

The unnamed stream (see Section 4.4.2) that flows through the TTZ represents a natural resource area. The streambed elevation is approximately 40 to 55 feet above the top of bedrock. Considering the substantial thickness of overburden between the bedrock TTZ and the streambed, daylighting of ISCO reagents to the stream is not anticipated; however, this possibility will be considered during design finalization.

No local planning or development issues have been identified within the TTZ.

4.4.4 Bedrock Characteristics and Groundwater Characteristics

In the area of the TTZ, the bedrock elevation ranges from −10 to +30 feet above mean sea level, and depth to bedrock ranges from 47 to 64 feet bgs. Bedrock elevations slope downward to the west.

In and near the TTZ, bedrock consists of the Cape Ann Granite. Borehole geophysical logging conducted at OB-45-BR in 2022 indicated tight fracture conditions with no measurable inflow or outflow within the borehole. However, some groundwater inflow is occurring as groundwater samples have been collected from the completed well. Fracture and fabric orientations were predominantly toward the west and northwest and likely represent relaxation (sheet) fractures from near-surface erosion. These radial fracture networks are most likely the dominant mechanism for groundwater flow within the bedrock. There is a north to northwesterly groundwater flow component from the Building 5 area toward the TTZ; to the west of the TTZ, groundwater flow is to the west toward Tozer Road.

Hydraulic conductivities in bedrock have been evaluated at the Site. Reported hydraulic conductivities in the granite range from 0.06 to 17.2 feet/day, with a median value of 2.3 feet/day (IT Corporation 2000). However, no hydraulic conductivity measurements have been reported within the TTZ. Vertical gradients between the deep overburden and bedrock are strongly downward within the TTZ (−0.23 to −0.36 ft/ft at OB-52-DO/OB-52-BR in 2022 and 2023).

4.5 Design and Operation Parameters (310 CMR 40.0874(3)(b)(6))

4.5.1 Target Treatment Zone

As shown on Figure 4-1, the treatment zone for bedrock is characterized by CVOCs observed in groundwater at OB-54-BR and OB-45-BR to the southeast, OB-28-BR to the northeast, and OB-52-BR to the northwest. It is approximately 40,000 ft^2 and represents the upper 50 feet of the bedrock aquifer. The dimensions of the TTZ (both laterally and vertically) will be refined to focus on areas of high concentrations that will be identified during the investigation prior to remedial amendment injection.

4.5.2 Remediation Amendment and Treatment Mechanisms

The remediation amendment selected for the bedrock area is $NaMnO_4$. The selection of the final remediation dosing will be completed following the investigation and prior to remedy implementation. Geochemical data collected during the design investigation may be used to identify locations and/or $NaMnO_4$ dosing.

Oxidation of chlorinated ethenes (for example, PCE and TCE) with $NaMnO_4$ involves cleaving (that is, breaking or splitting) the carbon-carbon bonds. The byproducts of this reaction are carbon dioxide, manganese dioxide, sodium, and chloride.

Oxidant demand tests are not needed for bedrock because the bedrock matrix has a low oxidant demand (low TOC), and it is challenging to mimic contact between an injected fluid and the bedrock matrix. Permanganate was selected based on the contaminants present (chlorinated ethenes) and their favorable kinetics for oxidation with permanganate. Dosing will be determined based on effective porosity of the bedrock matrix (based on fracture frequency and aperture) and CVOC concentrations.

4.5.3 Investigation Prior to Remedial Amendment Injection

Prior to injection, an investigation will be conducted to identify an effective ISCO implementation approach. The goals of the investigation include the following:

1. Evaluate the bedrock aquifer characteristics, such as fracture orientation, aperture, and density, and connectivity that can affect injectability and remedial amendment behavior.
2. Improve understanding of the spatial and vertical distribution and concentration of CVOCs.
3. Identify the geochemical characteristics of the groundwater that may affect remedial amendment dosing and treatment behavior.

Prior to the subsurface investigation, a utility location program, including GPR, will be performed to identify utilities that may conflict with proposed drilling locations. Drilling locations will be adjusted to avoid conflicts with utilities. If there are known or suspected utilities within 5 feet of a proposed location, hand-clearance by hand auger or air knifing will be performed to below the depth of the utility.

All data collected during the investigation will be summarized in a Phase IV Status Report submitted before remedy implementation.

4.5.3.1 Fracture and CVOC Distribution Characterization

Prior to the ISCO injection, characterization of the bedrock aquifer, especially the fracture network, will be conducted. Elements of the aquifer characterization will include the following:

- Borehole geophysical and flowmeter logging will be completed at up to 8 existing monitoring wells with open boreholes and at up to 11 new bedrock borings upgradient of, within, and downgradient of the TTZ to assess the connection of bedrock fractures.
- At selected boreholes, packer testing at candidate flowing fractures will be performed to evaluate VOC concentrations and fracture permeability.
- At selected boreholes, evaluation of the presence of DNAPL using DNAPL Flexible Liner Underground Technologies (FLUTe) liners and/or nuclear magnetic resonance (NMR) may be completed.

The results of the fracture network and CVOC distribution characterization will be used to refine the TTZ (both laterally and vertically), evaluate optimal spacing and locations for injection wells, and refine the ISCO application and potential recirculation parameters.

4.5.3.1.1 Borehole Geophysics and Flowmeter Logging of Existing Open Borehole Wells

Borehole geophysical and flowmeter logging from open borehole wells may include use of the following:

- Fluid temperature and conductivity log to evaluate borehole water quality characteristics and zones of inflow/outflow.
- Three-arm caliper to identify depth of casing bottom, potential casing defects, bedrock fractures, or borehole diameter variations.
- High-resolution optical televiewer log to identify potential fracture locations, orientation, and aperture size above and below the water table (for non-turbid water conditions).
- High-resolution acoustic televiewer to identify potential fracture locations, orientation, and aperture size below the water table in turbid groundwater conditions.
- Heat-pulse flowmeter or corehole dynamic flowmeter to measure the magnitude and direction of vertical flow at discrete locations selected within the borehole. Flowmeter logging will be conducted under pumping (stressed) and non-pumping (ambient) conditions at appropriate fracture intervals.
- NMR to assess the mobile versus immobile water in the fracture network, estimate hydraulic conductivity, and potentially identify DNAPL presence in fractures.

Results from these logs will be used to provide an overview of the existing fracture network prior to the next phase of drilling and may result in moving or eliminating proposed new boring locations.

4.5.3.1.2 Bedrock Boring Advancement

Up to 11 bedrock boreholes will be advanced using rotosonic or air-rotary methods to previously identified depths below the top of bedrock (Figure 4-7):

- Up to five bedrock borings will be advanced west of the TTZ to evaluate potential downgradient bedrock pathways toward Tozer Road and refine the conceptual site model. These will also provide the downgradient injection monitoring locations required by MassDEP regulations. Existing bedrock wells

between the TTZ and Tozer Road are either screened with polyvinyl chloride (PVC) (and not accessible to borehole geophysical logging) or only completed in shallow bedrock and do not monitor potential deeper bedrock flow pathways.

- Up to five bedrock borings will be advanced within and near the TTZ along Bomac Road to refine understanding of CVOC distribution and fracture network near the source area.
- Up to one boring will be advanced east of the TTZ and north of the Building 5 Source Area to evaluate potential northerly CVOC migration (in the localized direction of bedrock groundwater flow) and contribution to CVOC concentrations observed within the TTZ.

To limit cross-contamination, boring locations will begin from 'cleanest' locations to areas of known CVOC presence. To evaluate the vertical distribution of CVOCs in bedrock, including below the proposed TTZ vertical interval of 50 feet into bedrock, boreholes will be advanced to 75 feet below top of bedrock. Continuous cores will be recovered during drilling (either sonic cores, if rotosonic is used, or wireline coring ahead of air rotary), and lithology will be logged to better understand the geology and fracture characteristics. Rock lithology will be noted, and rock competency calculated, in addition to cementation and staining (oxidation or CVOC) at fracture zones. Either temporary or permanent steel surface casings will be keyed into bedrock and left in place while subsequent characterization and well installation activities occur in the open borehole sections. Prior to drilling (at least 48 hours prior to measure any background fluctuation), pressure transducers will be installed at up to five existing monitoring wells within and near the TTZ (OB-28-BR, OB-42BR, OB-45BR, OB-52BR, and OB -54BR) to monitor for water level influence during drilling. Detected water level changes would indicate that fractures associated with these wells are in communication with fractures located in the new borings (Figure 4-7). If DNAPL is encountered in bedrock fractures during drilling—and to prevent drawdown of the DNAPL deeper into bedrock—drilling will either be stopped at the level where DNAPL was encountered or additional precautions, such as installing additional casing across the DNAPL-bearing fracture, will be performed.

Blank FLUTe liners will be considered for use if a significant period of time is required between activities at the borehole (for example, borehole geophysics, well installs, and so forth). The liner is pushed down the borehole by adding water on the inside and effectively seals the borehole from any formation water entering. The liners will act to limit potential vertical cross-contamination between fractures. For source area borings (up to three), the FLUTe liners will also have a DNAPL-reactive covering that can help identify the presence/absence of DNAPL at fracture intervals.

4.5.3.1.3 DNAPL Presence Evaluation

The potential presence of DNAPL in the bedrock will be evaluated by the following methods:

- Bedrock cores will be screened with a PID and logged, and visual indications of DNAPL in fractures will be documented and photographed.
- During monitoring well gauging, an interface probe will be lowered to the bottom of the well to identify if DNAPL is present. If sufficient DNAPL is present in the well, a sample will be collected for laboratory analysis of VOCs and specific gravity.
- For source area borings (up to four), the FLUTe liners used to limit vertical cross-contamination will also have a DNAPL-reactive covering that can identify the presence/absence of NAPL at fracture intervals.
- If conducted, NMR will be performed at select wells to assess DNAPL presence in bedrock fractures.

4.5.3.1.4 Borehole Geophysics and Flowmeter Logging of New Borings

All new borings will undergo borehole geophysical and flowmeter logging within their open borehole sections with a suite identical to that presented in Section 4.5.3.1.1. These logging data will help assess flowing fractures or intervals within the borehole to undergo further testing and sampling.

4.5.3.1.5 Packer Testing and Groundwater Grab Sampling

Following geophysical and flowmeter logging, candidate flowing fractures will undergo packer testing to evaluate hydraulic conductivities and collect discrete groundwater samples for CVOC analysis. A dual-packer system to isolate the selected zones will be employed, and pressure transducers will be placed above, within, and below each zone. The sample interval will be pumped at a rate that causes some drawdown but ideally stabilizes before drying out the fracture.

A groundwater grab sample will be collected from each selected depth interval within the boring when the pressure readings (that is, water levels) within the sample interval have stabilized. The samples will be analyzed for VOCs (on an expedited TAT) and geochemical parameters (or example, anions, cations, and TOC) to select an appropriate screened interval for bedrock monitoring well installation. The geochemical and field parameters will be evaluated to assess potential hydraulic communication between sample intervals in the various boreholes. The transducer data will be used to estimate the hydraulic conductivity for each tested depth interval.

4.5.3.2 Monitoring Well Installation

Monitoring wells may be installed in the bedrock borings (at up to 11 locations) (Figure 4-7) based on results of the geophysical and chemical testing. Monitoring wells may be installed as either single-screen, nested, or multi-level wells, depending on project needs. Alternatively, site assessment bedrock borings may be left as open boreholes, abandoned, or completed as injection wells with wire-wrapped stainless steel screens.

4.5.3.3 Baseline Groundwater Sampling

Baseline groundwater sampling will be performed at new and existing bedrock monitoring wells near the bedrock TTZ prior to finalizing the injection design. These groundwater data will provide information on the groundwater geochemistry and CVOC concentration distribution prior to completing injections. Groundwater samples will be obtained using low-flow sampling procedures with collection of field parameters, including pH, ORP, DO, and specific conductivity. Groundwater samples will be analyzed for VOCs and bromide (if a tracer test is conducted; see Section 4.5.3.4). Passive-diffusion bags (PDBs) may be used if needed (for example, monitoring well is known to go dry during low-flow sampling). Additionally, photographs of purged water may be collected at selected locations, by filling a clear container, to visually compare changes over time. If DNAPL is observed in a well, a sample may be collected for laboratory analysis of VOCs and specific gravity.

Once baseline groundwater samples are collected, the monitoring and injection network will be reassessed to decide if additional well locations are required. If additional wells are required, they may be installed and sampled prior to injections (see Section 4.5.4.1). A conceptual monitoring well network is provided on Figure 4-7 and includes monitoring wells within the TTZ and upgradient and downgradient of the TTZ.

4.5.3.4 Bromide Tracer Test

Depending on the results of the fracture characterization work, a tracer test using a non-reactive tracer may be implemented at existing and new monitoring wells to improve understanding of fracture connectivity, bedrock porosity, groundwater travel times, and injection well spacing requirements.

If conducted, the tracer test would be completed using the tracer potassium bromide (KBr). The primary objective of the tracer test is to evaluate flow path connectivity between tracer injection wells and adjacent monitoring wells and estimate the bedrock porosity. The tracer test would be conducted using existing or newly installed wells (see Section 4.5.3.1 and **F**igure 4-7). Nearby monitoring wells would be monitored for bromide using an ion-specific electrode and/or by sending subsets of samples to analytical laboratories for analysis using USEPA Method 300.0. The tracer test results would also help assess the feasibility of recirculation during ISCO injections.

The arrival of bromide, along with its concentration, at a monitoring location will be an indicator of the travel time for permanganate and dilution along its travel path. Thus, using KBr as a tracer can help establish realistic ISCO delivery expectations and estimate appropriate permanganate injection volumes. This approach would also help prevent displacing CVOC-containing groundwater during injection.

4.5.4 Remedial Amendment Injection

Injections are expected to be performed in the TTZ using injection and/or recirculation wells. Based on the current understanding of the TTZ, up to 15 injection wells will be used in a grid pattern at roughly 70-foot spacing throughout the TTZ (Figure 4-7). Based on the findings of the investigation, the final injection well layout, permanganate dose, and injectate volume will be completed.

4.5.4.1 Boring Advancement and Injection Well Installation

Prior to any subsurface work, DigSafe notification and a third-party utility locate will be performed to identify utilities that may conflict with proposed injection locations. Bedrock borings will be advanced at least 50 feet (or to the TTZ depth decided during the investigation) into bedrock using sonic drilling or air-rotary techniques. Continuous cores will be recovered during drilling, and lithology will be logged to better understand the geology, which will be used to finalize target injection depths. Geophysical characterization and flowmeter logging will be conducted using a selection of the techniques described in Section 4.5.3.1.1.

4.5.4.2 ISCO Injection

The injections will be carried out by an injection contractor. The injection contractor will prepare a work plan prior to implementation, providing details on how the work will be carried out and the equipment to be used; the work plan will be included in a Phase IV Status Report. The final equipment used for injection will be verified prior to mobilization. The ISCO injection system is expected to include a portable, trailer-mounted, batch-mix, gravity-feed or low-injection pressure system and will be mobilized and set up within a secondary-containment basin constructed of 30-mil high-density polyethylene designed to hold 1.25 times the capacity of the storage tank. The injection equipment will include polyethylene mixing tanks, transfer pump, as well as fittings and instrumentation such as valves, flowmeters with totalizer, and pressure gauges. The flowmeters will be capable of measuring flow between 0.5 and 10 gallons per minute. Higher flow rates may be considered during delivery, and the decision will be made in the field based on observations of flow rates and hydrostatic head in the injection well. The pressure gauges on injection piping will be capable of measuring between 0 and 100 pounds per square inch. The mixing and

injection equipment will be operational and pressure tested with hydrant water prior to the first day of injection. Prior to injection, injection wells will be assessed with an interface probe to determine if DNAPL is present in the well. If DNAPL is present in sufficient quantity to be recovered, it will be removed by a pump or a bailer before oxidant injections.

Should injection time be greater than the expected duration, added hydraulic pressure will be tested by filling the injection well from the water table surface to near ground surface with $NaMnO_4$ solution at the end of each day, allowing the oxidant to enter the formation throughout the night by gravity flow.

4.5.4.2.1 Injection Monitoring

Injection monitoring data will be collected during the injection. The data will include injection pressures, injection volumes, injection flow rates, water levels in nearby monitoring wells, the injected mass and volume of the permanganate, and any other observations (such as surfacing or other abnormal conditions). During injections, the zone of influence (ZOI) will be verified at selected injection locations, where monitoring wells are present within the ZOI, via observation of changes in field parameters (for example, ORP, specific conductance, pH, and/or temperature) and oxidant concentrations. At a minimum, after every 1,000 gallons of injectate delivered to the subsurface, $NaMnO_4$ concentrations will be monitored at select monitoring wells using the colorimetric test Method 8034 with a Hach DR 850 portable colorimeter or similar field test kit to assess the distribution and ZOI of $NaMnO_4$. Visual observation of the groundwater color in monitoring wells will also be used to evaluate the arrival of $NaMnO_4$ solution during injection, since the purple color of permanganate is visible down to a relatively low concentration of approximately 2 mg/L and can be estimated in the field using a printed purple color scale.

4.5.4.2.2 Recirculation

Based on results of the investigation, groundwater recirculation may be used to distribute the permanganate throughout the fractured bedrock zone. Unlike ISCO applied by injections only, recirculation systems can proactively flush available fractures with the push-pull dynamic environment created with local hydraulic gradients. However, because there is no net withdrawal or injection of groundwater during recirculation, the overall sitewide hydraulic gradients and groundwater velocities are maintained. This approach also limits potential contaminant displacement during injections and can create treatment zones or in situ barriers where contaminants are hydraulically captured and treated.

Various recirculation configuration options are available to manipulate the in situ hydraulic gradients suited to Site hydraulics. If connectivity between the injection and extraction wells is present, groundwater circulation well technology has a larger ZOI for the treatment zone compared to single injection wells. This is due to the induced hydraulic gradients within the aquifer that locally increase groundwater velocities and decrease travel time of the injected oxidant throughout the TTZ. These systems have common components, including one groundwater submersible pump, a packer between the two vertical intervals for groundwater extraction and reinjection, and pressure transducers above and below the packer.

The feasibility of recirculation will be evaluated as part of the investigation and, if necessary, a recirculation test will be conducted. A tracer, like bromide, would be used rather than permanganate for this test. Laboratory samples would be collected during baseline and periodically during the test to assess the VOC and tracer distribution to confirm field observations.

4.6 Spill, Accidental Discharge, and System Malfunction Controls (310 CMR 40.0874(3)(b)(7))

The oxidant $NaMnO_4$ will be delivered to the Site in concentrated liquid form (40% by weight) and stored on pallets with secondary containment in a secure area in their original, tightly closed containers until used. It will be diluted to the design concentration before being delivered into the subsurface. If KBr is used as a tracer, it will be delivered to the Site as crystalline granules in 25-kilogram bags or fiber drums and mixed with water to create a solution.

The oxidant, mixing tanks, and associated hoses are the primary items that require design features to control accidental spills or discharges of the oxidant. Secondary containment will be constructed around the injection system trailer to contain spills. Spill response equipment, including oxidant-compatible sorbents, will be kept onsite near the injection system in addition to neutralizing solution for small spills and drips (for example, a vinegar-sugar solution) and a shovel and polyethylene waste drum to place larger amounts of impacted soil. Because the work will be conducted in the vicinity of a building, roadway, and parking lot in active use, traffic control measures will be implemented. Temporary work zones will be established around the remediation areas to allow access only to authorized personnel. These exclusion zones will be clearly marked with cones and/or caution tape. Spill control will be set up around each injection point to contain spills or surfacing, including protection of nearby storm sewer catch basins if present. Prior to injection, areas around the injection point will be visually inspected for potential preferential pathways, such as utility trenches/corridors, storm sewer manholes or old borings, where surfacing could occur. These areas will be visually monitored for surfacing during injection.

4.7 Waste Material Management and Disposal Methods (310 CMR 40.0874(3)(b)(8))

Efforts will be made to limit the amount of waste generated during remedy implementation. Material disposal and waste generation will be conducted in accordance with the general procedures described in this section. Waste will be characterized prior to final disposition. All of the oxidant $NaMnO_4$ will be mixed and applied, so no waste oxidant is anticipated. If unused oxidant $NaMnO_4$ remains, it will be characterized and disposed of as D001 (ignitable) hazardous waste at a licensed, offsite facility or returned unused to the manufacturer.

Soil, water, DNAPL (if recovered), daylighted injection fluids (if generated), and PPE waste will be characterized, managed, and disposed of offsite in accordance with state and federal regulations.

4.8 Deleterious Impact Mitigation (310 CMR 40.0874(3)(b)(10))

Environmental impact mitigation measures will be implemented to avoid deleterious impact on environmental receptors. Following delivery to the Site, 40% by weight $NaMnO_4$ will be stored onsite in a secured location within secondary containment to prevent spills.

While surfacing is not anticipated to occur, injections will be stopped if the remediation amendment surfaces during the injection. Remediation amendment solution/injectate that daylights, surfaces, or migrates to utility trenches or storm sewers will be cleaned up by dilution with water, neutralization, adsorbent pads, or shoveling impacted soil into a polyethylene drum, as needed.

4.9 Inspections and Monitoring

This section provides a general description of inspections and monitoring to document adequate construction and performance of the RAA. It also provides the basis of the OMM Plan that will be further developed once the design is complete.

4.9.1 Inspections and Monitoring During Injections

The number and condition of containers of remediation amendment will be inspected when delivered to the Site. The source and amount of potable water used will be documented. During batch mixing, the amount of amendment(s) and potable water added to each batch will be recorded to document that the prepared injection solution is consistent with the design specifications. The injection locations where the batch was delivered to the subsurface will also be documented. Equipment such as hoses, pressure gauges, flow gauges, and pressure-relief valves will be inspected prior to use to confirm proper function.

During oxidant injection, injection pressures and flow rates at each injection point/depth will be monitored and recorded. The volume of the oxidant solution will also be monitored and recorded and compared to the design. The volume injected, as measured by a flow totalizer, will be compared to the changes in volume observed in the injection system tank.

To assess injection volume and ZOI relationships, select monitoring wells will be used, based on the final injection layout, to assess distribution during injection. Prior to injections, groundwater parameters and groundwater elevations will be collected to provide a pre-injection baseline. Groundwater in select monitoring wells within, upgradient, and downgradient of the TTZ will be sampled periodically when injections are being carried out nearby to identify whether the oxidant has been distributed to the well. The groundwater samples will be visually monitored for the presence of $NaMnO_4$ (purple) and field parameters will also be measured (pH, ORP, DO, and specific conductivity). Air monitoring using a PID or multi-gas monitor will also be conducted prior to and during injection activities. Field monitoring equipment, including groundwater field parameter monitoring equipment and air monitoring equipment, will be calibrated daily, and calibration data will be recorded in a field book. Photographs will be taken before, during, and after injection activities.

Three rounds of injections are anticipated to take place approximately 6 to 12 months apart; however, groundwater performance monitoring results will be used to decide the exact timing for the second and third (or more) rounds of injections (see Section 4.9.2.2).

4.9.2 Groundwater Performance Monitoring

4.9.2.1 Baseline

A round of baseline groundwater sampling and water level measurements/DNAPL assessment using an interface probe will be collected before injections from a selected network of monitoring wells in the treatment area, as detailed in Section 4.5.3. Groundwater samples will be analyzed for VOCs, TOC, and bromide (if tracer test is conducted).

4.9.2.2 Post-injection Monitoring

Periodic groundwater monitoring will be performed following the injections to monitor the changes in groundwater elevation, DNAPL presence, and VOC concentrations and decide if/when reinjection may be required. Groundwater monitoring will generally be conducted using low-flow techniques, unless it is

determined during baseline sampling that groundwater recovery at certain wells is too slow, in which case PDBs may be used at these wells.

Initially following injections, groundwater monitoring of field parameters and permanganate is proposed weekly for 1 month at select locations believed to be within the ZOI of the injections. Additionally, photographs of purged water may be collected at selected locations, by filling a clear container, to visually compare changes over time.

After the first month, groundwater monitoring is proposed at 2 months post-injection for field parameters and permanganate, followed by quarterly monitoring for three quarters (3, 6, and 9 months post-injection) for VOCs in addition to field parameters and TOC. Two quarterly sampling events will be performed following a second injection event and prior to a potential third injection event, as well as after a third injection event. Following final injection, 6 months of quarterly monitoring and 2.5 years of semiannual monitoring will be conducted.

Groundwater samples with visible permanganate (purple color) will generally not be submitted for analysis; when visible permanganate is present in a groundwater sample, residual VOCs may potentially continue to be oxidized after sample collection, which may low-bias the VOC result. If permanganate persists and the VOC concentrations in a particular well need to be quantified, the residual permanganate in the sample will be neutralized in the field before the sample is sent to the lab for analysis.

Quarterly and semiannual monitoring events will include synoptic groundwater elevation measurements to evaluate groundwater flow patterns and calculate hydraulic gradients. An interface probe will be used to monitor for the presence and thickness of DNAPL. Groundwater samples will be analyzed for VOCs and TOC, but other parameters, such as ORP and manganese, may be added as needed, and the frequencies may vary at select locations. Optimization of the sampling network may be recommended based on post-injection sample results. Similarly, additional data may be collected, as needed, for troubleshooting or better assessment of Site groundwater reactions and processes. After 5 years of post-final injection monitoring, ISCO-related sampling will be integrated into the sitewide monitoring program. Groundwater monitoring data will be evaluated as follows:

- Upgradient monitoring well data will be monitored for potential changes in CVOC concentrations that may be related to upgradient remediation activities at the Building 3 and Building 5 Source Areas.
- As needed, groundwater data within the treatment zone will be monitored for geochemical changes attributable to the remediation amendments (for example, changes in geochemical conditions as a result of the remedial additions) as well as changes in groundwater concentrations, both temporally and spatially. Geochemical data within the TTZ will also be used to decide if the efficacy of the treatment is waning, indicating reinjection may be needed.
- As required by the MCP, groundwater data downgradient of the treatment zone will be evaluated for changes in CVOC concentrations and geochemical conditions as well as potential remediation amendment migration beyond the TTZ.

Groundwater data will also be evaluated graphically and statistically, once sufficient data is collected, to verify the overall stability of the bedrock plume.

The monitoring results will be reported in semiannual Phase IV or Phase V Status Reports and include an evaluation of overall remedial performance, progress toward meeting remedial goals, and any recommendations for remedy optimization, such as supplemental injections, if warranted.

4.10 Permits, Licenses and Approvals (310 CMR 40.0874(3)(f))

The following permits, licenses, and approvals will be required:

- A Massachusetts-certified well driller will be required to install monitoring wells.
- Injections proposed under this plan may be conducted within 50 feet of the culverted unnamed stream. This is one of the sensitive receptors listed in the MCP at 310 CMR 40.0046(3). Therefore, approval from MassDEP will be obtained prior to injections within 50 feet of the culverted unnamed stream.
- If required, a right-of-way permit from the City of Beverly will be obtained to conduct drilling activities within the Bomac Road right-of-way.

4.11 Property Access Issues (310 CMR 40.0874(3)(g))

An access agreement is already in place that will cover the ISCO injections, including staging of the injection system trailer, and performance monitoring near Building 5, Building 8, and/or 30 Tozer Road. Building operations will continue during ISCO injections and performance monitoring. Injection equipment will be staged so that ingress/egress to buildings is not blocked. If access to a building does need to be blocked, this will be negotiated with the property owners, and strategies such as night or weekend injections may be used.

4.12 Design/Construction Schedule (310 CMR 40.0874(3)(c)(2))

The anticipated schedule for the bedrock area activities includes the following:

- Phase IV Comment Period and Responses: November 2023 and December 2023
- Investigation, installation of monitoring wells, baseline sampling, and data evaluation: winter to spring 2024
- Phase IV Status Report: January 27, 2024
- Geophysical testing: spring and summer 2024
- Phase IV Status Report: July 27, 2024
- Installation of injection well network: summer to fall 2024
- First round of ISCO injections: fall 2024
- Post-injection performance monitoring: fall 2024 to winter 2025
- Second round of ISCO injections: TBD
- Continued post-injection performance monitoring: TBD, quarterly between injections
- Third round of ISCO injections (if necessary): TBD
- Continued post-injection performance monitoring: TBD; quarterly for 6 months post-final injection, followed by 2.5 years of semiannual monitoring, and 1 year of annual monitoring.

5. PSL10 Area – Remedy Implementation Plan Pending Additional Investigation

5.1 Nature and Extent of Contamination (310 CMR 40.0874(3)(b)(4))

Per the Phase III report (Aptim 2023), the TTZ was originally defined as the 7,200-ft^2 area bounded by CL10-S, CL10-DO, and MW2_32-Tozer to the west and the ISCO injection wells AP-19, AP-20, AP-21, and AP-22 to the east (Figure 5-1). Based on this area, an approximate average soil concentration of 4 mg/kg, and an approximate average groundwater concentration of 4 mg/L, it was estimated in the Phase III report (Aptim 2023) that the overburden has approximately 100 lb of CVOCs (85 lb adsorbed and 15 lb dissolved). CVOC concentrations at PSL10 are lower relative to other source areas. The concentrations in shallower wells, CL10-S, AP-20, and AP-22, exhibit seasonal fluctuations in CVOC concentrations, especially PCE, that seem to indicate the presence of vadose soil contamination that is mobilized and transported vertically to groundwater during seasonal groundwater table fluctuations or surficial precipitation recharge. Recent groundwater concentrations in the PSL10 area are summarized in Table 5-1.

Table 5-1. December 2022 and May 2023 Groundwater Concentrations in PSL10 Area Monitoring Wells

Well	Unit	Date	PCE	TCE	cis-1,2-DCE	VC
AP-19	Deep OB	12/2022	0.023	0.009	0.004	<0.002
AP-19	Deep OB	5/2023	<0.002	<0.002	0.005	<0.002
AP-20	Shallow OB	12/2022	4.9	0.3	2	0.49
AP-20	Shallow OB	5/2023	0.4	0.049	0.17	<0.002
AP-21	Deep OB	12/2022	0.031	0.012	0.003	<0.002
AP-21	Deep OB	5/2023	0.005	<0.002	<0.002	<0.002
AP-22	Shallow OB	11/2022	1.6	0.54	0.82	<0.01
AP-22	Shallow OB	5/2023	0.41	0.057	0.19	<0.002
CL-10-S	Shallow OB	11/2022	0.019	<0.002	<0.002	<0.002
CL-10-S	Shallow OB	5/2023	0.31	0.011	0.012	<0.002
CL-10-DO	Deep OB	12/2022	1.8	1.3	0.18	<0.02
CL-10-DO	Deep OB	5/2023	2.1	1.7	0.22	<0.02
MW2-32Tozer	Shallow OB	12/2022	0.75	0.13	0.73	0.12
MW2-32Tozer	Shallow OB	5/2023	0.002	<0.002	0.003	<0.002

Note: Concentrations in mg/L.

A soil gas survey performed to evaluate the area of residual VOC impacts in the vadose zone was conducted in August 2023 over an area of approximately 160 feet by 60 feet (Figure 5-2). The soil gas survey was originally planned to encompass an area of 160 feet by 100 feet, including the area around monitoring wells AP-19, AP-20, AP-21, and AP-22. However, due to dense vegetation and utilities

(including overhead power lines, a gas line, and two water lines) in the area of these monitoring wells, the survey area was reduced and focused on the area to the east. Initially, the target depth for soil gas sampling was 5 feet bgs. At two grid locations, soil vapor sampling was attempted, but samples could not be collected due to the tight soil conditions. Therefore, due to the tight soil conditions, subsequent samples were collected between approximately 2 and 5 feet bgs. A total of 18 soil gas samples were collected in the PSL10 area. Soil vapor sample locations A3, B4, D2, and G1 had negligible recovery, so samples were not collected.

Soil gas survey points were installed using a track-mounted, direct-push drill rig to a depth of 2 to 5 feet below grade. The Geoprobe Post Run Tubing system was used for soil vapor collection. This system uses a three-way valve connected to the three sections of tubing: one running from the bottom of the boring, one to the purging pump, and another to the sampling container to obtain a soil vapor sample. Vapor samples were collected over a 15-minute period using an evacuated canister. Following sample collection, the canisters were submitted for laboratory analysis of VOCs by USEPA Method TO15.

CVOCs were detected in soil vapor at concentrations up to 2,050,000 parts per billion by volume (ppb-V) (PCE) and 30,900 ppb-V (TCE) at soil vapor point D4, located approximately 60 feet northeast of monitoring wells AP-19, AP-20, AP-21, and AP-22 (Figure 5-2). Soil vapor samples collected from points 20 feet northwest, northeast, and southeast had detections of PCE ranging from 50.1 ppb-V (soil vapor point E4) to 35,800 ppb-V (soil vapor point C4). Soil gas survey concentrations are also provided in Table 5-2.

Table 5-2. PSL10 Area Soil Vapor Investigation Results

Location	Sample Date	cis-1,2-DCE		PCE		TCE		VC	
		µg/m³	ppb-V	µg/m³	ppb-V	µg/m³	ppb-V	µg/m³	ppb-V
PSL10-A2	08/21/2023	0.793 U	0.2 U	141	20.8	1.07 U	0.199 U	0.511 U	0.2 U
PSL10-A4	08/18/2023	16.8	4.24	11200	1650	379	70.6	8.61 U	3.36 U
PSL10-B2	08/18/2023	825	208	8950	1320	454	84.5	13.1	5.12
PSL10-B3	08/21/2023	15.6	3.94	854	126	20.9	3.89	1.24 U	0.484 U
PSL10-C2	08/21/2023	698	176	4700	693	96.7	18	4.24 U	1.66 U
PSL10-C3	08/21/2023	241	60.9	205000	30200	575	107	28.6 U	11.2 U
PSL10-C4	08/18/2023	1170	295	243000	35800	3130	583	284 U	111 U
PSL10-D3	08/21/2023	948	239	82700	12200	623	116	39.1 U	15.3 U
PSL10-D4	08/18/2023	289000	73000	13900000	2050000	166000	30900	6390 U	2500 U
PSL10-E2	08/21/2023	1.36	0.343	27.9	4.12	1.07 U	0.199 U	0.511 U	0.2 U
PSL10-E3	08/21/2023	6.98	1.76	780	115	9.51	1.77	1.19 U	0.465 U
PSL10-E4	08/21/2023	5.31	1.34	340	50.1	6.83	1.27	0.511 U	0.2 U
PSL10-F2	08/21/2023	0.793 U	0.2 U	78.7	11.6	1.07 U	0.199 U	0.511 U	0.2 U
PSL10-F3	08/21/2023	10.4 U	2.63 U	8680	1280	48	8.94	6.7 U	2.62 U
PSL10-F4	08/21/2023	2.43 U	0.614 U	1590	235	6.23	1.16	1.56 U	0.609 U
PSL10-G2	08/21/2023	0.845	0.213	24.8	3.66	1.07 U	0.199 U	0.511 U	0.2 U
PSL10-G3	08/21/2023	0.793 U	0.2 U	13.9	2.05	1.07 U	0.199 U	0.511 U	0.2 U
PSL10-G4	08/21/2023	5.95 U	1.5 U	1040	153	10.5	1.96	3.83 U	1.5 U

µg/m³ = microgram(s) per cubic meter; U = The analyte was analyzed for but was not detected above the reportable detection limit.

Based on the results of the 2023 soil gas survey, the residual source area (and therefore the TTZ) appears to extend farther to the east and is larger than the originally defined 7,200 ft^2. However, the results of the soil vapor survey indicate there is a relatively small area of VOC-impacted vadose zone soil that is a source of VOCs in groundwater in this area. During the week of September 18, 2023, five soil borings will be advanced in the PSL10 area to further assess the soil and groundwater impacts. These borings will be installed adjacent to soil vapor sampling points D4, E4, D3, and B2 and between points A4 and B4 (Figure 5-2). These borings will be completed as groundwater monitoring wells. If data from these new wells confirm that shallow vadose soil impacts are driving VOC detections in groundwater in this area, a simpler and quicker remedy to implement, such as soil excavation, may be more appropriate for PSL10. Residual vadose zone CVOC source area soil excavation in combination with a treatment such as ISCO/PAZ is expected to be a more effective remedial approach. Since excavation would reduce the mass of CVOC to treat in situ, groundwater quality in the area would be expected to improve sooner than was estimated in the March 2023 Phase III RAP.

The March 2023 Phase III RAP indicated that, depending on the results of the soil gas survey, a vadose zone remediation component, such as shallow soil excavation, may be added to the RAA. In addition, the Phase III RAP evaluated CAC in a reactive zone and also indicated that an alternative approach may be used, such as in situ chemical reduction (ISCR) (for example, ZVI) or a combination of ISCR and CAC. Based on initial evaluation of the pre-design investigation results, technologies such as a subgrade biogeochemical reactor (SBGR), which would involve source area excavation, backfill with amendments to enhance biological and geochemical degradation processes, and recirculation of groundwater through the placed media, may be an appropriate remediation technology.

The March 2023 Phase III RAP indicated that, depending on the results of the soil gas survey, a vadose zone remediation component, such as shallow soil excavation, may be added to the RAA. In addition, the Phase III RAP evaluated CAC in a reactive zone and also indicated that an alternative approach may be used, such as in situ chemical reduction (ISCR) (for example, ZVI) or a combination of ISCR and CAC. Based on initial evaluation of the pre-design investigation results, a reactive zone that uses a subgrade biogeochemical reactor (SBGR) may be an appropriate remediation technology. An SBGR reactive zone would involve source area excavation, backfill with amendments to enhance biological and geochemical degradation processes, and recirculation of groundwater through the placed media.

Since the remedy in the PSL10 may be revised, a Phase IV Plan for this area is not being presented in this report. If warranted by the results of the additional assessment being conducted, the Phase III RAP selected remedy for this area will be revised. However, at this time, soil excavation with a reactive zone may be the best approach for the PSL10 area. If data collected during the September 2023 well installation and soil/groundwater sampling program support this conclusion, an excavation and reactive zone plan would be submitted in a Phase IV Plan, Part 3. It is anticipated that this Phase IV Plan, Part 3 would be submitted in advance of and presented at the PIP meeting scheduled in November 2023 (see Section 8).

6. Construction Plans and Specifications

Per 310 CMR 40.0874 (3)(c)(1), the Phase IV Plan shall include construction plans that shall be prepared in conformance with appropriate engineering and construction standards and practices and regulations applicable to construction plans and activities.

6.1 Building 5 Area

As discussed in Section 3.5, investigation work is recommended to refine the design of the ISB remedy. Plans illustrating the location of potential injection and monitoring wells are provided in Figures 3-1 through 3-3. Details of the ISB remedy are also provided in Section 3.5. Additional construction details and drawings will be provided in a subsequent Phase IV Status Report.

6.2 Bedrock Area

As discussed in Section 4.5, investigation work is recommended to refine the design of the ISCO remedy. Plans illustrating the location of potential injection and monitoring wells are provided in Figure 4-7. Details of the ISCO remedy are also provided in Section 4.5. Additional construction details and drawings will be provided in a subsequent Phase IV Status Report.

6.3 PSL10 Area

As discussed in Section 5, a Phase IV Plan for the PSL10 area is not presented in this report.

7. Health and Safety Plan

Per 310 CMR 40.0874(3)(f), the Phase IV Plan shall include a Health and Safety Plan (HASP). A copy of the Site-specific HASP is presented in Appendix B. This document will be updated as needed based on each final design and the associated work scope to implement and operate the RAAs.

8. Public Involvement (310 CMR 40.0880)

In accordance with the MCP and the Site PIP, the following public involvement activities will be completed relevant to Phase IV including:

- The Chief Municipal Officer and Board of Health will be notified of the availability of the Phase IV Plan, Part 2, including information about how local officials may obtain a copy of the report.
- A copy of the Phase IV Plan, Part 2, will be sent to the information repository established in the PIP for the Former Varian Facility Site.
- A public meeting will be held on November 14, 2023, to present this document, followed by a 20-day public comment period to solicit public comments.

Copies of the PIP notices are included in Appendix C.

9. References

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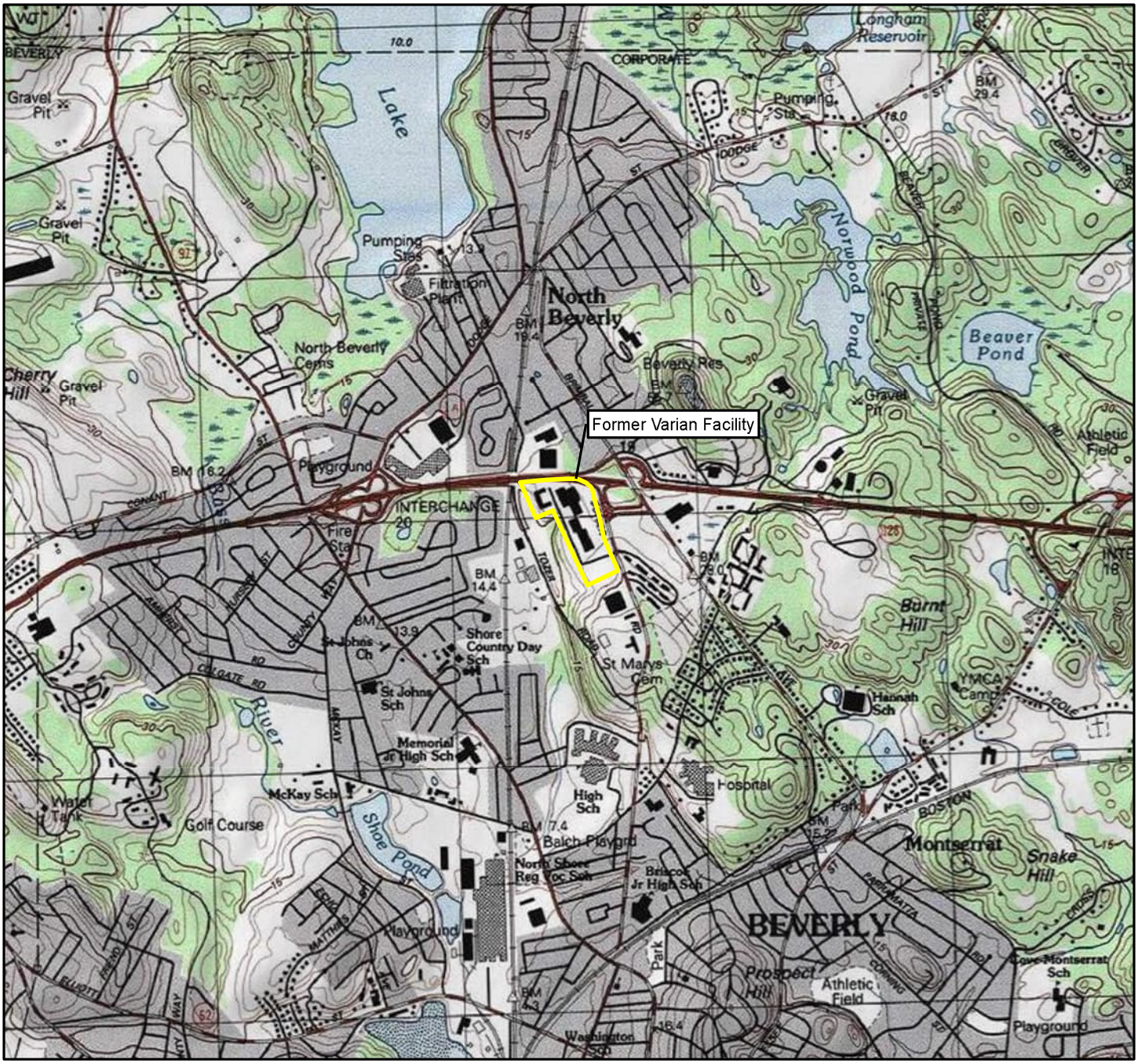
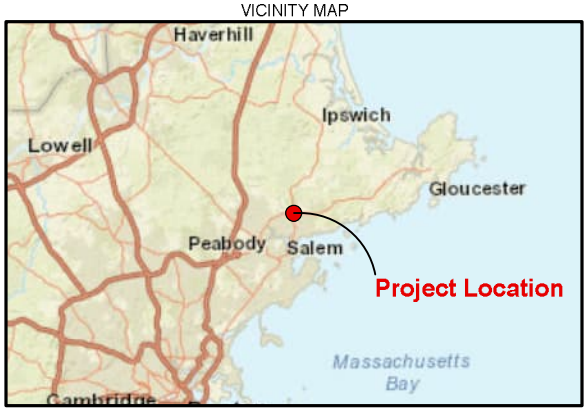
Figures



LEGEND

Former Varian Facility

VICINITY MAP

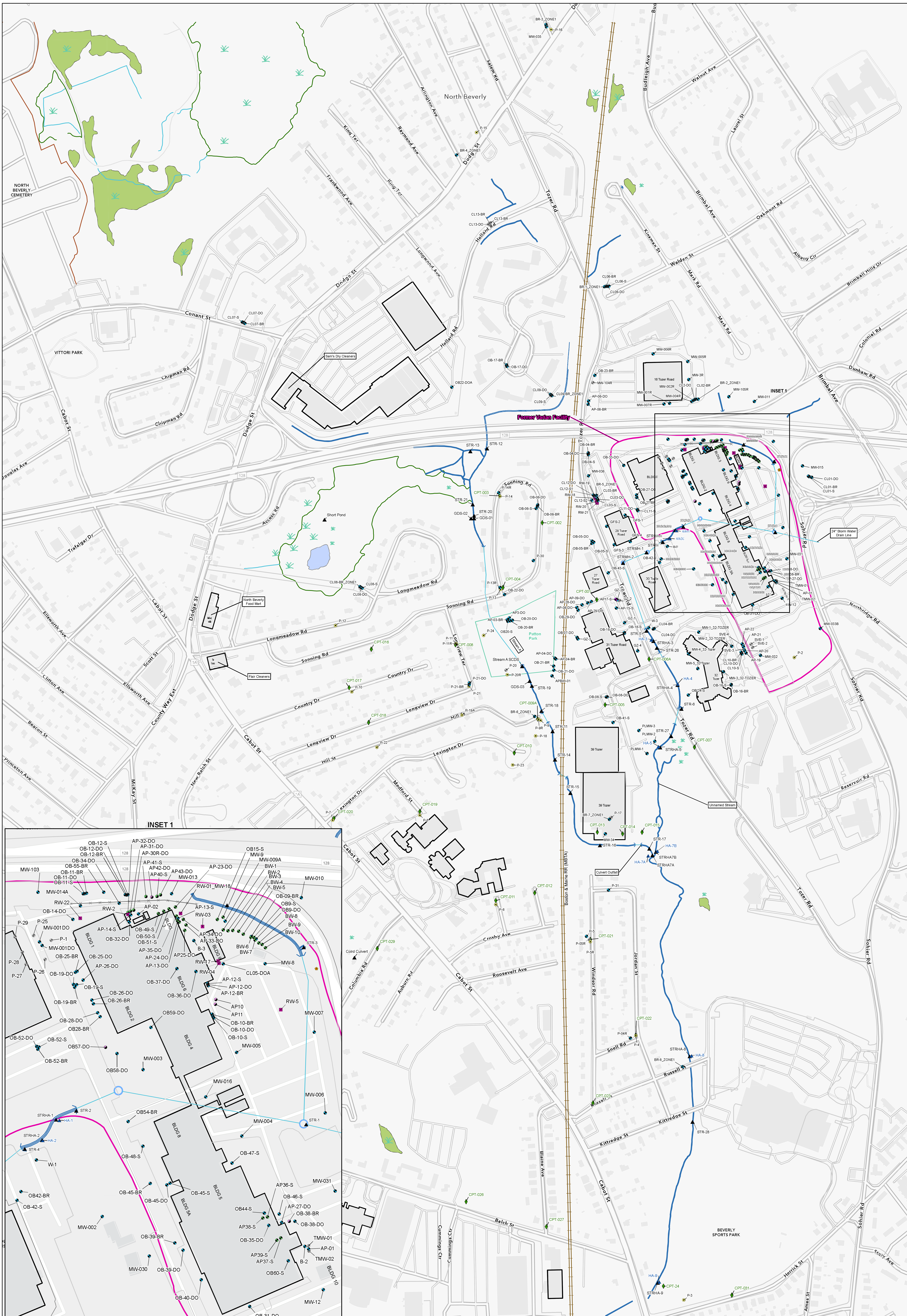


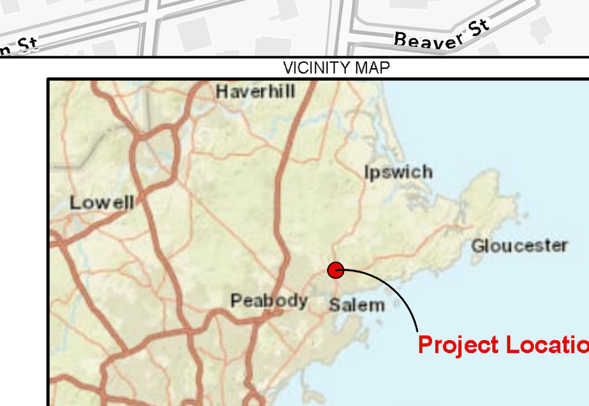
0 1,000 2,000 4,000
Feet

1:24,000 1 inch = 2,000 feet

Service Layer Credits: World Street Map: Esri, HERE, Garmin, NGA, USGS, NPS
USA_Topo_Maps: Copyright:© 2013 National Geographic Society, i-cubed

FIGURE 1-1
Site Location Map
Phase IV Remedy Implementation Plan
Beverly, Massachusetts





LEGEND

- Abandoned or Destroyed Well
- Angled Well
- Bioremediation Injection Well
- Monitoring Well (MW)
- Piezometer (P)
- Recovery Well (RW)
- Temporary Permanganate Injection Point
- Angled Bioremediation Injection Well
- Cone Penetrometer Testpoint (CPT)
- Hand Auger Sample Location (HA) Adjacent to a Stream (STRHA)
- Surface Water Stream (STR) Sample Location
- Benchmark Location (MSL)
- Approximate Location of Stream in Culvert
- Approximate Stream Location
- Fence Line
- Water and Marsh Area
- Vegetation
- Water
- Marsh
- Former Varian Facility
- Approximate Building Location

0 125 250 500 Feet
1:3,000 1 inch = 250 feet
N

Service Layer Credits: Light Gray Reference: Esri Community Maps Contributors, MassGIS, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, Human Geography Base: Esri Community Maps Contributors, MassGIS, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, World Street Map: Esri, HERE, Garmin, NGA, USGS, NPS, Human Geography Detail: Esri Community Maps Contributors, MassGIS, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, Human Geography Label: Esri Community Maps Contributors, MassGIS, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, Light Gray Base: Esri Community Maps Contributors, MassGIS, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA

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FIGURE 1-2
Expanded Site Plan
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

Jacobs

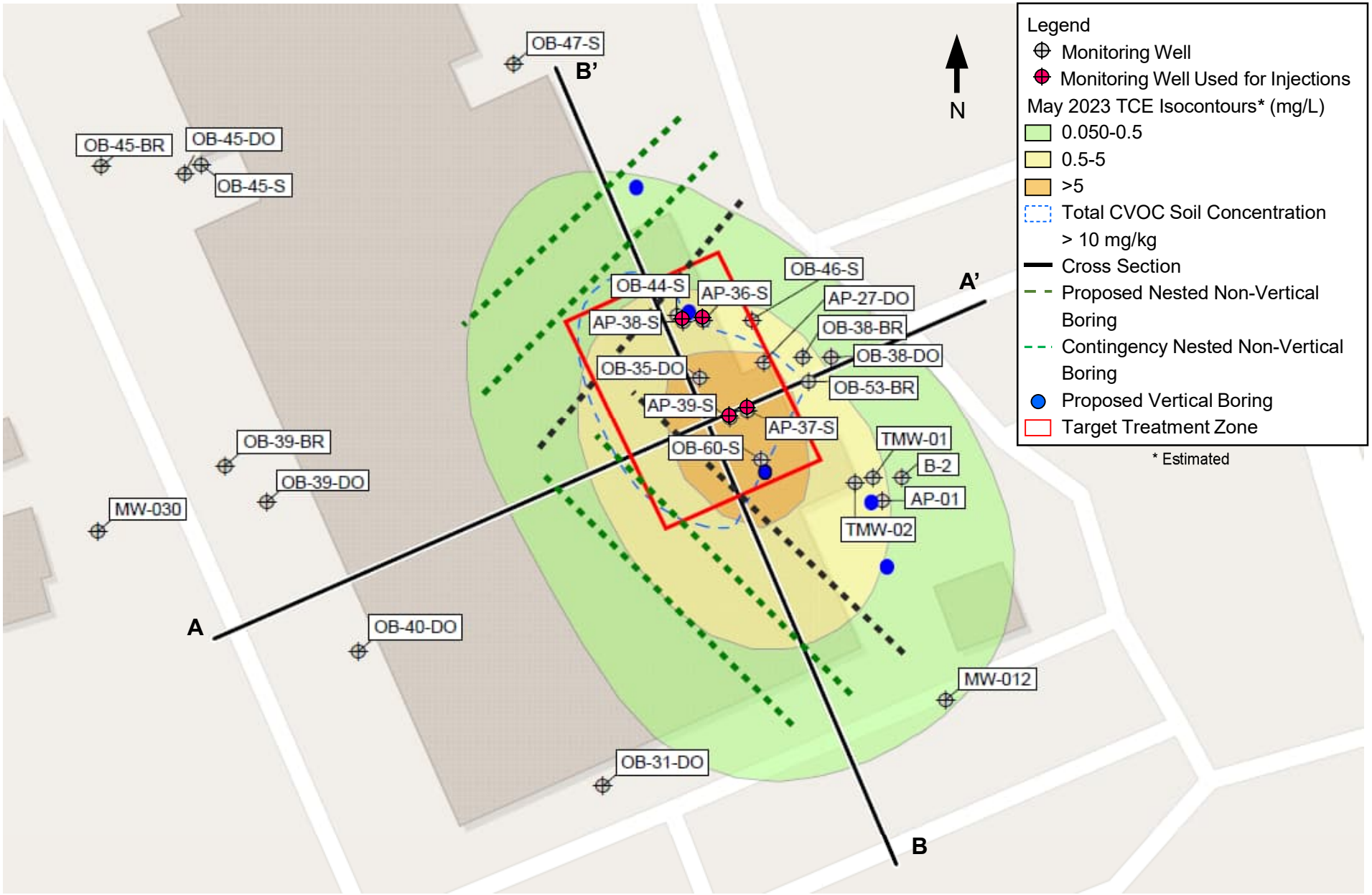
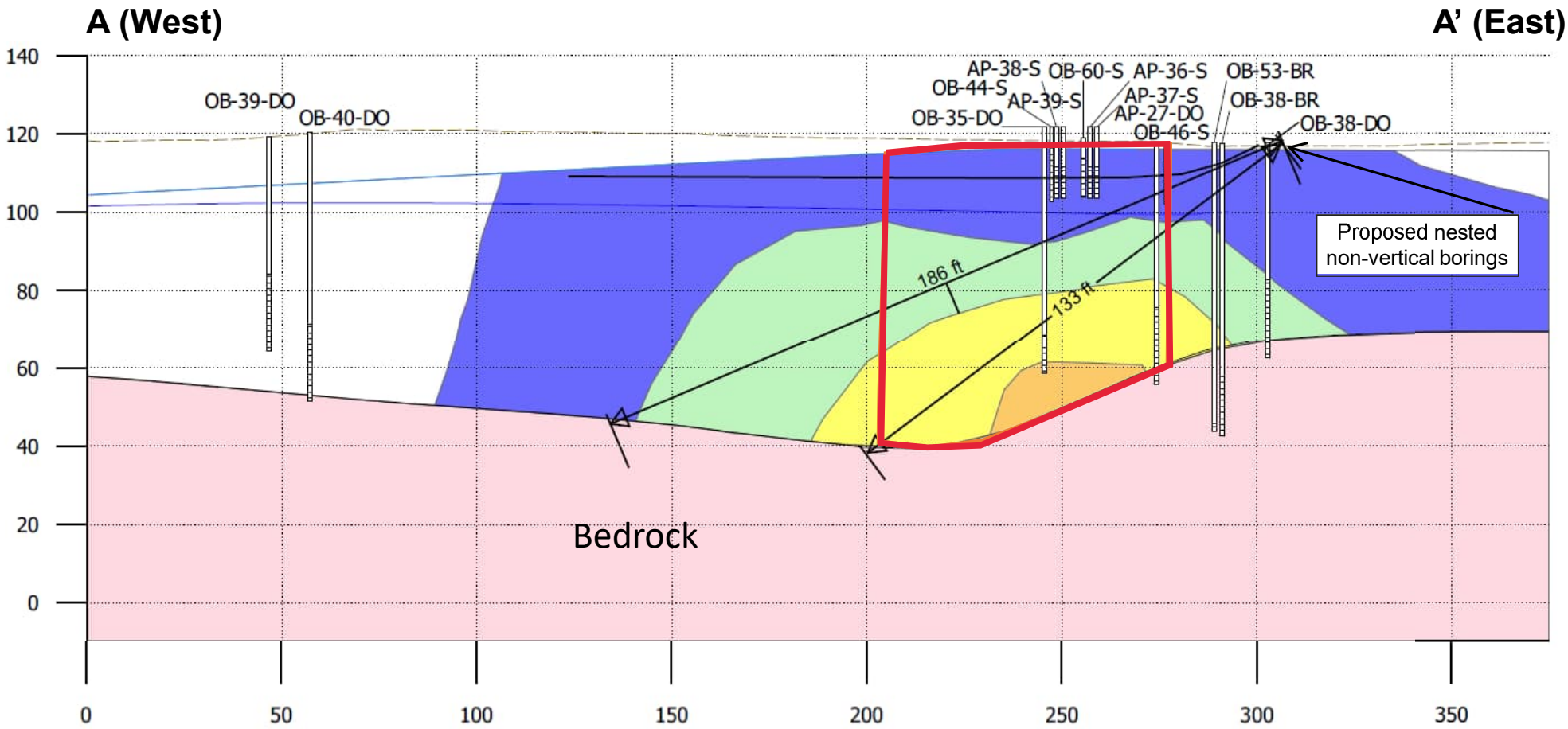


Figure 3-1
Building 5 Map and Proposed Borings
Phase IV Remedy Implementation Plan
Beverly, Massachusetts



Legend

TCE Q2 2023* (mg/L)

- <0.005
- 0.005 – 0.05
- 0.05 – 0.5
- 0.5 - 5
- > 5

- Topography
- Bedrock Surface
- Shallow Potentiometric Surface May 2023
- Bedrock Potentiometric Surface May 2023
- Target Treatment Zone

* Estimated

Scale: 1 in = 40 ft

Vertical exaggeration: 1x

0ft 100ft

Figure 3-2
Building 5 Cross Section A-A'
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

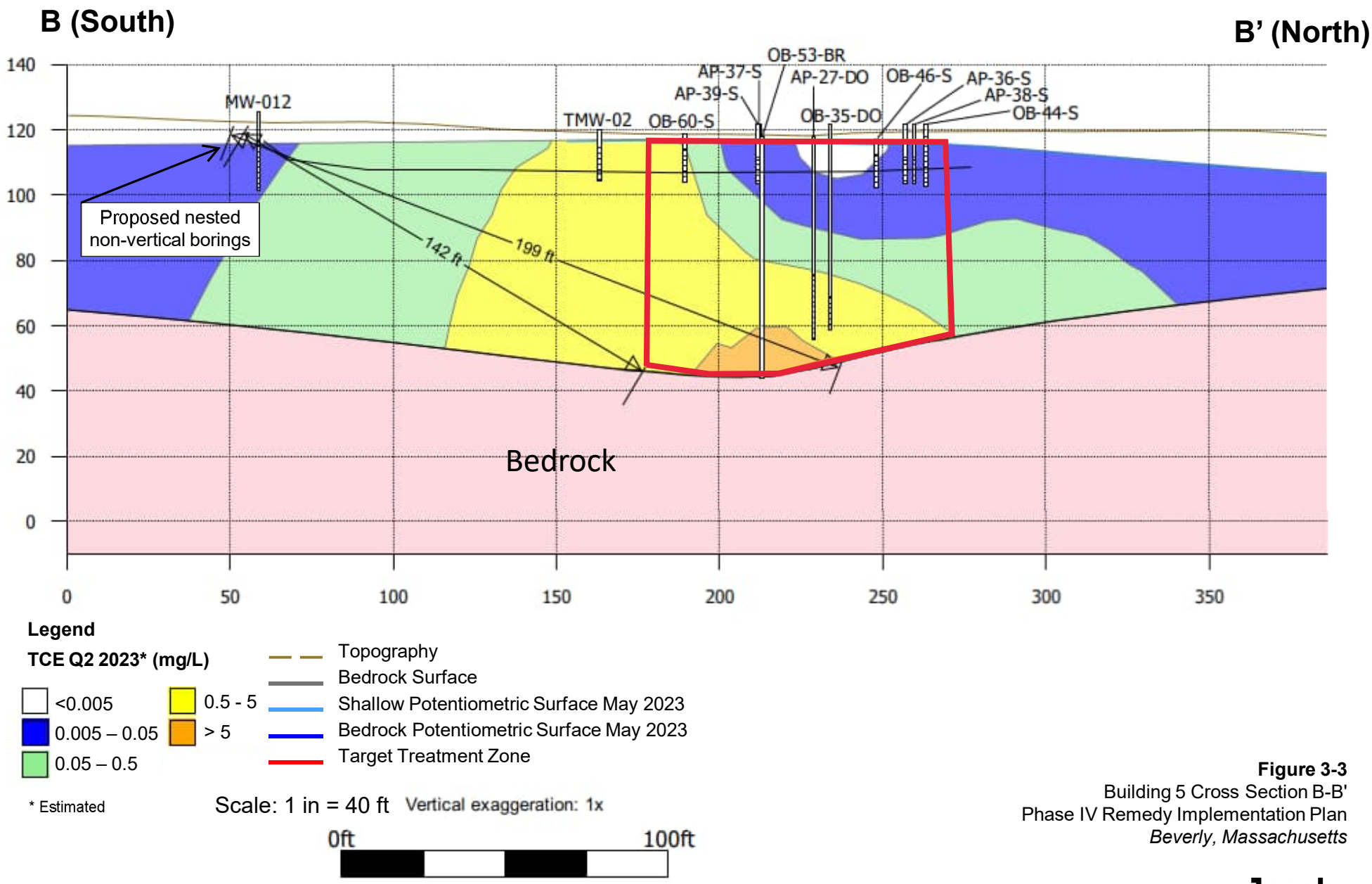
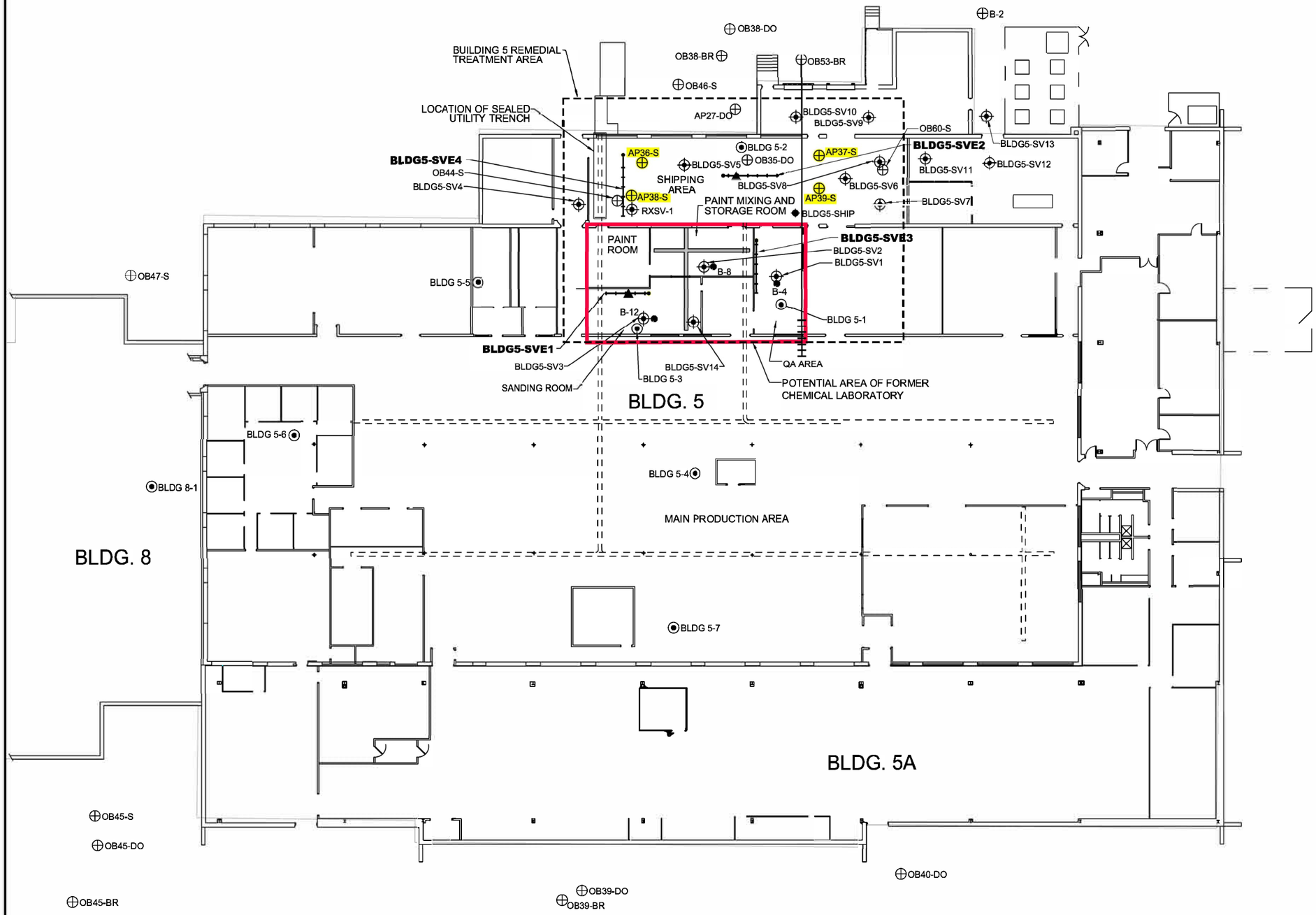


Figure 3-3
Building 5 Cross Section B-B'
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

Jacobs



LEGEND

- SUB-SLAB SOIL VAPOR SAMPLE LOCATION (2011-2014)
- INDOOR AIR SAMPLE LOCATION (2011-2014)
- SUB-SLAB SOIL VAPOR SAMPLE LOCATION (1995)
- MONITORING WELL
- SOIL BORING
- FORMER UTILITY TRENCH FILLED WITH CONCRETE
- UTILITY TRENCH
- SVE TRENCH WELL
- ANGLED WELL AND SCREEN
- AP37-S PREVIOUS INJECTION WELL

INDOOR AIR SAMPLE ID RTN 3-0485	ROOM
BLDG 5-1	QA AREA
BLDG 5-2	SHIPPING AREA
BLDG 5-3	SANDING ROOM
BLDG 5-4	PRODUCTION AREA
BLDG 5-5	CATHODE SPRAY ROOM
BLDG 5-6	COMMON OFFICE AREA
BLDG 5-7	DEGREASER AREA
BLDG 8-1	HIGH POWER TESTING BUILDING 8 BASEMENT

N

SCALE

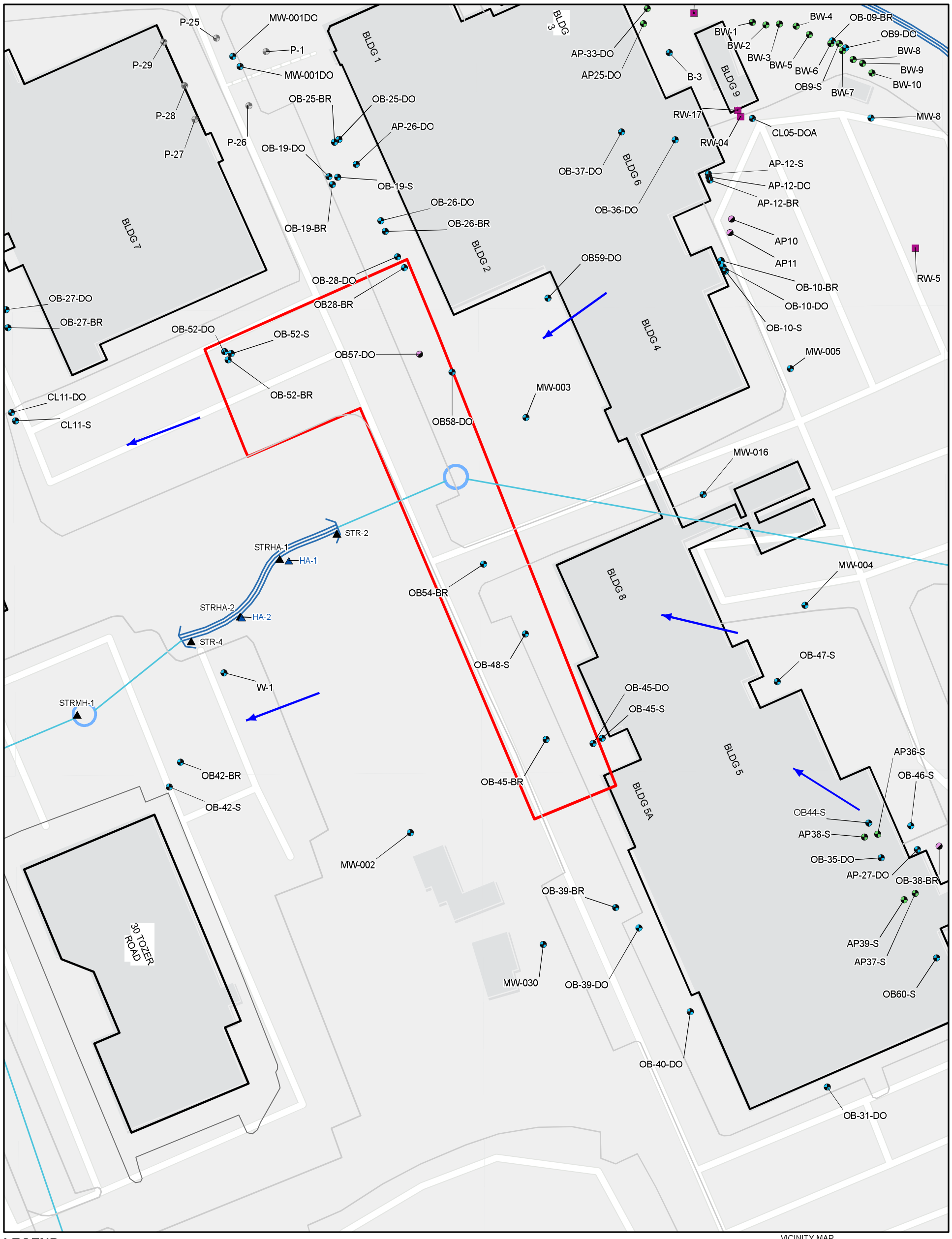
0 30 60

REFERENCE:

PLAN DERIVED FROM COMMUNICATIONS & POWER INDUSTRIES MAP, DATED 07/11/03, CLEAN HARBORS ENVIRONMENTAL SERVICES, INC. MAP TITLED "1962-BUILDING 5", AND CB&I ENVIRONMENTAL & INFRASTRUCTURE, INC., AND APTIM ENVIRONMENTAL & INFRASTRUCTURE, INC. FIELD RECONNAISSANCE, JULY 2012, APRIL 2014 AND AUGUST 2018.

FIGURE 3-4
BUILDING 5 LAYOUT
FORMER VARIAN FACILITY
150 SOHIER ROAD
BEVERLY, MASSACHUSETTS

Jacobs

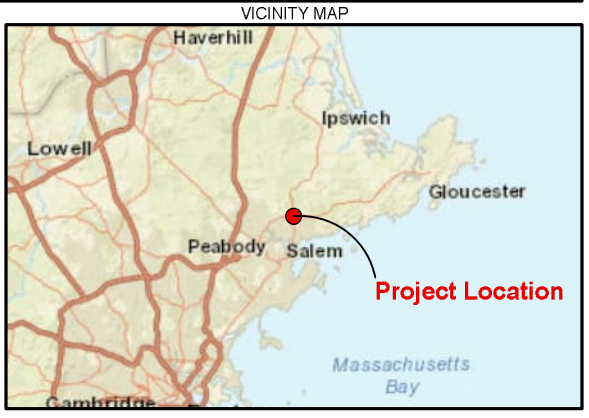


LEGEND

- Abandoned or Destroyed Well
- Angled Well
- Bioremediation Injection Well
- Monitoring Well (MW)
- Recovery Well (RW)
- Hand Auger Sample Location (HA) Adjacent to a Stream (STRHA)
- Surface Water Stream (STR) Sample Location
- Bedrock Potentiometer Flow Direction
- Approximate Location of Stream in Culvert
- Approximate Stream Location
- Treament Zone
- Approximate Building Location

0 37.5 75 150
Feet
1:900 1 inch = 75 feet

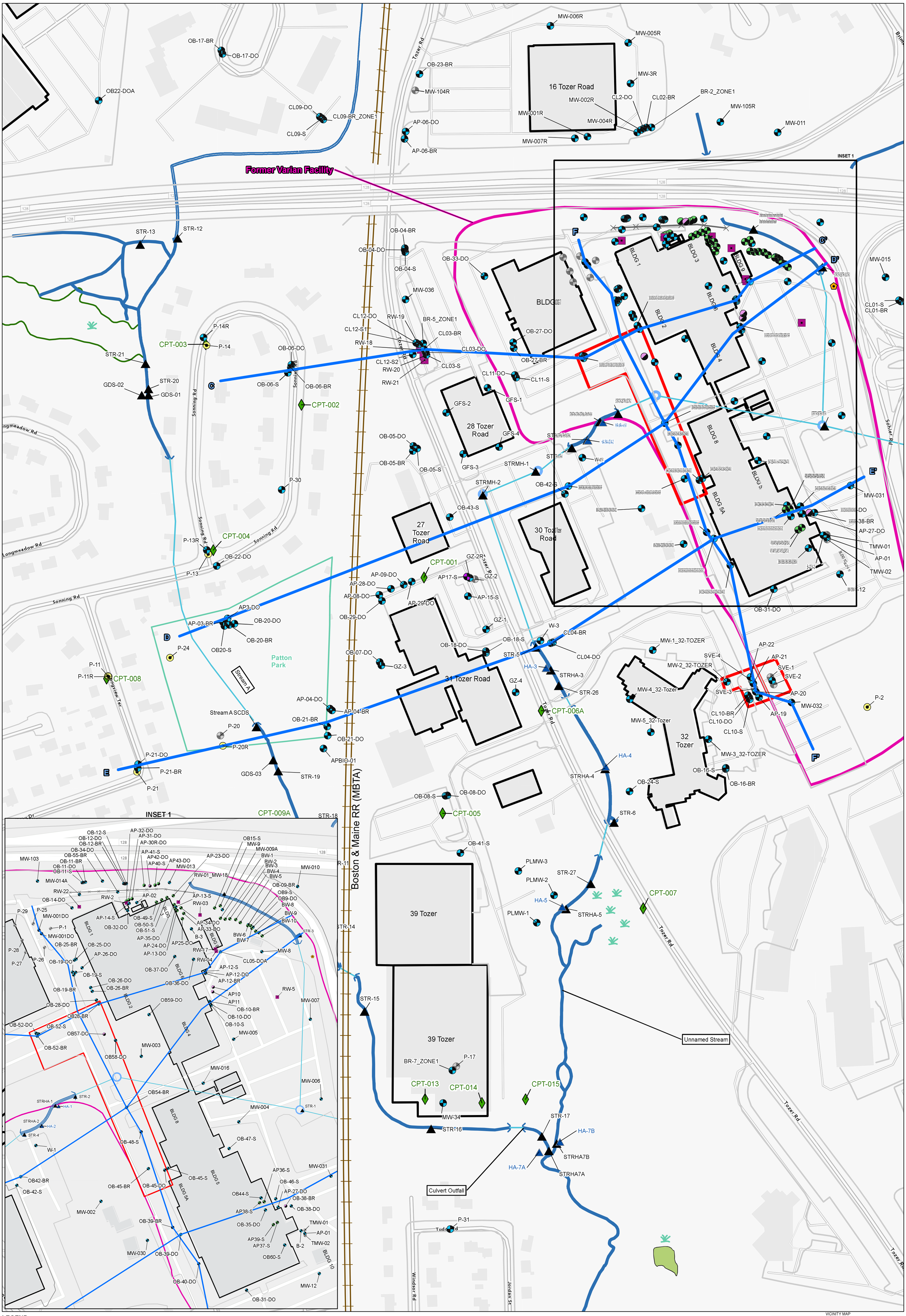
VICINITY MAP



Service Layer Credits: Light Gray Reference: Esri Community Maps Contributors, MassGIS, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA; World Street Map: Esri, HERE, Garmin, NGA, USGS, NPS; Light Gray Base: Esri Community Maps Contributors, MassGIS, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA

FIGURE 4-1
Bedrock Remedial Treatment Area
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

Jacobs



LEGEND

- Abandoned or Destroyed Well
- Angled Well
- Bioremediation Injection Well
- Monitoring Well (MW)
- Piezometer (P)
- Recovery Well (RW)
- Temporary Permanganate Injection Point
- Angled Bioremediation Injection Well
- Cone Penetrometer Testpoint (CPT)
- Hand Auger Sample Location (HA) Adjacent to a Stream (STRHA)
- Surface Water Stream (STR) Sample Location
- Benchmark Location (MSL)
- Approximate Location of Stream in Culvert
- Approximate Stream Location
- Fence Line
- Water and Marsh Area
- Vegetation
- Cross Sections
- Marsh
- Former Varian Facility
- Approximate Building Location
- Treament Zone

\\DC1VS01\GISPROJ\VIVARIAN\VARMS\MAPFILES\PHASE4\PHASE4.APRX AGAWINAM 9/19/2023 10:11 AM

VICINITY MAP

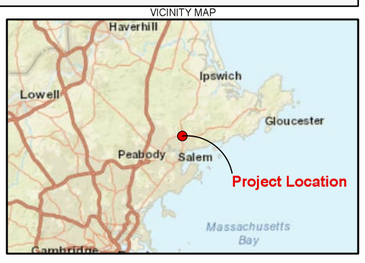
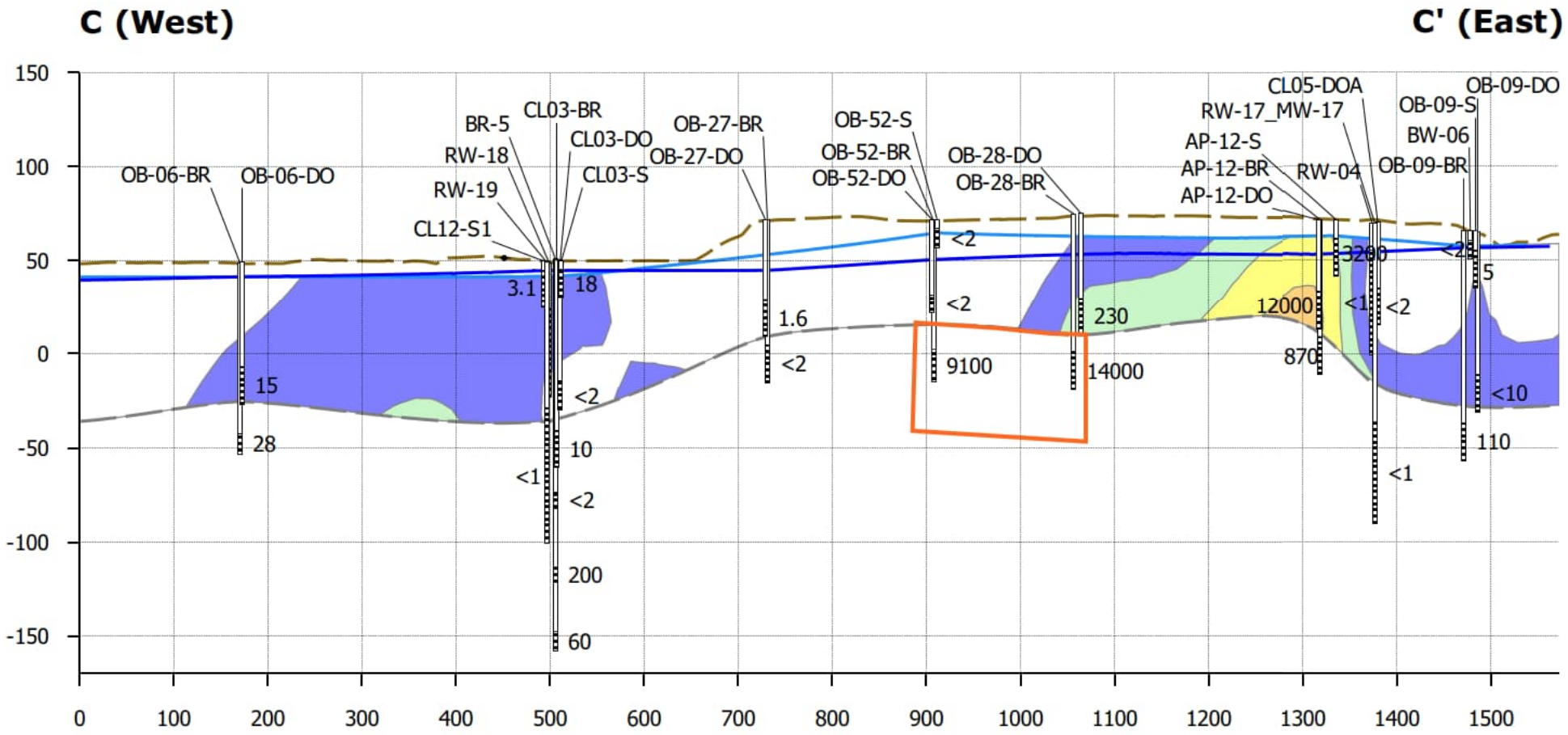


FIGURE 4-2
Bedrock Cross Sections
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

Jacobs



Legend

TCE Q2 2023 (µg/L)

- < 5
- 5 – 50
- 50 – 500
- 500 – 5,000
- > 5,000

- Topography
- Bedrock Surface
- Shallow Potentiometric Surface May 2023
- Bedrock Potentiometric Surface May 2023
- Target Treatment Zone

Scale: 1 in = 2000 ft

Vertical Exaggeration: 2x

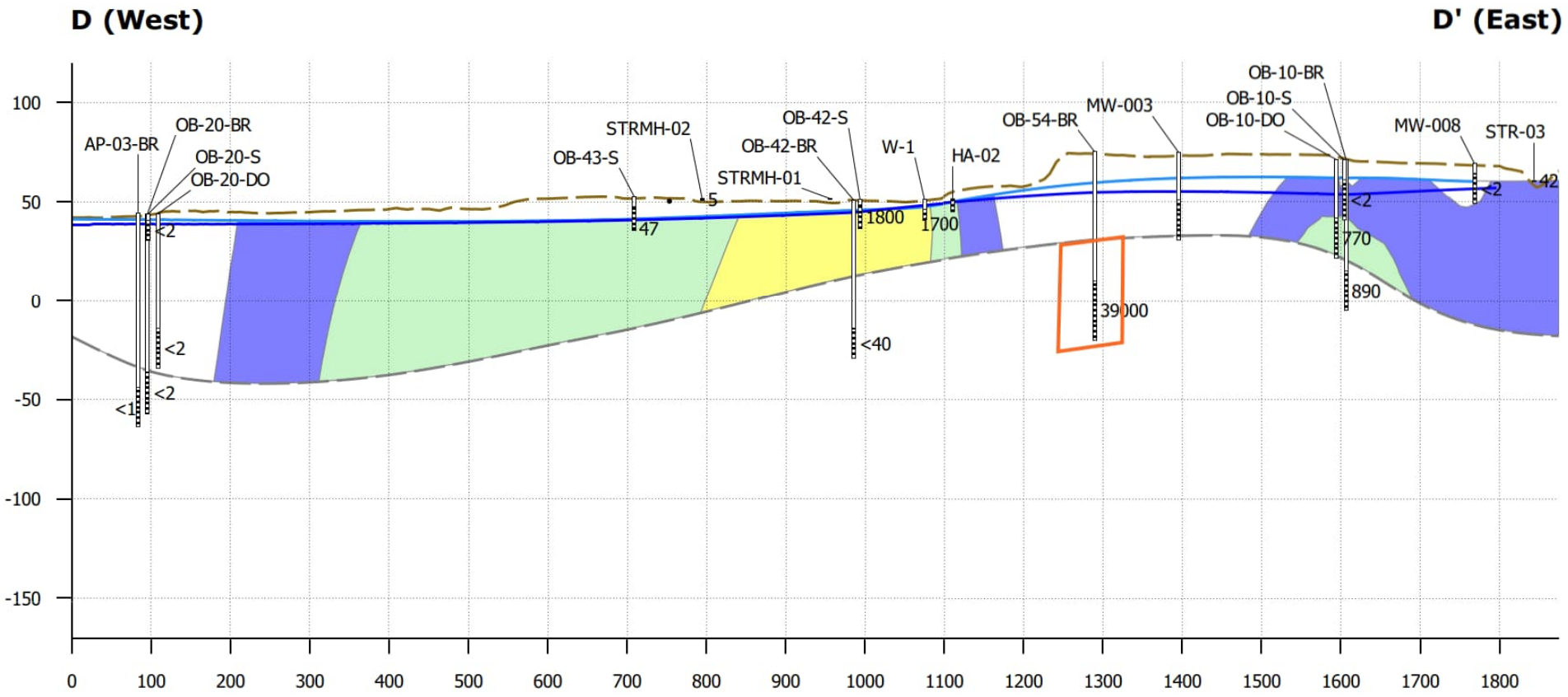
0 ft 200 ft

Notes:

1. TCE groundwater concentrations represent either the May 2023 sampling event or last date sampled where May 2023 data not available.
2. Locations shown are within 15 feet of the section line.
3. Groundwater elevations derived from May 2023 synoptic event.
4. TCE plume depiction in overburden is an estimate.

Figure 4-3
Bedrock Cross Section C-C'
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

Jacobs



Legend

TCE Q2 2023 (µg/L)

- < 5
- 5 – 50
- 50 – 500
- 500 – 5,000

- Topography
- Bedrock Surface
- Shallow Potentiometric Surface May 2023
- Bedrock Potentiometric Surface May 2023
- Target Treatment Zone

Scale: 1 in = 2,400 ft

Vertical Exaggeration: 2.5x

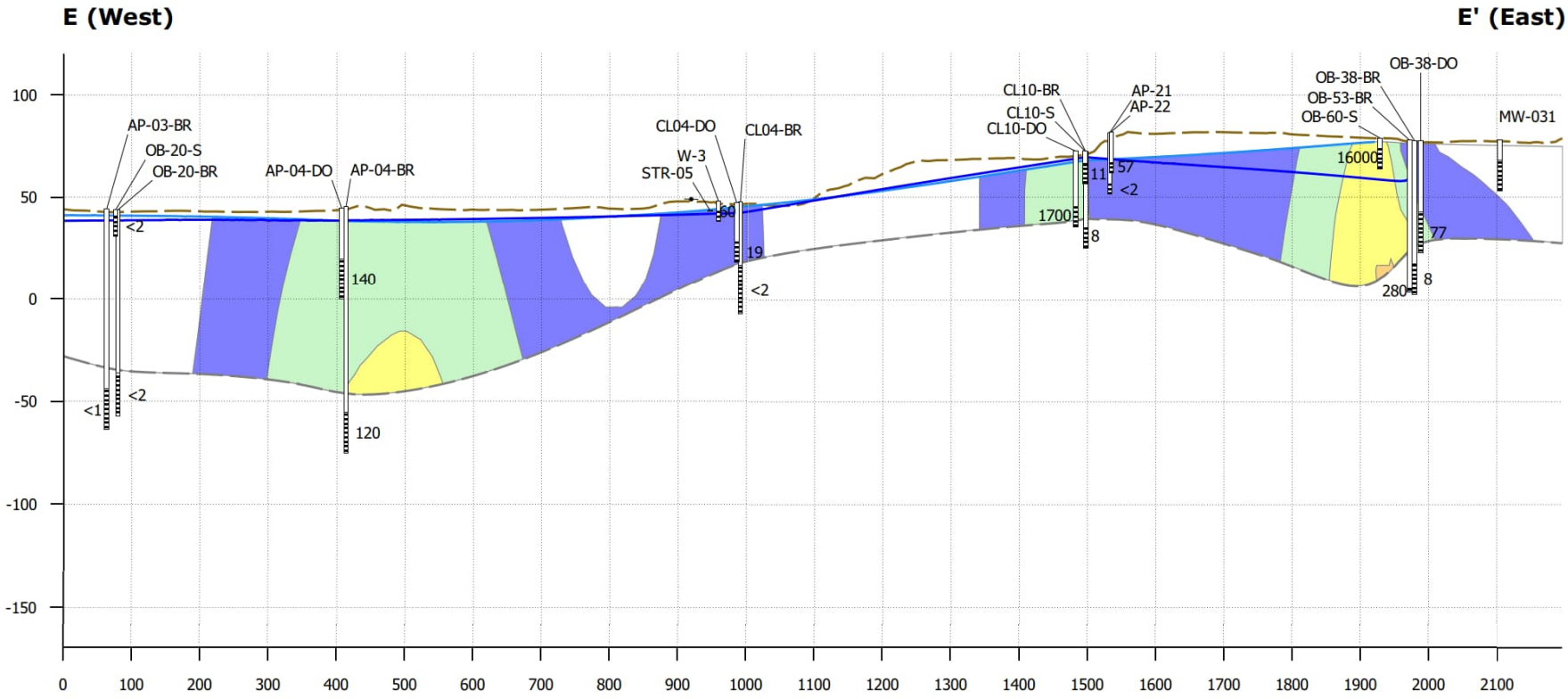
0 ft 300 ft

Notes:

1. TCE groundwater concentrations represent either the May 2023 sampling event or last date sampled where May 2023 data not available.
2. Locations shown are within 15 feet of the section line.
3. Groundwater elevations derived from May 2023 synoptic event.
4. TCE plume depiction in overburden is an estimate.

Figure 4-4
Bedrock Cross Section D-D'
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

Jacobs



Legend

TCE Q2 2023 (µg/L)

- < 5
- 5 – 50
- 50 – 500
- 500 – 5,000
- > 5,000

- Topography
- Bedrock Surface
- Shallow Potentiometric Surface May 2023
- Bedrock Potentiometric Surface May 2023
- Target Treatment Zone

Scale: 1” = 3000 ft

Vertical Exaggeration: 3x

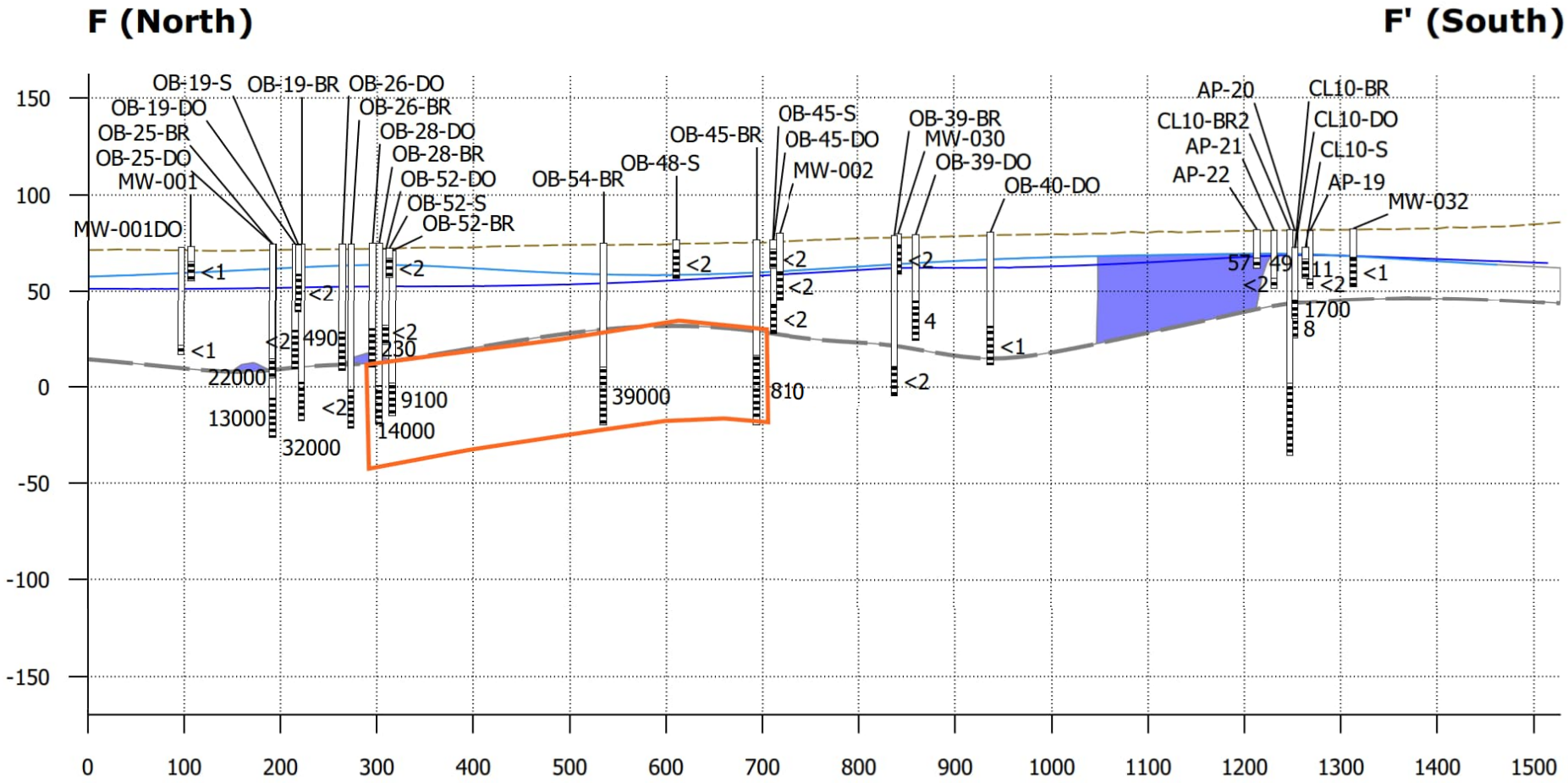
0 ft 400 ft

Notes:

1. TCE groundwater concentrations represent either the May 2023 sampling event or last date sampled where May 2023 data not available.
2. Locations shown are within 15 feet of the section line.
3. Groundwater elevations derived from May 2023 synoptic event.
4. TCE plume depiction in overburden is an estimate.

Figure 4-5
Bedrock Cross Section E-E’
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

Jacobs

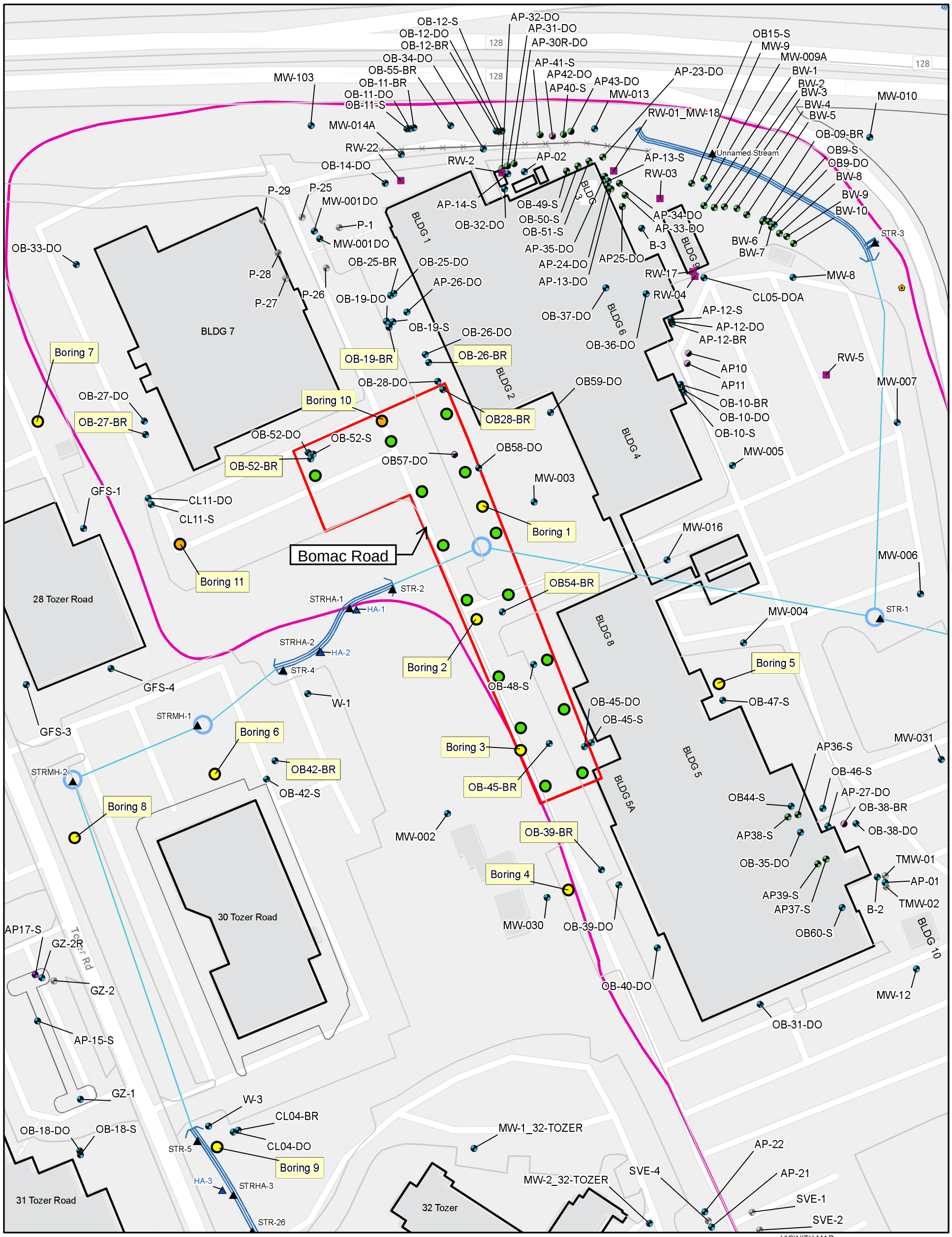


Notes:

1. TCE groundwater concentrations represent either the May 2023 sampling event or last date sampled where May 2023 data not available.
2. Locations shown are within 15 feet of the section line.
3. Groundwater elevations derived from May 2023 synoptic event.
4. OB-25-BR and OB-19-BR, north of the ISCO target treatment zone, have CVOC concentrations above treatment goals but are associated with the Building 3 Thermal/ISB Remedy.
5. TCE plume depiction in overburden is an estimate.

Figure 4-6
Bedrock Cross Section F-F'
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

Jacobs



LEGEND

- Proposed Bedrock Monitoring Well
- Conditional Site Assessment Bedrock Boring
- Potential Injection Well Location
- Abandoned or Destroyed Well
- Angled Well
- Bioremediation Injection Well
- Monitoring Well (MW)
- Recovery Well (RW)
- Temporary Permanganate Injection Point
- Angled Bioremediation Injection Well
- Hand Auger Sample Location (HA) Adjacent to a Stream (STRHA)
- Surface Water Stream (STR) Sample Location
- Benchmark Location (MSL)
- Fence Line
- Approximate Location of Stream in Culvert
- Approximate Stream Location
- Former Varian Facility
- Approximate Building Location
- Treament Zone

0 50 100 200 Feet

1:1,200 1 inch = 100 feet

VICINITY MAP

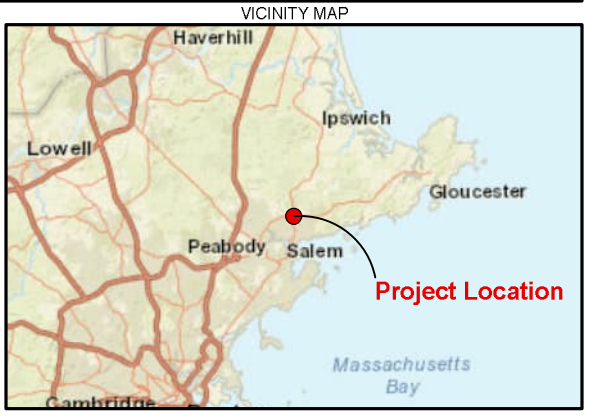


FIGURE 4-7
Proposed Bedrock Investigation and Potential ISCO Injection Locations
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

Service Layer Credits: Light Gray Reference: Esri Community Maps Contributors, MassGIS, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA; World Street Map: Esri, HERE, Garmin, NGA, USGS, NPS; Light Gray Base: Esri Community Maps Contributors, MassGIS, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA

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OB-31-DO
MW-1_32-TOZER
AP-22
SVE-4
AP-21
MW-2_32-TOZER
SVE-1
CL10-BR2
SVE-2
SVE-3
AP-20
MW-4_32-Tozer
CL10-BR
AP-19
MW-032
MW-5_32-Tozer
32 Tozer
CL10-DO
CL10-S
MW-3_32-TOZER
OB-16-BR
OB-16-S
OB-24-S
STR-6

LEGEND

- Abandoned or Destroyed Well
- Monitoring Well (MW)
- Surface Water Stream (STR) Sample Location
- Approximate Stream Location
- Original Target Treatment Zone
- Proposed Expanded Target Treatment Zone
- Approximate Building Location

0 25 50 100
Feet
1:600 1 inch = 50 feet

VICINITY MAP

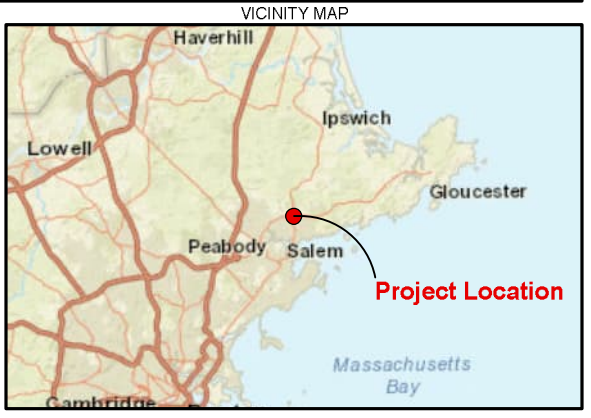
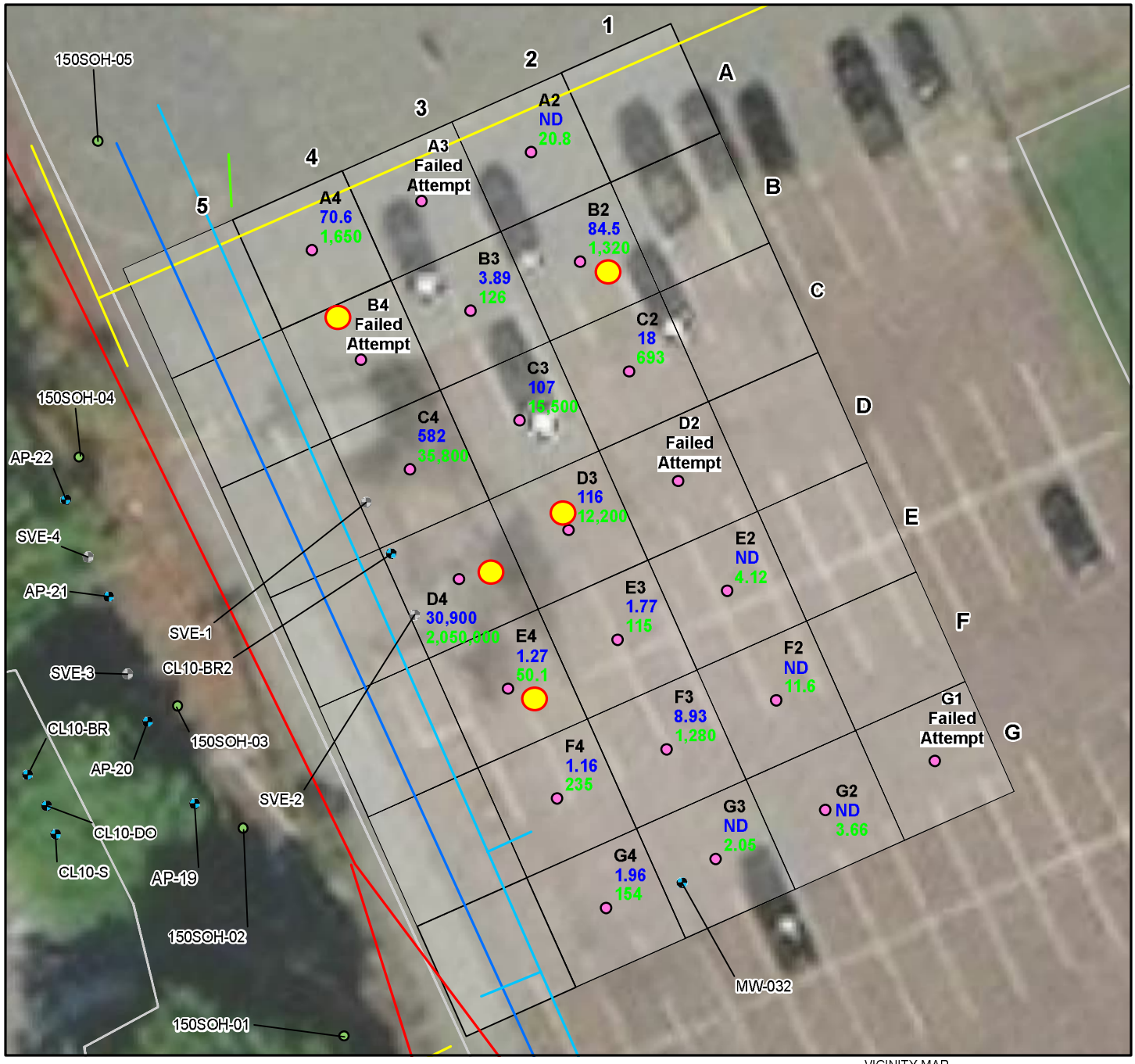


FIGURE 5-1
PSL10 Area
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

Jacobs

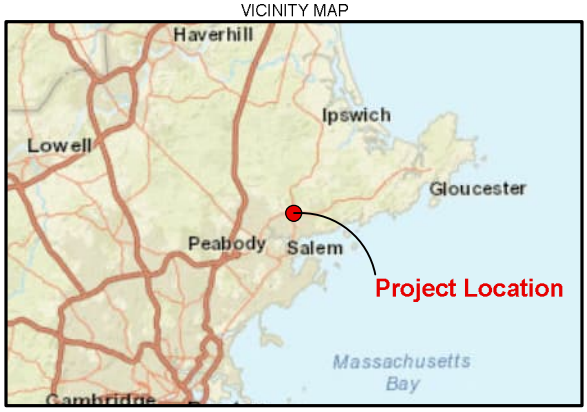


LEGEND

- Soil Vapor Sampling Point (2023)
- Soil Vapor Sampling Point (1999)
- Abandoned or Destroyed Well
- Monitoring Well (MW)
- Proposed Soil Boring/Well
- Storm/Sewer
- 30" Water Line
- 6" Water Line
- Gas Line
- Overhead Electric

Notes:
TCE in soil vapor (ppb)
PCE in soil vapor (ppb)
ND = non-detect
ppb = parts per billion

VICINITY MAP



0 12.5 25 50
Feet
1:300 1 inch = 25 feet

FIGURE 5-2
PSL10 2023 Soil Vapor Survey Results
Phase IV Remedy Implementation Plan
Beverly, Massachusetts

Jacobs

Tables

Table 5-2: PSL10 Area Soil Vapor Investigation Results

Former Varian Facility Site 150 Sohier Road Beverly, Massachusetts

Location	Sample Date	cis-1,2-DCE		PCE		TCE		VC	
		µg/m^3	ppb-V	µg/m^3	ppb-V	µg/m^3	ppb-V	µg/m^3	ppb-V
PSL10-A2	08/21/2023	0.793 U	0.2 U	141	20.8	1.07 U	0.199 U	0.511 U	0.2 U
PSL10-A4	08/18/2023	16.8	4.24	11200	1650	379	70.6	8.61 U	3.36 U
PSL10-B2	08/18/2023	825	208	8950	1320	454	84.5	13.1	5.12
PSL10-B3	08/21/2023	15.6	3.94	854	126	20.9	3.89	1.24 U	0.484 U
PSL10-C2	08/21/2023	698	176	4700	693	96.7	18	4.24 U	1.66 U
PSL10-C3	08/21/2023	241	60.9	205000	30200	575	107	28.6 U	11.2 U
PSL10-C4	08/18/2023	1170	295	243000	35800	3130	583	284 U	111 U
PSL10-D3	08/21/2023	948	239	82700	12200	623	116	39.1 U	15.3 U
PSL10-D4	08/18/2023	289000	73000	13900000	2050000	166000	30900	6390 U	2500 U
PSL10-E2	08/21/2023	1.36	0.343	27.9	4.12	1.07 U	0.199 U	0.511 U	0.2 U
PSL10-E3	08/21/2023	6.98	1.76	780	115	9.51	1.77	1.19 U	0.465 U
PSL10-E4	08/21/2023	5.31	1.34	340	50.1	6.83	1.27	0.511 U	0.2 U
PSL10-F2	08/21/2023	0.793 U	0.2 U	78.7	11.6	1.07 U	0.199 U	0.511 U	0.2 U
PSL10-F3	08/21/2023	10.4 U	2.63 U	8680	1280	48	8.94	6.7 U	2.62 U
PSL10-F4	08/21/2023	2.43 U	0.614 U	1590	235	6.23	1.16	1.56 U	0.609 U
PSL10-G2	08/21/2023	0.845	0.213	24.8	3.66	1.07 U	0.199 U	0.511 U	0.2 U
PSL10-G3	08/21/2023	0.793 U	0.2 U	13.9	2.05	1.07 U	0.199 U	0.511 U	0.2 U
PSL10-G4	08/21/2023	5.95 U	1.5 U	1040	153	10.5	1.96	3.83 U	1.5 U

Notes:

µg/m^3 - microgram(s) per cubic meter

cis-1,2-DCE - cis-1,2-dichloroethene

PCE - tetrachloroethene

ppb-V - parts per billion by volume

TCE - trichloroethene

U = The analyte was analyzed for, but was not detected above, the reportable detection limit.

VC - vinyl chloride

Appendix A
Comprehensive Response Action Transmittal Form

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC 108

Release Tracking Number
3 - 485

COMPREHENSIVE RESPONSE ACTION TRANSMITTAL FORM & PHASE I COMPLETION STATEMENT

Pursuant to 310 CMR 40.0484 (Subpart D) and 40.0800 (Subpart H)

A. SITE LOCATION:

1. Site Name: VARIAN-MICROWAVE DIV

2. Street Address: 150 SOHIER RD

3. City/Town: BEVERLY 4. ZIP Code: 019150000

☑ 5. Check here if the disposal site that is the source of the release is Tier Classified. Check the current Tier Classification Category:

☑ a. Tier I ☐ b. Tier ID ☐ c. Tier II

B. THIS FORM IS BEING USED TO: (check all that apply)

☐ 1. Submit a **Phase I Completion Statement,** pursuant to 310 CMR 40.0484.

☐ 2. Submit a **Revised Phase I Completion Statement,** pursuant to 310 CMR 40.0484.

☐ 3. Submit a **Phase II Scope of Work,** pursuant to 310 CMR 40.0834.

☐ 4. Submit [illegible] **interim Phase II Report.** This report does not satisfy the response action deadline requirements in 310 CMR [illegible].

☐ 5. Submit a **final Phase II Report and Completion Statement,** pursuant to 310 CMR 40.0836.

☐ 6. Submit a **Revised Phase II Report and Completion Statement,** pursuant to 310 CMR 40.0836.

☐ 7. Submit a **Phase III Remedial Action Plan and Completion Statement,** pursuant to 310 CMR 40.0862.

☐ 8. Submit a **Revised Phase III Remedial Action Plan and Completion Statement,** pursuant to 310 CMR 40.0862.

☑ 9. Submit a **Phase IV Remedy Implementation Plan,** pursuant to 310 CMR 40.0874.

☐ 10. Submit a **Modified Phase IV Remedy Implementation Plan,** pursuant to 310 CMR 40.0874.

☐ 11. Submit an **As-Built Construction Report,** pursuant to 310 CMR 40.0875.

☐ 12. Submit a **Phase IV Status Report,** pursuant to 310 CMR 40.0877.

☐ 13. Submit a **Phase IV Completion Statement,** pursuant to 310 CMR 40.0878 and 40.0879.

Specify the outcome of Phase IV activities: (check one)

☐ a. Phase V Operation, Maintenance or Monitoring of the Comprehensive Remedial Action is necessary to achieve a Permanent or Temporary Solution.

☐ b. The requirements of a Permanent Solution have been met. A completed Permanent Solution Statement and Report (BWSC104) will be submitted to DEP.

☐ c. The requirements of a Temporary Solution have been met. A completed Temporary Solution Statement and Report (BWSC104) will be submitted to DEP.

B. THIS FORM IS BEING USED TO (cont.): (check all that apply)

☐ 14. Submit a **Revised Phase IV Completion Statement,** pursuant to 310 CMR 40.0878 and 40.0879.

☐ 15. Submit a **Phase V Status Report,** pursuant to 310 CMR 40.0892.

☐ 16. Submit a **Remedial Monitoring Report.** (This report can only be submitted through eDEP.)

a. Type of Report: (check one) ☐ i. Initial Report ☐ ii. Interim Report ☐ iii. Final Report

b. Frequency of Submittal: (check all that apply)

☐ i. A Remedial Monitoring Report(s) submitted monthly to address an Imminent Hazard.

☐ ii. A Remedial Monitoring Report(s) submitted monthly to address a Condition of Substantial Release Migration.

☐ iii. A Remedial Monitoring Report(s) submitted every six months, concurrent with a Status Report.

☐ iv. A Remedial Monitoring Report(s) submitted annually, concurrent with a Status Report.

c. Status of Site: (check one) ☐ i. Phase IV ☐ ii. Phase V ☐ iii. Remedy Operation Status ☐ iv. Temporary Solution

d. Number of Remedial Systems and/or Monitoring Programs: _____

A separate BWSC108A, CRA Remedial Monitoring Report, must be filled out for each Remedial System and/or Monitoring Program addressed by this transmittal form.

☐ 17. Submit a **Remedy Operation Status,** pursuant to 310 CMR 40.0893.

☐ 18. Submit a **Status Report to maintain a Remedy Operation Status,** pursuant to 310 CMR 40.0893(2).

☐ 19. Submit a **Transfer and/or a Modification of Persons Maintaining a Remedy Operation Status (ROS),** pursuant to 310 CMR 40.0893(5) (check one, or both, if applicable).

☐ a. Submit a Transfer of Persons Maintaining an ROS (the transferee should be the person listed in Section D, "Person Undertaking Response Actions").

☐ b. Submit a Modification of Persons Maintaining an ROS (the primary representative should be the person listed in Section D, "Person Undertaking Response Actions").

c. Number of Persons Maintaining an ROS not including the primary representative: _____

☐ 20. Submit a **Termination of a Remedy Operation Status,** pursuant to 310 CMR 40.0893(6).(check one)

☐ a. Submit a notice indicating ROS performance standards have been met. A plan and timetable pursuant to 310 CMR 40.0893(6)(b) for resuming the ROS are attached.

☐ b. Submit a notice of Termination of ROS.

☐ 21. Submit a **Phase V Completion Statement,** pursuant to 310 CMR 40.0894.

Specify the outcome of Phase V activities: (check one)

☐ a. The requirements of a Permanent Solution have been met. A completed Permanent Solution Statement and Report (BWSC104) will be submitted to DEP.

☐ b. The requirements for a Temporary Solution have been met. A completed Temporary Solution Statement and Report (BWSC104) will be submitted to DEP.

☐ 22. Submit a **Revised Phase V Completion Statement,** pursuant to 310 CMR 40.0894.

☐ 23. Submit a **Temporary Solution Status Report,** pursuant to 310 CMR 40.0898.

☐ 24. Submit a **Plan for the Application of Remedial Additives** near a sensitive receptor, pursuant to 310 CMR 40.0046(3).

a. Status of Site: (check one)

☐ i. Phase IV ☐ ii. Phase V ☐ iii. Remedy Operation Status ☐ iv. Temporary Solution

C. LSP SIGNATURE AND STAMP:

I attest under the pains and penalties of perjury that I have personally examined and am familiar with this transmittal form, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of (i) the standard of care in 309 CMR 4.02(1), (ii) the applicable provisions of 309 CMR 4.02(2) and (3), and 309 CMR 4.03(2), and (iii) the provisions of 309 CMR 4.03(3), to the best of my knowledge, information and belief,

> *if Section B indicates that a* ***Phase I, Phase II, Phase III, Phase IV or Phase V Completion Statement*** *and/or a* ***Termination of a Remedy Operation Status*** *is being submitted*, the response action(s) that is (are) the subject of this submittal (i) has (have) been developed and implemented in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) comply(ies) with the identified provisions of all orders, permits, and approvals identified in this submittal;

> *if Section B indicates that a* ***Phase II Scope of Work*** *or a* ***Phase IV Remedy Implementation Plan*** *is being submitted,* the response action(s) that is (are) the subject of this submittal (i) has (have) been developed in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) comply(ies) with the identified provisions of all orders, permits, and approvals identified in this submittal;

> *if Section B indicates that an* ***As-Built Construction Report,*** *a* ***Remedy Operation Status,*** *a* ***Phase IV, Phase V or Temporary Solution Status Report,*** *a* ***Status Report to Maintain a Remedy Operation Status,*** *a* ***Transfer or Modification of Persons Maintaining a Remedy Operation Status*** *and/or a* ***Remedial Monitoring Report*** *is being submitted,* the response action(s) that is (are) the subject of this submittal (i) is (are) being implemented in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) comply(ies) with the identified provisions of all orders, permits, and approvals identified in this submittal.

I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.

1. LSP#: 9456
2. First Name: MATTHEW E
3. Last Name: HACKMAN
4. Telephone: 4017379211
5. Ext.:
6. Email: matthewehackman@verizon.net
7. Signature:
8. Date: (mm/dd/yyyy)
9. LSP Stamp:

COMPREHENSIVE RESPONSE ACTION TRANSMITTAL FORM & PHASE I COMPLETION STATEMENT

Pursuant to 310 CMR 40.0484 (Subpart D) and 40.0800 (Subpart H)

D. PERSON UNDERTAKING RESPONSE ACTIONS:

1. Check all that apply: ☐ a. change in contact name ☐ b. change of address ☐ c. change in the person undertaking response actions

2. Name of Organization: VARIAN MEDICAL SYSTEMS INC

3. Contact First Name: MATTHEW 4. Last Name: GILLIS

5. Street: 801 PENNSYLVANIA AVE NW STE 73 6. Title:

7. City/Town: WASHINGTON 8. State: DC 9. ZIP Code: 200040000

10. Telephone: 11. Ext: 12. Email:

E. RELATIONSHIP TO SITE OF PERSON UNDERTAKING RESPONSE ACTIONS: ☐ Check here to change relationship

☑ 1. RP or PRP ☐ a. Owner ☐ b. Operator ☐ c. Generator ☐ d. Transporter

☑ e. Other RP or PRP Specify: NON-SPECIFIED PRP

☐ 2. Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)

☐ 3. Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 5(j))

☐ 4. Any Other Person Undertaking Response Actions Specify Relationship:

F. REQUIRED ATTACHMENT AND SUBMITTALS:

☑ 1. Check here if the Response Action(s) on which this opinion is based, if any, are (were) subject to any order(s), permit(s) and/or approval(s) issued by DEP or EPA. If the box is checked, you MUST attach a statement identifying the applicable provisions thereof.

☐ 2. Check here to certify that the Chief Municipal Officer and the Local Board of Health have been notified of the submittal of any Phase Reports to DEP.

☐ 3. Check here to certify that the Chief Municipal Officer and the Local Board of Health have been notified of the availability of a Phase III Remedial Action Plan.

☑ 4. Check here to certify that the Chief Municipal Officer and the Local Board of Health have been notified of the availability of a Phase IV Remedy Implementation Plan.

☐ 5. Check here to certify that the Chief Municipal Officer and the Local Board of Health have been notified of any field work involving the implementation of a Phase IV Remedial Action.

☐ 6. If submitting a Transfer of a Remedy Operation Status (as per 310 CMR 40.0893(5)), check here to certify that a statement detailing the compliance history for the person making this submittal (transferee) is attached.

☐ 7. If submitting a Modification of a Remedy Operation Status (as per 310 CMR 40.0893(5)), check here to certify that a statement detailing the compliance history for each new person making this submittal is attached.

☐ 8. Check here if any non-updatable information provided on this form is incorrect, e.g. Release Address/Location Aid. Send corrections to: BWSC.eDEP@state.ma.us.

☑ 9. Check here to certify that the LSP Opinion containing the material facts, data, and other information is attached.

Attachment to BWSC 108
150 Sohier Road, Beverly, MA
RTN 3-0485

Approvals from the Massachusetts Department of Environmental Protection that this submittal is subject to include:

- Massachusetts Department of Environmental Protection Termination of Remedy Operation Status Notice of Noncompliance, dated February 18, 2022.

- Massachusetts Department of Environmental Protection approval of extension request, letter to Varian Medical Systems, Inc., dated July 6, 2022.

- Public Comment Draft Phase II Addendum Reporting Schedule, Aptim Environmental and Infrastructure, LLC letter to Massachusetts Department of Environmental Protection, dated September 12, 2022

Appendix B
Health and Safety Plan

Varian Medical Systems
Project Health, Safety and Environment Plan
Beverly, Essex County, Massachusetts

August 2023

Varian Medical Systems

Approvals

This Project Health, Safety, and Environment Plan (PHSEP) has been written for use by Jacobs only. Jacobs claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific project and site conditions and identified scope(s) of work and must be amended if those conditions or scope(s) of work change.

By approving this PHSEP, the Project Health and Safety Lead, or Project Health and Safety Manager (HSM) certifies that the personal protective equipment has been selected based on the task hazard/impact identification and risk assessment (HIIRA).

Author:	Sandra Wise
Project Health and Safety Manager Approval:	Sandra Wise, CSP, CHMM
Project Manager Approval:	Lauren McKinlay, Raymond Cadorette
Contract Number:	

Document history and status

Revision	Date	Description of Revisions	Author	Approved By/Title:
0	5/16/23	Initial document	Sandra Wise	Sandra L. Wise Health and Safety Manager Project Manager
	6/23/23	Add O&M task for monitoring of residential vapor intrusion system	Sandra Wise	Sandra L. Wise Health and Safety Manager Project Manager
	7/24/23	Add vapor pin installation/utility locating tasks	Sandra Wise	Sandra L. Wise Health and Safety Manager Raymond Cadorette via email Project Manager
	8/10/23	Add drilling, soil gas study activities	Sandra Wise	Sandra L. Wise Project Manager

Contents

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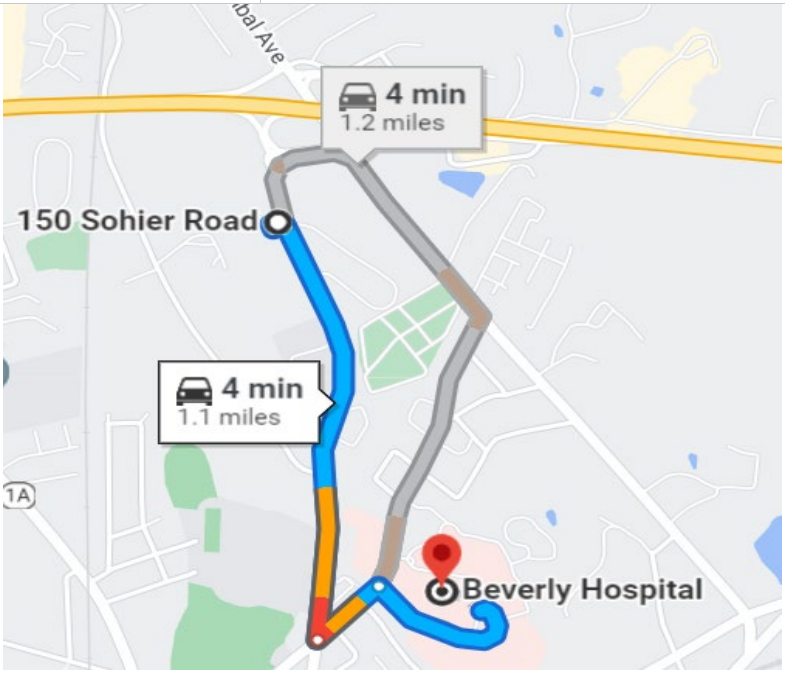
Project Emergency Contacts

WorkCare 24-hour Injury Care – 1-888-449-7787	
Medical Emergency—911 See local hospital information and route to hospital below	**Non-Emergency medical Injuries** (no matter how minor) WorkCare: 1-888-449-7787 (call as soon as injury occurs—they will find an occupational clinic if clinic is needed)
Fire/Spill Emergency—911 **Security & Police—911**	**Utilities Emergency Phone Numbers** Water: 911 Gas: 911 Electric: 911
Jacobs Project Manager (PM) Name: Lauren McKinlay Phone: (781) 413-6589 Name: Raymond Cadorette Phone: (774) 571-1183 **Jacobs Site Manager** Name: Laurent Levy Phone: (617) 417-5340	**Jacobs Project Health and Safety Manager (HSM)** Name: Sandra Wise; or Mark Orman Phone: (303) 944-5214; (414) 712-4138
Jacobs Deputy Site Manager Name: Raymond Cadorette Phone: (774) 571-1183	**Jacobs Safety Liaison (SL)** Name: Deirdre Kearney Phone: (781) 710-4276
Jacobs US Security Officer Name: Keith Waddell Phone: 214-920-8327	**Jacobs Project Environmental Manager and Waste Coordinator** Name: Beth Vaughan Phone: (334) 734-4489
Automobile Accidents **Rental**: Vehicle Accident Form required to be sent to AutoClaims@jacobs.com (see Vehicle Accident Guidance attached to this plan) **Fleet Vehicle**: Karyna Zarate 281-721-8634	**Media Inquiries Corporate Strategic Communications** Name: Kerrie Sparks Phone: 214-583-8433 **Human Resources Department** Submit a request through Global People Services on Jacobs Connect Workman's Compensation Claims: WCClaims@jacobs.com
Facility/Site Alarms: TBD by SL upon mobilization	**Federal Express Dangerous Goods Shipping** Phone: 800-238-5355 **Jacobs Contact for Dangerous Goods Shipping** Name/Phone: Chris Heckler/484-661-6494 **CHEMTEL (hazardous material spills)** Phone: 800-255-3924
Facility/Site Evacuation Route(s): TBD by SL upon mobilization	**Evacuation Assembly Areas(s):** TBD by SL upon mobilization

Directions and Map to Local Hospital

Beverly Hospital 85 Herrick St, Beverly, MA 01915 Phone: 978-922-3000	**Local Occupational Clinic (Consult with WorkCare prior to any clinic visit)** **WorkCare**: 1-888-449-7787 (call as soon as injury occurs) :



150 Sohier Rd
Beverly, MA 01915

- Head south toward Sohier Rd — 46 ft
- Turn left toward Sohier Rd — 98 ft
- Turn right at the 1st cross street onto Sohier Rd — 0.7 mi
- Sharp left onto Herrick St — 0.1 mi
- Turn right — 0.2 mi

Beverly Hospital
85 Herrick St, Beverly, MA 01915

Applicability

This PHSEP applies to:

All Jacobs staff, including subcontractors and tiered subcontractors of Jacobs working on the site;

- All visitors to Jacobs construction or remediation sites in the custody of Jacobs (including, but not limited to, visitors from the Client, the Government, or the public,).
- In addition, subcontractors and tiered subcontractors shall also follow any of their company HSE programs, and site-specific PHSEPs and task hazard/impact identification and risk assessment (HIIRA) (e.g., activity or job hazard analyses). Even though this plan applies to non-Jacobs personnel as stated above, each employer is ultimately responsible for the health, safety, and well-being of their employees.

This PHSEP does not apply to the third-party contractors, their workers, their subcontractors, their visitors, or any other persons not under the direct control or custody of Jacobs.

The objective of this PHSEP is to ensure that project hazards and environmental impacts are eliminated or mitigated through the identification of hazards, environmental impacts assessment of risk and the application of effective control measures and to achieve a safe and healthy workplace for ourselves and subcontractor to whom we have a legal and moral duty of care. Further, there is a requirement to ensure that our activities are conducted in an environmentally friendly and responsible manner.

Jacobs has undertaken a structured hazard/impact identification and risk assessment process and shall implement a Safe System of Work (SSoW) for delivery of our services on this project. As part of the SSoW, this PHSEP defines the procedures and requirements for the health and safety of staff and visitors when they are physically on the work site. The work site includes the project area (as defined by the contract documents) and the project offices, trailers, and facilities thereon.

This PHSEP will be kept onsite during field activities and will be reviewed as necessary. The PHSEP will be reviewed at least annually and revised as project activities or conditions change or when supplemental information becomes available. The PHSEP adopts, by reference, the Jacobs Business Management System Global Health, Safety and Environment (HSE) and People and Places Solutions (P&PS) HSE Procedures and Work Instructions, as appropriate. In addition, applicable requirements contained in the Jacobs Federal and Environmental Services (F&ES) Field Handbook (Handbook) will be implemented. The Handbook is attached to this PHSEP. The PHSEP may adopt procedures from the project Work Plan and any governing regulations. If there is a contradiction between this PHSEP and any governing regulation, the more stringent and protective requirement shall apply.

All staff and subcontractors must sign the employee sign-off form (Attached to this PHSEP) to acknowledge review of this document. Copies of the signature page will be maintained onsite by the Safety Liaison (SL).

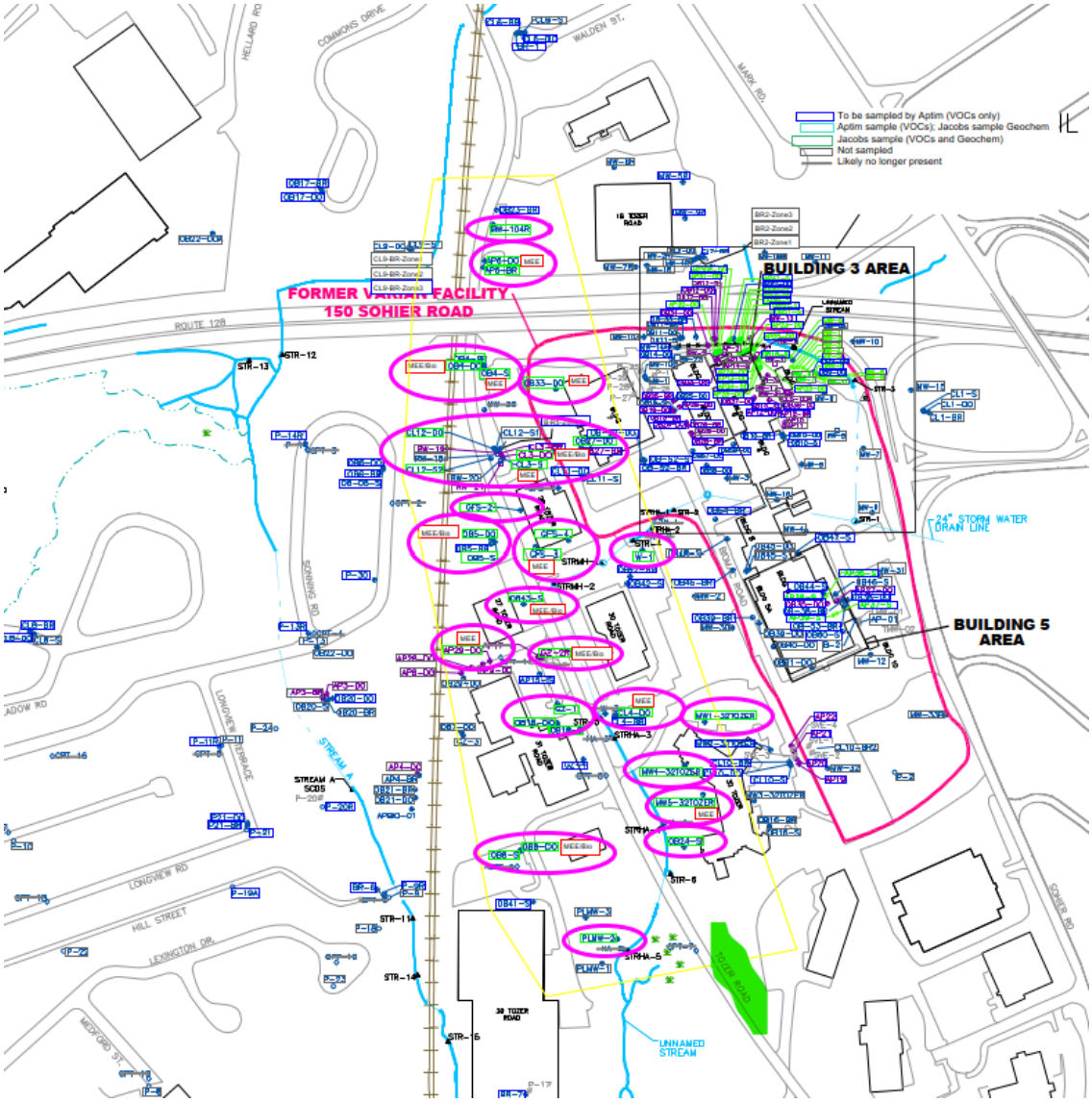
1. General Project Information

1.1 Project Information and Background

Project Number: VARMS106; VARMS108; VARMS 111	Project/Site Name: Varian Medical Systems
Client: Varian Medical Systems	Site Address: 150 Sohier Road in Beverly, Essex County, Massachusetts
Date HSE Plan Prepared: 05-2023; Updated 08-2023	Date(s) of Site Work: 05/22/23 – 05/01/24

1.2 Site Background, Setting and Map

The former Varian facility is located at 150 Sohier Road in Beverly, Essex County, Massachusetts. The facility and surrounding area are shown below.



The facility is located on approximately 24 acres of land and contains four large complexes of buildings covering approximately 250,000 square feet. The facility's southern portion includes an open field and a paved parking

area. The central portion of the Site includes a building complex (Buildings 5, 5A, 8, and 10) (referred to as the Building 5 complex). North of the Building 5 complex is a paved parking area and to the northwest is another building complex (Buildings 1, 2, 3, 4, and 6) (referred to as the Building 3 complex). Northeast of the Building 3 complex is a wastewater treatment plant in Building 9. West of the Building 3 complex is former Building 7, which is now operated as Kelly Classics and Restoration. Presently, Communications & Power Industries, Inc. (CPI) maintains the use of Buildings 1 through 6, 8, 9, and 10 and other structures at the 150 Sohier Road property.

Information about historical industrial processes and subsurface analytical data from Potential Source Location (PSL) investigations indicated that the contaminants of concern (COCs) at the Site are chlorinated volatile organic compounds (VOCs). Trichloroethene (TCE), tetrachloroethene (PCE), and 1,1,1-trichloroethane (1,1,1-TCA) were the three primary chlorinated solvents historically used at Varian's former facility. Eight COCs were identified for the Site including the three parent compounds, TCE, PCE, 1,1,1-TCA, and five common degradation ("daughter") compounds, cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), 1,1-dichloroethene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), and vinyl chloride (VC).

Releases of VOCs appear to have occurred in PSL-5 (former Building 1 septic tank/leach field), PSL-6 (former septic tank/leach field beneath Building 6), and PSL-11 (Building 3 chemical laboratory). These PSLs are collectively referred to as the Building 3 Source Area. Releases of VOCs appear to have also occurred at PSL-7 (Building 5 chemical laboratory), which is referred to as the Building 5 Source Area. Additionally, VOC releases seem to have occurred at PSL-10 (open field), primarily on the western property line near 32 Tozer Road. This location is referred to as the PSL-10 Source Area.

Tozer Road is located approximately 500 feet to the west of the facility western property boundary. It runs northwest to southeast. Tozer Road is hydraulically downgradient of the facility and generally perpendicular to the groundwater flow direction.

The objective of the sampling event is to collect groundwater samples along Tozer Road to assess groundwater COC concentrations and geochemical conditions downgradient of the former Varian facility. A synoptic water level survey will also be conducted. The results will be used to develop remedial strategies and designs for the Tozer Road area.

On November 5, 2021, the Massachusetts Department of Environmental Protection (MassDEP) was orally notified by APTIM of concentrations of trichloroethene (TCE) in subs-lab soil gas above the MassDEP Residential Threshold Value (TV) and soil gas concentrations above the MassDEP Residential Sub-Slab Soil Gas Screening Level at the 34 Longview Drive property. Although a condition of No Significant Risk continues to exist at the property, a sub-slab depressurization system (SSDS) was installed at the 34 Longview Drive property to limit the potential for TCE concentrations in indoor air above the MassDEP Residential TV.

The SSDS process utilizes a vacuum blower which induces negative pressure on extraction nodes to create a zone of negative pressure beneath a portion of the building floor slab (referred also as pressure field extension [PFE]), largely focused on the highest concentration of sub-slab VOCs. Sub-slab soil gas is drawn under vacuum from the nodes and into a conveyance pipe where the airflow is routed under vacuum through a regenerative blower (fitted with a variable-frequency drive [VFD]) outside of the building. And then under positive pressure, airflow passes through an exhaust stack to discharge above the roofline. The system installed at the property has three nodes (two which extend through the slab of the building and one affixed to the sump pump) and three vapor monitoring points (vapor pins) to assess overall performance of the system. Final system design will be confirmed during the startup visits.

1.3 Description of Tasks

Below is a description of the tasks covered by this plan. Any additions or changes in scope will require a revision to this PHSEP; see Change Management below.

Scope of work covered by this PHSEP includes:

- Groundwater sampling across the site
- Waste Management
- Monitoring of the SDSS at 34 Longview Drive
- MiP drilling on Tozer Road
- Monitoring well installation
- Soil gas vapor study on Varian property
- Site walks, biological surveys
- Vapor pin installation and monitoring at select residences
- Utility locating for intrusive work (subcontractor)
- Surveying (subcontractor)

1.4 Change Management

Changes to this PHSEP shall be documented and approved by the HSM for the project. The following are examples of changes that may require a revision to the plan:

- Change in staff listed by name in this plan;
- New subcontractor to perform work;
- New chemicals brought to site for use;
- Change in scope or addition of new tasks;
- Change in contaminants of concern (COCs) or change in concentrations of COCs;
- New hazards or hazards not previously identified that are not addressed in this PHSEP; and
- New environmental impacts or environmental impacts not previously identified that are not addressed in this PHSEP.

1.5 Changes to Project Health, Safety and Environment Plans

Changes to the PHSEP shall be documented and accepted by using the Health and Safety Field Change Request (FCR) form (included in Attachments) or by resubmitting a revised PHSEP for acceptance. A revised PHSEP should be produced when several changes using FCRs have been issued. The Project Manager (PM) and HSM shall be responsible for the review and acceptance of the FCR, and the HSM will maintain an FCR log of approved changes. FCRs are not required for safety-related changes that a Safety Liaison (SL) or HSM would normally make in the field, such as upgrade or downgrade to PPE within pre-established action levels, expansion or reduction of work control zones based on air monitoring results, and similar changes made within the operating parameters of the PHSEP. The field copy of the PHSEP shall be kept up to date by annotating the appropriate section to indicate that an FCR is in effect; copies of FCRs should be kept with the PHSEP. The FCR number must be referenced in the PHSEP and available for review.

1.6 Daily Safety Meetings and Point of Work Risk Assessments

Daily safety meetings are a means to coordinate project HSE activities and review HSE performance on a regular basis. Daily safety meetings are to be held with all project personnel in attendance, including subcontractors, to review the hazards, controls, and task HIIRAs that apply for each day's activities, as well as any environmental impacts, requirements and/or best management practices. Site supervisors/Field Team Leads (FTL) shall lead

the daily safety meeting. Everyone involved in the day's work needs to participate and sign a sign-in form to show they've attended the meeting.

Point of Work Risk Assessments (POWRAs) (previously known as Safe Plan of Action or Pre-Task Safety Plans) shall be completed by individual crews to focus on those hazards and environmental impacts posed by their specific work, taking into account field conditions and/or hazards at the point of work. If a POWRA shows an unacceptable level of risk, field crew shall contact the PM and HSM.

A copy of the POWRA, form is included as an Attachment to this PHSEP.

1.7 Readiness Review

The PM shall complete a HSE readiness review with the project site supervisor, SL, HSM, and EM prior to field work. The readiness review shall discuss work scope, schedule, equipment, safety plan, training, hazards and controls.

1.8 StepBack Process

(Reference BIAF Global Guide, BIAF-350-G-01, HSE StepBack Process)

The StepBack process applies to all Jacobs employees and subcontractors that are performing tasks in an office or at a site location. It is a critical thinking process to supplement HSE planning tools such as the POWRA, task HIIRA, and PHSEPs and should be applied at the start of shift, after a break, when the task or location change, when adjacent work may present additional hazards, or any other hazard or change to task is identified. The StepBack questions are included as an attachment to this plan. See the Handbook for additional information.

2. Management of Subcontractors to Jacobs

Currently no subcontractors are part of this effort. If waste disposal becomes necessary, this plan will be updated.

2.1 Procurement and pre-start

The Project Manager subcontracting any field or site-based work activity will take reasonably practicable steps to ensure that our subcontractor is competent and able to carry out work safely before they start work. Specifically, they will:

- Ensure subcontractors are pre-qualified for health and safety and environmental activities
- Carry out competency checks i.e., view safety policy, risk assessments, ascertain experience, technical knowledge & competence
- Provide the subcontractor with information on foreseeable hazards and the controls required by Jacobs
- Communicate Jacobs HSE expectations in our subcontract and at start-up
- Discuss job/safety requirements and coordinate work activities
- Request and review the subcontractor's task/location specific safe systems of work and risk assessments
- Ensure that the subcontractors' personnel are briefed on their own risk assessments and safe systems of work
- Coordinate work activities which may require an emergency response with the Client Representative
- In coordination with the HSM, determine level of supervision to be provided by subcontractor and Jacobs. A level of Jacobs oversight of subcontractors for all field tasks is expected. If oversight has not

been coordinated, work must pause until a risk mitigation plan is in place prior to commencing with the work. The plan is developed by the HSM in coordination with the PM.

- Provide a Jacobs induction
- Ensure a Client induction is given where required

2.2 During work

The Project Manager will:

- Ensure that our subcontractor attends a pre shift briefing and has completed a point of work risk assessment immediately before commencement of work
- Monitor our subcontractor when they are working (in proportion to the risk)
- Hold our subcontractor accountable for any substandard HSE performance.

2.3 After work

The Project Manager will review and document the subcontractor's performance and consider:

- Was subcontractor satisfactory?
- Was our risk assessment valid?
- Any changes for future use with this subcontractor?

2.4 Subcontractor HSE Chartering Meeting

(Reference P&PS Work Instruction, IB-HS-WI-0520, Health, Safety, and Environmental Requirements for Subcontractors)

A subcontractor HSE chartering meeting shall be held with subcontractors performing field work on the project. The purpose of the meeting is to discuss and agree on key HSE requirements on a project, and to emphasize and reinforce expectations for subcontractor HSE performance. The target audience includes key project staff with HSE responsibilities (e.g., PM, HSM, SL, EM FTL) and key subcontractor staff (e.g., project manager, supervisors, designated field HSE contact, drill team leads, foreman). The subcontractor crew members should attend if available. The meeting should be held prior to mobilization with enough time to ensure that HSE issues identified can be addressed prior to the start of work. The meeting can be held over the phone or in person depending on project needs. An example agenda can be found attached to this PHSEP, titled "Site Work HSE Pre-Start Meeting Agenda".

3. Project HSE Objective Targets and Indicators

All project personnel and its visitors are to strive to meet the project-specific HSE goals outlined below.

- Project management to demonstrate a top-down commitment to HSE
- Create an incident-free environment
- Establish and share the BeyondZero® culture
- Accomplish zero loss incidents (e.g., injuries, spills, vehicle incidents property damage)
- Reduce risks to our health and the environment by identifying, assessing, and mitigating hazards and environmental impacts.
- Continually improve project environmental performance (e.g., reduce number of spills, achieve compliance with any applicable environmental permit)
- Ensure 100% participation in training programs, conformance to company requirements and HSE compliance
- 100% participation in safety meetings
- 100% on-schedule completion of environmental, safety and security corrective actions from audits or incidents
- Achieve recognition from the client for outstanding performance
- Participate in the BZO process and strive for recognition in the BZO of the month awards.
- Recognize project and subcontractor HSE excellence through project or corporate reward and recognition programs.

4. Project Organization and Responsibilities

A full description of responsibilities, including Employee Responsibilities and Authority, can be found in the Handbook, Section 3, "Roles and Responsibilities."

4.1 Client

Facility Contact Name:	Matt Gilis, Varian Program Manager
Phone:	(410) 459-1710

4.2 Jacobs

Project Manager
PM Name: Lauren McKinlay; Raymond Cadorette
Office: BOS
Cellular Number: 781-413-6589; 774-571-1183

Environmental Manager
EM Name: Beth Vaughan
Office: PNS
Cellular Number: 334-734-4489

Responsible Health and Safety Manager
Project HSM Name: Sandra Wise or Mark Orman
Office: DEN/KNV
Cellular Number: 303-944-5214/414-712 4138

Safety Liaison
FTL Name: Deirdre Kearney
Office: BOS
Cellular Number: 781-710-4276

Manager of Projects
MoP Name: Garth Colvin
Office: DET
Telephone number: 517-290 6405

Field Team Lead
FTL Name: Deirdre Kearney
Office: BOS
Telephone number: 781-710-4276

4.3 Subcontractors

Subcontractor: GPRS
Scope: Utility locating
Contact Name:
Contact number:

Subcontractor: Geo Logic Earth Explorations
Scope: Geoprobe soil gas installation
Contact Name:
Contact number:

Subcontractor: TBD
Scope: Surveying
Contact Name:
Contact number:

Subcontractor: TBD
Scope: Monitoring Well Installation
Contact Name:
Contact number:

4.4 Client Contractors

Client Contractor: APTIM
Contact Name:
Telephone number:
Cellular Number:

Client Contractor:
Contact Name:
Telephone number:
Cellular Number:

This PHSEP does not cover contractors that are contracted directly to the client or the owner. Jacobs is not responsible for the health and safety or means and methods of the client contractor's work, and we must never assume such responsibility through our actions (such as advising on health and safety issues).

5. Task Hazard/Impact Identification and Risk Assessment

(See P&PS Work Instruction IB-HS-WI-0101-IB, P&PS Risk Assessment and Safety System of Work)

As part of the SSoW, a hazard identification and environmental impact risk assessment (HIIRA) must be undertaken for all tasks performed by Jacobs and their subcontractors. A task hazard/impact identification (Table 1) has been completed for this project. Specific project tasks are listed in Table 1 with a designation of who could be affected by the hazards associated with the task; Jacobs, subcontractor, or both. The environmental impacts are also included in the table and visitors and members of the public, when on or near the site, will be assumed to be affected by the same hazards and impacts as Jacobs or subcontractor personnel. Initial risk and residual risk associated with the hazards identified below shall be documented in the task HIIRA form (see attachments for form). Visitors that are trained and qualified to enter the work area must be escorted and briefed on the hazards they may be exposed to by reviewing applicable portions of the PHSEP and task HIIRAs.

The SSoW to mitigate these hazards includes:

- The hazard control sections listed in this plan (or referred to in the Handbook)
- The task HIIRA for each project task listed in Table 1; and
- The POWRA performed by the workers prior to performing the task.

Jacobs' task HIIRAs for the tasks below are attached to this plan. Jacobs' subcontractors are required to submit a similar SSoW (e.g., job or activity hazard analyses, HSE plan) specific to their scope of work for acceptance by Jacobs prior to the start of work. Additions or changes in field activities, equipment, tools, or material used to perform work or hazards not addressed requires an updated to be prepared and reviewed by Jacobs.

Table 1: Project Tasks and Associated Hazards and Environmental Impacts

Associated Hazard Section	Project Activity	Site walks, surveys, GW sampling and water level measurements	Waste Management	SSDS Monitoring 34 Lawnview Drive	Vapor Pin Installation and Utility Locating	Soil Gas Installation, Monitoring Well Installation MiP Drilling
General Hazards – Refer to General Hazards and Controls in the F&ES HSE Field Handbook, Section 7, or Jacobs BMS HSE Procedures and Work Instructions (where noted by "BMS")						
Bloodborne Pathogens (if first aid is rendered)		J	J	J	J, S	J, S
Chemical and Petroleum Storage		J	J			J, S
Driving Safety ***(Critical Risk – Driving)***		J	J	J	J, S	J, S
Electrical Safety ***(Critical Risk – Electrical Work)***		J		J	J, S	J, S
Extended Work Hours & Fatigue Management		Not anticipated				
Field Ergonomics and Manual Lifting		J	J	J	J, S	J, S
Field Vehicles ***(Critical Risk – Driving)***		J	J	J	J, S	J, S

Table 1: Project Tasks and Associated Hazards and Environmental Impacts

Associated Hazard Section / Project Activity	Site walks, surveys, GW sampling and water level measurements	Waste Management	SSDS Monitoring 34 Lawnview Drive	Vapor Pin Installation and Utility Locating	Soil Gas Installation, Monitoring Well Installation MiP Drilling
Fire Prevention	J	J	J	J, S	J, S
General Practices and Housekeeping	J	J	J	J, S	J, S
Hazard Communication	J	J	J	J, S	J, S
Knife Use	Not permitted				
Lighting	J	J	J	J, S	J, S
Personal Hygiene	J	J	J	J, S	J, S
Personal Security	J	J	J	J, S	J, S
Shipping and Transportation of Hazardous Waste		J			
Substance Abuse	J	J	J	J, S	J, S
Project-Specific Hazards – Refer to the F&ES HSE Field Handbook, Section 8, and the additional project-specific controls in this plan when specified.					
Compressed Gas Cylinders (calibration gas)	J	J	J		J, S
Confined Space Entry ***(Critical Risk – Confined Space Entry)***	None identified; Not permitted				
Crystalline Silica (see hazard section below)				J	
Drilling (see hazard section below					J, S
Drum and Portable Tank Handling	J	J			J, S
Drum Sampling Safety		J			J, S
Groundwater Sampling/Water Level Measurements (see hazard section below)	J				
Hand and Power Tools (see hazard section below)	J	J		J, S	J, S
Limited Service Workers	Not anticipated				

Table 1: Project Tasks and Associated Hazards and Environmental Impacts

Associated Hazard Section / Project Activity	Site walks, surveys, GW sampling and water level measurements	Waste Management	SSDS Monitoring 34 Lawnview Drive	Vapor Pin Installation and Utility Locating	Soil Gas Installation, Monitoring Well Installation MiP Drilling
Public Safety (see hazard section below)	J			J, S	J, S
Residential Home Hazards (see hazard section below)			J	J, S	
Slips, Trips and Falls	J	J	J	J, S	J, S
Spotters during Vehicle Backing Operations (see hazard section below)	J	J	J	J, S	J, S
Traffic Control (see hazard section below)	J				J, S
Utilities (underground) (see hazard section below)				J, S	J, S
Utilities (overhead) (see hazard section below)					J, S
Working Alone (see hazard section below)			J		
Vinyl Chloride	J	J			J, S
Physical Hazards – Refer to Physical Hazards in the F&ES HSE Field Handbook, Section 9, and the additional project-specific controls in this plan when specified.					
Ultraviolet Light exposure (sunburn)	J	J	J	J, S	
Temperature Extremes	J	J	J	J, S	
Biological Hazards – Refer to Biological Hazards in the F&ES HSE Field Handbook, Section 10, and the additional project-specific controls in this plan when specified.					
Aggressive Dogs (residential areas) (see hazard section below)	J		J	J, S	J, S
Bees and Other Stinging Insects	J	J	J	J, S	J, S
COVID-19 Exposure (see hazard section below)	J	J	J	J, S	J, S
Poison Ivy, Oak and Sumac (see hazard section below)	J		J	J, S	J, S
Snakes	J	J	J	J, S	J, S
Spiders – Brown Recluse and Black Widow	J	J	J	J, S	J, S

Table 1: Project Tasks and Associated Hazards and Environmental Impacts

Associated Hazard Section / Project Activity	Site walks, surveys, GW sampling and water level measurements	Waste Management	SSDS Monitoring 34 Lawnview Drive	Vapor Pin Installation and Utility Locating	Soil Gas Installation, Monitoring Well Installation MiP Drilling
Ticks (see hazard section below)	J		J	J, S	J, S
Environment Impacts – Refer to additional project-specific controls in this plan, specific HIIRAs, or in the project's stand-alone environmental plan (if applicable).					
Protected Fauna	J				J, S
Protected Flora	J				J, S
Waste Management	J	J		J	J, S
Wastewater	J	J			J, S
Water (Water Contamination)	J				J, S
Wetlands	J				J, S

J – Hazard identification applicable to Jacobs personnel
S – Hazard identification applicable to Subcontractor personnel

* For activities above identified as Critical Risks, refer to Jacobs Global Work Instruction JJ-HS-WI-0303-JJ, *Critical Risk Management,* the Critical Risk Awareness Booklet, and the Critical Risk Awareness Guide for Managers and Supervisors. For Environmental Aspects, refer to P&PS Work Instruction IB-HS-WI-0101-IB, *Risk Assessment and Safe System of Work,* Table 9.4.

6. Hazards and Controls

(See P&PS Work Instruction IB-HS-WI-0101-IB, P&PS Risk Assessment and Safety System of Work)

Safe work practices and hazard control measures to reduce or eliminate potential hazards as identified in Table 1 are stated in the Handbook, Sections 7-10, the associated Jacobs Procedure, Work Instruction, or Guideline, and/or are addressed in task HIIRAs. Any additional project-specific control measures, or those hazards requiring additional emphasis, are identified in the following sections.

Always consult the appropriate Procedures or Work Instruction referenced in the hazard sections to ensure all requirements are implemented. All employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. Jacobs employees and subcontractors who do not understand any of these provisions should contact the HSM for clarification prior to commencing with work.

A POWRA shall be performed at the start of each shift or when conditions significantly change. Implement the StepBack process throughout the duration of the task.

6.1 General Hazards and Controls

See the associated general hazard section of the Jacobs HSE Field Handbook for hazards identified in Table 1.

6.2 Project-Specific Hazards and Controls

6.2.1 Crystalline Silica

(Reference BMS Work Instruction US-HS-WI-0203-US, *Hazardous Substances Management*)

Crystalline silica can be a hazard during use of rotary drills on concrete surfaces.

Jacobs and its subcontractors shall control employee exposure to crystalline silica when exposures are at or above the ACGIH TLV and the OSHA action level of 0.025 mg/m^3.

Exposure control measures include for vapor pin installation include:

- When using handheld and stand-mounted drills (including impact and rotary hammer drills) (e.g., for soil vapor probe installation):
  - Use a drill equipped with commercially available shroud or cowling with HEPA filtered dust collection system
  - Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions
  - The dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism
  - Use a HEPA-filtered vacuum when cleaning holes
- Maintaining surfaces as clean as practicable to minimize accumulation of crystalline silica containing particulate material;
- Clean surfaces with a HEPA-filter vacuum or equivalent method;
- An area on the worksite must be designated to be free of crystalline silica for workers to consume food or beverages;
- Restricting access to the work area where crystalline silica exposure may exist to only those authorized to perform work or enter the area;

- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in these areas; and
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person. This is not anticipated for this project provided a shroud and HEPA vacuum are used for vapor pin installation as long as all the control measures above are implemented.
- Take the Respirable Crystalline Silica Awareness training on e3.

6.2.2 Drilling

Below are the hazard controls and safe work practices to follow when working around or performing drilling.

- When considering drilling at sites with nearby monitoring wells, particularly in cases where drilling methods use pressurized fluids (air or water), consider the potential risk of hydraulic communication between the drilling location and the adjacent wells and/or other subsurface conduits.
- The drill rig is not to be operated in inclement weather.
- The driller is to verify that the rig is properly leveled and stabilized before raising the mast.
- Personnel should be cleared from the sides and rear of the rig before the mast is raised.
- The driller is not to drive the rig with the mast in the raised position.
- The driller must check for overhead power lines before raising the mast if within 50 feet of any overhead line. Maintain a minimum distance of 20 feet between mast and overhead lines and an additional 0.4 inch for every 1 kV over 50 kV. Verify the voltage of nearby overhead power lines to determine the minimum distance.
- Personnel should stand clear before rig startup.
- The driller is to verify that the rig is in neutral when the operator is not at the controls.
- Become familiar with the hazards associated with the drilling method used (e.g., cable tool, direct-push technology, and hollow-stem auger).
- Do not wear things that could get caught in moving parts (e.g., loose-fitting clothing or watches).
- Do not smoke or permit other spark-producing equipment around the drill rig.
- The drill rig must be equipped with a kill wire or switch, and all personnel are to be informed of its location.
- Be aware and stand clear of heavy objects that are hoisted overhead.
- The driller is to verify that the rig is properly maintained in accordance with the drilling company's maintenance program.
- The driller is to verify that all machine guards are in place while the rig is in operation.
- The driller is responsible for housekeeping (maintaining a clean work area).
- The drill rig should be equipped with at least one fire extinguisher.
- If the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately.
- Use the drilling self-assessment checklist to evaluate drilling operations and the 385 drilling equipment checklist (Attachment 4).

6.2.3 Drum and Portable Tank Handling

Below are the hazard controls and safe work practices to follow when overseeing the movement of drums or when handling drums:

- Ensure that personnel are trained in proper lifting and moving techniques to prevent back injuries;
- Ensure drum or tank bungs and lids are secured and are labeled prior to moving;
- Ensure that drums and tanks remain covered except when removing or adding material or waste. Covers and/or lids will be properly secured at the end of each workday;
- Provide equipment to keep the operator removed from the drums to lessen the likelihood of injury. Such equipment might include: a drum grappler attached to a hydraulic excavator; a small front-end loader, which can be either loaded manually or equipped with a bucket sling; a rough terrain forklift; Roller conveyor equipped with solid rollers; drum carts designed specifically for drum handling;
- Drums containing liquids or hazardous waste will be provided with secondary containment and may not be located near a storm water inlet or conveyance;
- Allow enough aisle space between drum pallets and between drums and other equipment that the drums can be easily accessed (at least 2 to 3 feet) by fire control equipment and similar equipment; and
- Make sure that a spill kit is available in drum or tank storage areas (or where liquids are transferred from one vessel to another).

6.2.4 Drum Sampling Safety

Personnel are permitted to handle and/or sample drums containing certain types of waste (drilling waste, investigation-derived waste, and waste from known sources) only. Handling or sampling drums with unknown contents requires a plan revision or amendment approved by the HSM. The following control measures will be taken when sampling drums:

- Minimize transportation of drums;
- Sample only labeled drums or drums from a known waste stream;
- Do not sample bulging or swollen drums. Contact the HSM;
- If drums contain, or potentially contain, flammable materials, use non-sparking tools to open;
- Use the proper tools to open and seal drums;
- Reseal bung holes or plugs whenever possible;
- Avoid mixing incompatible drum contents;
- Sample drums without leaning over the drum opening;
- Transfer/sample the content of drums using a method that minimizes contact with material;
- Use the PPE and perform air monitoring as specified in the PPE and Site Monitoring sections of the project safety plan;
- Take precautions to prevent contaminated media from contacting the floor or ground, such as having plastic under the sampling area, having a spill kit accessible during sampling activities; and
- If transferring/sampling drums containing flammable or combustible liquids, drums and liquid transfer equipment should be grounded and bonded to reduce the potential of a static discharge.

6.2.5 Groundwater Sampling/Water Level Measurements

Below are the hazard controls and safe work practices to follow when personnel or subcontractors are performing groundwater sampling and/or water level measurements.

- Full coolers are heavy. Plan in advance to have two people available at the end of the sampling effort to load full coolers into vehicles. If two people won't be available use several smaller coolers instead of fewer large ones.
- Wear the appropriate PPE when sampling, including safety glasses, nitrile gloves, and steel toe boots (see PPE section of this plan and HIIRA).
- Monitor headspace of wells prior to sampling to minimize any vapor inhalation (refer to the "Site Monitoring" section of this plan).
- Use caution when opening well lids. Wells may contain poisonous spiders and hornet or wasp nests. Wear leather gloves.
- Use the appropriate lifting procedures when unloading equipment and sampling at each well.
- Avoid sharp edges on well casings.
- Avoid contact with pump outflow while purging or troubleshooting. Never place effluent line near the body or face, as pumps and flow can start unexpectedly.
- If dermal contact occurs with groundwater or the acid used in sample preservation, immediately wash all affected skin thoroughly with soap and water.
- Preservatives are often corrosive. Review SDS prior to use and document training. Ensure spills are thoroughly cleaned up as residual preservative on surfaces can still cause burns.
- Spilled liquids (in coolers, or in work areas) may be corrosive liquids (preservatives). Test for spill corrosivity hazards with pH paper and immediately clean up small spills.
- Utilize spill pads or neutralizing agents for spill cleanup.
- Inspect sample containers. If sample containers appear sticky or have indication of spilled acid, wash off all containers and surfaces they have contacted with copious water, and notify field team/coworkers of potential acid release from sample bottles.
- If sample containers arrive with leaked acid, also contact lab to inform them so they can be more careful about lid tightness before shipping
- Avoid eating and drinking on site and during sampling.
- Use ear plugs during sampling if sampling involves a generator.
- Containerize all purge water and transport to the appropriate storage area.
- Use two people to transport full coolers/containers whenever possible. If two people are not available use a dolly to move coolers. If the coolers weigh more than 50 pounds, they should never be lifted by one person.

6.2.6 Hand and Power Tools

- Hand and power tools will be used for their intended use and operated in accordance with manufacturer's instructions and design limitations;
- Screwdrivers are one of the most used and abused tools, never:

  - Hammer with a screwdriver
  - Use as a pry bar
  - Use with a broken handle
  - Use with worn out tips
- Maintain all hand and power tools in a safe condition;
- When possible, use power tools over hand tools. Powered tools tend to require less exertion and reduce repetitive motion. Be sure that the weight of a powered tool (and cording) does not create additional force issues.
- Whenever possible, select tools that use a full-hand power grip rather than a precision finger grip. The greater the efforts to maintain control of a hand tool, the higher the potential for injury. A compressible gripping surface rather than hard plastic should be used.
- Avoid repetitive trigger-finger actions. Select tools with large switches that can be operated with all four fingers.
- When possible, use tools with extension handles that let you stand up while performing a floor-level task (extension handles must be manufacturer-approved)
- To lessen vibration:
  - Pad tool handles with a soft compressible surface
  - Use vibration damping (gel filled) gloves
  - Select tools (hammers and chippers) with built in damping systems (springs/hydraulics)
- Maintain straight wrists. Avoid bending or rotating the wrists; a variety of bent-handle tools are commercially available.
- Avoid static muscle loading. Reduce both the weight and size of the tool. Do not raise or extend elbows when working with heavy tools.
- Use PPE (such as gloves, safety glasses, earplugs, and face shields) when exposed to a hazard from a tool;
- Do not carry or lower a power tool by its cord or hose;
- Portable power tools will be plugged into GFCI protected outlets;
- Portable power tools will be Underwriters Laboratories (UL) listed and have a three-wire grounded plug or be double insulated;
- Disconnect tools from energy sources when they are not in use, before servicing and cleaning them, and when changing accessories (such as blades, bits, and cutters);
- Safety guards on tools must remain installed while the tool is in use and must be promptly replaced after repair or maintenance has been performed; and
- If a cordless tool is connected to its recharge unit, both pieces of equipment must conform strictly with electrical standards and manufacturer's specifications.

6.2.7 Public Safety

Due to the fact that part of this work involves work in residential neighborhoods, emphasis must be placed on warning and directing the public. Work areas will be clearly demarcated and signs will be posted to indicate no authorized entry.

Should a member of the public inadvertently enter the work area, site personnel shall cease all work until the unauthorized person is escorted out of the work area.

If members of the public ask you what you are doing, you can have them call the task manager or check with the project manager beforehand to ask what an appropriate response would be (e.g., performing long-term monitoring for the client).

6.2.8 Residential Home Hazards and Precautions

Follow the requirements below when performing work on residential property:

- Contact residents by phone prior to arriving on site. Inquire whether there are any pets or any other conditions to be aware of when in their yard. Communicate that pets need to be kept inside the house during sampling. If this is not possible, ask how the pets will be secured during work.
- There is no need to enter the main home; SSDS is accessed through a separate entry
- Upon arrival at the site, verify with each property owner, or adult resident, whether dogs (or other pets) are present and secured prior to entry. Ask owner and then inform each crew member of location / number of dogs. Do not enter if you suspect dogs are not secured.
- If residents appear to be under the influence of something and do not seem to understand your requests – don't continue onto property. Elevate concerns to the PM and RHSM.
- Be good stewards of property (don't leave puddles of water, leave hoses as you found them, don't assume you can put sampling equipment on furniture, don't leave trash, park considerately, etc.).
- If the homeowner is not present, leave behind the card indicating the time you were there and that you collected a sample.
- Survey travel path before carrying sample equipment through the yard or down the stairs. Ensure area is free from slip/trip hazards, always have one free hand to hold handrail. Use material handling devices such as carts or equipment dollies if necessary.
- See the working alone section of this HSE plan.

6.2.9 Spotters during Vehicle Backing Operations

Spotters should be used for these tasks as indicated below.

- Evaluate vehicle operations prior to performing the task to assess the following:
  - Can the distance of reversing the vehicle be eliminated or minimized?
  - Are there any hazards along the route that would interfere with the safe completion of the job including any points along the path of travel where the spotter may be placed in a dangerous position or line of fire?
  - Can the route be modified to make the task safer?
  - Can the route be cleared of workers (pedestrians) within 8 feet (2.5m) of the moving vehicle? If not, do not proceed. Contact HSM and PM.

- In additional to verbal communications, the driver/operator and spotter must agree to communicate via one of the following: hand signals, two-way radio, lights, handheld air horn or other (specify in daily safety briefings, POWRA, etc.).
- Only one spotter should be used at a time.
- Spotters responsibilities are:
  - Position to enable the driver to maintain visual contact with me
  - Never cross the path of travel of a **moving** vehicle
  - Maintain a minimum 8 feet (2.5 m) distance from **moving** vehicle
  - Wear a high visibility vest
  - Wear the PPE requirements for the area
  - Communicate to the driver to **STOP** immediately if any unexpected hazards are observed
  - Never ride on the vehicle while it is moving
  - Keep the route free of people that don't need to be there
- Driver responsibilities include:
  - STOP immediately if visual contact with the spotter is lost
  - STOP immediately if instructed by the spotter
  - STOP immediately if anyone comes within 8 feet (2.5 m) of the vehicle
  - Operate the vehicle so speed does not exceed the walking pace of the spotter
  - Communicate the blind spots of the vehicle to the spotter
  - Turn radio and any other distractions off in the cab of vehicle
  - Make sure window(s) are open to receive spotter communications
  - Make sure windows and mirrors are clear to ensure good visibility

6.2.10 Traffic Control

(Reference BMS Work Instruction HS-HS-WI-0036-PC, Working Adjacent to Live Traffic)

The following precautions must be taken when working around traffic, and in or near an area where traffic controls have been established by a subcontractor. Ensure the requirements below are followed.

- Jacobs employees must never perform traffic control activities for 3rd party subcontractors.
- Exercise caution when exiting traveled way or parking along street – avoid sudden stops, use flashers, etc.
- Park in a manner that will allow for safe exit from vehicle, and where practicable, park vehicle so that it can serve as a barrier.
- All staff working on or adjacent to active roadways or within traffic control zones must wear reflective/high-visibility safety vests, safety-toed shoes or boots, hard hats, and safety glasses.
- Remain aware of factors that influence traffic related hazards and required controls – sun glare, rain, wind, flash flooding, limited sight-distance, hills, curves, guardrails, width of shoulder (i.e., breakdown lane), etc.
- Always remain aware of an escape route (e.g., behind an established barrier, parked vehicle, guardrail, etc.).
- Always pay attention to moving traffic – never assume drivers are looking out for you.
- Work as far from traveled way as possible to avoid creating confusion for drivers.
- When workers must face away from traffic, a "buddy system" should be used, where one worker is looking towards traffic.
- Use cones and caution tape to delineate work areas. Inspect and maintain traffic control devices. Inspect equipment at the beginning of each work shift and periodically throughout the day. Immediately restore equipment to its original position if knocked over. Reflective equipment shall be kept clean.

- Traffic control training module on the e3 shall be completed when Jacobs workers who work in and around roadways and who exposed to public vehicular traffic.

6.2.11 Utilities (overhead)

(Reference P&PS Work Instruction, HS-HS-WI-0335-PC, *Utility Avoidance*)

Ensure any task that may take work equipment, load line or load (including rigging and accessories) within 50 feet (15.25 meters) of an overhead power line undertakes a site/task specific risk assessment (e.g., AHA, PoWRA, with HSM review) which shall include reviewing the proximity to power lines and verifying voltage with line owners. If in any doubt, the overhead line's owner will be able to advise you on safe clearance distances.

Ensure operators know the working height of their equipment. Ensure the distance to and voltage of conductors or cables are established and briefed to all staff. The distance (height) should be obtained from the line owner or measured by a suitably trained person using non-contact measuring devices and documented inf the field notebook/AHA. Note that the height of the suspended conductors or cables may alter depending on the temperature and weather conditions including ice and wind.

Request and verify power to any overhead utilities has been shut off and positive means have been taken to prevent lines from being energized (such as lockout) in coordination with the local power utility and is visibly grounded at the work site.

If it is not possible to isolate the energized overhead line, exclusion zones shall be established, and overhead conductors or cables shall be highlighted with warning signs and or barriers and use of insulating blankets have been placed by the utility owner. If insulating blankets are used, the utility will determine the minimum safe operating distance (get this determination in writing the utility owner representative's signature). Refer to table below for exclusion zone distances. Note that exclusion zones must take account of unintended scenarios (e.g., drilling rig collapse see figure below).

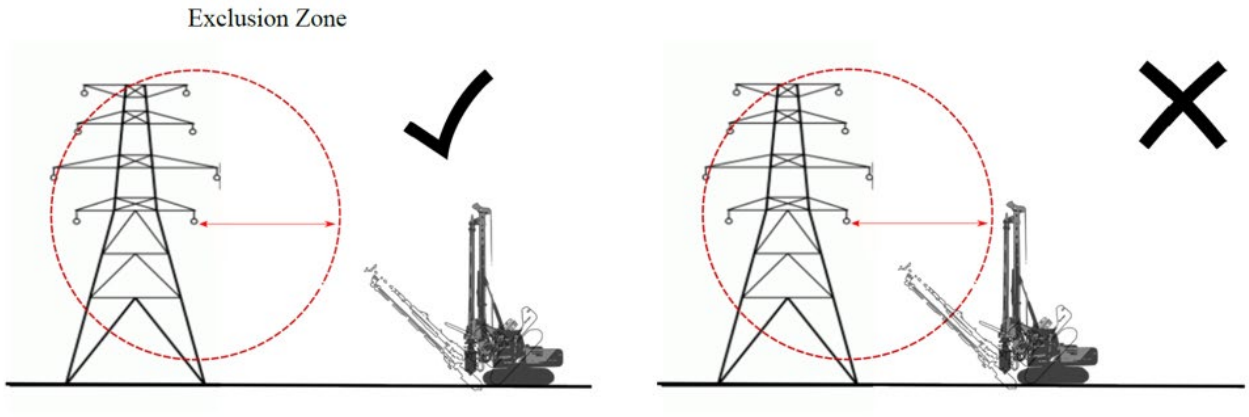
Erect and maintain, where vehicle routes pass below an overhead cable, an elevated non-conductive warning line (goal post), barricade, or line of signs, in view of the operator, equipped with flags or similar high-visibility markings, at the minimum clearance distance cited in local regulations. **Note:** If the operator is unable to see the elevated warning line, a dedicated banksman/spotter must be used. The notices and warning line may need to be illuminated at night, or in poor weather conditions, to make sure they are visible.

Note: Any deviation from the exclusion zone distances must be approved by both the PM and HSM with consultation from MoP and F&ES HSE Lead. Deviations submitted for approval must include a risk assessment and an update to this PHSEP.

MINIMUM DISTANCES FROM POWERLINES – per Jacobs Utility Avoidance Work Instruction

Powerlines Nominal System Kv	Minimum Required Distance ("exclusion zone"), Feet (Meters)
0-350	20 (6.1)
351-500	25 (7.6)
501 – 1000	45 (13.7)
Over 1000	Established by utility owner/operator or by a professional engineer in electrical power transmission/distribution

(These distances have been determined to eliminate the potential for arcing based on the line voltage.)



6.2.12 Utilities (underground)

(Reference P&PS Work Instruction, HS-HS-WI-0335-PC, *Utility Avoidance*)

An assessment for underground utilities must be conducted where there is a potential to contact underground utilities or similar subsurface obstructions during intrusive activities. Intrusive activities include excavation, trenching, drilling, vapor pin installation, hand-augering, soil sampling, or similar activities.

The assessment must be conducted before any intrusive subsurface activity and must include at least the following elements:

- A background and records assessment of known utilities or other subsurface obstructions.
- Contacting and using the designated local utility locating service.
- Conducting an independent field survey to identify, locate, and mark potential underground utilities or subsurface obstructions. Note: This is independent of, and in addition to, any utility survey conducted by the designated local utility locating service above.
- A visual survey of the area to validate the chosen location.
- Complete Utility Verification Checklist.

When any of these steps identifies an underground utility within 3 feet of intrusive work, then non-aggressive means must be used to physically locate the utility before a powered tools, drill rig, backhoe, excavator or other aggressive method is used.

Aggressive methods are never allowed within 3 feet of an identified high risk utility (see paragraph below).

Any deviation from these requirements must be approved by the HSM and the PM.

6.2.12.1 Background and Records Assessment of Known Utilities

Identify any client- or location-specific permit and/or procedural requirements (e.g., dig permit or intrusive work permit) for subsurface activities.

Obtain available utility diagrams and/or as-built drawings for the facility.

Review locations of possible subsurface utilities including sanitary and storm sewers, electrical lines, water supply lines, natural gas lines, fuel tanks and lines, communication lines, lighting protection systems, etc. Note: Use caution in relying on as-built drawings as they are rarely 100 percent accurate.

Request that a facility contact with knowledge of utility locations review and approve proposed locations of intrusive work.

6.2.12.2 Designated Local Utility Locating Service

Contact your designated local utility locating service (e.g., Dig-Safe, Blue Stake, One Call) to identify and mark the location of utilities. In the US, call 811 in the go to www.call811.com to identify the appropriate local service group. Contacting the local utility locating service is a legal requirement in most jurisdictions. (Some US states, [e.g., Washington] require that the entity performing the intrusive work be the responsible for contacting the local service.) Where subcontractors are responsible for the intrusive work, Jacobs personnel shall verify the subcontractor has contacted the designated local utility locating service.

6.2.12.3 Independent Field Survey (Utility Locate)

The organization conducting the intrusive work (Jacobs or subcontractor) shall arrange for an independent field survey to identify, locate, and mark any potential subsurface utilities **extending at least six feet beyond the intrusive work area**. This survey is in addition to any utility survey conducted by the designated local utility locating service.

The independent field survey provider shall determine the most appropriate instrumentation/technique or combinations of instrumentation/techniques to identify subsurface utilities based on their experience and expertise, types of utilities anticipated to be present, and specific site conditions.

A Jacobs or subcontractor representative must be present during the independent field survey to observe the utility locate and verify that the work area and utilities have been properly identified and marked. If there is any question that the survey was not performed adequately or the individual was not qualified, then arrangements must be made to obtain a qualified utility locate service to re-survey the area. Obtain documentation of the survey and clearances in writing and signed by the party conducting the clearance. Maintain all documentation in the project file.

If the site owner (military installation or client) can provide the independent field survey, Jacobs or the subcontractor shall ensure that the survey includes:

- Physically walking the area to verify the work location and identify, locate, and mark underground utility locations:
- Having qualified staff available and instrumentation to conduct the locate;
- Agreeing to document the survey and clearances in writing.
- Should any of the above criteria not be met, Jacobs or subcontractor must arrange for an alternate independent utility locate service to perform the survey.
- The markings from utility surveys must be protected and preserved until the markings are no longer required. If the utility location markings are destroyed or removed before intrusive work commences or is completed, the PM, SL, or designee must notify the independent utility locate service or the designated local utility locating service to resurvey and remark the area.

6.2.12.4 Visual Assessment before and during Intrusive Activities

Perform a “360 degree” assessment. Walk the area and inspect for utility-related items such as valve caps, previous linear cuts, patchwork in pavement, hydrants, manholes, utility vaults, drains, and vent risers in and around the dig area.

The visual survey shall include all surface landmarks, including manholes, previous liner cuts, patchwork in pavement, pad-mounted transformers, utility poles with risers, storm sewer drains, utility vaults, and fire hydrants.

If any unanticipated items are found, conduct further research before initiating intrusive activities and implement any actions needed to avoid striking the utility or obstruction.

6.2.12.5 Completion of the Utility Verification Checklist

The utility verification checklist shall be completed by the SL and submitted to the PM and HSM for review and signature. Follow the instructions on the form and keep it accessible in the field during intrusive operations. Evaluate intrusive activities for changed conditions and contact the PM and HSM to ensure hazards are addressed and whether a new checklist needs to be completed.

6.2.12.6 Intrusive Activities within 3 feet of an Underground Utility (or if there is Uncertainty)

Any intrusive activities conducted within 3 feet of an underground utility or when there is uncertainty about utility locations, utility locations must first be physically verified by non-aggressive means such as air or water knifing, hand digging, or human powered hand augering. Non-conductive tools must be used if electrical hazards may be present.

Once the utility has been located, non-aggressive methods (hand digging, vacuum excavation, etc.) must still be used to perform intrusive activities within 3 feet of a high risk utility). Whenever feasible, utilities shall be de-energized. Deviations from this must be approved by the PM and HSM prior to work.

6.2.12.7 Spotter

A spotter shall be used to monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon, presence of pea gravel or sand in soils, presence of concrete or other debris in soils, refusal of auger or excavating equipment). If any suspicious conditions are encountered stop work immediately and contact the PM or HSM to evaluate the situation. The spotter must have a method to alert an operator to stop the intrusive activity (e.g., air horn, hand signals).

6.2.13 Working Alone

Personnel can only be tasked to work alone by the Project Manager, who shall assess potential hazards and appropriate control measures, with assistance from the HSM.

The presence of "lone workers" with an accountability system in place is permitted, depending on the hazards presented during the execution of the task. Reference the "Lone Worker Protocol," which is included as an attachment to this PHSEP.

Only limited operations tasks are permitted to be performed alone. Activities that are not permitted to be performed by a lone worker include the following:

- Working at heights (e.g., on ladders, lifts, and scaffolding)
- Work on or near energized electrical systems (not permitted under this PHSEP)
- Any entry into a confined space
- Work involving electricity or other hazardous equipment

The employee working alone shall at all times be equipped with a working voice communication device such as a cellular phone, satellite phone, personal alarms, or two-way radio to check in to their project contact(s) at pre-determined times.

6.2.13.1 Call-in System for Lone Worker Accountability

The employee working alone shall at all times be equipped with a working voice communication device such as a cellular phone, satellite phone, personal alarms, or two-way radio to check in to their project contact(s) at pre-determined times.

Each time before going into the field, a daily check-in via phone or text shall be performed between the lone worker and task manager. A record of the check-in must be kept. The log/spreadsheet will document the date and time of check-inand the next scheduled check-in time).

During fieldwork, the lone worker and office contact worker must both have cell phones and each other's' phone number, as well as an alternate person's phone number.

The lone worker shall carry his/her cell phone throughout the field event; the ringer should be set on its loudest setting because wind or other noise can muffle the sound. If for any reason the cell phone becomes inoperable, the fieldworker shall immediately stop work, leave the site, and find an alternative method of contacting the task manager to verify the lone worker's safety and to inform the task manager of the issue.

Work shall not proceed in the field until the lone worker has a working device that provides communication with the task manager.

If at any time the task manager does not receive a check-in at the scheduled time, then they should attempt to contact the lone worker. If no contact is made, then the task manager should contact the facility contact person to check on the lone worker.

If no contact is made with the lone worker, then the task manager shall contact the PM and/or HSM to let them know that there is a possible emergency and to instruct the PM and/or HSM to go to the field location and assist the lone worker. The office contact worker will provide to emergency services the lone worker's name, last known location, vehicle description, and contact information.

6.3 Physical Hazards and Controls

See the associated physical hazard section of the Jacobs HSE Field Handbook and sections below for hazards identified in Table 1.

6.4 Biological Hazards and Controls

See the associated biological hazard section of the Jacobs HSE Field Handbook and sections below for hazards identified in Table 1.

6.4.1 Aggressive Dogs

Working on in or around residential property can involve work where residents' pets are present. Follow the requirements below when performing work on residential property:

If you encounter a dog, know the signs of aggressive behavior—

- Ears are back, close to head;
- Eyes - Narrow or staring challengingly;
- Mouth/teeth - Lips open, drawn back to expose teeth bared in a snarl. Possible jaw snapping;
- Body is tense, upright, hackles up on neck (dominant position);
- Tail straight out from body and fluffed up; and
- Vocalization is snarling, growling, loud barking.

If you are threatened by a dog, remain calm, do not scream and avoid eye contact. If you say anything, speak calmly and firmly. Do not turn and run, try to stay still until the dog leaves, or back away slowly until the dog is out of sight or you have reached safety (e.g. vehicle). Identify the nearest "safe" location for each property and work area e.g. vehicle, building, etc.

If attacked, retreat to vehicle; attempt to place something between you and the dog, use dog repellant. If you fall or are knocked to the ground, curl into a ball with your hands over your head and neck and protect your face. If bitten, call 911.

6.4.2 Coronavirus Disease 2019 (COVID-19)

Coronavirus disease 2019 (COVID-19) is a respiratory illness that can spread rapidly from person-to-person mainly between people who are in close contact with one another (within about 6 feet), through respiratory droplets produced when an infected person talks, coughs, or sneezes. It also may be possible that a person can get COVID-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose, or possibly their eyes. Field personnel can potentially be exposed to COVID-19 while working in close proximity to other field staff that have been previously exposed to the virus.

Common signs of infection include but are not limited to: fever or chills, cough, shortness of breath, fatigue, muscle or body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, diarrhea. Symptoms may appear 2 to 14 days after exposure to the virus.

Refer to the Jacobs Connect COVID-19 page for further precautions, control measures, and frequently asked questions. If you are experiencing symptoms or showing signs of COVID-19, do not report to project site for work. Contact the project SL, HSM, PM and supervisor to immediately report symptoms to your supervisor.

- Review and follow Jacobs Global Security Companywide Travel Restriction and FAQs
- Review signs and symptoms of Coronavirus with all field staff.
- Face coverings are currently not required unless required by the client, relevant government or health authority, the wearing of face coverings has been determined through an approved HSE risk assessment, or people want to voluntarily wear a face-covering.
- Ensure FTL and Safety Liaison have cell phone number of all field staff for communication to project teams.
- Wash hands frequently, or at a minimum, use hand sanitizer and then wash hands with soap and water for at least 20 seconds once hand washing can be performed.
- Use disinfectant to frequently clean shared surfaces including, but not limited to rental cars; hotel room touch points; temporary office trailer touch points (e.g. door handles, workstations). For rental cars: steering wheels, control knobs/touch screens, shift knob, door handles, window switches, locks.
- **Note:** All references are frequently updated. Check Jacobs and CDC COVID-19 webpages frequently for updates.

6.4.3 Poison Ivy, Poison Oak, and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Shrubs are usually 12 to 30 inches high, or can also be a tree-climbing vine, with triple leaflets and short, smooth hair underneath. Plants are red and dark green in spring and summer, with yellowing leaves anytime especially in dry areas. Leaves may achieve bright reds in fall, but plants lose its (yellowed, then brown) leaves in winter, leaving toxic stems. All parts of the plant remain toxic throughout the seasons. These plants contain urushiol a colorless or pale yellow oil that oozes from any cut or crushed part of the plant, including the roots, stems and leaves and causes allergic skin reactions when contacted. The oil is active year round.

Become familiar with the identity of these plants (see below). Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

Poison Ivy

Poison Sumac

Poison Oak

Contamination with poison ivy, sumac or oak can happen through several pathways, including:

- Direct skin contact with any part of the plant (even roots once above ground foliage has been removed).
- Contact with clothing that has been contaminated with the oil.
- Contact from removing shoes that have been contaminated (shoes are coated with urishol oil).
- Sitting in a vehicle that has become contaminated.
- Contact with any objects or tools that have become contaminated.
- Inhalation of particles generated by weed whacking, chipping, vegetation clearing.

If you must work on a site with poison ivy, sumac or oak the following precautions are necessary:

- Do not drive vehicles onto the site where it will come into contact with poison ivy, sumac or oak. Vehicles which need to work in the area, such as drill rigs or heavy equipment must be washed as soon as possible after leaving the site.
- All tools used in the poison ivy, sumac or oak area, including those used to cut back poison oak, surveying instruments used in the area, air monitoring equipment or other test apparatus must be decontaminated before they are placed back into the site vehicle. If on-site decontamination is not possible, use plastic to wrap any tools or equipment until they can be decontaminated.
- Personal protective equipment, including Tyvek coveralls, gloves, and boot covers must be worn. PPE must be placed into plastic bags and sealed if they are not disposed immediately into a trash receptacle.
- As soon as possible following the work, shower to remove any potential contamination. Any body part with suspected or actual exposure should be washed with Zanfel, Tecnu or other product designed for removing urishiol. If you do not have Zanfel or Tecnu wash with cold water. Do not take a bath, as the oils can form and invisible film on top of the water and contaminate your entire body upon exiting the bath.
- Tecnu may also be used to decontaminate equipment.
- Use IvyBlock or similar products to prevent poison oak, ivy and sumac contamination. Check with a local drug sotre the closest Jacobs warehouse to see if these products are available. Follow all directions for application.
- If you do come into contact with one of these poisonous plants and a reaction develops, contact your supervisor and WorkCare. Be aware that in some instances, there can be a delay between contact with poisonous plants and the symptoms. If you are working near poison ivy or other poisonous plants and feel a mild skin irritation, apply Zanfel/Technu immediately and contact the occupational nurse.

6.4.4 Ticks

Every year employees are exposed to tick bites at work and at home putting them at risk of illness. Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to 0.25 inch (6.4 mm) in size.

In areas where significant population density or infestation exists, tick reduction should be considered. Tick reduction can be achieved by disrupting tick habitats and/or direct population reduction using tick-toxic pesticides (e.g., Damminix, Dursban, Sevin).

Habitat disruption may include only simple vegetative reduction such as removing leaf litter and trimming grass and brush. Trim/clear walking paths and specific work locations or request facility mow areas prior to fieldwork. Often, projects schedule subcontractors to assist with vegetation reduction tasks prior to fieldwork. Tick populations can be reduced by between 72 and 100 percent when leaf litter alone is removed. In more heavily infested areas, habitat disruption may include grubbing, tree trimming or removal, and pesticide application (Damminix, Dursban, Sevin, etc.). This approach is practical in smaller, localized areas or perimeter areas that require occasional access. Habitat controls are to be implemented with appropriate health and safety controls, in compliance with applicable environmental requirements, and may be best left to the property owner or tenant or to a licensed pesticide vendor. Caution should be exercised when using chemical repellents or pesticides in or around areas where environmental or industrial media samples will be collected for analysis.

If vegetation removal or pesticide to eliminate ticks is not feasible or not effective, the requirements to prevent tick bites are “the three I’s”: Insecticide, Isolation, and Inspection. You need all three I’s to successfully protect yourself from ticks.

6.4.4.1 Insecticide

- Apply DEET or Picaridan repellent to exposed skin or clothing per product label. CDC recommended natural repellents may be used on a case-by-case basis for project staff sensitive to DEET or Picaridan. Repellant is required when walking in vegetated areas with potential tick habitat; AND
- Apply permethrin to the outside of boots, clothing and cloth field equipment (e.g. backpacks, snake chaps) before wearing, per product label. Consult this video, SDS, FAQ and label instructions for information on one of the available permethrin products that includes how to properly treat clothing and gear. Reapply Permethrin spray per the instructions (typically every six washings or six weeks). Insect Shield clothing is an alternative to spray permethrin, and lasts up to 60 washes.

6.4.4.2 Isolation

- So that ticks may be easily seen, wear light-colored clothing. Full-body New Tyvek (paper-like disposable coveralls) may also be used.
- To prevent ticks from getting underneath clothing tuck pant legs into socks or tape to boots and/or use tick gaiters (available through the warehouses). Tuck shirt into pants.
- Wear long-sleeved shirts, a hat or hard hat, and high safety-toed boots.

6.4.4.3 Inspection

- Carry a tick removal kit (available through the warehouses).
- Carry a lint roller. Frequently check for ticks and remove from clothing. Use lint roller, especially in the areas you can’t see (back, back of the legs), the white roller body of the lint roller makes it much easier to identify and remove the very small ticks.
- At the end of the day, search your entire body for ticks (particularly groin, armpits, neck, and head) and shower.

See the 2022 Tick Fact Sheet for more detailed information on tick identification, illnesses, and removal steps. If bitten by a tick, follow the removal procedures found in the Tick Fact Sheet, and call the HSM, PM, TM, and WorkCare.

Be aware of the symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme disease is a rash that might appear that looks like a bull's eye with a small welt in the center. RMSF is a rash of red spots under the skin 3 to 10 days after the tick bite. In both RMSF and Lyme disease, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, again call the HSM, PM, TM, and JacobsCare.

Be sure to assist the HSM in completing an Incident Report using the Intelex system on Jacobs Connect if you do come in contact with a tick, attached or not.

7. Required Permits

(See Jacobs Global Work Instruction JJ-HS-WI-0305-JJ, Safe Work Permits)

Safe work permits are used as a work control process for defined hazardous activities. The use of work permits may be required by clients or as a result of task risk assessment.

Safe work permits are mandatory for the following types of operations (others based on client or other requirements may be needed as well):

- Hot Work
- Confined Space Entry
- Excavations
- Line Breaking
- Energized Electrical Work

No work permits are anticipated for this scope of work.

8. Hazard Communication

(See P&PS Work Instruction IB-HS-WI-0202-IB, Chemical Hazard Communication)

As indicated in Section 7 of the Handbook, under "Hazard Communication," the hazard communication (HazCom) coordinator (the SL or qualified designee) must perform the following (additional HazCom duties are outlined in the Handbook):

- Complete an inventory of chemicals brought on site by Jacobs using the chemical inventory form included as an attachment to this PHSEP;
- Confirm that an inventory of chemicals brought on site by subcontractors is available;
- Request or confirm locations of Globally Harmonized System (GHS) compliant (i.e., consisting of 16 sections that appear in the same order and contain uniform information regarding the chemical) safety data sheets (SDSs) from the client, contractors, and subcontractors for chemicals to which Jacobs employees potentially are exposed;
- For chemicals used by Jacobs workers, before or as the chemicals arrive onsite, obtain a SDS for each hazardous chemical, include on the chemical inventory sheet (attached to this PHSEP), and maintain SDSs in an accessible binder onsite long with the chemical inventory sheet . Ensure everyone knows where SDSs are kept;
- The six required elements of the GHS label must include the product identifier, pictograms, signal word, hazard statements, precautionary statements, and the name, address, and telephone number of the chemical manufacturer, importer or other responsible party;
- The manufacturer's original label on any incoming regulated product must not be removed or defaced. The manufacturer's label and markings must be retained on the package or container until it is sufficiently cleaned of residue and purged of vapors to remove any potential hazards;
- Ensure all secondary containers are labeled in compliance with GHS labeling requirements. If GHS compliant information has not yet been provided by the manufacturer or chemical distributor, the HCC must contact the manufacturer or chemical distributor and document in the chemical inventory when the GHS labeling information will be available, until the labeling requirement is fulfilled;
- In the United States, the container label shall be in English, although labels in other languages may be kept as well. Container labels in other languages for non-speaking English-speaking workers will be made available when specified by the client for their project site or facility;
- Give employees required chemical-specific HazCom training using the chemical-specific training form included as an attachment to this PHSEP and ensure that the GHS training module on Jacobs' E3 Learning and Development platform has been completed.
- Ensure that chemical use is included in the task HIIRA.

9. Contaminants of Concern

The table below summarizes the potential contaminants of concern (COC) and their occupational exposure limit and signs and symptoms of exposure. The table also includes the maximum concentration of each COC and the associated location and media that was sampled (groundwater, soil boring, surface soil). These concentrations were used to determine engineering and administrative controls described in the "Project-Specific Hazard Controls" section of this PHSEP, as well as PPE and site monitoring requirements.

Table 2: Contaminants of Concern

Contaminant	Location and High[a] Concentration	Exposure Limits[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Acetone	7,800 µg /L	250 ppm	2500 ppm [10%LEL]	irritation eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis	9.69
1,1-Dichloroethane	GW: 120 µg /L	100 ppm	3000 ppm	irritation skin; central nervous system depression; liver, kidney, lung damage	11.06
1,2-Dichloroethane	GW: 100 µg /L	1 ppm (CA), 10 ppm (TLV)	50 Ca	CNS depression, nausea, vomiting, dermatitis, eye irritation, liver, kidney, and CNS damage; corneal opacity	11.05
1,1-Dichloroethene	GW: 180 µg/L	5 ppm	NL Ca	Eye, skin, and throat irritation; dizziness; headache; nausea; difficult breathing; liver and kidney dysfunction; pneumonitis.	9.65
1,2-Dichloroethene (trans)	GW: 110 µg /L	200 ppm	1,000	CNS depression, eye irritation.	9.65
1,1,2,2-Tetrachloroethane	GW: 210 µg/L	1 ppm	100 Ca	Nausea, vomiting, abdominal pain, finger tremors, jaundice, hepatitis, liver tenderness, monocytosis, kidney damage, dermatitis	11.10
Tetrachloroethylene (PCE)	GW: 240,000 µg/L	25 ppm	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
1,1,1-Trichloroethane	GW: 52,000 µg/L	350 ppm	700 ppm	irritation eyes, skin; headache, lassitude (weakness, exhaustion), central nervous system depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage	11.00
1,1,2-Trichloroethane	GW: 2,900 µg/L	10 ppm	100 Ca	Eye and nose irritation, CNS depression, liver damage, dermatitis	11.00

Contaminant	Location and High[a] Concentration	Exposure Limits[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Trichloroethylene (TCE)	GW: 600,000 µg/L;	10 ppm	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
Vinyl chloride	GW: 130,000 µg/L	1 ppm	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), SS (Surface Soil), SL (Sludge), SW (Surface Water).
[b] Appropriate value of permissible exposure limit (PEL), recommended exposure limit (REL), Cal/OSHA PEL (CA) or threshold limit value (TLV) listed.
[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.
[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.
eV = electron volt
mg/kg = milligram per kilogram
mg/m^3 = milligrams per cubic meter
ug/m^3 = micrograms per cubic meter

Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of PPE.	**Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of respiratory protection when other forms of control do not reduce the potential for exposure.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

10. Site Monitoring

10.1 Direct Reading Monitoring

For each task listed in the table below, perform the associated monitoring ensuring the equipment is calibrated daily (or bump tested) according to the manufacturer's recommendations.

Note: The term "calibration" is used but it may actually be a "bump test" depending on what the manufacturer requires. There is a difference between actually calibrating (manually adjusting sensors to read a value) and "bump testing" (field verification that the instrument is reading what it's supposed to.) Many equipment manufacturers now say that performing actual calibration daily can damage the sensors, so they recommend a "bump test" daily or before use to verify the instrument is reading correctly, and they state a prescribed calibration frequency requirement. Refer to the manufacturer's instrument manual on the recommended daily calibration or bump test requirements. Be sure the calibration/bump test is documented.

Use the Daily Site Monitoring Form (or equivalent) to document the calibration (or bump test) and the readings taken. Retain area monitoring readings with project records.

Personal Breathing Zone and Area Samples

Personal breathing zone and area sampling results must be sent immediately to the HSM..

Exposure records (breathing zone and personal air sampling) must be preserved for the duration of employment plus thirty years. Copies of all project exposure records (e.g., copies of Daily Site Monitoring form or field logbook pages where breathing zone readings are recorded along with associated calibration) shall be sent to the F&ES Safety Program Assistant for retention and also maintained in the project files.

Subcontractors are responsible for air monitoring and performing integrated personal sampling for their employees as documented in their PHSEP or, if permitted, according to the table below.

Table 3: Direct Reading Monitoring Specifications

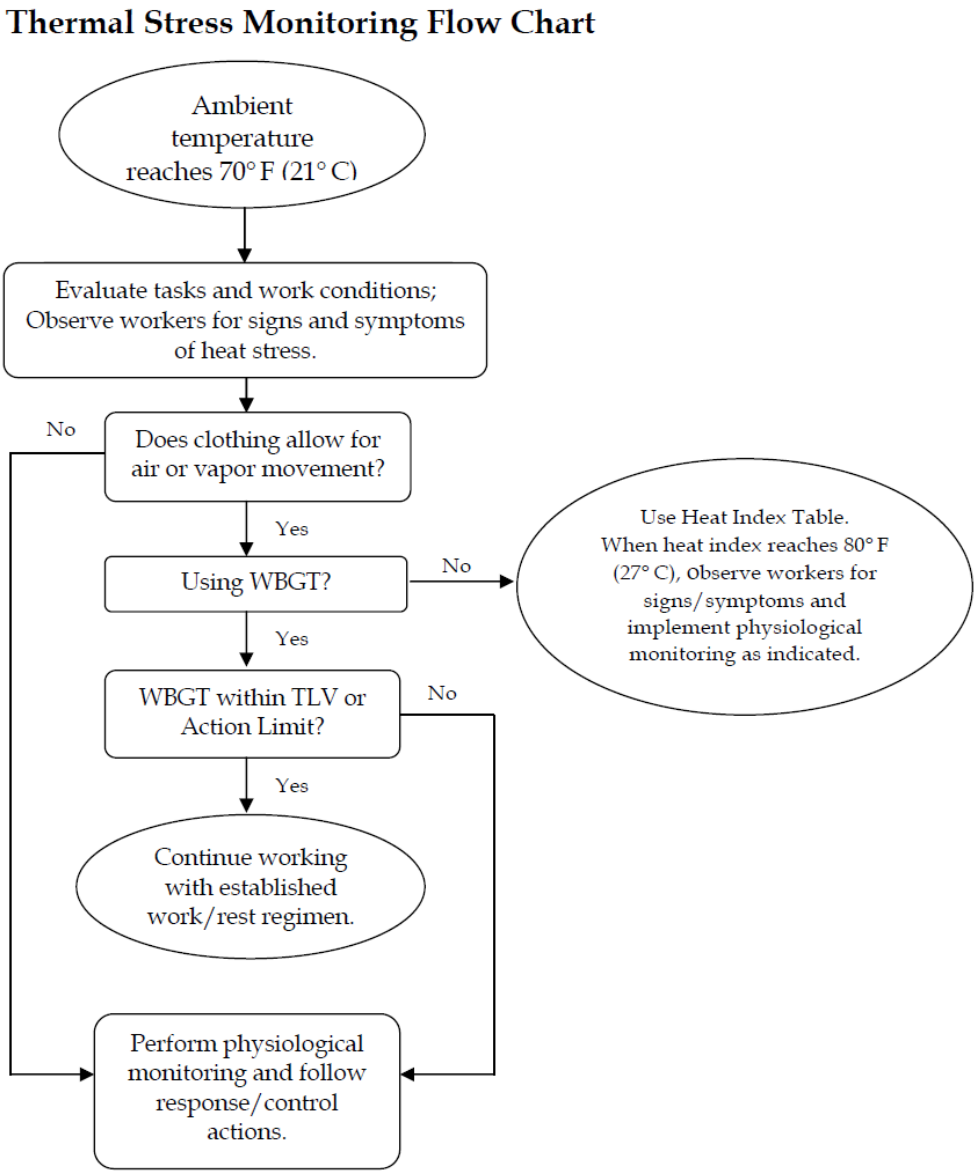
Instrument	Tasks	Action Levels[a]	Action to be Taken when Action Level reached	Frequency [b]	Calibration
Toxic Gas Monitor: MultiRAE Plus with 11.7 eV lamp (VOCs, O_2, LEL, CO, H_2S)	Drilling, GW monitoring; drum sampling any task where contact with contaminated GW or media is possible	< 1 ppm ≥ 1 ppm sustained in breathing zone	Continue work Move out of area and allow to ventilate. If sustained, suspend work and contact the HSM	Initially and periodically	Daily
	Drilling, GW monitoring	0-10%: >10% LEL:	No explosion hazard Explosion hazard; evacuate or vent		Daily
	Drilling, GW monitoring	>25%[c] O_2: 20.9%[c] O_2: <19.5%[c] O_2:	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent or use SCBA		Daily

Instrument	Tasks	Action Levels[a]	Action to be Taken when Action Level reached	Frequency [b]	Calibration
Heat Stress Monitor - Refer to Flow Chart Below ☒ Ambient Temperature ☐ WBGT ☒ Heat Index ☒ Physiological (pulse or temperature)	Anytime heat index is over 80 degrees (or ambient temperature of 70 degrees is working in Tyvek)	Refer to the Handbook for the type of monitoring conducted.	Refer to the Handbook for the type of monitoring conducted.	When Heat Index reaches criteria.	

[a] Action levels apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SL; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate.
[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry.
[d] Noise monitoring and audiometric testing also required.

Figure 1: Heat Stress Monitoring Flow Chart

Use the flow chart below and refer to the applicable protocol in Section 7 of the Handbook for heat stress monitoring.



11. Personal Protective Equipment

11.1 Required Personal Protective Equipment (PPE)

(See P&PS Work Instruction, IB-HS-WI-0310-IB, Personal Protective Equipment Minimum Standards and IB-HS-WI-0310-US, PPE Guidance - USA))

PPE must be worn by employees when actual or potential hazards exist and engineering controls or administrative practices cannot adequately control those hazards.

A PPE assessment has been conducted by the HSM based on project tasks (see PPE specifications below). Verification and certification of assigned PPE by task is completed by the HSM that approved this plan. Refer to the Handbook, Section 9.1, "Personal Protective Equipment," for requirements on the use, care, and maintenance of PPE.

The table below outlines PPE to be used according to task based on project-specific hazard assessment. If a task other than the tasks described in this table needs to be performed, contact the HSM so this table can be updated. Task-specific PPE is also contained in task HIIRA for each task.

Ensure that all PPE is inspected prior to use and that you have been trained in its use. Ensure the PPE used fits properly. Contact the HSM if there are deficiencies or you haven't been trained on care, use, and limitations of PPE.

Table 4: PPE Requirements

Project-Specific Personal Protective Equipment Requirements [a]				
Task	**Level**	**Body**	**Head**	**Respirator [b]**
Site visits, setting up for GW sampling (not in vegetation where additional PPE would be required for ticks/poisonous plants)	D	☒ Work clothes (long-sleeved shirt, long pants) ☐ Cotton Coveralls ☒ Safety-toed Boots ☒ Gloves (leather) when handling materials ☒ ANSI/ISEA 107-2010 high visibility vest when walking near traffic or roadways ☐ Other: (specify)	☒ Hat with wide brim ☒ANSI Z87.1 Safety glasses (clear and shaded in case entry into buildings are needed) ☒Hearing protection, as needed [d]	None required

Project-Specific Personal Protective Equipment Requirements [a]				
Task	**Level**	**Body**	**Head**	**Respirator [b]**
Hand augering Geoprobe boring Soil boring Well installation	Modified D	☒ Work clothes (sleeved shirt, long pants) ☒ Tyvek coveralls or apron** ☒ ANSI/ISEA 107-2010 high visibility vest ☒ Safety-toed boots ☐ Safety-toed rubber boots (can be deconned in a boot wash) ☒ Outer boot covers** ☒ Inner surgical-style nitrile** ☒ Outer chemical-resistant nitrile gloves.** ☒ Other: (specify) Snake chaps/gaiters as required (see snakes hazard section) when working in tall grass. PPE required if in vegetated areas. Survey area for poisonous plants and refer to AHA/HIIRA for precautions ** (SL/SSHO may determine body protection based on potential contact with site contaminants. If outer layer of personal clothing cannot be kept clean, then outer cotton coveralls or uncoated Tyvek coveralls shall be worn. (Polycoated Tyvek when there is potential to contact contaminated groundwater or free liquids from drums).	☐ ANSI Z89.1 Hardhat [c] ☒ ANSI Z87.1 Safety glasses ☒ Hearing protection [d]	None required
Groundwater sampling, Containerizing purge water and transferring to drum (waste management), drum sampling, vapor pin installation	Modified D	☒ Work clothes (long-sleeved shirt, long pants) ☒ Cotton coveralls, Tyvek coveralls or apron ** ☒ ANSI/ISEA 107-2010 high visibility vest ☒ Safety-toed boots ☐ Outer boot covers ☒ Inner surgical-style nitrile** ☒ Leather gloves for opening wells, handling materials, roto-hammer use ** (SL may determine body protection based on potential contact with site contaminants. If outer layer of personal clothing cannot be kept clean, then outer	☒ANSI Z89.1 Hardhat ☒ANSI Z87.1 Safety glasses (clear and shaded in case entry into buildings are needed) ☒Hearing protection, as needed [d]	None required

Project-Specific Personal Protective Equipment Requirements [a]				
Task	**Level**	**Body**	**Head**	**Respirator [b]**
		cotton coveralls or uncoated Tyvek coveralls or Tyvek apron shall be worn.		
Working in vegetated areas (tick habitat)—add this to PPE ensembles above	D	☒ Permethrin-treated clothing (long-sleeved shirts, pants, socks and boots). Treat and re-treat as needed according to manufacturer's instructions label, there is also pre-treated clothing available through various vendors) ☒ Wear Lymeez tick gaiters or tuck pants into socks and duct tape where they join. ☒ Use DEET-containing insect repellent on exposed skin ☒ Frequent tick checks with lint roller over clothing. Contact HSM if ticks are found crawling to determine if other measures are needed. ☒ Have tick removal kit for each field crew member	☐ ANSI Z89.1 Hardhat [c] ☒ ANSI Z87.1 Safety glasses ☐ Hearing protection [d]	None required.

Reasons for Upgrading or Downgrading Level of Protection (with approval of the HSM)	
Upgrade[f]	**Downgrade**
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels in the "Site Monitoring" section exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decrease the hazard. • Change in work task that will reduce contact with hazardous materials.

[a] Modifications are as indicated. Jacobs will provide PPE only to Jacobs employees.
[b] No facial hair that would interfere with respirator fit is permitted.
[c] Hardhat and face-shield areas are to be determined by the SL.
[d] Hearing protection should be worn when conversations cannot be held at distances of 3 feet (1 meter) or less without shouting.
[e] See cartridge change-out schedule.
[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SL qualified at that level is present.

12. Worker Training and Qualification

12.1 Jacobs Worker Training

(See P&PS Work Instruction, IB-HS-WI-0200-IB; HSE Training and Competency)

The Project Manager shall ensure that all employees, including subcontractor employees, have the correct training, skills and experience to undertake the tasks they are engaged in. All project staff will have the necessary licenses to drive vehicles, operate equipment and undertake specialized work as required by law.

The following training is required for Jacobs personnel working onsite, in addition to their assigned worker category training (SLHW, HWW, HWWL). Copies of training will either be available onsite, or readily available from the Jacobs Learning Management System (LMS) training database system. Refer to Section 12 of the Handbook for a description of HAZWOPER-related and Safety Liaison training.

Table 5: Jacobs Required Worker Training

Required Jacobs Worker Training	Jacobs Task or Equipment-Specific Training (if performing task)
☒ 40-hour HAZWOPER Training	☐ Aerial Lift Operator Training
☒ 8-hour HAZWOPER Refresher	☐ Confined Space Entry Training
☒ 3-day HAZWOPER OJT	☐ Excavation Safety Training
☒ Jacobs PHSEP Training	☐ Fall Protection (site-specific)
☒ Jacobs F&ES HSE Field Handbook	☐ Forklift Operator
☒ Jacobs task HIIRA	☐ Hazard Communication
☐ Subcontractor PHSEP	☐ On-Track Railroad Safety Training
☐ 10-hour OSHA Construction Safety Training ☒ First Aid/CPR/BBP – at least 2 people	☐ NFPA 70E Training (energized electrical safety training) (refer to raining category/user group for all applicable training needed)
☒ At least one SL-HW (refer to training category/user group for all applicable training needed)	☐ Qualified Earthmoving Equipment Operator
☒ HWW (refer to raining category/user group for all applicable training needed)	☐ Scaffold Training
☐ At least one SL-C (refer to raining category/user group for all applicable training needed)	☒ ADT Driver Training/Jacobs Permit to Drive
☒ Embracing BeyondZero	☒ Other (specify): Familiar with using rotohammer, review operating manual and operate in accordance with the manual

Required Jacobs Worker Training	Jacobs Task or Equipment-Specific Training (if performing task)
Project-Specific Required Training (available on Jacobs' E3 Learning and Development platform)	
☐ 3R Munitions Safety Awareness Training	☒ Hand Safety Training
☐ Cadmium Training	☒ Manual Lifting Training
☒ Drum Handling Training	☐ Railroad Safety On-line Training
☐ Excavation Safety Training	☒ Traffic Safety Training
☒ Globally Harmonized System Training (HazCom)	☒ Other (specify) Silica awareness training

12.2 HAZWOPER-Exempted Tasks

The following tasks are not within the scope of the HAZWOPER standard so HAZWOPER training is not required for workers performing these tasks:

In general, the regulation doesn't apply if:

- Workers work exclusively within uncontaminated areas of the hazardous waste site,
- Do not enter areas where hazardous waste may exist, are stored or are processed, and
- Are not exposed to health or safety hazards related to hazardous waste operations.

Note—tasks below must meet all three bulleted items above.

Task	Task
Site visits outside of demarcated exclusion zones where sampling is being performed	

13. Medical Surveillance and Qualification

The following medical surveillance is required for Jacobs and subcontractor personnel working onsite. Copies of physician's medical opinion will either be available onsite, or for Jacobs staff, readily available from the Jacobs Learning Management System database. Refer to Section 13 of the Handbook for a description of HAZWOPER, respirator user, and hearing conservation medical surveillance.

Table 6: Medical Surveillance Requirements

General Required Medical Surveillance	Job or Activity-Specific Medical Surveillance (required if performing this work)
☒ HAZWOPER Medical Clearance	☒ Noise
☒ Respirator Medical Clearance	☐ Baseline Blood Lead
	☐ Asbestos Medical Clearance
	☐ Other (specify):

14. Site Control Plan

Site control is established to prevent the spread of contamination at the site and to ensure that only authorized individuals are permitted into potentially hazardous areas.

Use of the buddy system will be implemented. The SL will implement site control procedures for Jacobs work. Site control will vary dependent upon the activity and location where the activity is taking place.

For activities such as groundwater sampling, extraction well work, site control shall be dependent upon the potential for unauthorized personnel entering the work space. If there is potential, cones, flagging or some other form of demarcating the work zone shall be used.

Establish onsite communication consisting of the following:

- Line-of-sight and hand signals
- Air horn
- Mobile phone
- Establish and maintain the "buddy system."
- Initial air monitoring is conducted by the SL in appropriate level of protection.

The SL is to conduct periodic inspections of work practices to determine the effectiveness of site control. Deficiencies are to be corrected by the subcontractor or SL and noted in the field log book.

15. Decontamination

15.1 Decontamination During Medical Emergencies

Refer to the Handbook, Section 15, "Decontamination," for a complete description of decontamination activities and diagrams of typical decontamination areas. Decontamination areas will be established for work in potentially contaminated areas to prevent the spread of contamination. Decontamination areas should be located upwind of the exclusion zone where possible and should consider any adjacent or nearby projects and personnel. No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones.

All contaminated material generated through the personnel and equipment decontamination processes (e.g., contaminated disposable items, gross debris, liquids, sludges) will be properly containerized and labeled, stored at a secure location, and disposed in accordance with project plans.

Personnel	Sample Equipment
• Body-coverall/apron removal, if used • Glove removal • Hand wash/rinse • Face wash/rinse • Shower ASAP • Contain PPE for disposal	• Wash/rinse equipment • Contain rinsate for disposal, as directed by the waste management plan • Containerize, label and transport purge water to drum per waste management plan

16. Communications

A primary and backup means of communication for field crews have been established as described below:

Type of Communication	Primary Means	Backup Means
Communication between field crew	☒ Voice	☐ Voice
	☐ Radio	☐ Radio
	☐ Phone	☒ Phone
Communication with Office crew	☐ Radio	☐ Radio
	☒ Phone	☒ Landline
Communication with Fire and Emergency Services	☐ Radio	☐ Radio
	☒ Phone	☒ Landline

17. Required Facilities and Equipment

(See P&PS Procedure, IB-HS-PR-0600-IB, Health and Well Being)

The following facilities and equipment are required and used for safe completion of work:

Facility	Type	Location
☒ Restrooms	In authorized indoor locations (buildings)	Varies
☒ Supplementary Illumination (as needed)	Portable type if needed	At work site
☒Emergency Eyewash	Squeeze bottle type or full eyewash capable of flushing eyes for 15 minutes (e.g., injections or other chemical)	In field vehicles, staged at work area
☒ First aid kit/supplies, bloodborne pathogen kit	Portable, Class A, Type IV (for GW monitoring)	In field vehicles, staged at work area
☒ Fire extinguishers	Type ABC	In vehicles, staged at work area
☒ Spill Kit(s)	Portable, various sizes	In vehicles, staged at work area
☒ Potable Water		In field vehicles
☒ Shade/rest area	Portable tarps/canopies, A/C vehicle	Varies as needed
☒ COVID Mitigation supplies such as hand sanitizer, disinfectant wipes	hand sanitizer, disinfectant wipes	In field vehicles

18. Emergency Response Plan

Personnel responsible for coordinating emergency situations during site activity are identified below. The Emergency Contacts Page and a site map showing assembly points and directions to the authorized medical facility is at the front of this plan. Documented rehearsal and critique of this plan is required at least once during the task, or more often as necessary.

Responsibility	Name	Phone Number(s)
Emergency Response Coordinator (ERC)	Deirdre Kearney	Mobile: (781) 710-4276
Alternate ERC	Erin McGuire	Mobile: (978) 660-0814
Type (desk or field) and frequency of rehearsal	N/A – short duration work, review emergency response actions upon mobilization at new work locations	

If an emergency situation develops which requires evacuation of the work area, the following steps shall be implemented.

Evacuation Step	Methods and comments:
Notify affected workers	Notify Jacobs workers of any evacuation needed via voice, radio or phone, use evacuation route and rally point. Notify subcontractors.
Evacuate to safe location	Evacuate to the designated rally point (determined daily by SL)
Assemble and account for workers	SL to account for all workers, contact subcontractor and ensure subcontractor has accounted for all workers
Notify Supervisor/Manager	Notify Jacobs PM, HSM, (EM if needed) of incident
Complete incident report	HSM or EM to complete with input from SL

Potential emergency situations and response actions are identified below.

In case of:	Response actions:
Injury or illness	Major Medical: FA/CPR trained personnel respond. If additional response required, contact local emergency responders and 911. Have a designee assist with guiding ambulance service to site if needed. If Jacobs P&PS employee, call WorkCare at 888-449-7787. Minor Medical: FA/CPR trained personnel respond. If Jacobs P&PS employee, call WorkCare at 888-449-7787. Transport to occupational health clinic if advised to do so.
Chemical exposure	Decon affected employee, seek medical treatment if necessary. Utilize eyewash and shower if needed. If additional response required, contact local emergency responders. If Jacobs P&PS employee, call WorkCare at 888-449-7787.
Fire or explosion	Evacuate site to designated location, call 911. Provide necessary first aid, seek treatment if necessary. For small fires, only respond to trash can size fires with site fire extinguishers.
Adverse weather	Shut down work; rally to nearest structure.

Heat Stroke	Call 911, have a designee give location and directions to ambulance service if needed. If Jacobs P&PS employee, call WorkCare at 888-449-7787.
Material spill or release	Appropriate spill response materials for all chemicals must be present at the job site. Only qualified (by training and previous experience) who have proper PPE and equipment available shall provide spill response operations, when safe to do so. Immediately identify the character, exact source, amount, and areal extent of any released materials, if safe to do so.
Active Shooter	Have a plan when working on client premises—look for at least 2 evacuation routes/points. Program emergency numbers in your phone (client emergency service numbers, HSM, PM, Supervisor, WorkCare, US Security Officer, Keith Waddell (214-920-8327). If an active shooter is on the premises follow Run, Hide, Fight: • Run: Leave belonging behind. Try to get out of the building or danger area if possible using exits. Call 911 when in a safe area and then call Keith Waddell, Security (+1 214 616 5662 (mobile)), PM and HSM. • Hide: Act quickly - Find a place, closet or office, or something to hide behind out of the vision of shooter. Lock or barricade or otherwise secure the spot if possible. Turn off lights, silence cell phones. Stay calm and quiet • Fight: Last resort! If your life is at risk—work alone as or as a group. Use improvised weapons, act aggressively, disarm or injure the shooter, commit to your actions. When law enforcement arrives – stay calm—show hands, spreading fingers. Avoid sudden movements, yelling or pointing. Allow law enforcement to do their job to control the area. Their first priority is finding the shooter. Once you are safe – be sure to notify your supervisor, the PM, and HSM of your status. The PM/Supervisor shall follow the incident reporting process, including notification in accordance with the incident reporting flowchart. HSM will complete an Intelex report.

Evacuation Signals:	Meaning:
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

19. Incident Notification, Reporting, and Investigation

(See P&PS Work Instruction IB-HS-WI-0400-IB, P&PS Incident Reporting and Investigation)

19.1 Incident Notification

All employees and subcontractors' employees shall immediately report any incident (including "near misses,") in which they are involved or witness to their supervisor.

The Jacobs or subcontractor supervisor, upon receiving an incident report, shall inform his immediate supervisor and the Jacobs SL (see incident notification flowchart at the end of this section).

The SL shall immediately verbally report the following information to the HSM and PM by phone and e-mail (an initial incident notification form is available as an attachment to this PHSEP):

- Project Name and Site Manager;
- Date and time of incident;
- Description of incident;
- Extent of known injuries or damage;
- Level of medical attention; and
- Preliminary root cause/corrective actions

If the incident was an environmental permit issue (potential permit non-compliance, other situation that result in a notice of violation) or a spill or release, contact the Project EM immediately so they can evaluate reportable quantity requirements and if subsequent agency notification is required.

In critical emergency situations (medical, natural disaster, security, civil unrest, etc.), the local emergency responders listed on the Emergency Contact Page should be the initial point of contact. If necessary, use the Jacobs International SOS (ISOS) application (Membership #: 14AGDA950544IT). ISOS provides expanded medical and security advisement resources.

19.1.1 Determine the Actual Severity and Worst Potential Severity

Work with your HSM or EM and use the severity table below to determine the Actual Severity (AS) and the Worst Potential Severity (WPS) of the incident. WPS is a way of rating the incident based on what harm may have realistically been experienced considering the controls in place at the time had the incident realized its full potential. Once the AS and WPS are determined, ensure the verbal reporting take place at the time period specified. Ensure that both operations and HSE chains are notified. AS and WPS with increasing severity requires a higher level of notifications. See table and incident notification flowchart.

AS or WPS (specific Operations reporting requirements)	Injury/Illness	Environment	Reputation	Economic / Material Production	Motor Vehicle Incident (MVI)
5 (Report up to LoB President and CEO within 2 hours)	Fatality or total permanent disability or kidnapping	Serious off-site impact, significant remediation required	International media coverage; regulatory sanction	USD$ > 3 million	Collision with another vehicle or object with at least one vehicle moving at high speed; >50mph (80kph) or an incident involving vehicle roll-over or striking a pedestrian, bicycle or motorcycle
4 (Report up to LoB SVP within 2 hours)	Partial disability; life changing; intensive care or aggravated assault	Significant off-site impact, some remediation required	National media coverage; regulatory action	USD$ 300k-3mill	Collision with another vehicle or object with at least one vehicle moving at medium speed; >40 and 65kph and < 80kph)
3 (Up to VP/GM within 2 hours)	Urgent treatment; surgery or assault	Release significantly above reportable limit or some local impact	State media coverage; Prohibition Notice	USD$ 30k-300k	Collision with another vehicle or object with at least one vehicle moving at medium speed; >30 and < 40mph (>48kph and < 65kph)
2 (Up to Regional Ops within 1-2 hours)	Medical treatment to prevent deterioration (i.e., more than first aid) or harassment	Release above reportable limit or minor impact	Local media coverage; citations/ fines	USD$ 3k-30 k	Low speed collision (< 30mph or 48kph) with another vehicle or object
1 (up to PM by end of the day)	Simple, immediate treatment or simple threat	Small release contained onsite and no impact	No media coverage	USD$ < 3 k	Minor collision while stationary or moving at slow speed while parking, backing, or maneuvering

19.2 Intelex and Incident Report Form

The HSM or EM shall complete an entry into the Intelex system located on JacobsConnect. The SL shall summarize the incident and provide any pictures and forward it to the HSM within 24 hours.

19.3 WorkCare Injury Management and Return to Work (for U.S./Puerto Rico-based P&PS Jacobs Staff Only)

In the event of an injury, or potential injury (i.e., involvement in motor vehicle collision with no apparent injury; a puncture wound with no bleeding or apparent infection, etc.), the following actions shall be taken:

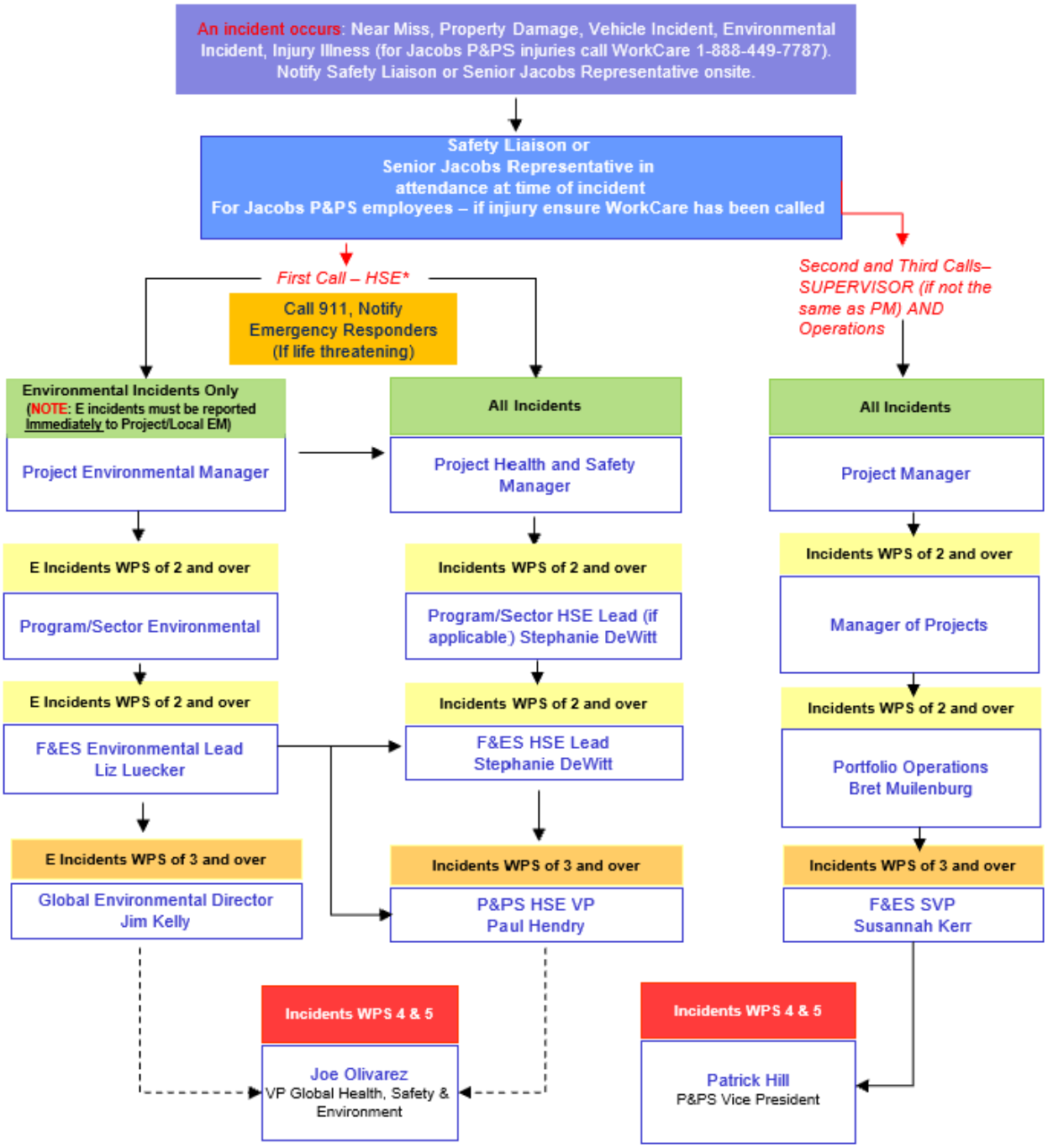
- Employee informs their supervisor.
- Employee calls the Injury Management Program toll free number 1-888-449-7787 immediately and speaks with the Occupational Injury Nurse. This number is operable 24 hours per day, 7 days a week. **Employees are encouraged to enter this phone number into their cell phones prior to starting field work.**
- Supervisor ensures employee immediately calls the Injury Management Program number. Supervisor makes the call with the injured worker or for the injured worker, if needed.
- Nurse assists employee with obtaining appropriate medical treatment, as necessary schedules clinic visit for employee (calls ahead, and assists with any necessary follow up treatment). The supervisor or

SL accompanies the employee if a clinic visit is necessary to ensure that employees receive appropriate and timely care.

- SL or designee shall verbally notify the HSM and PM. The SL or designee may use the hardcopy Incident Report attached to this plan to forward to the HSM for Intelex entry. HSM completes the Intelex entry within 24 hours.
- Nurse notifies appropriate Jacobs staff by e-mail (supervisor, Health & Safety, Human Resources, Workers' Compensation).
- Nurse communicates and coordinates with and for employee on treatment through recovery.
- Supervisor and/or PM ensures suitable duties are identified and available for injured or ill workers who are determined to be medically fit to return to work on transitional duty (temporary and progressive).
- Supervisor and/or PM ensures medical limitations prescribed (if any) by physician are followed until the worker is released to full duty.

Verbal incident notification is made to both the HSE and the Operations chains to the indicated group depending on the severity, and any project, geographic, or client specific notification and reporting requirements as shown in the flowchart below (Also refer to P&PS Work Instruction IB-HS-WI-0400-IB, Incident Reporting and fInvestigation). The HSM will complete an Intelex report.

Jacobs F&ES Verbal Chain for Reporting all Field Incidents



* First call HSE – If the incident is an environmental incident, immediately (within 15 minutes) call the EM to ensure timely reporting to external agencies, if necessary. If any other type of incident, call the HSM as the first call.

Notes:

1. Worst Potential Severity (WPS) definitions are to be found in Global Work Instruction JJ-HS-WI-0400-JJ, HSE&S Incident Mgmg.
2. Actual 4 and 5 must be communicated to Legal and Communications by the HSE VP or GVP
3. All incidents involving Jacobs employees or a subcontractor under Jacobs control (including motor vehicle accidents, injuries, environmental incidents and near-misses) shall be reported as soon as possible **in person or by telephone**.
4. If your Project Manager is not your Line Manager, it is essential that a call is made to both.
5. Calls must be made to both the relevant HSE and operations chains. These are not alternatives.
6. Security and Sustainability Directors / VP's will be notified where appropriate by HSE&S VP / HSE VP
7. Where required by legislation, a Jacobs HSES&S Manger will make the necessary report to the enforcing authorities.

19.4 Drug and Alcohol-Free Workplace

(See Jacobs Human Resource Policy PL-EB-PL-6830-PL, Drug and Alcohol-Free Workplace)

All employees, subcontractors, and other employed individuals are expected to arrive at work fit to carry out their jobs and to be able to perform duties safely without any limitations due to the use or after effects of alcohol or drugs (whether prescribed, over the counter, or illegal).

It is forbidden to be present at the workplace after consuming alcohol or drugs and/or possess and/or consume alcohol or drugs at the workplace. Any employee or subcontractor who violates these rules will not be permitted to work. Immediate supervisors are responsible for monitoring adherence to the policy.

When an employee, subcontractor or employed individual arrives at work or during the workday and a supervisor reasonably believes that they are under the influence of alcohol or drugs, the supervisor must immediately contact Human Resources in order that the person can be provided with assistance and an investigation can be undertaken.

19.5 Post-Incident Drug Testing Requirements

(See Jacobs Human Resource Procedures US-EB-PR-6830-US, Drug and Alcohol-Free Workplace Testing, Searches and Inspection)

Post-Incident Drug and Alcohol testing may be initiated by the employee supervisor, Human Resources and/or Drug and Alcohol-Free Workplace Program Administrator (DAFWPA) when any of the following occur:

- An employee experiences a work-related injury on or in Company Property/Workplace with a Worst Potential Severity of 3 (WPS 3), or greater, as described in JJ-HS-WI-0400-JJ, HSE&S Incident Management, in which the Company reasonably believes (under the reasonable suspicion provisions and processes in the reference procedure (US-EB-PR-6830)) that drug and/or alcohol use is a contributing factor.
- An employee experiences an incident resulting in property damage where the Company reasonably believes the damages are rated at least a WPS 3, resulting in a cost of over US$30,000 or greater and/or where the employee is alleged to be at fault for causing the incident.
- Any incident with a WPS 3 or greater on or in Company property/workplace (to an employee or any third parties) involving the employee's use and operation of any heavy machinery and/or where the employee is alleged to be at fault for causing the Incident leading to injury while operating a motor vehicle or equipment.
- Any work-related incident involving an employee considered to be a serious near miss event rated at least a WPS 3 that occurs in the field or in the office as reasonably determined by the Company and where the Company reasonably believes (under and following the reasonable suspicion provisions and processes in this Procedure) that drug and/or alcohol use by the employee is a contributing factor to the serious near miss.
- Other circumstances as may be appropriate, as determined by management and HR, in consultation with the DAFWPA (and Legal, as necessary).

20. Inspections, Observations, and Leadership Engagement

20.1 Inspections and Audits

(See P&PS HSE Procedures IB-HS-PR-0400-IB, HSE Governance)

Various types of inspections, observations, and leadership engagement may be conducted, including the HSE Site Inspection Report, Leadership HSE Site Walks/Engagement, project activity self-assessments, Beyond Zero Observations, Agency inspections, and operational project reviews which are described below.

20.1.1 HSE Site Inspection Reports

The HSE Site Inspection Report shall be performed monthly by the PM or designee. It is available as an attachment to this plan or can be filled out electronically through the Intelex Audit Module (also available on mobile devices). If using a hard copy form, be sure to keep with the project files. Notify the HSM or EM of any findings.

20.1.2 Leadership Engagement/Site Visits

The project PM and Managers of Project (or their designees) will conduct a minimum of two Leadership Engagement sessions or Site Walks to the project every year (this would include ORRs, subcontractor chartering meetings, site walks, project kick offs when the PM/MoP participates). The PM may delegate completion to the task lead, field team leader, or construction manager if the project is of short duration and a visit is not planned.

The Leadership Engagement session or Site Walk will be documented using the Leadership Engagement tool in the Intelex Beyond Zero Observation Module. Contact your HSM if you need directions for completing the form and copy your HSM on your submittal. Examples of Leadership Engagement include leading the subcontractor chartering call, engaging with project team on matters of HSE, performing a site visit/walk to observe HSE at the project, completing a HSE Site Inspection Report, holding an HSE Stand-Down, etc.

20.1.3 Environmental Inspections

Additional environmental inspections may be required based on the scope of the project. These can include weekly hazardous waste container inspections, daily hazardous waste tank inspections, monthly oil Spill Prevention Control and Countermeasures (SPCC) inspections, and routine stormwater inspections. Contact your Environmental Manager to determine what environmental inspections may be needed. A separate plan (e.g., waste management, environmental, spill plan) may be appropriate and may include environmental inspection checklists; such a plan can be referenced in this section.

20.1.4 HSE Audits

HSE project audits will be determined and scheduled based on the risk profile of the project and input from the LOB or Regional BU HSE Lead. The F&ES HSE Project Audit Plan will be populated in the Intelex Audit Module. Audit findings will be entered into the Audit Module and findings tracked to completion.

20.2 Project Activity Self-Assessment Checklists

The following self-assessment checklists are required when the task or exposure is initiated and weekly thereafter. The checklists shall be completed by the SL or other Jacobs representative and maintained in project files.

Biological Hazards	Groundwater Sampling	Hand and Power Tools
Lifting	PPE	Traffic Control
Drilling		

20.3 BeyondZero Observations

(Reference Jacobs Global Work Instruction, JJ-HS-WI-0306-JJ, BeyondZero Observations)

BZOs are a required element of our BeyondZero Culture of Caring and can be performed for project observations as well as away from work. The minimum frequency on this project is to submit a BZO is once per week, using the BZO mobile app of Intelex platform on JacobsConnect.

Reach out to your HSM/EM if you need help entering aa BZO. Be sure to add the HSM (or EM if an environmental observation) to the "additional notifications" field of the BZO form so they are notified. Attach photos whenever possible.

20.4 Agency Inspections

If a Federal or local agency (e.g., OSHA, local water board, EPA, Department of Environmental Quality) announces it will be performing inspection, either announced or unannounced, refer to the attachment, Agency Inspections, in this plan. Contact the PM, HSM and EM as soon as you receive notice.

21. Records and Reports

Refer to the Handbook, Section 19, “Records and Reports,” for a complete description of HSE recordkeeping requirements.

22. PHSEP Induction Record

EMPLOYEE SIGNOFF FORM

By signing below, I have been instructed by the Project Manager (or their designee) in the following HSE requirements:

- Project HSE Plan
- Safe Work Methods
- General Workplace Hazards and Controls.
- I have been trained in the use of PPE
- I am aware of the project emergency procedure requirements.
- I have been introduced to the scope of work and general work locations
- I have completed an orientation of my work area with my supervisor

Project Name: Project Number:

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

Appendix A. Attachments

Employee Signoff Form
Project HSE Forms
- Chemical Inventory
- Chemical-Specific Training
- Daily Site Monitoring Report
- FCR Form
- FES POWRA and Daily Safety Meeting Sign-In
- HSE Site Inspection Form
- Heat Stress Monitoring Form
- StepBack Form
- Working Alone Contact Form

Project HSE Fact Sheets
- 2022 Ticks and Tickborne Pathogens Fact Sheet
- 2022 Vehicle Accident Guidance
- Agency Inspection Fact Sheet

Project Self-Assessment Checklists
- Drilling
- Groundwater Sampling
- Hand and Power Tools
- Lifting
- PPE
- Traffic Control

Jacobs HIIRAs

Appendix C
Public Notice

NOTICE OF AVAILABILITY

PUBLIC COMMENT DRAFT PARTIAL PHASE IV
REMEDY IMPLEMENTATION PLAN, PART 2

FORMER VARIAN FACILITY SITE
150 SOHIER ROAD, BEVERLY, MASSACHUSETTS
MADEP SITE #3-0485

On September 20, 2023, a Partial Phase IV Remedy Implementation Plan, Part 2 (Phase IV Plan, Part 2) was provided to the Massachusetts Department of Environmental Protection (MassDEP) for the former Varian Facility Site in Beverly, Massachusetts. The purpose of the Phase IV Plan, Part 2, is to present plans for the implementation of the selected remedial alternatives for the Building 5 Area, the Bedrock Area, and the PSL10 Area. The Phase IV Plan, Part 2, will be presented at a public meeting on November 14, 2023. Additional information about this meeting will be provided in a separate notice, and a public comment period will begin the next day.

A copy of the Public Comment Draft, Partial Phase IV Remedy Implementation Plan, Part 2, is on file and available for review at the local information repository established for this Site at the Beverly Public Library:

Beverly Public Library – Reference Desk
32 Essex Street
Beverly, MA 01915
978.921.6062
HOURS: Monday-Thursday 9:00 am- 9:00 pm
Friday and Saturday: 9:00 am- 5:00 pm
Sunday: 1:00 pm-5:00 pm

A copy of this report is also available at the MassDEP website at the following link:

<hyperlink>

Copy: PIP Mailing List

PARTIAL PHASE IV REMEDY IMPLEMENTATION PLAN, PART 2
Former Varian Facility Site in Beverly, Massachusetts,
Executive Summary

This Partial Phase IV Remedy Implementation Plan (Phase IV Plan, Part 2) was prepared for the Former Varian Facility Site in Beverly, MA. The Phase IV Plan, Part 2, presents plans for the implementation of the selected remedial alternatives to address the presence of volatile organic compounds (VOCs) in three site areas. This cleanup plan, as well as the remedial actions outlined in the March 2023 Phase IV Plan, Part 1, are expected to result in a Permanent Solution at the site. The following three site areas are included in the Phase IV Plan, Part 2:

- **Building 5 Source Area:** In situ bioremediation (ISB) and continued soil vapor extraction (SVE) system operation.

- **Bedrock Area:** In situ chemical oxidation (ISCO)

- **PSL10 Source Area:** Soil excavation with colloidal activated carbon permeable adsorptive zone (CAC PAZ) or a similar treatment pending additional assessment

The Phase IV Plan, Part 2, presents the following general remedial objectives for the three treatment areas:

- Control or eliminate the source
- Control chemical migration
- Remove dense nonaqueous phase liquid (DNAPL), where potentially present
- Reduce chemical concentrations in groundwater

In compliance with the Massachusetts Department of Environmental Protection (MassDEP) requirements, the purpose of the Partial Phase IV Plan, Part 2, is to:

- Ensure that the information, plans, and reports related to the design, construction, and implementation of the selected remedial alternative(s) are sufficiently developed and documented to support the implementation of the selected cleanup alternative(s)
- Ensure that following initial implementation, the selected cleanup plan meets design and performance specifications

To achieve this requirement, the Partial Phase IV Plan provides detailed information on the cleanup approaches for the Building 5 and the Bedrock treatment areas. These details include:

- Design and operation parameters for the cleanup alternatives
- Spill control in each area
- Waste management at the site
- Control measures for possible adverse impact of treatment
- Inspection and monitoring that will be completed
- Construction plans and specifications
- Operation and maintenance for the cleanup alternatives

- Permits and approvals
- General schedule

Implementation of the selected remedial action alternative in each area is intended to achieve a Permanent Solution at the site.