FIFTH FIVE-YEAR REVIEW REPORT FOR SULLIVAN'S LEDGE SUPERFUND SITE BRISTOL COUNTY, MASSACHUSETTS

Prepared by

U.S. Environmental Protection Agency
Region 1
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LIST OF ABBREVIATIONS & ACRONYMS

ALM	Adult Lead Methodology
ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substances and Disease Registry
AWQS	Ambient Water Quality Standard
BLL	Blood Lead Level
CASRN	Chemical Abstracts Service Registry Number
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIC	Community Involvement Coordinator
COC	Contaminant of Concern
DCE	1,1-Dichloroethene
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
ESV	Ecological Screening Value
FS	Feasibility Study
FYR	Five-Year Review
GERE	Grant of Environmental Restriction and Easement
GW-RBC	Groundwater Risk-Based Concentration
GWTP	Groundwater Treatment Plant
HFPO-DA	Hexafluoropropylene Oxide Dimer Acid
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
ICs	Institutional Controls
IRIS	Integrated Risk Information System
J	Estimated
LEL	Lower Explosive Limit
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
µg	Microgram
µg/dL	Micrograms per Deciliter
µg/L	Micrograms per Liter
mg/kg	Milligrams per Kilogram
mg/kg-day	Milligrams per Kilogram per Day
mg/L	Milligrams per Liter
MMCL	Massachusetts Maximum Contaminant Level
MRL	Minimal Risk Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ng/L	Nanograms per Liter
NPL	National Priorities List
O&M	Operation and Maintenance
OHHRRAF	OLEM's Human Health Regional Risk Assessment Forum
OLEM	Office of Land and Emergency Management
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PFAS	Per- and Polyfluoroalkyl Substances
PFBA	Perfluorobutanoic Acid
PFBS	Perfluorobutane Sulfonic Acid
PFDA	Perfluorodecanoic Acid
PFHpA	Perfluoroheptanoic Acid
PFHxA	Perfluorohexanoic Acid
PFHxS	Perfluorohexane Sulfonate

PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonic Acid
PMC	Project Management Committee
PMP	Performance Monitoring Plan
POC	Point of Compliance
ppm	Parts per Million
PPRTV	Provisional Peer Reviewed Toxicity Value
ppt	Parts per Trillion
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
RSL	Regional Screening Level
SL	Screening Level
TAL	Total Analyte List
TBC	To Be Considered
TCE	Trichloroethene
TOC	Total Organic Carbon
UU/UE	Unlimited Use and Unrestricted Exposure
VISL	Vapor Intrusion Screening Level
VOC	Volatile Organic Compound

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fifth FYR for the Sullivan's Ledge Superfund Site (Site). The triggering action for this statutory review is the completion date of the previous FYR. The FYR has been prepared because hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of two operable units (OUs). OU1 consists of a 12-acre former disposal area and the adjacent Unnamed Stream. OU2 consists of a 13-acre wetland called Middle Marsh and a 1.5-acre wetland area bordering the Unnamed Stream, referred to as the Adjacent Wetlands. This FYR addresses both OUs.

EPA remedial project manager (RPM) Kimberly White led the FYR. Participants from EPA included community involvement coordinator (CIC) Aaron Shaheen, human health risk assessor Courtney Carroll, ecological risk assessor TaChalla Gibeau and site attorney Naomi King. Additional participants included Dorothy Allen from the Massachusetts Department of Environmental Protection (MassDEP) and Johnny Zimmerman-Ward and Jill Billus from EPA FYR contractor Skeo. The Project Management Committee (PMC) for the Sullivan's Ledge Site Group (formed by the OU1 Settling Defendants) and the City of New Bedford, a responsible party, were notified of the initiation of the FYR. The review began on 2/6/2023.

Appendix A includes a list of documents reviewed for this FYR. Appendix B provides a chronology of site events.

Site Background

The Site is in the city of New Bedford, Bristol County in southeastern Massachusetts (Figure 1). The Site consists of a 12-acre former disposal area and the adjacent Unnamed Stream (OU1) and affected wetland areas downgradient of the former disposal area (OU2). The disposal area operated as a granite quarry from the 1840s through 1921. The City of New Bedford acquired the property in 1935 and used the quarry pits for the disposal of hazardous materials and other industrial and solid wastes through the 1970s. Waste disposal practices contaminated groundwater, soil, surface water and sediment, primarily with volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs) and other hazardous substances.

Current Site features at OU1 include the capped former disposal area and a groundwater treatment plant (GWTP) for treatment of VOC- and PCB-impacted groundwater (Figure 2). A 1.76-megawatt photovoltaic solar array was constructed on the cap in 2014. A fence surrounds the OU1 property and limits unauthorized access. Hathaway Road and the Whaling City Golf Club, owned by the City of New Bedford, are immediately north of the OU1 property. The Interstate 195/Route 140 interchange is to the south. Commercial properties are to the east and west. The Unnamed Stream flows from the former disposal area underneath Hathaway Road into the golf club.

OU2 is located within the Whaling City Golf Club. It consists of a 13-acre wetland called Middle Marsh and a 1.5-acre wetland area bordering the Unnamed Stream (400 feet upstream of the Middle Marsh), referred to as the Adjacent Wetlands (Figure 2). OU2 is bounded on the east and west by fairways of the golf course and to the south by Hathaway Road. Apponagansett Swamp is north of OU2.

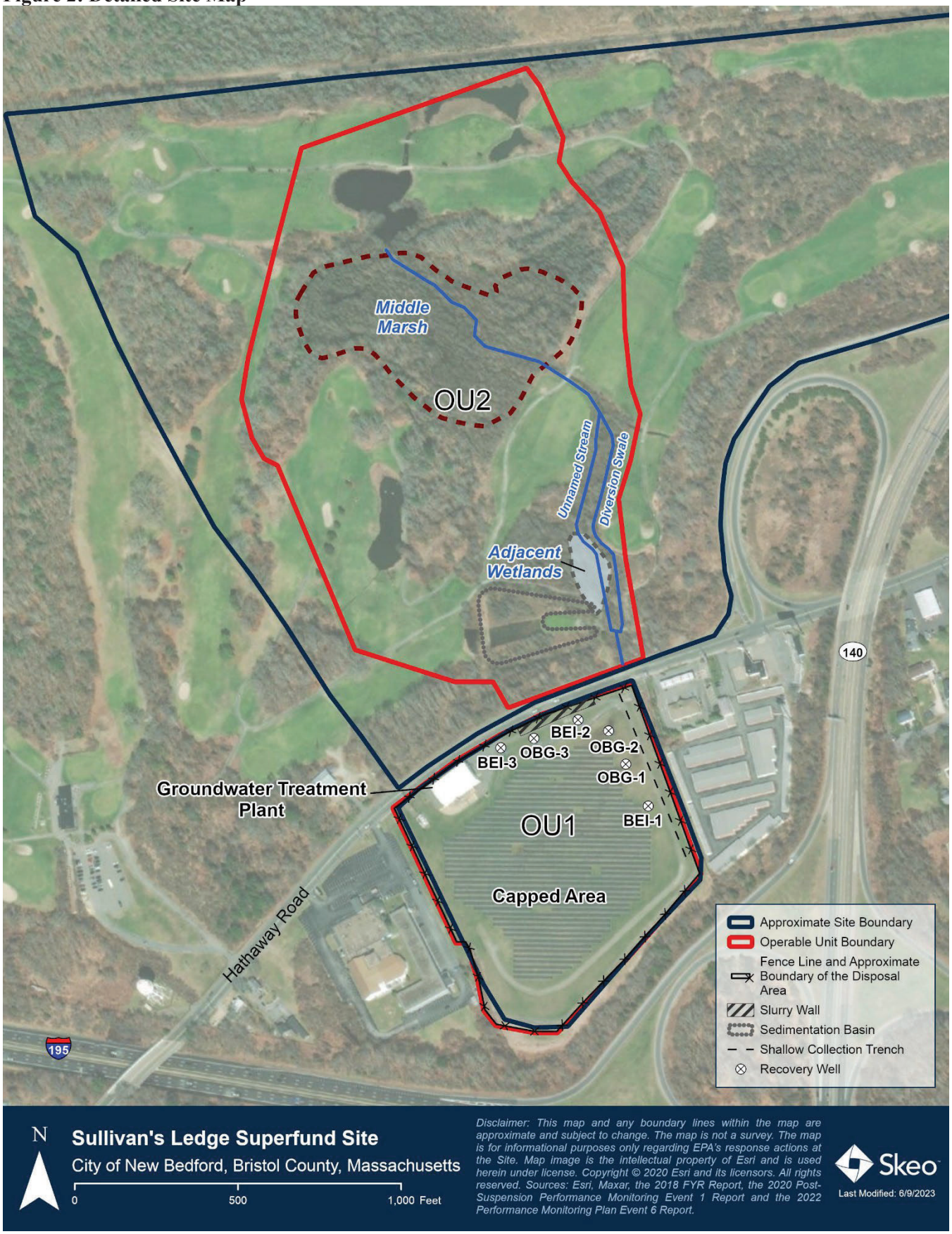
Groundwater beneath the Site occurs in overburden and shallow, intermediate and deep bedrock. Local groundwater flow in the overburden and bedrock beneath the former disposal area is generally to the northeast and north toward the downgradient wetland area, under non-pumping conditions. Groundwater beneath the Site is not used for drinking water. MassDEP issued a Final Groundwater Use and Value Determination for the Site in March 2016. MassDEP assigned a medium use and value to the groundwater at the Site based on the non-drinking water status of the groundwater beneath, and in close proximity to, the Site, along with the nearby presence of sensitive ecological receptors.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Sullivan's Ledge		
EPA ID: MAD980731343		
Region: 1	**State:** MA	**City/County:** New Bedford/Bristol
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA		
Author name: Kimberly White		
Author affiliation: EPA		
Review period: 2/6/2023 - 9/6/2023		
Date of site inspection: 3/22/2023		
Type of review: Statutory		
Review number: 5		
Triggering action date: 9/13/2018		
Due date *(five years after triggering action date)*: 9/13/2023		

Figure 1: Site Vicinity Map

Figure 2: Detailed Site Map



II. RESPONSE ACTION SUMMARY

Basis for Taking Action

In 1982, the Massachusetts Department of Public Works discovered the presence of electrical capacitors on site during test borings for the construction of a proposed commuter parking lot. EPA performed an air monitoring program of the greater New Bedford Area in 1982 and installed monitoring wells around the Site in 1983. Based, in part, on the results of the studies, EPA added the Site to the Superfund program's National Priorities List (NPL) in September 1984.

OU1

EPA completed a remedial investigation (RI) and feasibility study (FS) for OU1 in 1989. The results found high concentrations of PCBs in surface soil, subsurface soil and sediments, and VOCs and inorganics in overburden, shallow bedrock and deep bedrock groundwater. VOC contamination in groundwater increased with depth.

EPA's 1991 human health risk assessment (HHRA) for OU1 estimated potential human health risks associated with exposure to 59 indicator compounds in surface soils, sediments, air, surface water and groundwater. Appendix C includes the list of indicator compounds from the 1989 Record of Decision (ROD). The risk assessment assumed that access to the Site was restricted and the land was zoned as commercial but considered a proposed future use of the Site as a soccer field. Human health risks were calculated for an adult and an older child assuming occasional site visits and inadvertent contact with contaminated soil. PCBs and total polycyclic aromatic hydrocarbons (PAHs) contributed most of the total carcinogenic risk from direct contact with surface soils. Incidental ingestion of on-site soils by children was also a potential concern due to the lead in surface soil. Though groundwater was not a current source of drinking water, carcinogenic risks and noncarcinogenic hazards from future ingestion of groundwater were estimated. Benzene, trichloroethene (TCE), vinyl chloride and PCBs contributed over 99% of the total cancer risk. 1,1-Dichloroethene (DCE) was the major contributor to the noncarcinogenic groundwater hazard at the Site. Direct contact with contaminated sediments in the Unnamed Stream was the highest carcinogenic risk contributor from exposure to sediments.

The ecological risk assessment indicated that a potential risk existed for aquatic organisms due to exposure to contaminants in surface water of the Unnamed Stream. It was noted that risk to aquatic organisms due to PCB exposure in water could not be accurately evaluated because the detection limit for PCBs (1.0 micrograms per liter [µg/L]) was greater than the water quality criteria concentration (0.014 µg/L) at that time. However, PCB exposure via water for aquatic organisms was likely in the Unnamed Stream and water hazards on the golf course because of high levels of PCBs in sediment.

OU2

A supplemental RI and FS to address Middle Marsh and the Adjacent Wetlands (OU2) on the golf course property was completed in 1991. An HHRA for the OU2 area evaluated the potential risks to adult golfers, maintenance workers and older children who may frequent the OU2 area. It evaluated exposures to contaminated sediment/soil and surface water in Middle Marsh and the Adjacent Wetlands. Exposure to groundwater was not evaluated in the 1991 HHRA because it was addressed under OU1. The HHRA concluded that human exposures to contaminants in Middle Marsh and the golf course/wetland area through current and anticipated future pathways would not result in unacceptable risks or noncarcinogenic hazard.

The ecological risk assessment for OU2 completed in 1991 concluded that aquatic exposures and wetland/ terrestrial exposures to PCB-contaminated sediments in portions of the Middle Marsh presented an unacceptable risk to biota. The findings of the ecological risk assessment were the primary basis for the OU2 remedial action.

Response Actions

Initial Response

In the early 1970s, a fire occurred on site, primarily involving tires disposed of in the quarry pits. Due to concern regarding possible recurrence of such fires, efforts were made to regrade the Site to cover exposed refuse.

In September 1984, EPA issued an Administrative Order to the City of New Bedford, requiring them to install a fence around the former disposal area and post warning signs at the Site. The City of New Bedford completed the actions in 1984.

Remedy Selection

EPA selected the remedy for OU1 in the Site's 1989 ROD and modified the OU1 remedy with three Explanations of Significant Differences (ESDs) issued in 1995, 2000 and 2003. Table 1 presents the remedial action objectives (RAOs) for the OU1 remedial action and the selected remedy components for OU1.

EPA selected the remedy for OU2 in the Site's 1991 ROD. Table 1 presents the RAOs for the OU2 remedial action and the selected remedy components for OU2.

Table 1: OU1 and OU2 RAOs and Remedy Components

OU	RAOs	Remedy Components
OU1	• Prevent or mitigate the continued release of hazardous substances to the Unnamed Stream, Middle Marsh and Apponagansett Swamp. • Reduce risks to human health associated with direct contact with or incidental ingestion of contaminants in the surface and subsurface soils. • Reduce risks to animal and aquatic life associated with the contaminated surface soils and sediments. • Reduce the volume, toxicity or mobility of the hazardous contaminants. • Maintain air quality at protective levels for on-site workers and nearby residents during site remediation. • Reduce further migration of groundwater contamination from the quarry pits in the upper 150 feet of the bedrock groundwater flow system. • Significantly reduce the mass of contaminants in groundwater located in and immediately adjacent to the quarry pits. • Provide flushing of groundwater through the pits to encourage continued removal of contaminants at the Site. • Minimize the threat posed to the environment from contaminant migration in the groundwater and surface water.	*Source Control* • Excavation of contaminated soils and sediments from the Unnamed Stream, water hazards on the golf course property and other areas of OU1 with placement in the former disposal area. The 1989 ROD originally required treatment of excavated soils and sediment, but the 1995 ESD removed the treatment requirement. • Construction of an impermeable cap over the former disposal area. *Management of Migration* • Construction of a 750-foot-long underground culvert adjacent to the disposal area cap and construction of a new stream channel about the same length downstream on the golf course property to recreate wetlands habitat lost. The 1989 ROD originally called for the diversion and lining of a portion of the Unnamed Stream but the 2000 ESD replaced the requirement with the culvert. • Construction and operation of an active groundwater collection system composed of deep bedrock extraction wells located close to the disposal pits. • Construction of a passive underdrain collection system (collection trench) at the top of the bedrock surface along the eastern and northern boundaries of the disposal area. The 2000 ESD modified this remedy component to include construction of a 200-foot-long slurry wall in place of part of the collection trench along Hathaway Road. • Groundwater treatment consisting of oxidation/filtration for metals removal and ultraviolet/ozonation for organics removal. • Methane gas collection (required by the 2003 ESD). *Additional Measures* • Wetland restoration/enhancement of wetland areas adversely impacted by the remedial action and ancillary activities. • Long-term environmental monitoring of on-site (i.e., the former disposal area property) and off-site (i.e., areas outside the former disposal area property) overburden and bedrock groundwater and sediments in the Unnamed Stream.

OU	RAOs	Remedy Components
		• Institutional controls designed to ensure that groundwater in the zone of contamination will not be used as a drinking water source and to ensure that any use of the Site will not interfere with the effectiveness of the cap.
OU2	• Reduce exposure of aquatic organisms to PCB-contaminated pore water and sediments either through direct contact or diet-related bioaccumulation. • Reduce exposure of terrestrial and wetland species to PCB-contaminated sediment/soils through direct contact or diet-related bioaccumulation. • Prevent or reduce releases of PCBs to the Unnamed Stream and the Apponagansett Swamp. • Mitigate the impacts of remediation on wetlands.	• Site preparation. • Excavation of contaminated sediment/soils from portions of Middle Marsh and the Adjacent Wetlands. • Dewatering of the excavated materials. • Disposal of the materials beneath the cap that will be constructed over portions of the former disposal area. • Restoration of the affected wetlands. • Institutional controls to prevent future residential use of and to restrict access to Middle Marsh and the Adjacent Wetlands. • Long-term monitoring, including sediment/soil monitoring and wetlands monitoring.

Cleanup Levels

Soil and Sediment

Table 2 summarizes the soil and sediment cleanup levels for OU1 and OU2, as identified in the 1989 ROD and 1991 ROD.

Table 2: OU1 and OU2 Soil and Sediment Cleanup Levels

Contaminants of Concern (COC)	OU1			OU2	
	Soil Within Disposal Area[a]	Soil Outside the Disposal Area[a]	Sediment[b, c]	Sediment/Soil in Aquatic Areas in Middle Marsh[c]	Sediment/Soil in Non-Aquatic Areas in Middle Marsh and Adjacent Wetlands[c]
Total PCBs	50 mg/kg	10 mg/kg	20 µg/gram carbon	20 µg/gram carbon	15 mg/kg
Total Carcinogenic PAHs	30 mg/kg	--	--	--	--

Notes:

a) Human health risk-based level. The levels within the disposal area correspond to a 10^{-5} risk level under current site use conditions and a 10^{-4} risk level under future site use conditions (soccer field). The level outside the disposal area is based on a 10^{-5} risk. The cleanup level of 10 mg/kg is more stringent than the cleanup level for soil within the disposal area because soils outside the disposal area are located in unrestricted areas resulting in greater frequency of exposure. In addition, soils outside the disposal area will not be covered with a cap.

b) Applies to sediment of the Unnamed Stream, its tributaries and the golf course water hazards.

c) Ecological risk-based level.

mg/kg = milligrams per kilogram

µg = microgram

-- = cleanup goal not established for the area

Sources: 1989 ROD, pages 43 to 46, and 1991 ROD, pages 49 and 50.

Groundwater

The 1989 ROD identified VOCs and PCBs as contaminants of concern (COCs) in groundwater; however, it did not identify specific numeric cleanup goals for individual VOCs or PCBs in groundwater. The 1989 ROD states that EPA considers it technically impracticable from an engineering perspective to clean up the contaminated deep bedrock groundwater to maximum contaminant levels (MCLs) and Massachusetts drinking water standards.

EPA waived the requirements to meet MCLs promulgated under the Safe Drinking Water Act, Massachusetts drinking water standards and Massachusetts groundwater quality standards. Instead, EPA determined that the cleanup goals for groundwater are 1) the significant reduction of contaminant mass in bedrock groundwater, and 2) the protection of surface water bodies. Both goals are addressed by the active and passive groundwater collection systems at the Site.

Active Collection System Cleanup Levels
To address significant reduction in contaminant mass, two criteria are used to evaluate this goal: 1) a concentration range of 1 milligram per liter (mg/L) to 10 mg/L (1,000 µg/L to 10,000 µg/L) total VOCs, and/or 2) an asymptotic curve using groundwater monitoring data indicating that significant concentration reductions are no longer being achieved.[1]

Passive Collection System Cleanup Levels
The objective of the passive collection system is to prevent degradation of the Unnamed Stream by collecting shallow contaminated groundwater. The 1989 ROD for OU1 states that the cleanup levels for the passive system will be based on Ambient Water Quality Standards (AWQS) and the designated use of the receiving waters.

Status of Implementation

The section presents the remedial activities implemented at OU1 and OU2. It also addresses recommendations from a 2015/2016 EPA Optimization Review to improve the Site's remedy.

OU1

EPA reached a settlement agreement with 14 potentially responsible parties (PRPs), who formed the Sullivan's Ledge Site Group. The parties agreed to construct the OU1 remedy and perform operations and maintenance (O&M) activities for 30 years. EPA approved the remedial design for the OU1 remedy in June 1997. Remedial construction began in March 1998 and finished in 2002 (except for the landfill gas extraction system, which was added in 2004). In January 2003, EPA approved the March 2002 Sullivan's Ledge Superfund Site, Operable Unit 1, Remedial Construction Report. The following remedial activities were completed for OU1.

Site Preparation

Initial site activities included installation of fencing and gates, vegetation and debris clearing, demolition of a former car wash adjacent to the Site, grading, abandonment of monitoring wells within the former disposal area, proof rolling (or ensuring there are no unstable areas), and placement of a temporary cover over parts of the Site not scheduled for capping until a later phase.

Soil Excavation

Soil excavation took place in the bed of the Unnamed Stream and southern tributary, east bank (north and south of the car wash) and east of the stream channel. About 2,100 cubic yards of soil/rock were removed and placed in areas within the limits of the cap system. Post-excavation confirmation samples confirmed the cleanup criteria of 10 mg/kg PCBs had been met.

Diversion and Lining of the Unnamed Stream

This component of the remedy involved lining the Unnamed Stream east of the disposal area with a 72-inch pre-stressed concrete cylinder pipe.

[1] The Remedial Design/Action Plan Statement of Work for OU1, Section V.C.4.a, states that for the Active Collection System, "Consistent with the Consent Decree, the Groundwater Cleanup Standards must be demonstrated at all points of compliance sampling locations for one year (four consecutive quarters) during the operation of the active extraction and groundwater treatment systems before, upon approval of EPA, in consultation with the DEP, the active extraction system and groundwater treatment systems can be shut off."

Groundwater Collection and Treatment

The remedy component involved the construction of the active groundwater collection system and the passive groundwater collection system (shallow collection trench, the slurry wall and two recovery wells), and the GWTP.

The active groundwater collection system included installation of three bedrock recovery wells, conversion of three existing bedrock monitoring wells to recovery wells and installation of associated infrastructure to connect the recovery wells to the treatment plant. Figure 2 shows the locations of the six recovery wells.

The passive groundwater collection system consisted of a 660-foot-long shallow collection trench, manholes, a pump station, a valve vault and associated piping. A portion of the passive collection system was substituted with a slurry wall along the northern limits of the landfill cap and two recovery wells (called interim wells P-291 and P-192) with pumps, controls and associated piping. The slurry wall was installed to a depth of 20 to 25 feet and a width of 6 to 16 feet. However, due to debris encountered during excavation, the design goals were not met and there was a gap between the bottom of the slurry wall and the top of the bedrock surface of up to 20 to 25 feet. This resulted in recommendations to modify the collection trench, the cap and drainage collection features near Hathaway Road. The top 3 feet of the slurry wall were also subsequently stabilized. As of 2015, the groundwater from the shallow collection trench discharges either to the city sewer system or is pumped to the GWTP for treatment prior to discharge to the city sewer system. Discharge of water from the passive collection trench to the city sewer system provides a means for managing the water level in the trench and prevents off-site seepages.[2]

The GWTP began operating in December 1999. The ultraviolet/ozonation system was replaced with an air stripper and liquid-phase activated carbon system in 2010, as was discussed in the 1989 ROD.[3]

In 2015 and 2016, EPA conducted an optimization review of the Site's remedy, with a focus on OU1. More information on the review is in the Optimization Review section of this FYR Report. One of the recommendations was to discontinue the active extraction system and conduct post-shutdown monitoring if conditions allow. At the time, many of the point of compliance (POC) wells were meeting the performance standard (1,000 µg/L to 10,000 µg/L total VOCs). The purpose of the shutdown was to evaluate whether the GWTP is still needed and/or whether an alternative remedial action would be more effective. EPA, MassDEP, the City of New Bedford and the PMC signed an agreement for the shutdown in December 2018 following well repairs, as well as additional sampling and evaluations to establish the conditions of the performance monitoring period during the shutdown.

In January 2020, the PMC submitted a Final Sullivan's Ledge Ground Water Treatment Plant Suspension Plan. It provided the steps necessary to suspend operations and maintain the facility's equipment in such a condition that will allow the facility to be returned to service, if necessary. In June 2020, the PMC submitted a Final Post-Suspension Performance Monitoring Sampling Plan. The plan includes monitoring groundwater conditions inside and outside the disposal area at various frequencies over seven years.

EPA and MassDEP initiated the temporary shutdown of the GWTP on July 23, 2020, and the system was turned off the next day. The seven-year performance monitoring period began at that time. The sampling frequency at each monitoring location in the program varies (quarterly, semiannually, annually and bi-annually). To date, Events 1 through 7 have been performed. Post-suspension groundwater and pore water monitoring data collected indicate total VOC concentrations in groundwater are increasing and migrating north towards the OU2 wetlands. As a result, the GWTP was turned back on in May 2023. Recent data from the post-suspension performance monitoring program are addressed in the Data Review section of this FYR Report.

[2] The Ground Water Treatment Plant Operations & Maintenance Manual, dated May 2020, states that the discharge is permitted by the Industrial Pretreatment Permit issued by the Wastewater Division of the City of New Bedford.
[3] The 1989 ROD for OU1 had contemplated the use of air stripping with granular activated carbon if the ultraviolent/ ozonation system was determined to be ineffective or significantly more costly.

Cap Construction
Cap construction included installation of a gas venting system as well as installation of a geosynthetic clay liner, flexible membrane cover and synthetic drainage layer, placement of a barrier protection material and placement of topsoil. Work also included excavation and construction of the sedimentation basin, augmentation of the Hathaway Road culvert, construction of run-on/run-off controls and access roads, and installation of the perimeter fence and gates.

Wetlands Restoration/Enhancement
The restoration of affected wetlands in OU1 was conducted concurrently with OU2 wetlands restoration.

Sediment Treatment
About 7,600 cubic yards of sediment were excavated from a tributary of the Unnamed Stream and two golf course hazards (Ponds A and B). Post-excavation confirmation samples met the cleanup criteria of 20 µg PCBs/gram carbon. Excavated sediments were treated with stabilization agents (lime kiln dust and sand), moisture conditioned and placed within the limits of the cap system.

Active Landfill Gas Extraction System
Active methane gas removal was not part of the remedy specified in the ROD for OU1. However, landfill gas monitoring conducted in 2001 and 2002 indicated that several gas monitoring wells had methane concentrations that exceeded 25% of the lower explosive limit (LEL) for methane. A pilot gas extraction system was constructed and ran until early 2004.

EPA issued an ESD in 2003 to add active landfill gas extraction as part of the OU1 remedy. Installation of the full-scale landfill gas collection system began in early 2004 and became operational in June 2004. Over time, modifications have occurred to the system to address the accumulation of water/condensate in the lower leg of the collection system and to apply additional vacuum to the eastern portion of the landfill cap.

In 2018, the PMC conducted a soil gas study to better understand the potential source of the methane near gas monitoring well GM-18 where exceedances of the 25% LEL were observed. As discussed in an April 2019 Revised Soil Gas Evaluation Letter Report, there are several lines of evidence pointing to sources of methane outside the cap. Recent data are discussed in the Data Review section of this FYR Report.

The landfill gas extraction system continues to operate and landfill gas monitoring continues quarterly.

OU2
EPA and MassDEP entered into a Consent Decree with AVX Corporation as the lead settling party, the City of New Bedford and the OU1 settling parties requiring them to implement the OU2 remedial action. The OU2 settling parties implemented the OU2 remedial action between 1999 and 2001.

Activities associated with soil/sediment removal, including any necessary dewatering, took place from April 1999 to September 2000. A total of 25,485 cubic yards of soil, sediment and debris was removed from Middle Marsh and the Adjacent Wetlands. The soil/sediment was stabilized as needed and placed in the OU1 disposal area, prior to capping. Activities associated with wetlands restoration took place from July 1999 to September 2000. EPA approved the August 2001 Final Remedial Construction Report, Sullivan's Ledge Superfund Site, Second Operable Unit in January 2003. Long-term monitoring activities began at that time and are ongoing.

2015/2016 Optimization Review and Related Activities
EPA completed an optimization review of the Site's remedy in 2016. The optimization review included several recommendations, which are addressed in more detail in the 2018 FYR Report. As a result of the recommendations, the PMC or the City of New Bedford completed the following activities:

- Collected additional PCB groundwater data (completed in 2016; collection of additional PCB data is ongoing as part of the post-suspension monitoring program).

- Discontinued the active extraction system and conducted post-shutdown monitoring (ongoing).
- Installed a gravity line from the passive system collection trench to the sewer system (completed in 2015).
- Addressed methane at the eastern property boundary. The PMC completed a study in June 2018 and determined the methane may be from an off-site source. The PMC also connected gas vent GV-2 to the landfill gas extraction system in September 2019.
- Conducted additional wetlands monitoring (completed in 2021).

In addition, the optimization review recommended that the treatment system be streamlined. The City of New Bedford evaluated the potential for streamlining the system in an informal pilot study in 2016 and determined that operating costs would not be significantly reduced by modifying the system. The City did not plan to further pursue an alternative treatment process at that time.

The optimization review also recommended that EPA/MassDEP revisit the ROD groundwater cleanup criteria for the disposal pits and downgradient bedrock groundwater because the current cleanup standards do not address known risk at the Site. MassDEP issued a Final Groundwater Use and Value Determination for the Site in March 2016. MassDEP assigned a medium use and value to the groundwater at the Site based on the non-drinking water status of the groundwater beneath and in close proximity to the Site, along with the nearby presence of sensitive ecological receptors. The determination stated that potential vapor migration risk and impacts of groundwater discharge to surface water at concentrations that could pose a significant risk to aquatic organisms should be considered in evaluating risk and remedy performance. As an interim action, EPA developed groundwater risk-based concentrations (GW-RBCs) for protection of aquatic organisms in surface water that receives groundwater from the Site.

Institutional Controls

The 1989 ROD for OU1 called for institutional controls to ensure that groundwater in the zone of contamination will not be used as a drinking water source and to ensure that any use of the Site will not interfere with the effectiveness of the cap. The 1991 ROD for OU2 called for institutional controls to prevent future residential use of and to restrict access to Middle Marsh and the Adjacent Wetlands. Institutional controls have been implemented at the Site in the form of a Grant of Environmental Restriction and Easement (GERE), recorded with the Bristol County Registry of Deeds in May 2014. The institutional control instrument restricts residential, commercial and industrial uses of the Site, allows use of the downgradient part of the Site as a golf course, and requires any proposed use or activity be undertaken only with written approval of MassDEP.

The GERE stipulates that the City of New Bedford provide in January of each year an annual written compliance report to MassDEP, with a copy to EPA, the OU1 Settling Defendants and AVX. The annual compliance reports are required to describe any permitted activities and uses during the preceding year, summarize the implementation and status of any work plans required for those activities and uses, and certify that the City is in compliance with the restrictions and any related work plans. MassDEP and EPA have not received annual compliance reports from the City during this FYR period. Based on the FYR site inspection in March 2023, land use was consistent with the permitted uses in the GERE, and there were no signs of disturbed soil or groundwater use. However, the City is required to submit the annual reports to certify compliance with the restrictions outlined in the GERE.

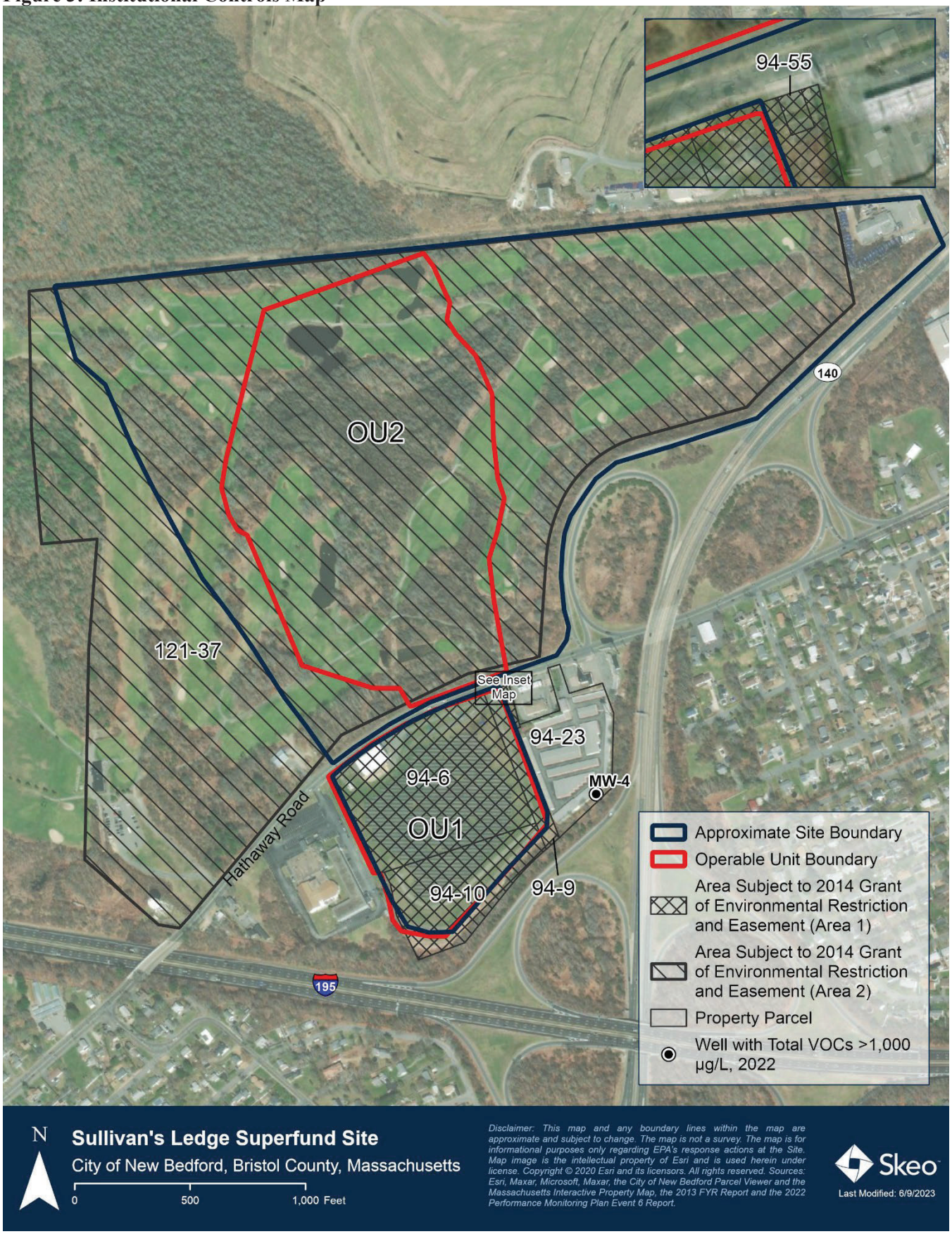
Table 3 summarizes the area covered by the institutional control instrument as well as its restrictions. Figure 3 shows the area covered by the institutional control instrument. Based on review of Figure G-6 and Figure G-10 in Appendix G, which show total VOC concentrations in groundwater in August 2022, groundwater contamination extends outside the area covered by the institutional control instrument. In particular, shallow bedrock well MW-4, located east of the OU1 landfill and on a property used for self-storage, had a total VOC concentration of 1,790 µg/L in 2022, which is generally consistent with concentrations observed prior to the GWTP shutdown. TCE contributed 940 µg/L of the total VOCs (compared to the TCE MCL of 5 µg/L). Although the property east of the Site is connected to public water, additional institutional controls may be needed to restrict use of groundwater to ensure long-term protectiveness.

Table 3: Summary of Planned and/or Implemented Institutional Controls (ICs)

Media, Engineered Controls, and Areas That Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Groundwater, the former disposal area (cap), Middle Marsh and Adjacent Wetlands sediment and soil, remedial components	Yes	Yes	Map 94, Lots 6, 9, 10 and 55 (Area 1, south of Hathaway Road) Map 121, Lot 37 (Area 2, north of Hathaway Road)	For Area 1 only: • Restrict excavation, removal or disposal of loam, peat, gravel, sand rock or other mineral or natural resource. For Area 1 and Area 2: • Restrict extraction, excavation, dewatering, consumption or utilization of groundwater for any purpose, including without limitation, extraction for potable, industrial, irrigation or agricultural use. • Restrict cultivation of crops for human consumption. • Restrict residential, commercial or industrial activities or use. • Restrict any use or activity that would disturb or interfere with or would be reasonably like to disturb or interfere with, the implementation, operation or maintenance of the remedy.	Grant of Environmental Restriction and Easement, May 2014
Off-site groundwater	Yes	Yes	Map 94, Lot 23 (parcel east of OU1)	• Restrict use of groundwater for any purpose.	To be determined[4]

[4] Additional monitoring data are required to evaluate whether hydraulic containment has been reestablished with the restart of the GWTP, which results in a reduction of contaminant concentrations over time in areas beyond the OU1 landfill. Further evaluation may also be needed to: 1) delineate the eastern extent of contamination beyond MW-4, and 2) determine if groundwater restrictions exist or need to be put in place to prevent access and use of the groundwater areas beyond the landfill, although groundwater has been classified as not being a current or potential drinking water source area.

Figure 3: Institutional Controls Map



Systems Operations/Operation & Maintenance (O&M)

OU1

The City of New Bedford is responsible for implementing O&M activities at OU1. The activities address O&M of the landfill cap, the groundwater collection and treatment system, and the landfill gas extraction system. The Sullivan's Ledge Site Group PMC implements the Site's groundwater, landfill gas, sediment and surface water long-term monitoring program.

Landfill Cap and General Site Maintenance

The City of New Bedford performs monthly inspections of the landfill cap and site security features in accordance with the 2002 Site Operations and Maintenance Manual. The City of New Bedford inspects the landfill cap for signs of vegetative stress, burrowing animals, settlement, erosion, slope instability and other damage. They also inspect three surveyed benchmarks, the access road, perimeter fence, gas vents, perimeter monitoring wells and drainage controls for signs of damage or other issues. The 2002 Site Operations and Maintenance Manual also requires inspections of the culverted portions of the Unnamed Stream every five years to ensure its integrity. The City of New Bedford documents the results of the inspections in monthly reports submitted to EPA and makes repairs as needed. Routine maintenance also includes mowing and clearing of vegetation in drainage swales. During this FYR period, damage to the perimeter fence was reported and repaired. As noted in the 2018 FYR Report, the Site's O&M Manual should be updated to reflect any changes in maintenance and monitoring since the solar array was added to the cap in 2014.

Groundwater Collection and Treatment System

With EPA and MassDEP approval, the GWTP was shut down in July 2020 in accordance with the January 2020 Suspension Plan. Prior to that time, the City of New Bedford performed O&M of the groundwater collection and treatment system in accordance with the 2000 Ground Water Treatment Plant Operation and Maintenance Manual (O&M Manual) and its revisions. The O&M Manual was most recently updated in May 2020 in anticipation of the GWTP shutdown but it did not address changes recommended in the 2018 FYR Report. When the GWTP was operating, the City of New Bedford prepared monthly reports documenting effluent and other GWTP operating data.

After the shutdown of the GWTP, the City of New Bedford performed maintenance and inspections of the GWTP as required by the 2020 Suspension Plan. During the shutdown, the shallow collection trench continued to discharge to the city's sewer system. The discharge is regulated by the city's industrial pretreatment performance program (discharge permit number L-026A). The flow to the sewer is monitored at manhole MH-4. The Data Review section of this FYR Report discusses recent monitoring results at MH-4.

With the anticipated restart of the GWTP, the City's industrial discharge permit L-026 was renewed and is effective from April 1, 2023, to April 1, 2026.

Landfill Gas Extraction System

The City of New Bedford performs O&M of the landfill gas extraction system in accordance with the revised 2020 O&M Manual. The landfill gas extraction system's purpose is to remove landfill gases (methane) that may accumulate beneath the cap. It is comprised of a blower to apply a vacuum, a knock out drum to collect any accumulated moisture, control valves and instrumentation controls.

In accordance with the April 2019 Revised Soil Gas Evaluation Letter Report, gas vent GV-2 was connected to the landfill gas extraction system during the week of September 16, 2019, and the differential pressure gauge and monitoring port were installed during the week of September 30, 2019. The objectives of connecting GV-2 to the landfill gas extraction system were to improve the radius of influence of the gas extraction system and to evaluate further lines of evidence regarding the source of methane on the eastern side of the Site.

Long-Term Surface Water, Sediment and Landfill Gas Monitoring
OU1 monitoring activities are conducted in accordance with the 2015 Surface Water, Sediment and Landfill Gas Monitoring Field Sampling Plan, with results submitted to EPA following the sampling events. The monitoring program includes:

- Collection and analysis of surface water and sediment samples once every two years from five locations within the Unnamed Stream.
- Quarterly monitoring of the perimeter gas monitoring wells and other locations for explosive gases and hydrogen sulfide.

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The Data Review section of this FYR Report presents recent results from the monitoring program.

Groundwater Monitoring
Prior to shutdown of the GWTP system in 2020, long-term groundwater monitoring took place quarterly through 2008 and then semiannually beginning in March 2009 in accordance with a 1996 Post-Construction Environmental Monitoring Plan. In 2020, the long-term groundwater monitoring program was temporarily suspended and replaced with the Post-Suspension Performance Monitoring Plan (PMP).

The PMP includes monitoring groundwater conditions inside and outside the disposal area during 12 sampling events (i.e., Event 1 through Event 12) at various frequencies over seven years (quarterly for one year, semiannually for two years, then annually for four years) subsequent to the temporary shutdown of the GWTP on July 24, 2020. The sampling approach is presented in the June 2020 Sullivan's Ledge Superfund Site – Post-Suspension Performance Monitoring Sampling Plan. It includes monitoring at the sample locations shown on Figures D-1 through D-5 in Appendix D. Samples are analyzed for VOCs and PCBs. The Data Review section of this FYR Report presents recent results from the post-suspension PMP.

In May and June 2021, PMC contractors rehabilitated monitoring wells MW-8 and MW-10B and replaced the bladder pump system at MW-17 to address issues previously identified at these wells during the PMP events. The sampling frequency was also modified in 2021 to include quarterly sampling in year three due to changing conditions of the groundwater. With the request to restart the GWTP, EPA and MassDEP also requested that an updated monitoring and maintenance plan for the GWTP be provided.

OU2

Wetland Restoration Monitoring
Post-construction environmental monitoring and long-term wetlands monitoring activities are conducted in accordance with the 1997 Wetland Restoration Plan and the 1999 Final Operation and Maintenance Plan for the Second Operable Unit. Wetland monitoring is to be performed annually for the first three years after initial restoration, during the fifth year, and once every five years thereafter. Previous wetland monitoring events took place in 2001 through 2006, 2011 and 2017. Wetlands monitoring activities include monitoring of hummocks, wetlands hydrology, soil development, and biological attributes including survival rates of planted trees and shrubs, tree growth, vegetative diversity, plant community, and presence of the Mystic Valley Amphipod.

The City of New Bedford led the most recent wetlands monitoring event in 2021, with results documented in the 2022 Environmental Monitoring Sampling and Results Report. It combined results for OU1 and OU2 wetlands monitoring. The Data Review section of this FYR Report summarizes recent results.

III. PROGRESS SINCE THE PREVIOUS REVIEW

Table 4 includes the protectiveness determinations and statements from the 2018 FYR Report. Table 5 includes the recommendations from the 2018 FYR Report and the current status of those recommendations.

Table 4: Protectiveness Determinations/Statements from the 2018 FYR Report

OU #	Protectiveness Determination	Protectiveness Statement
OU1	Short-term Protective	The remedy for OU1 is currently protective of human health and the environment because the construction of the remedy is complete, operation and maintenance and monitoring of the remedy is being performed, and institutional controls are in place. However, in order for the remedy to be protective in the long term, the following actions need to be taken to ensure protectiveness: 1) evaluate monitoring data and take actions necessary to ensure gas is not migrating beyond the boundaries of the landfill; 2) enhance the monitoring network on the north side of Hathaway Road to effectively monitor VOCs and PCBs beyond the disposal area; and 3) sample for perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS) and perfluorobutane sulfonic acid (PFBS) contaminants.
OU2	Short-term Protective	The remedy for OU2 is currently protective of human health and the environment because the construction of the remedy is complete, operation and maintenance and monitoring of the remedy is being performed, and institutional controls are in place. However, in order for the remedy to be protective in the long term, continue to monitor PCB concentrations in sediment and take corrective actions as needed to ensure protectiveness of aquatic organisms.
Sitewide	Short-term Protective	The remedies for the Site are protective in the short term, of human health and the environment because the construction of the remedy is complete, operation and maintenance and monitoring of the remedy is being performed, and institutional controls are in place. However, in order for the remedy to be protective in the long term, the following actions are needed to ensure protectiveness: 1) evaluate monitoring data and take actions necessary to ensure gas it is not migrating beyond the boundaries of the landfill; 2) enhance the monitoring network on the north side of Hathaway Road to effectively monitor VOCs and PCBs beyond the disposal area; 3) sample for PFOA, PFOS and PFBS contaminants; and 4) continue to monitor PCB concentrations in sediment and take corrective actions as needed to ensure protectiveness of aquatic organisms.

Table 5: Status of Recommendations from the 2018 FYR Report

OU #	Issue	Recommendation	Current Status	Current Implementation Status Description	Completion Date (if applicable)
OU1	Elevated methane levels were detected along the eastern property boundary above 25% of the lower explosive limit (LEL) and is therefore, not in compliance with the goals of the 2003 ESD and the Post-Construction Environmental Monitoring Plan.	Review the findings of the bar hole study and conduct any necessary evaluations to ensure gas is not migrating beyond the boundaries of the landfill. Implement a Corrective Action Alternative Analysis and modify the landfill gas monitoring, extraction and collection system as needed.	Completed	Gas vent GV-2 was connected to the landfill gas extraction system in September 2019. Landfill gas data on the eastern boundary of the Site continue to show methane levels similar to before the connection of GV-2 to the system. Ongoing monitoring indicates that methane may be from a source outside the landfill.	6/19/2020

OU #	Issue	Recommendation	Current Status	Current Implementation Status Description	Completion Date (if applicable)
OU1	PCBs in groundwater within the disposal area may be mobile and the current monitoring network may not be adequate for monitoring PCBs.	Enhance the monitoring network on the north side of Hathaway Road and conduct and sample the new locations for VOCs and PCBs.	Completed	Additional wells (including multi-level well ECJ-5 near the stream just north of Hathaway Road) were installed and samples collected for VOC and PCB analysis. Monitoring is ongoing to evaluate the mobility of PCBs.	9/30/2019
OU1	It is unknown if PFBS, PFOA or PFOS were released at the Site.	Include per- and polyfluoroalkyl substances (PFAS) that include PFOS, PFOS and PFBS in an upcoming groundwater monitoring event to determine if these compounds are associated with the Site.	Completed	EPA contractors sampled for PFAS in March 2023. PFAS were detected in several groundwater samples. Results are presented in the Data Review section of this FYR Report.	3/22/2023
OU2	Sediment monitoring indicates some PCB concentrations above the total organic carbon (TOC) normalized cleanup levels, which if increased could potentially pose a risk to aquatic organisms. The total PCB concentrations do not appear to be increasing at this time.	Collect the required sediment samples and implement corrective actions as needed.	Completed	The City of New Bedford completed a wetland sampling event in 2021, with results reported in the 2022 Environmental Monitoring Sampling and Results Report, Sullivan's Ledge Superfund Site, Operable Unit 2. Sediment PCB results were below the ROD cleanup goals. Results are presented in the Data Review section of this FYR Report.	8/25/2022

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Community Involvement and Site Interviews

EPA issued an online news release in January 2023 to announce that the FYR was underway. A copy of the news release is included in Appendix E. The results of the review and the completed FYR Report will be made available at EPA's site profile page at https://www.epa.gov/superfund/sullivansledge.

During the FYR process, interviews were conducted to document any perceived problems or successes with the remedy that has been implemented to date. The results of these interviews are summarized below. Appendix F includes the completed interview forms.

Dorothy Allen, the MassDEP project manager, noted that the GWTP is aging and needs continued repairs and upgrades. Before shutdown it contained the plume and provided appropriate treatment. The active gas collection system needs monitoring but captures most of the disposal area gas. Since the shutdown the groundwater contamination has spread and no longer meets the performance standards. The treatment plant needs to restart and to pump and treat an adequate volume of groundwater to draw back and once again contain the plume of contamination. Ms. Allen also noted that the recent shutdown has demonstrated that the pump-and-treat remedy

has not addressed the source of the contamination and that to contain the plume, it would need to operate for an indeterminate period of time to meet the performance standards stipulated in the ROD. Further, it is not clear if these standards are appropriate for the Site since they are not risk based. A re-examination of the performance standards for the Site and design of a more appropriate long-term remedy is necessary. She noted that the Site is in reuse as a golf course, wetland habitat and electricity generating location.

Marilyn Wade, a representative from Brown and Caldwell on behalf of the PMC, indicated that overall, the remedy has been successful in reducing contaminant levels and restoring the wetland area. She noted that since GWTP operations were suspended and the PMP began in 2020, groundwater VOC concentrations were observed to increase in select wells. The most significant rebounding has occurred in the deep bedrock fracture zone. As a result, the GWTP will be restarted. The anticipated resulting trend is a decrease in groundwater concentrations with time as the recovery wells' cone of influence is reestablished and expands to provide containment. She also noted that landfill gas monitoring events are consistent from quarter to quarter. While methane is detected at gas monitoring well GM-18, multiple lines of evidence from collected data support that the methane is from an off-site source. The PMC suggests reducing the landfill gas monitoring events from quarterly to semiannual.

James Costa, Superintendent of Wastewater for the City of New Bedford, is well informed of the Site's activities. The City of New Bedford collects regular monitoring data for the GWTP when it is operational. O&M activities have recently focused on repairs and maintenance for the facility to function properly. He noted that the plant needs extensive repairs and part replacements due to its operational timeframe and would benefit from an overhaul or replacement of the facility. He was unaware of changes to local regulations that might affect the protectiveness of the Site's remedy. He was unaware of any changes in projected land use.

EPA's CIC also made several attempts by phone and once in person to speak with a representative of the Whaler Inn and Suites, which abuts the Site to the west. However, no response was received.

Data Review

Data reviewed for this FYR include groundwater and sediment pore water data from the post-suspension PMP, OU1 monitoring data for direct discharge to the city sewer, OU1 surface water and sediment monitoring data, OU1 landfill gas monitoring data and OU1/OU2 wetlands monitoring data. Per- and polyfluoroalkyl substances (PFAS) analytical data from a March 2023 groundwater sampling event were also reviewed. General findings of this review are:

- Total VOC concentrations have rebounded since operation of the GWTP was suspended in July 2020. The most significant rebound and increasing concentration trends are seen in the intermediate and deep bedrock groundwater north of Hathaway Road between the former disposal area and the golf course. As a result, the GWTP was turned back on in May 2023 to reestablish hydraulic containment.
- Total VOC concentrations in POC wells exceed the total VOC cleanup standard of 1,000 µg/L to 10,000 µg/L.[5]
- Direct discharge of overburden groundwater from the collection trench to the city sewer continues to meet the discharge criteria at sample location MH-4.
- During biennial surface water and sediment sampling in 2019, VOCs and PCBs were not detected in surface water samples. Carbon normalized PCB concentrations in sediment were below the OU1 PCB sediment cleanup goal of 20 µg PCB/g carbon.
- Methane is consistently detected in landfill gas monitoring wells along the eastern side of the landfill cap (GM-17 and GM-18 and sporadically at GM-19 and GM-20) greater than 25% of the LEL. However, multiple lines of evidence suggest that the methane detections along the eastern site boundary are not site related.
- Wetlands monitoring observations at OU1 and OU2 support the trend that the Middle Marsh wetland has recovered from the restoration work for OU1 and OU2, although invasive species control should continue.

[5] POC wells were established in the Post-Closure Environmental Monitoring Plan, October 1996.

- Select groundwater samples were analyzed for PFAS for the first time in March 2023. Perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) were detected above EPA tap water regional screening levels (RSLs) in some samples. Total PFAS concentrations in most wells also exceeded the Massachusetts Maximum Contaminant Level (MMCL) for total PFAS.

More information on the data review is below.

PMP Monitoring

With EPA approval, operation of the GWTP was temporarily suspended in July 2020 and the seven-year post suspension PMP began. Event 1 of the PMP, which is considered the baseline sampling event, took place in October 2020. The most recent event for which data were available for review (Event 6) took place in August 2022. The primary source of information for this review is the Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Preliminary data from Event 7, completed in January 2023, were also reviewed and are discussed in context with the Event 6 data, as appropriate.

Groundwater Flow Direction

Figures G-1 and G-2 in Appendix G present overburden well and shallow bedrock well groundwater contours from Event 6 in August 2022. Overburden groundwater and shallow bedrock groundwater both flow northeast and north from OU1 toward the downgradient wetland area where it is discharged. Figures G-3 and G-4 present groundwater levels for the intermediate bedrock groundwater and deep bedrock groundwater, respectively. PMP monitoring is not required at enough monitoring wells to develop representative contours in these bedrock zones. However, based on the groundwater elevations, a general trend toward the downgradient wetland to the north is observed in both the intermediate and deep bedrock groundwater, consistent with the overburden and shallow bedrock groundwater flow directions.

Groundwater and Sediment Pore Water

Groundwater sampling locations for the post-suspension PMP included conventional monitoring wells, piezometers and Westbay® well ports within the overburden zone and shallow, intermediate and deep bedrock zones. Sediment pore water samples were also obtained from four locations (PW-1, PW-2, PW-3 and PW-4). The monitoring locations are shown on Figures D-1 through D-5 in Appendix D. Samples were analyzed for VOCs and PCBs. Tables H-1 and H-2 in Appendix H present summaries of the VOC groundwater data and PCB groundwater data from Event 6, respectively. The tables include the number of locations with detections, maximum detected concentrations and the location of the maximum detection concentration. VOC and PCB data are discussed separately below.

VOCs

As shown in Table H-1, cis-1,2-DCE, benzene, ethylbenzene, toluene, vinyl chloride and TCE were the six constituents present at the highest concentrations during PMP Event 6. The highest concentrations of these VOCs were detected in non-operational recovery well OBG-1 and shallow bedrock wells MW-24 and MW-4. Consistent with PMP Events 1 through 5A, cis-1,2-DCE was the highest detected VOC at 101,000 µg/L (in OBG-1 during PMP Event 6). The highest total VOC concentration was detected in OBG-1 at an estimated (J) concentration of 138,914 µg/L. Consistent with previous PMP sampling events, VOCs were non-detect in pore water sample PW-1. VOCs were also not detected in PW-2. Total VOCs were detected during PMP Event 6 at PW-3 (16.57 J µg/L), and PW-4/DUP PW-4 (148.36 J/150.45 J µg/L).

Figures G-5 through G-15 in Appendix G provide an aerial depiction of the changes in total VOC concentrations at all groundwater monitoring samples prior to startup of the GWTP in 1999, through the baseline sampling event in October 2020 (PMP Event 1) and in August 2022 (PMP Event 6). Graphs I-1 through I-4 in Appendix I present total VOC concentration trends in overburden groundwater monitoring locations, and shallow, intermediate and deep bedrock groundwater monitoring locations over PMP Events 1 through 6.

The PMP program data to date show that VOC concentrations in many wells in all of the monitored zones are increasing (Graphs I-1 through I-4) since shutdown of the GWTP in 2020. Some of the greatest increases, by one to two orders of magnitude, are in deep bedrock groundwater (Graph I-4). The data also show VOCs are

migrating downgradient of the former disposal area in overburden groundwater as well as shallow, intermediate and deep bedrock groundwater (Figures G-5 through G-15). Groundwater contamination in shallow bedrock also extends east of the OU1 landfill onto an adjacent parcel (MW-4). The eastern extent of contamination in this area is not delineated beyond MW-4 (Figure G-2).

As of August 2022, VOCs have not been detected in the following downgradient points of evaluation: MW-5A (overburden) and MW-5 (shallow bedrock) located northeast of the Site, MW-8A (overburden), MW-8, MW-10, and MW-10B (shallow bedrock) located in the wetland area, or in pore water PW-1 located in the downstream portion of the tributary. Only a low concentration (2.6 µg/L total VOCs) was detected once in overburden MW-10AR (during PMP Event 5A). VOCs were not detected in MW-10AR during PMP Event 6. Therefore, the extent of downgradient migration has not reached the furthest downgradient wells in the wetland area. Two of the locations noted above, MW-5 and PW-1, were also sampled in Event 7 in January 2023. VOCs were not detected in samples from either location.

The cleanup standard for the active collection system (recovery wells) is the significant reduction in the mass of bedrock contamination in the groundwater bedrock monitoring wells that are designated as POCs. The monitoring wells designated as POCs are bedrock wells MW-2, MW-4, MW-5, MW-6, MW-13, MW-17, MW-24, GCA-1 and all ports of Westbay® wells ECJ-1, ECJ-2 and ECJ-3. The analytical data from the most recent PMP Event through August 2022 during which the POCs were sampled show the cleanup standard of 1,000 µg/L to 10,000 µg/L of total VOCs was exceeded at POCs GCA-1, ECJ-1 (72), and all ports of ECJ-2.[6] The total VOC cleanup standard was not exceeded at POCs MW-2, MW-4, MW-5, MW-6, MW- 13, MW-17 and MW-24. ECJ-3 was not sampled during the PMP program. At those POCs sampled in PMP Event 7 (January/February 2023), the cleanup standard was exceeded at GCA-1, MW-6, ECJ-1 (72), ECJ-1 (267) and all ports of ECJ-2.

Due to increasing VOC concentrations, exceedances of the performance standard in POC wells and downgradient migration of contaminants, the PMC, in coordination with the City of New Bedford, restarted the GWTP in May 2023. Data collection and evaluation are ongoing to determine if the system will regain hydraulic control.

PCBs

PCBs have been detected in samples from six of the 27 points of evaluation (ECJ-2 [47], ECJ-2 [117], ECJ-2 [152] and ECJ-2 [187], ECJ-5-I4 and MW-6A) and in samples from nine of the 19 non-points of evaluation (OBG-1, BEI-1, ECJ-1 [72], ECJ-1 [267], GCA-1, MW-2, MW-12AR, MW-24 and PZ-12) during the PMP program to date.[7] The highest concentration of total PCBs in each groundwater zone during the PMP program to date were mostly detected in non-points of evaluation as follows: overburden MW-12AR at 0.96 µg/L during PMP Event 4; shallow bedrock MW-24 at 159 µg/L during PMP Event 6; deep bedrock ECJ-1 (267) at 1,141 µg/L during PMP Event 3; and in open-borehole former recovery well OBG-1 at 29.1 µg/L during PMP Event 5. The highest concentration of total PCBs in the intermediate bedrock was in point of evaluation ECJ-2 (152) at 12.5 µg/L during PMP Event 2.

Graphs I-5 through I-8 in Appendix I present total PCBs concentration trends in overburden groundwater monitoring locations, and shallow, intermediate and deep bedrock groundwater monitoring locations over PMP Events 1 through 6. The groundwater data from the PMP sampling events to date show decreasing trends in total PCB concentrations (when detected) or low fluctuating concentrations in most sampling locations. At the location (MW-24) where the data trend shows an increase in the concentrations of PCBs in the unfiltered and filtered samples obtained during the two PMP events sampled, the concentrations were either non detect or significantly less in the filtered samples. The PMP program data to date shows that PCBs have only been detected at low concentrations near the detection limit at points of evaluation ECJ-2 (47), ECJ-2 (117), ECJ-2 (152) and ECJ-2 (187), ECJ-5-I4 and MW-6A located upgradient of the tributary.

PCB data obtained from wells close to a surface water/sediment pore water discharge point (overburden MW-6A, shallow bedrock MW-6, ECJ-2, ECJ-5, PZ-16 and PZ-17) were also compared to a site-specific GW-RBC for

[6] For Westbay® wells, the well location is followed by the sample port depth, e.g., ECJ-1 (72).
[7] Established points of evaluation from EPA letter dated December 4, 2018.

protection of aquatic organisms from an August 2018 EPA memorandum, which is included in Appendix N. The GW-RBC for total PCBs is 1.5 µg/L. Pore water sample data were also compared to a toxicity benchmark of 0.014 µg/L total PCBs from the 2018 EPA memorandum. Groundwater sample results from bedrock intervals ECJ-2 (47), ECJ-2 (117), ECJ-2 (152), and ECJ-2 (187) exceeded the GW-RBC for total PCBs during PMP Events 1, 2, 3 and/or 5. However, the GW-RBC for total PCBs was only exceeded at ECJ-2 (152) during PMP Event 6. Pore water sample results did not exceed the toxicity benchmark for PCBs during the October 2020 sampling event (Event 1), which was the only sampling event with detection limits lower than the toxicity benchmark. PCBs were not detected in the pore water samples in subsequent events; however, detection limits for the PCB samples (ranging from 0.24 µg/L to 0.28 µg/L) were greater than the toxicity benchmark of 0.014 µg/L total PCBs. The data show that although there is a potential for exposure by wetland/aquatic organisms as evidenced by the underlying bedrock groundwater data, the overburden groundwater data does not exceed GW-RBCs. The pore water data from the tributary show that there were no toxicity benchmark exceedances to PCBs by wetland/aquatic organisms in October 2020, but it is unknown if more recent data exceed the benchmark because detection limits were greater than the toxicity benchmark.

OU1 Monitoring of Direct Discharge to Sewer

Groundwater from the shallow collection trench has been directly discharged to the sewer at times when water levels in the shallow collection trench are high enough to reach the invert of the gravity pipe. The direct discharge to the sewer has to meet discharge criteria established in the City's industrial pretreatment discharge permit. Since shutdown of the GWTP, the discharge is monitored at manhole MH-4 approximately quarterly and results have been included in the City's quarterly reports. Of the reports available for review from October 2020 to July 2021 and April 2022, some VOCs and metals have been detected in the samples at levels below the pretreatment criteria. PCBs were not detected. Discharge criteria are being met.

OU1 Long-Term Surface Water and Sediment Monitoring

The most recent long-term biennial surface water and sediment monitoring was performed in September 2019. Sampling did not take place in 2021 in lieu of the pore water sampling taking place as part of the post-suspension PMP. Figure G-16 in Appendix G shows the surface water and sampling locations. Tables H-3 and H-4 in Appendix H present the data summary tables from the September 2019 Biennial Surface Water and Sediment Monitoring Report.

Surface water samples were collected from three of the five specified locations (SW-1, SW-2 and SW-4). Surface water samples were unable to be collected at SW-3 and SW-5 because there was no standing water present at the time of sampling. Samples were analyzed for VOCs, PAHs, PCBs and total analyte list (TAL) metals, including mercury. For PCB and metals analysis, two sets of samples were collected, one filtered and the other unfiltered. Sediment samples were collected from five locations (SD-1 through SD-5) and analyzed for PCBs, PAHs, TAL metals, total organic carbon (TOC) and percent solids. Because VOCs and PCBs are the primary constituents of concern at the Site, they are addressed further in this review.

VOCs and PCBs were not detected in the surface water samples. PCBs were detected in the sediment samples at concentrations up to 0.124 mg/kg (SD-1 duplicate). The maximum detected concentration in 2019 was lower than the maximum detected concentration in 2017 (0.952 mg/kg in SD-3). The detected PCB concentrations in 2019 were converted to carbon normalized PCB concentrations, using TOC results, for comparison to the OU1 PCB sediment cleanup goal of 20 µg PCB/g carbon. All carbon normalized PCB concentrations were below the OU1 PCB sediment cleanup goal.

OU1 Landfill Gas Monitoring

Landfill gas monitoring is conducted quarterly in accordance with the 2015 Surface Water, Sediment and Landfill Gas Monitoring Field Sampling Plan. During each event, the landfill gas monitoring wells along the perimeter of the landfill cap, the discharge stack of the gas extraction system and ambient air near the gas extraction unit are screened for VOCs, methane, carbon dioxide, oxygen and hydrogen sulfide. Figure G-17 in Appendix G shows the monitoring locations. Ambient air, along the fence line and within catch basins at the gas station northeast of the former disposal area, is also screened for landfill gases.

Methane is consistently detected in landfill gas monitoring wells along the eastern side of the landfill cap (GM-17 and GM-18 and sporadically at GM-19 and GM-20) greater than 25% of the LEL. For example, in the recent monitoring event in December 2022, methane was detected in the pre-purge and post-purge samples from GM-18 at 4.6%, which is 92% of the methane LEL. Table H-7 in Appendix H includes a summary of the Landfill Gas Monitoring Report from December 2022. The methane levels in the pre-purge and post-purge samples from GM-18 exceeded the Massachusetts Solid Waste Management 25% LEL criterion. VOCs were detected in only the pre-purge samples in GM-17 (2.2 parts per million, ppm) and GM-18 (0.2 ppm). Hydrogen sulfide was detected in the pre- and post-purge samples from GM-18 at 4 ppm. Consistent with previous sampling events, methane, hydrogen sulfide or VOCs were not detected in ambient air samples.

GV-2 was connected to the landfill gas extraction system as requested by the agencies in September 2019. Landfill gas data on the eastern boundary of the Site continue to show methane levels similar to levels before the connection of GV-2 to the system. Because GM-18 and GM-17 and other wells along the eastern border still show methane readings similar to those observed before the connection, there is a strong line of evidence that there could be an off-site source.

OU1/OU2 Wetlands Monitoring

Post-construction environmental monitoring activities were required annually for the first three years, in year five, and then once every five years. The City of New Bedford led the most recent environmental monitoring event in 2021, with results documented in the 2022 Environmental Monitoring Sampling and Results Report. The 2021 monitoring event included the following activities:

- Collection of four co-located surface water and sediment samples (three locations in the Unnamed Stream and one location in the unnamed pond north of Middle Marsh) with analysis for PCBs and TOC.
- Collection of six wetland soil/non-aquatic sediment samples (four from Middle Marsh and two from the Adjacent Wetlands) with analysis for PCBs and TOC.
- Wetlands monitoring observations at OU1 and OU2. Activities include monitoring of hummocks, wetlands hydrology, soil development and biological attributes including survival rates of planted trees and shrubs, tree growth, vegetative diversity, plant community and presence of the Mystic Valley Amphipod.

Figure G-18 in Appendix G shows the sampling locations. Table H-5 in Appendix H presents the sampling results. The 2017 QAPP required that samples be collected during low streamflow; however, due to an unseasonably wet season, this condition was not met for the October 2021 sampling event. Based on the results presented below, sampling at normal water levels does not appear to have significantly affected the data.

Consistent with results from 2013 and 2017, PCBs were not detected in any of the surface water samples (reporting limit of 0.1 µg/L).

Total PCBs were detected in three of the four sediment samples with results ranging from 0.0294 mg/kg to 0.229 mg/kg. The detected concentrations were converted to carbon normalized PCB concentrations, using TOC results, for comparison to the OU2 PCB sediment cleanup goal of 20 µg PCB/g carbon for aquatic areas. All of the carbon normalized PCB concentrations were below the sediment cleanup goal for aquatic areas. The 2021 results represented a decrease in carbon normalized PCB concentrations from the previous sampling event in 2017 when carbon normalized PCB concentrations were above the sediment cleanup goal.

PCBs were detected in one wetland soil/non-aquatic sediment sample (SoilPC3 from location OU2-MM2) collected in Middle Marsh. The detected concentration of 0.0287 mg/kg was below the OU2 PCB sediment cleanup level of 15 mg/kg for non-aquatic areas.

Goals of the wetland monitoring are to evaluate four biological indicators: 1) survival rate of trees and shrubs, 2) tree growth, 3) vegetative diversity and 4) plant community. Wetlands monitoring observations at OU1 and OU2 support the trend that the Middle Marsh wetland has recovered from the restoration work for OU1 and OU2. The

plant community continues to diversify in species composition and vertical structure. The overall canopy coverage continues to increase. The targeted invasive species management in areas such as in OU1 MM1 and OU1 MW1 appears to have had a sustained benefit. Several plots that were previously dominated by poison ivy (*Toxicodendron radicans*) such as in OU2 Adjacent Wetlands #1 have now matured and diversified to include a greater variety of herbaceous species. Efforts should be made to ensure the invasive species in areas maintained by the golf course and in areas that have observed population of invasives do not cross allowable thresholds.

PFAS Monitoring Data

EPA contractors collected groundwater samples from four locations that monitor overburden groundwater (MW-6A, MW-12AR, PZ-11, PZ-15A) and four locations that monitoring shallow bedrock groundwater (GCA-1, MW-6, MW-24 and PZ-17S) in March 2023 (Figures D-1 and D-2 in Appendix D). The samples were analyzed for PFAS. Table H-6 in Appendix H includes a summary of the detected PFAS. Results are compared to EPA's tap water RSLs based on a noncarcinogenic hazard quotient (HQ) of 0.1, and the MMCL for total PFAS (20 nanograms per liter, ng/L). Of the PFAS detected, PFOS concentrations exceeded the RSL of 4 ng/L at five locations with a maximum detected concentration of 10 ng/L at MW-6. PFOA concentrations exceeded the RSL of 6 ng/L at all eight locations sampled. The maximum detected concentration of PFOA was estimated at 29 ng/L at GCA-1. Total PFAS concentrations at six sample locations exceeded the MMCL of 20 ng/L for total PFAS.

Site Inspection

The site inspection was conducted on 3/22/2023. In attendance were EPA CIC Aaron Shaheen, Jennifer Lambert and Erik Hall from EPA contractor Nobis Group and Johnny Zimmerman-Ward and Jill Billus from EPA FYR support contractor Skeo. City of New Bedford participants included Jim Costa, Chance Perks, Michele Paul, Laura Breig and David Nieves. EPA RPM Kimberly White, EPA ecological risk assessor TaChalla Gibeau and EPA human health risk assessor Ayana Cunningham joined the group via video conference for the beginning of the meeting. The purpose of the inspection was to assess the protectiveness of the remedy. Appendix J includes the completed site inspection checklist. Appendix K includes photographs from the site inspection.

Site inspection participants met in the parking area for the OU1 GWTP, and then viewed the treatment building interior. The groundwater treatment system was not operating at the time of the inspection. The City of New Bedford representative noted that preparations were underway to bring the system back online by May 1, 2023. Site inspection participants then walked across Hathaway Road to the golf course (OU2). They observed some minor iron-rich siltation in the culvert under Hathaway Road. The restored wetland areas in OU2 appeared in good condition. Some invasive species were observed. The City of New Bedford representative indicated that a Notice of Intent had been filed recently to allow the City to remove the phragmites throughout the golf course wetlands. The phragmite spraying is planned for late summer, which will be followed by a cut and removal of the phragmites. Monitoring well MW-8 on the golf course property was not secured properly, and some minor erosion was observed beneath the well pad.

Site inspection participants also observed the OU1 landfill area, which is surrounded by a chain-link fence. An area of the fence along Hathaway Road appeared to have a temporary repair. The City of New Bedford indicated that it had been damaged by a car. A more permanent fence repair is planned. The landfill's cover is well established with grass. No bare spots were observed. An animal burrow was observed on the north side of the landfill cap; animal burrows were also observed beneath one of the solar panel footings near the center of the landfill. Minor vegetation was observed in the riprap drainages on the landfill but did not appear as if it would impede flow. Site inspection participants also observed the extraction well housings, gas wells and monitoring locations, monitoring wells and the location of the shallow collection trench and slurry wall. The City of New Bedford representatives indicated that the electrical wiring and other components for the extraction wells had recently been replaced in anticipation of the GWTP startup. The extraction well housings were in poor condition. The City of New Bedford representative noted that they may be replaced as funds allow.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

OU1
No. Based on review of site documents, monitoring data, RAOs and site inspection results, the OU1 remedy is not functioning as intended by the 1989 ROD, as modified by the 1995, 2000 and 2003 ESDs. Operation of the GWTP was suspended in 2020 but restarted in May 2023. Between 2020 and 2023, the post-suspension groundwater monitoring data revealed that total VOC concentrations in groundwater are increasing and migrating north towards the OU2 wetlands. Now that the GWTP has been restarted the control of groundwater contaminant migration is currently being evaluated.

OU2
Yes. Based on review of site documents, monitoring data, RAOs and site inspection results, the OU2 remedy is functioning as intended by the 1991 ROD. Further discussion for both OUs is presented below.

Remedial Action Performance

OU1
The OU1 remedy included excavation of contaminated soils/sediments from the Unnamed Stream, water hazards on the golf course property and other areas of OU1 with placement in the former disposal area, construction of an impermeable cap, collection and treatment of contaminated groundwater, construction of a landfill gas extraction system, wetlands restoration, long-term monitoring, and institutional controls.

The remedial action met the soil and sediment cleanup standards set in the 1989 ROD and ESDs, thus removing the source of contamination to sediment and surface water and reducing risk to human health and aquatic organisms. O&M of the landfill cap and gas extraction system has been effective to eliminate direct exposure to contamination and waste.

Groundwater and pore water monitoring data have shown that total VOC concentrations have rebounded since operation of the GWTP was suspended in 2020. The most significant rebound and increasing concentration trends are seen in the intermediate and deep bedrock groundwater north of Hathaway Road between the former disposal area and the golf course. In addition, monitoring data have shown that total VOC concentrations in POC wells exceed the total VOC cleanup standard of 1,000 µg/L to 10,000 µg/L. Shallow bedrock monitoring well MW-4, located east of the OU1 landfill and on an adjacent property where no groundwater use restrictions are in place, also had a total VOC concentration greater than 1,000 µg/L in 2022. As a result, the GWTP was turned back on in May 2023 to reestablish hydraulic containment. Monitoring will continue to evaluate contaminant concentrations over time and potential impacts to downgradient ecological receptors. Further evaluation may also be needed to delineate the eastern extent of contamination beyond MW-4.

As requested by EPA, PMC is evaluating groundwater data and pore water data against GW-RBCs for ecological protection. The overburden groundwater data do not exceed GW-RBCs. The pore water data from the tributary collected in October 2020 show that there were no toxicity benchmark exceedances for PCBs at that time. PCBs were not detected in the pore water samples in subsequent sampling events; however, detection limits for the PCB samples were greater than the toxicity benchmark of 0.014 µg/L total PCBs. EPA and MassDEP will continue to evaluate the need for further remedial action at the Site, or an update to the cleanup standards.

Methane continues to be detected in landfill gas monitoring wells along the eastern side of the landfill cap greater than 25% of the LEL. However, multiple lines of evidence suggest that the methane detections along the eastern site boundary are not site related. Landfill gas monitoring is ongoing.

OU2
The OU2 remedy included excavation of contaminated soils/sediment from parts of Middle Marsh and Adjacent Wetlands with placement under the OU1 cap, wetlands restoration, institutional controls to prevent future land use and long-term monitoring. The OU2 remedy was complete by 2001. The most recent wetlands monitoring event took place in 2021. PCBs were not detected in surface water samples during the 2021 sampling event, and PCBs were below ROD sediment cleanup goals. Wetlands monitoring observations support the trend that the Middle Marsh wetland has recovered from the restoration work. The plant community continues to diversify in species composition and vertical structure. The overall canopy coverage continues to increase. The targeted invasive species management conducted during the FYR period appears to have had a sustained benefit. Efforts should be made to ensure the invasive species in areas maintained by the golf course and in areas that have observed population of invasives do not cross allowable thresholds.

System Operations/O&M

OU1
The City of New Bedford is responsible for implementing O&M activities at OU1. The activities address O&M of the landfill cap, groundwater collection and treatment system, and landfill gas extraction system. The City of New Bedford noted that many components of the GWTP are reaching the end of their functional timeframe; many parts need to be repaired or replaced. The Sullivan's Ledge Site Group PMC implements the Site's groundwater, landfill gas, sediment and surface water long-term monitoring program. The O&M Plan should be updated to include any requirements associated with the solar panels installed in 2014.

OU2
Post-construction environmental monitoring and long-term wetlands monitoring activities are conducted in accordance with the 1997 Wetland Restoration Plan and the 1999 Final Operation and Maintenance Plan for the Second Operable Unit. The City of New Bedford led the most recent wetlands monitoring event in 2021.

Implementation of Institutional Controls and Other Measures

OU1 and OU2
Institutional controls have been implemented in the form of a GERE and no violations have been reported. However, the City of New Bedford has not been submitting annual compliance reports, as required by the GERE.

Elevated VOC concentrations were detected in shallow bedrock well MW-4 in August 2022. This well is located east of OU1 and outside areas covered by the existing institutional control instrument (Figure 3). This is not a current issue of protectiveness since the property uses public water. However, additional institutional controls may be needed to prohibit groundwater use on the parcel to ensure long-term protectiveness of the remedy.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

Question B Summary:
No. There have been changes in toxicity values, exposure pathways and method of evaluating risk since the 1989 and 1991 RODs were issued as discussed below. In addition, PFAS, an emerging contaminant, has been detected in groundwater at the Site at levels above EPA's RSLs. However, the changes noted below do not affect protectiveness of the remedy because groundwater at the Site is not in use for drinking water and institutional controls are in place and effectively prevent future exposures to contaminated groundwater at the Site.

Changes in Standards and To Be Considered Criteria (TBCs)
New standards (federal or state statutes and/or regulations), as well as new TBC guidance, should be considered during the FYR process as part of the protectiveness determination. Under the NCP, if a new federal or state statute and/or regulation is promulgated or a new TBC guidance is issued after the ROD is signed, and, as part of the FYR process it is determined that the standard needs to be attained or new guidance procedures followed to

ensure that the remedy is protective of human health and the environment, then the FYR should recommend that a future decision document be issued that adds the new standard as an applicable or relevant and appropriate (ARAR) or guidance as a TBC to the remedy.

EPA guidance states:

> "Subsequent to the initiation of the remedial action new standards based on new scientific information or awareness may be developed and these standards may differ from the cleanup standards on which the remedy was based. These new…[standards] should be considered as part of the review conducted at least every five years under CERCLA §121(c) for sites where hazardous substances remain on-site. The review requires EPA to assure that human health and the environment are being protected by the remedial action. Therefore, the remedy should be examined in light of any new standards that would be applicable or relevant and appropriate to the circumstances at the site or pertinent new [standards], in order to ensure that the remedy is still protective. In certain situations, new standards or the information on which they are based may indicate that the site presents a significant threat to health or environment. If such information comes to light at times other than at the five-year reviews, the necessity of acting to modify the remedy should be considered at such times." (See CERCLA Compliance with Other Laws Manual: Interim Final (Part 1) EPA/540/G-89/006 August 1988, pp. 1-56.)

The 1989 ROD identified Safe Drinking Water Act MCLs and the Massachusetts groundwater quality standards as relevant and appropriate at the Site. However, EPA waived compliance with the ARARs relating to groundwater because compliance with the ARARs is technically impracticable from an engineering perspective. As such, cleanup levels for the active collection system are not ARAR-based. Instead, two performance criteria were established: 1) a concentration range of 1 mg/L to 10 mg/L total VOCs, and 2) an asymptotic curve using groundwater monitoring data indicating that significant concentration reductions are no longer being achieved.

The 1989 ROD stated that the cleanup levels for the passive collection system will be based on AWQS and the designated use of the receiving waters.

The 2003 ESD added the Massachusetts Solid Waste Management Facility regulations (Sections 19.117, 19.118, 19.132 and 19.150 in the Code of Massachusetts Regulations) pertaining to landfill gas as an additional ARAR for the Site. These regulations require the detection and monitoring of landfill gases, the use of corrective actions when gases exceed 25% of the LELs to address public health and safety concerns, and the notification of government parties within specified time frames when such concentrations are detected. The ARARs have not changed in a manner that could affect protectiveness of the remedy.[8]

Per- and Polyfluoroalkyl Substances (PFAS) (Federal)
In May 2022, EPA issued updated noncancer reference dose (RfD) values for several PFAS compounds which result in the following RSLs at HQ target of 0.1:

- PFOA: 6 ng/L (equivalent to parts per trillion [ppt])
- PFOS: 4 ng/L
- Perfluorononanoic acid (PFNA): 6 ng/L
- Perfluorohexane sulfonate (PFHxS): 40 ng/L
- Hexafluoropropylene oxide dimer acid (HFPO-DA) (Gen-X): 6 ng/L

The RfD values for PFOA, PFOS, PFNA and PFHxS are based on Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs) for ingestion exposure.

The RfD value for HFPO-DA (Gen-X) is based on a chronic oral RfD from EPA Office of Water, which is 3E-06.

[8] https://www.mass.gov/regulations/310-CMR-19000-solid-waste-facility-regulations (accessed 5/18/2023).

In May 2021, EPA issued an updated noncancer RfD for perfluorobutane sulfonic acid (PFBS). PFBS has a chronic oral RfD of 3E-04. The RSL for PFBS is 600 ng/L.

In December 2022, EPA released a new oral RfD of 1.0E-03 milligrams per kilogram per day (mg/kg-day) for perfluorobutanoic acid (PFBA) based on a new Integrated Risk Information System (IRIS) value. Previously, no RfD was available for PFBA. The RSL for PFBA is 1,800 ng/L.

In April 2023, EPA released a new oral RfD of 5.0E-04 mg/kg-day for perfluorohexanoic acid (PFHxA) based on a new IRIS value. Previously no RfD was available for PFHxA. The RSL for PFHxA is 990 ng/L.

PFAS (State)
On October 2, 2020, the state promulgated MMCLs for drinking water for the sum of six PFAS compounds into the state's drinking water regulations (310 CMR 22.00). The MMCL is 20 ng/L (ppt) for the sum of six PFAS compounds:

- PFOS
- PFOA
- PFHxS
- PFNA
- Perfluoroheptanoic acid (PFHpA)
- Perfluorodecanoic acid (PFDA)

At this time EPA has made no determination of whether these state standards will need to be added as an ARAR for this Site. They should, however, be used as screening values for PFAS compounds, along with the RSLs. For purposes of this FYR, EPA has evaluated the PFAS data collected against EPA's RSLs and the state's PFAS MMCLs.

PFAS (Summary)
Several PFAS were detected in site groundwater during a March 2023 sampling event. PFOS and PFOA concentrations were detected in several samples above the EPA RSLs. The maximum detected PFOS concentration was 10 ng/L (MW-06) compared to the RSL of 4 ng/L. The maximum detected PFOA concentration was a concentration of 29 J ng/L (GC-1), compared to the RSL of 6 ng/L. The sum of six PFAS compounds also exceeded the state's PFAS MMCL in six samples (GCA-1, MW-6, MW-6A, MW12-AR, MW-24 and PZ-5A), with the maximum detected sum of the six PFAS of 34.9 ng/L.

Although there are exceedances of the RSLs and the state MMCL, the remedy remains protective because no one is drinking the groundwater and institutional controls are in place and effective at preventing future exposures to groundwater. However, as the GWTP has been restarted, influent and effluent will be monitored for PFAS to determine if additional measures are needed to treat PFAS or to prevent it from being discharged to the publicly owned treatment works (POTW). In addition, additional investigation of PFAS in surface water and sediment is being considered, with results compared to the ecological screening values (ESVs) for PFAS.

1,4-Dioxane (Federal)
Using 2013 updated IRIS toxicity information and the standard Superfund risk assessment approach, EPA's carcinogenic risk range of 10^{-6} to 10^{-4} for 1,4-dioxane equates to a concentration range of 0.46 µg/L to 46 µg/L (parts per billion).

1,4-Dioxane (Summary)
1,4-Dioxane has not been sampled for at the Site. However, even if detected, the remedy remains protective for human health because no one is drinking the groundwater and institutional controls are in place and effective at preventing future exposures to groundwater. The ecological exposure pathway for aquatic receptors potentially exposed to 1,4-dioxane in surface water downgradient of OU1 has not been evaluated. Therefore, surface water samples may need to be collected for 1,4-dioxane and compared to the ESV of 22,000 µg/L.

Floodplain
Federal regulations at 40 CFR Part 6, Appendix A identified in the ROD were withdrawn. Furthermore, these regulations, and therefore the current CERCLA remedy, only addressed potential floodplain impacts up to the 100-year flood elevation. Current federal floodplain regulations at 40 CFR Part 9 require a greater assessment of potential floodplain impacts, including preventing the release of contamination from waste management units and other remedial infrastructure up to the 500-year floodplain elevation. EPA has assessed potential floodplain impacts from a 500-year flood event on the Site. The GWTP and capped landfill are outside the 500-year floodplain. Because EPA has not identified any protectiveness issues at this time, we do not include a recommendation to add this requirement as an ARAR in a future determination.

Changes in Toxicity and Other Contaminant Characteristics
The 1989 and 1991 RODs selected soil cleanup levels for PCBs and total carcinogenic PAHs based on human health risk. The RODs also selected sediment cleanup levels protective of ecological receptors. Based on evaluation of the cleanup levels compared to current RSLs, the cleanup levels based on human health risk remain protective (Appendix L). The sediment cleanup levels based on ecological risk also remain protective.

The sediment cleanup level was established as 20 µg of PCBs per gram of carbon. This risk-based target level was developed based on potential risk to aquatic organisms and wildlife receptors. The cleanup level was estimated in the risk assessment using sediment partitioning and the ambient water quality criteria based on the protection of wildlife consuming aquatic organisms. PCB tissue concentrations estimated from direct exposure to PCB-contaminated sediments were also used in developing the risk-based target level of 20 µg per gram of carbon. As noted in the 2018 FYR Report, based on larger risk-based data sets from other sites in New England with aquatic habitats, this level of PCBs in sediments is expected to be protective of aquatic and semi-aquatic receptors.

2022 cis-1,2-DCE Noncancer Toxicity Value
In October 2022, EPA released a noncancer reference concentration (RfC) of 4.00E-02 milligrams per cubic meter for cis-1,2-DCE, based on a provisional peer reviewed toxicity value (PPRTV) screening value. Previously, no RfC was available for cis-1,2-DCE.

Cis-1,2-DCE is consistently detected in Site groundwater. The maximum detected concentration during PMP Event 6 of the PMP was 101,000 µg/L (OBG-1). The change in the toxicity value for cis-1,2-DCE does not affect the protectiveness of the remedy because no one is drinking the groundwater and institutional controls are in place to prevent future use of the groundwater.

2022 PFBA Noncancer Toxicity Value
In December 2022, EPA released a new oral RfD of 1.0E-03 mg/kg-day for PFBA based on a new IRIS value. Previously, no RfD was available for PFBA.

PFBA was detected at a maximum concentration of 18 ng/L in PZ-11 in March 2023 and below the PFBA RSL of 1,800 ng/L. The remedy remains protective because no one is drinking the groundwater and institutional controls are in place and effective at preventing future exposures to groundwater.

2022 PFOA Noncancer Toxicity Value
In May 2022, EPA released an updated oral RfD of 3E-06 mg/kg-day for PFOA, based on the ATSDR MRL. The new value indicates that PFOA is more toxic from noncancer health effects and would result in an increased noncancer risk.

PFOA was detected at a maximum concentration of 29 ng/L in GCA-1 in March 2023, which exceeds the EPA RSL and the state MCL. However, the remedy remains protective because no one is drinking the groundwater and institutional controls are in place and effective at preventing future exposures to groundwater.

2022 PFOS Noncancer Toxicity Value
In May 2022, EPA released an updated oral RfD of 2E-06 mg/kg-day for PFOS, based on the ATSDR MRL. The new value indicates that PFOS is more toxic from noncancer health effects and would result in an increased noncancer risk.

PFOS was detected at a maximum concentration of 10 ng/L in MW-06 in March 2023, which exceeds the EPA RSL. The remedy remains protective because no one is drinking the groundwater and institutional controls are in place and effective at preventing future exposures to groundwater.

2022 PFNA Noncancer Toxicity Value
In May 2022, EPA released an oral RfD of 3E-06 mg/kg-day for PFNA, based on the ATSDR MRL. Previously, no RfD was available for PFNA.

PFNA was not detected in site groundwater in March 2023, with a maximum detection limit of 2 ng/L. Therefore, there is no impact to protectiveness.

2022 PFHxS Noncancer Toxicity Value
In May 2022, EPA released an oral RfD of 2.0E-05 mg/kg-day for PFHxS, based on the ATSDR MRL. Previously, no RfD was available for PFHxS.

PFHxS was detected at a maximum concentration of 2.2 ng/L in MW-12AR and PZ17S in March 2023, which is below the EPA RSL. Additionally, the remedy remains protective because no one is drinking the groundwater and institutional controls are in place and effective at preventing future exposures to groundwater.

2021 PFBS Noncancer Toxicity Value
In May 2021, EPA released an oral RfD of 3E-04 mg/kg-day, based on an EPA PPRTV (USEPA, 2021a). The new value indicates that PFBS is more toxic from noncancer health effects and would result in an increased noncancer risk.

PFBS was detected at a maximum concentration of 2.6 ng/L in MW-24 in March 2023, which is below the EPA RSL. Additionally, the remedy remains protective because no one is drinking the groundwater and institutional controls are in place and effective at preventing future exposures to groundwater.

2020 Trans-1,2-Dichloroethylene (Trans-1,2-DCE) Noncancer Toxicity Value
In November 2020, EPA finalized a new RfC for trans-1,2-DCE based on a new PPRTV. There previously was no RfC for trans-1,2-DCE.

Trans-1,2-DCE is consistently detected in site groundwater. The maximum detected concentration during Event 6 of the PMP was 91.4 J µg/L (BEI-1). The change in the toxicity value for trans-1,2-DCE does not affect the remedy because no one is drinking the groundwater and institutional controls are in place to prevent future use of the groundwater.

Lead in Soil Cleanups
EPA continues to examine the science around lead exposure. Updated scientific information indicates that adverse health effects are associated with blood lead levels (BLLs) at less than 10 micrograms per deciliter (µg/dL). Several studies have observed "clear evidence of cognitive function decrements in young children with mean or group BLLs between 2 and 8 µg/dL."

Based on this updated scientific information, EPA is including an evaluation of potential lead risks with a goal to limit exposure to residential and commercial soil lead levels such that a typical (or hypothetical) child or group of similarly exposed children would have an estimated risk of no more than 5% of the population exceeding a 5 µg/dL BLL. This is based on evidence indicating cognitive impacts at BLLs below 10 µg/dL. A target BLL of 5 µg/dL reflects current scientific literature on lead toxicology and epidemiology that provides evidence that the adverse health effects of lead exposure do not have a threshold.

EPA's 2017 OLEM memorandum "Transmittal of Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters" (OLEM Directive 9285.6-56) provides updates on the default baseline blood lead concentration and default geometric standard deviation input parameters for the Adult Lead Methodology (ALM). These updates are based on the analysis of the National Health and Nutrition Examination Survey 2009-2014 data, with recommended updated values for baseline blood lead concentration being 0.6 µg/dL and geometric standard deviation being 1.8.

Using updated default Integrated Exposure Uptake Biokinetic Model and ALM parameters at a target BLL of 5 µg/dL, site-specific lead soil screening levels (SLs) of 200 ppm and 1,000 ppm are developed for residential and commercial/industrial exposures, respectively.

Given the ongoing review of information, the above SLs are considered in this FYR for informational purposes.

A review of historical soil and sediment samples collected during the RI, conducted as part of the 2018 FYR Report, showed some detected lead concentrations above 200 mg/kg, but these locations were either covered (capped) or excavated as part of the OU1 and OU2 remedies. In addition, the maximum detected lead concentration in OU1 sediment (sampled/analyzed in 2019) is 120 J mg/kg, which is below the lead SL for residential exposures. In addition, there are institutional controls in place at the landfill property and golf course property that prohibit residential use of the properties. Therefore, the updates to the lead SLs do not affect protectiveness of the remedy.

Changes in Risk Assessment Methods

There have been multiple changes to EPA's risk assessment methodologies since the Site's 1991 risk assessment, as summarized in previous FYR reports. However, there are no additional changes in risk assessment methods from the previous FYR, other than routine updates to EPA's RSLs, which have been incorporated in the chemical-specific screening of the monitoring data discussed throughout this FYR Report.

Changes in Exposure Pathways

Land use at the Site has not changed since the previous FYR. OU1 is a capped landfill surrounded by a fence. Solar panels were installed on the cap in 2014. There are no anticipated changes in land use at OU1. OU2 includes part of the Whaling City Golf Club. This portion of the Site will continue to be used as a golf course or for other recreational purposes in the foreseeable future. Institutional controls are in place to assure that land use changes resulting in more intense human exposures than under current conditions do not occur.

As noted previously, PFAS, an emerging contaminant of concern, has been identified in groundwater above EPA RSLs. However, there are no current exposures to contaminated groundwater. Public water is available for the Site and surrounding area. Institutional controls are in place to prevent exposures to contaminated groundwater on City of New Bedford property (OU1 and the Whaling City Golf Club); however, additional institutional controls may be needed to prevent groundwater use on the property east of OU1 where total VOC concentrations are greater than 1,000 µg/L and concentrations of individual constituents (such as TCE) exceed drinking water standards. Additional sampling for PFAS in pore water and/or surface/sediment in the wetland areas may also be considered.

Vapor Intrusion

While there has been some historical evaluation of landfill gas migration to neighboring properties, vapor intrusion of volatiles from groundwater had not been evaluated prior to the 2018 FYR. Buildings are located to the east of the landfill in an area where groundwater is about 15 feet below the ground surface. The 2018 FYR Report reviewed groundwater sampling results for overburden wells in this area and performed a comparison to EPA's Vapor Intrusion Screening Levels (VISLs) based on a commercial use exposure scenario. Based on the available groundwater data and current commercial use of the area, the 2018 FYR Report concluded that the remedy appears to be protective with regards to vapor intrusion risk.

This FYR re-evaluates vapor intrusion risk to the gas station building and storage buildings east of the Site using EPA's VISL calculator and recent groundwater data from overburden wells MW-12AR (2022 data) and MW-4A (2020 data), both of which appear to be within 150 feet of a building (Figure G-1, Appendix G). Based on the screening-level evaluation, vapor intrusion is not a concern at the Site at this time because detected concentrations correspond to risks that fall within EPA's risk management range of 1×10^{-6} to 1×10^{-4} and the corresponding noncancer HQ is below EPA's point of departure of 1 (Appendix M). However, if Site conditions change (i.e., change in land use or increase in contaminant concentrations), the potential for vapor intrusion should be re-evaluated.

2018 EPA VISL Calculator

In February 2018, EPA launched an online VISL calculator which can be used to obtain risk-based screening level concentrations for groundwater, sub-slab soil gas and indoor air. The VISL calculator uses the same database as the RSLs for toxicity values and physiochemical parameters and is automatically updated during the semiannual RSL updates. The User's Guide provides further details on how to use the VISL calculator: https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator.

As noted above, the VISL calculator was used for a screening-level vapor intrusion assessment; current issues of concern for vapor intrusion were not identified.

2018 Groundwater Risk-Based Concentrations (GW-RBCs)

In August 2018, GW-RBCs were developed for the Site to address the recommendation in MassDEP's 2016 Groundwater Use and Value Determination to consider the potential impacts to aquatic organisms in surface water that receives groundwater from OU1. Appendix N provides a copy of the GW-RBCs. The GW-RBCs are currently being used by the project team and groundwater data does not exceed GW-RBCs. However, to evaluate the in-stream ecological impacts, the current detection limits for the toxicity analysis need to be adjusted. Additional evaluations also need to be conducted in order to determine if Site cleanup levels need to be updated to align with the site-specific GW-RBCs. As an interim action the GW-RBCs should be incorporated into the site groundwater monitoring plan and used to screen potential impacts to ecological receptors.

2021 Development of the ESVs for PFAS

ESVs have been developed to support screening-level ecological risk assessments sites where PFAS have been detected in soils and surface waters. The ESVs, developed for eight PFAS, represent PFAS concentrations in soil and surface water at or below which chronically exposed biota are not expected to be adversely affected and ecological risks or other impacts are unlikely.

The ESVs support the screening-level steps (steps 1 and 2 of eight steps) of EPA's Ecological Risk Assessment Guidance for Superfund and may be applied at sites undergoing investigation for the historic release or disposal of PFAS, to identify whether PFAS levels pose potential unacceptable ecological risks. Sites that have concentrations of PFAS that exceed ESVs may require further investigation in a baseline ecological risk assessment, which in turn may support risk-management decisions and actions to reduce risks. These ESVs are solely for use in conducting screening-level ecological risk assessments and are not recommended or intended for use as default cleanup values.

The ESVs were developed for the following media and receptors:

- Soils for invertebrates.
- Soils for plants.
- Soils for avian and mammalian wildlife.
- Surface water for freshwater and marine aquatic biota.
- Surface water for aquatic-dependent avian and mammalian wildlife.

The ESVs can be found in Derivation of PFAS Ecological Screening Values (M. Grippo, J. Hayse, I. Hlohowskyj, and K. Picel, Environmental Science Division, Argonne National Laboratory, September 2021).

The ecological exposure pathway of concern is the potential for aquatic ecological receptors potentially exposed to PFAS in surface water downgradient of OU1. Surface water samples were not collected for PFAS analysis; however, this additional sampling may be considered.

Expected Progress Towards Meeting RAOs

Excavation of contaminated soil/sediment with placement under a cap has reduced risks to human health associated with direct exposure to contamination. It has also reduced risks to animals and aquatic life. The Site is currently not meeting the RAO to reduce migration of contaminated groundwater. Progress is also not being made on significantly reducing the mass of contaminants in groundwater in and immediately adjacent to the quarry pits. The GWTP is expected to reduce contaminant mass, regain hydraulic control of contaminated groundwater and reduce potential discharge to downgradient wetlands.

The presence of PFAS in groundwater might also affect progress toward meeting RAOs.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

The expected impacts of climate change in New England pose increasing risks to contaminated sites. Increases in air and water temperature, precipitation, flooding and periods of drought may result in altered fate and transport pathways and exposure assumptions, impaired aquatic habitats, dispersal of contaminants, damage to remediation related structures and ultimately, ineffective remedies. At coastal sites, saltwater impacts made more likely by sea-level rise may cause corrosion of remediation equipment and impair restoration efforts. Increased frequency of extreme weather events may cause damage or releases at sites, impairing remedial efforts where remedies have not been adequately designed to protect against these risks.

The risks posed by climate change in New England are not expected to alter the protectiveness of the remedy at the Sullivan's Ledge Superfund Site because the changes discussed do not impact protectiveness due to the low risk of flooding at the Site.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues and Recommendations Identified in the FYR:
None

Issues and Recommendations Identified in the FYR:

OU(s): OU1	**Issue Category: Remedy Performance**			
	Issue: Although the GWTP was restarted in May 2023 following a brief shutdown, groundwater data collected during the post-suspension monitoring period showed that total VOC concentrations in groundwater are increasing and migrating north towards the OU2 wetlands and extending off site to the east.			
	Recommendation: Evaluate whether hydraulic control has been reestablished with the restart of the GWTP and take action, as necessary, to address the migration of contamination in groundwater toward the OU2 wetlands and east of OU1.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
Yes	Yes	PRP	EPA/State	9/1/2025

OU(s): OU1, OU2	**Issue Category: Monitoring**			
	Issue: PFAS has been detected in site groundwater above EPA RSLs. PFAS has not been sufficiently evaluated to determine if there are additional impacts beyond the OU1 groundwater.			
	Recommendation: Collect additional PFAS samples in pore water, surface water and/or sediment and determine if risk is posed to receptors from PFAS through these exposure routes. If so, PFAS should be identified as a site COC.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/1/2027

OU(s): OU1	**Issue Category: Remedy Performance**			
	Issue: Detection limits for PCBs in some of the pore water samples were greater than the toxicity benchmark of 0.014 µg/L total PCBs.			
	Recommendation: Determine if lower detection limits can be achieved to meet the toxicity benchmark so that the ecological risk can be better assessed.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/1/2025

OU(s): OU2	Issue Category: Monitoring			
	Issue: 1,4-Dioxane has not been sampled for at the Site and the potential for an ecological exposure scenario has not been ruled out.			
	Recommendation: Collect 1,4-dioxane samples in groundwater, pore water, surface water and/or sediment and determine if risk is posed to receptors from 1,4-dioxane through these exposure routes. If so, 1,4-dioxane should be identified as a site COC.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/1/2027

Other Findings

The following are recommendations that were identified during the FYR but do not affect current or future protectiveness:

- The PMC representative noted that landfill gas monitoring data has been consistent from quarter to quarter. Determine if a reduction in landfill gas monitoring frequency can be reduced from quarterly to semiannual.
- Landfill gas monitoring wells on the eastern boundary of the Site show methane concentrations that exceeded 25% of the LEL for methane. Evaluations of monitoring data indicate that methane may be from a source outside the landfill. The adjacent property owner should be notified of the condition, although LEL exceedances do not appear to be site related.
- Update the O&M Plan for OU1 to incorporate any changes needed due to the presence of the solar panels installed in 2014.
- PFAS has been detected in overburden and bedrock groundwater at the Site. Sample the direct discharge at MH-4 and influent/effluent at the GWTP for PFAS to determine if additional measures are needed to prevent it from being discharged to the POTW.
- Continue to implement invasive species control in the OU1/OU2 wetlands.
- Ensure all monitoring wells are properly secured.
- Repair minor erosion beneath the well pad at MW-8.
- Fill in any animal burrows on the OU1 cap in a timely manner, consistent with the Site's O&M Plan.
- GW-RBCs for protection of aquatic organisms should be incorporated into the O&M Plan as a screening tool to determine if additional testing, particularly toxicity testing, is necessary when GW-RBCs are exceeded. Evaluate whether site-specific RBCs need to be incorporated as Site cleanup levels.
- The City of New Bedford has indicated that many parts of the GWTP need repair or replacement since they are nearing the end of their functional timeframe. Make repairs to the existing GWTP and/or explore options for optimizing the GWTP.
- The City of New Bedford did not provide annual institutional control compliance reports to MassDEP and EPA during this FYR period, as required by the 2014 GERE. Provide annual compliance reports to MassDEP and EPA in January of each year.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement		
Operable Unit:1	*Protectiveness Determination:* Protectiveness Deferred	*Planned Addendum Completion Date:* September 13, 2025
Protectiveness Statement: A protectiveness determination of the remedy at OU1 cannot be made at this time until further information is obtained. Further information will be obtained by taking the following actions: evaluate whether hydraulic control has been reestablished with the restart of the GWTP and take action, as necessary, to address the migration of contamination in groundwater toward the OU2 wetlands and east of OU1. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made and documented in a FYR Addendum, on or before September 13, 2025.		

Protectiveness Statement	
Operable Unit:2	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The remedy for OU2 currently protects human health and the environment because the construction of the remedy is complete, long-term monitoring is ongoing and institutional controls are in place to prevent future human exposures to contamination. For the remedy to be protective in the long term, the following action needs to be taken: collect PFAS and 1,4-dioxane samples in groundwater, pore water, surface water and/or sediment and determine if risk is posed to receptors through these exposure routes. If so, PFAS and 1,4-dioxane should be identified as a site COCs.	

Sitewide Protectiveness Statement	
Protectiveness Determination: Protectiveness Deferred	*Planned Addendum Completion Date:* September 13, 2025
Protectiveness Statement: Because a protectiveness determination of the remedy at OU1 cannot be made at this time, a sitewide protectiveness statement cannot be made until further information is obtained. Further information will be obtained by taking the following actions: evaluate whether hydraulic control has been reestablished with the restart of the GWTP and take action, as necessary, to address the migration of contamination in groundwater toward the OU2 wetlands and east of OU1. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made and documented in a FYR Addendum, on or before September 13, 2025.	

VIII. NEXT REVIEW

The next FYR for the Sullivan's Ledge Superfund Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

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M. Grippo, J. Hayse, I. Hlohowskyj, and K. Picel. 2021. Derivation of PFAS Ecological Screening Values, Environmental Science Division, Argonne National Laboratory, September 2021.

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APPENDIX B – SITE CHRONOLOGY

Table B-1: Site Chronology

Event	Date
Quarrying operations took place on site	1840s to 1921
The City of New Bedford acquired site land through a tax title foreclosure	1935
The quarry pits were used for waste disposal	1930s to early 1970s
The Massachusetts Department of Public Works identified capacitors in the subsurface during advancement of geotechnical borings EPA conducted an air monitoring program for the greater New Bedford area	1982
EPA installed groundwater monitoring wells around the Site and confirmed contamination	1983
EPA listed the Site on the NPL	September 1984
NUS Corporation completed the OU1 Phase I RI report	September 1987
Ebasco Services, Inc. completed the OU2 Final RI/FS report	January 1989
EPA completed the OU1 phased RI/FS and issued the OU1 ROD	June 1989
Metcalf & Eddy, Inc. completed the OU2 Final RI – Additional Studies of Middle Marsh	April 1991
Metcalf & Eddy, Inc. completed the OU2 FS for Middle Marsh	May 1991
EPA issued the OU2 ROD	September 1991
A Consent Decree for OU2 was lodged in U.S. District Court in Massachusetts	January 1993
EPA issued an ESD for OU1, modifying the remedy so that treatment would no longer be required for soil and sediments to be covered by the landfill cap	July 1995
EPA approved the 100% remedial design for OU1	June 1997
Start of on-site construction at OU1	March 1998
Start of on-site construction at OU2	April 1999
Startup of the OU1 groundwater collection and treatment system	December 1999
EPA issued a second ESD for OU1, substituting a slurry wall for the shallow collection trench along a section of the site boundary and culverting a section of the Unnamed Stream instead of lining it in concrete	September 2000
URS Corporation completed the Final Remedial Construction Report for OU2	August 2001
O'Brien & Gere Engineers completed the Remedial Construction Report for OU1	March 2002
EPA approved the OU2 Construction Completion Report and OU1 Construction Completion Report	January 2003
EPA issued an ESD adding Solid Waste regulations as an ARAR and requiring mitigation of a landfill gas migration issue	September 2003
EPA issued the Site's first FYR Report	September 2003
Institutional controls are implemented for City of New Bedford property	2004
The fifth year of post-construction wetland monitoring took place	2006
EPA issued the Site's second FYR Report	September 2008
The first year of long-term wetland monitoring took place	2011
EPA issued the Site's third FYR Report	September 2013
The Site achieved the Sitewide Ready for Anticipated Reuse performance measure	May 2014
EPA completed an Optimization Review Report	March 2016
EPA issued the Site's fourth FYR Report	September 2018
The GWTP was shut down and the seven-year PMP began	July 2020
The GWTP was restarted in response to increasing VOC concentration in groundwater and migration of the plume	May 2023

APPENDIX C – 1989 ROD INDICATOR COMPOUNDS

TABLE 1

INDICATOR COMPOUNDS
SULLIVAN'S LEDGE SITE
NEW BEDFORD, MASSACHUSETTS

VOLATILE ORGANICS

2-butanone
4-methyl-2-pentanone
benzene
toluene
xylenes
ethylbenzene
chlorobenzene
1,2-dichloroethane
trans-1,2-dichloroethene
trichloroethene
vinyl chloride
chloroform
methylene chloride
styrene

SEMI-VOLATILE ORGANICS

Acid Extractables

Pentachlorophenol

Base/Neutral Extractables

bis(2-ethylhexyl)phthalate
polycyclic aromatic hydrocarbons (PAHs)
- acenapthane
- acenapthylene
- anthracene
- benzo(a)anthracene
- benzo(b)fluoranthene
- benzo(k)fluoranthene
- benzo(g,h,i)perylene
- benzo(a)pyrene
- chrysene
- dibenzo(a,h)anthracene
- fluoranthene
- fluorene
- ideno(1,2,3-cd)pyrene
- phenanthrene
- pyrene
- naphthalene
- 2-methylnaphthalene
- 2-chloronaphthalene

1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
1,2,4-trichlorobenzene
n-nitrosodimethylamine
n-nitrosodiphenylamine
bis(2-chloroethyl)ether
dibenzofuran

PESTICIDES/PCBs

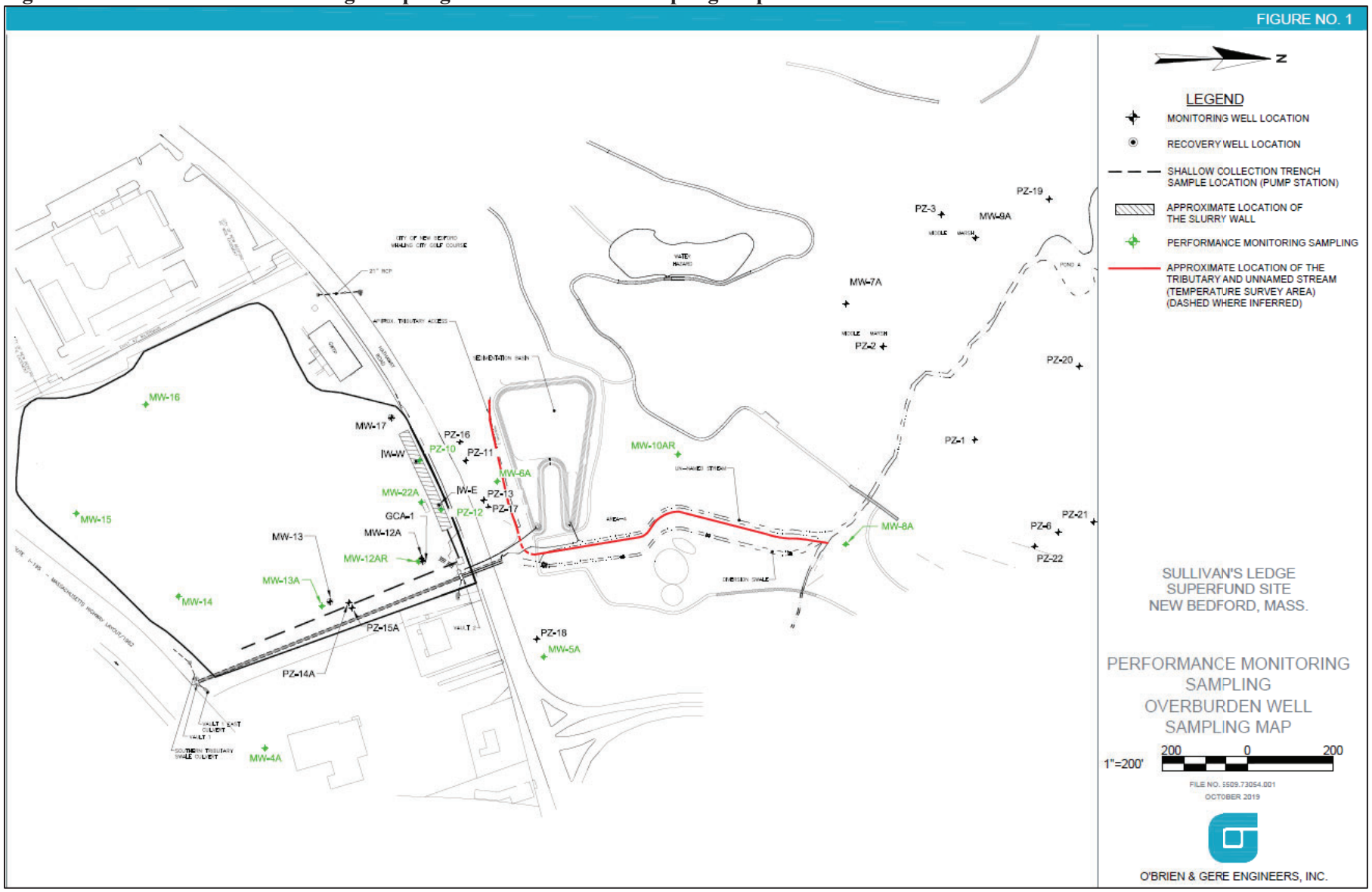
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260

INORGANICS

barium
copper
iron
lead
manganese
mercury
nickel
silver
sodium
zinc

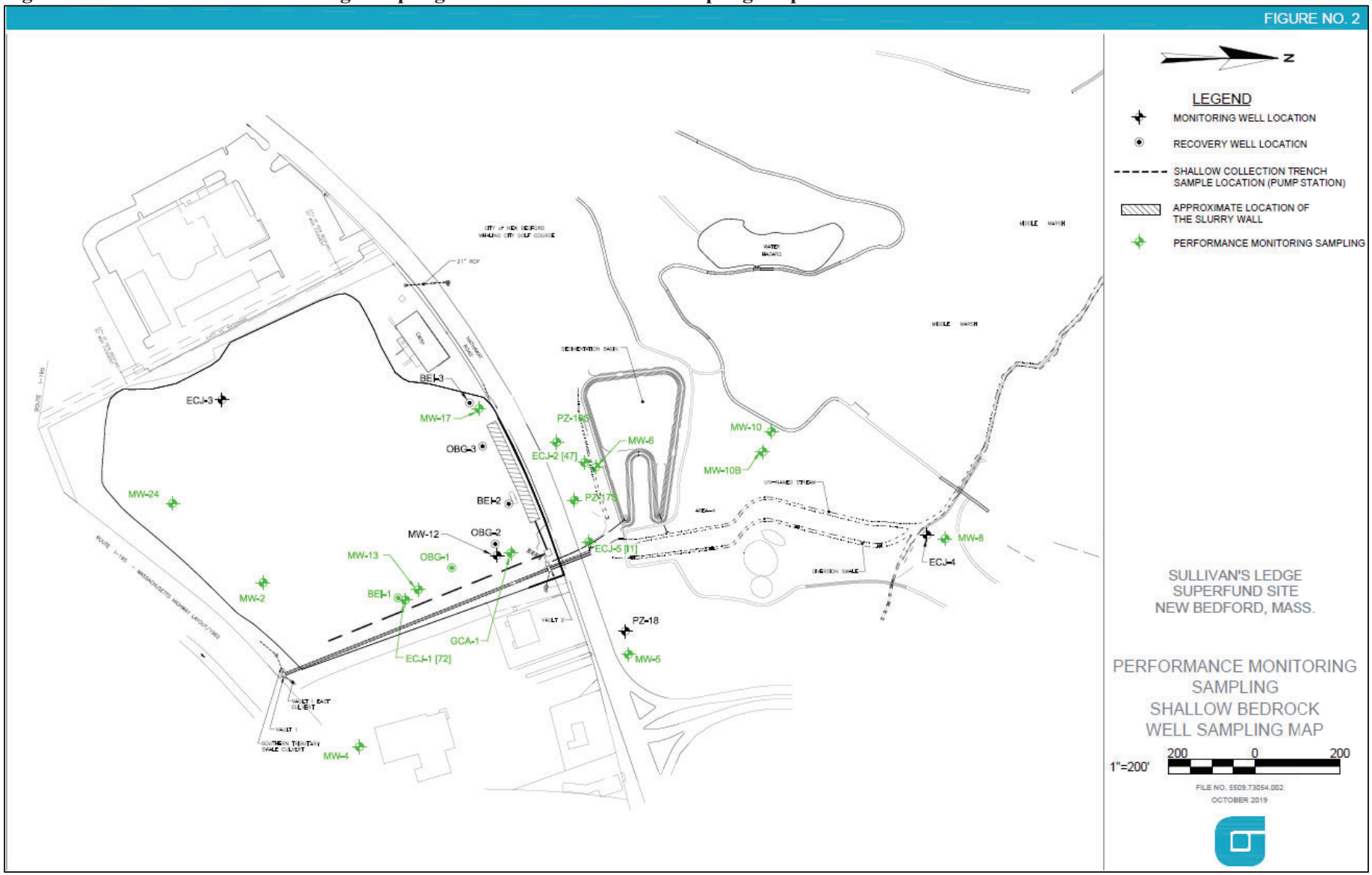
APPENDIX D – PMP MONITORING LOCATIONS

Figure D-1: Performance Monitoring Sampling Overburden Well Sampling Map



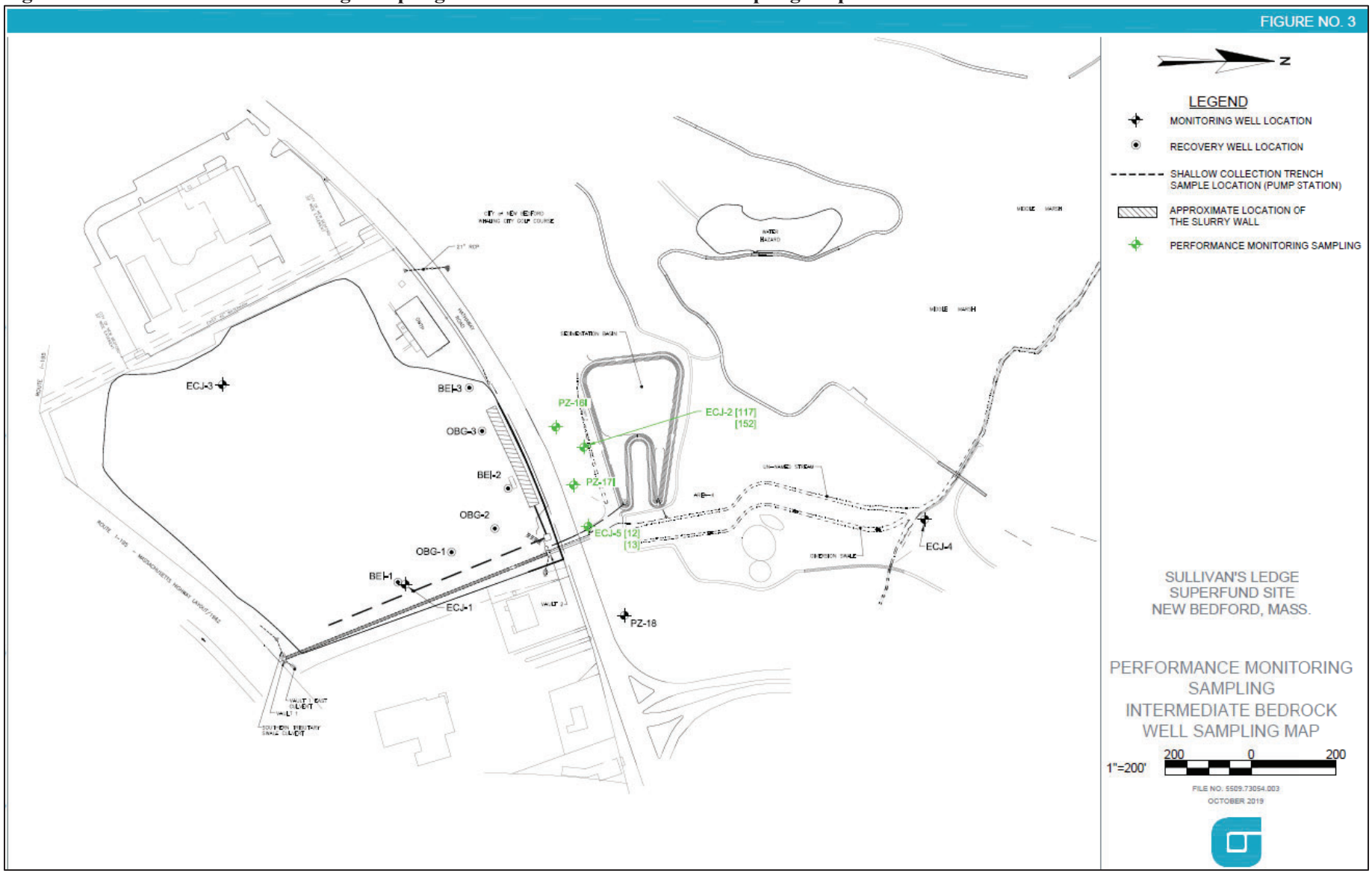
Source: Final PMP Sampling Plan, July 2020. Prepared by O'Brien & Gere Engineers, Inc.

Figure D-2: Performance Monitoring Sampling Shallow Bedrock Well Sampling Map



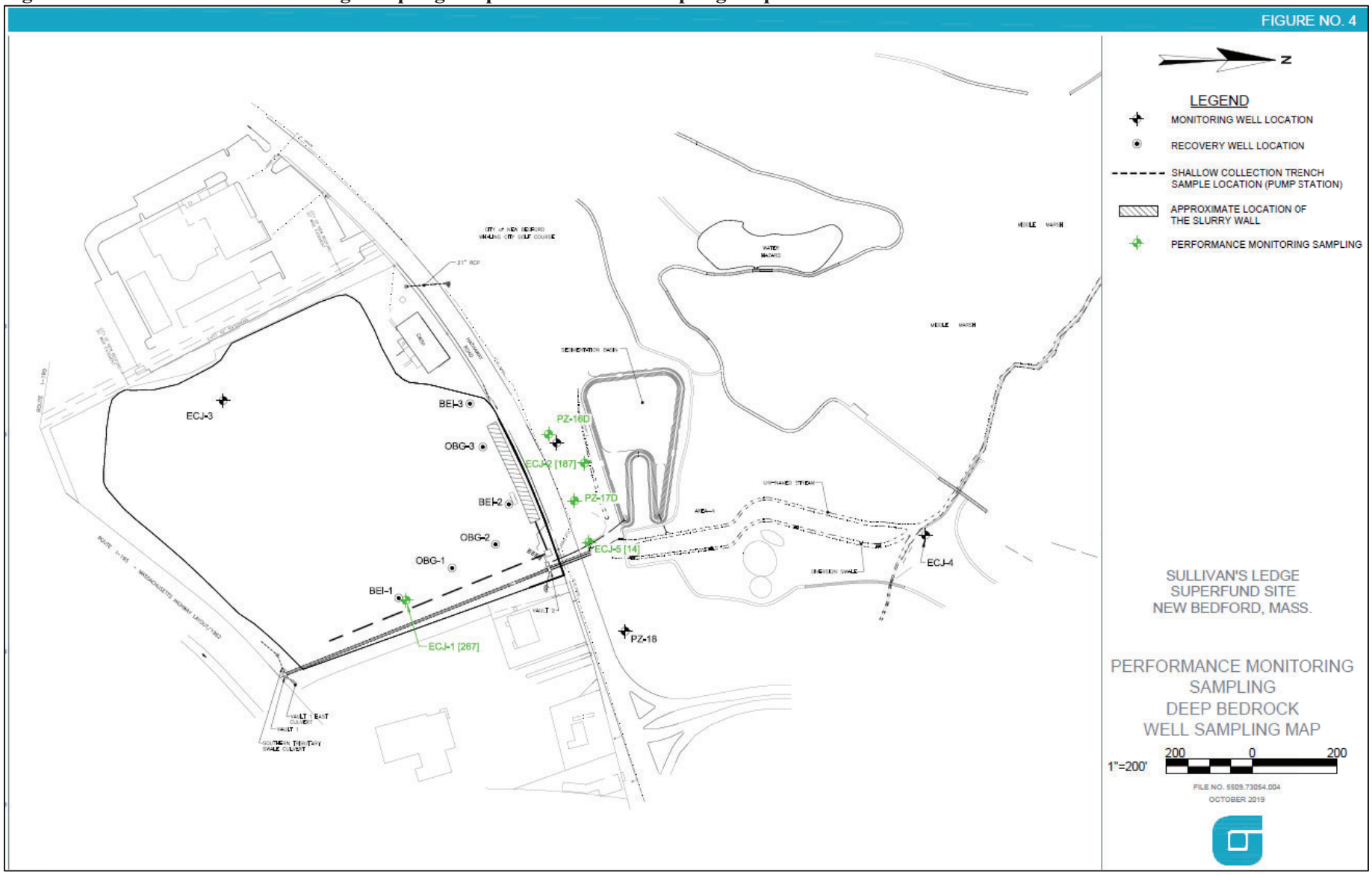
Source: Final PMP Sampling Plan, July 2020. Prepared by O'Brien & Gere Engineers, Inc.

Figure D-3: Performance Monitoring Sampling Intermediate Bedrock Well Sampling Map



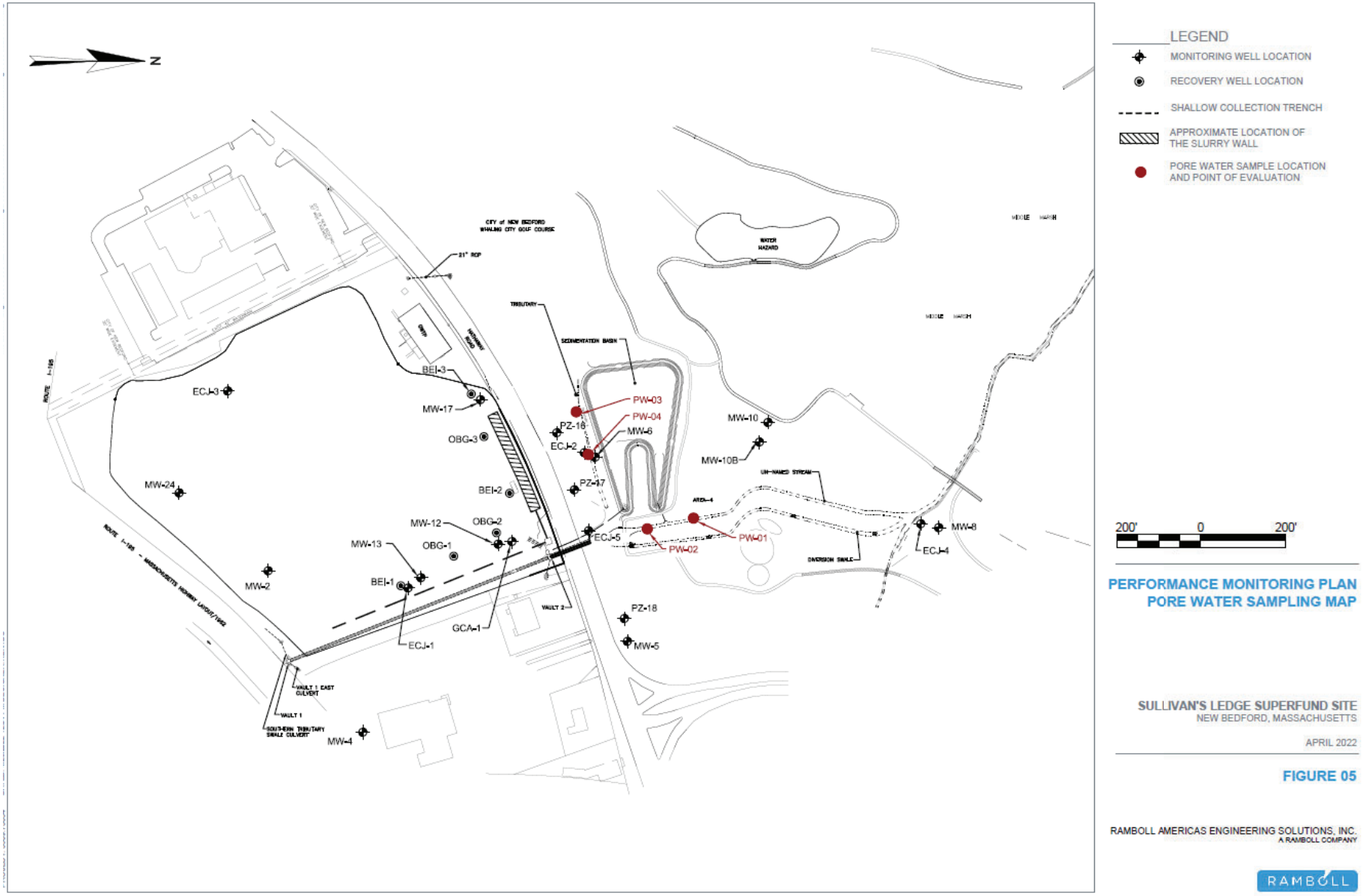
Source: Final PMP Sampling Plan, July 2020. Prepared by O'Brien & Gere Engineers, Inc.

Figure D-4: Performance Monitoring Sampling Deep Bedrock Well Sampling Map



Source: Final PMP Sampling Plan, July 2020. Prepared by O'Brien & Gere Engineers, Inc.

Figure D-5: Performance Monitoring Plan Pore Water Sampling Map



Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

News Releases: **Region 01** <https://epa.gov/newsreleases/search/press_office/region-01-226161>

CONTACT US <https://epa.gov/newsreleases/forms/contact-us>

EPA to Review Cleanups at Six Massachusetts Superfund Sites this Year

January 18, 2023

Contact Information
David Deegan (deegan.dave@epa.gov)
(617) 918-1017

BOSTON (Jan. 18, 2023) – The U.S. Environmental Protection Agency (EPA) will conduct comprehensive reviews of completed cleanup work at six National Priority List (NPL) Superfund sites in Massachusetts this year.

The sites will undergo a legally required Five-Year Review to ensure that previous remediation efforts at the sites continue to protect public health and the environment.

"Throughout the process of designing and constructing a cleanup at a hazardous waste site, EPA's primary goal is to make sure the remedy will be protective of public health and the environment, especially for communities that have been overburdened by pollution," **said EPA New England Regional Administrator David W. Cash**. "It is important for EPA to regularly check on these sites to ensure the remedy is working properly and Massachusetts communities continue to be protected."

The Superfund Sites where EPA will conduct Five-Year Reviews in 2023 are listed below with web links that provide detailed information on site status as well as past assessment and cleanup activity. Once the Five-Year Review is complete, its findings will be posted to the website in a final report.

Five-Year Reviews of Superfund sites in Massachusetts to be completed in 2023:

Iron Horse Park , Billerica

Plymouth Harbor CEC , Plymouth

Re-Solve, Inc., Dartmouth

Shpack Landfill , Norton/Attleboro

Sullivan's Ledge , New Bedford

Federal Facility

Otis Air National Guard Base/Camp Edwards , Falmouth, Bourne, Sandwich, Mashpee

More information:
The Superfund program, a federal program established by Congress in 1980, investigates and cleans up the most complex, uncontrolled, or abandoned hazardous waste sites in the country and EPA endeavors to facilitate activities to return them to productive use. In total, there are 123 Superfund sites across New England.

Superfund and other cleanup sites in New England <https://epa.gov/superfund/search-superfund-sites-where-you-live>

EPA's Superfund program <https://epa.gov/superfund>

Contact Us <https://epa.gov/newsreleases/forms/contact-us> to ask a question, provide feedback, or report a problem.

LAST UPDATED ON JANUARY 18, 2023

APPENDIX F – INTERVIEW FORMS

SULLIVAN'S LEDGE SUPERFUND SITE FIVE-YEAR REVIEW INTERVIEW FORM	
Site Name: Sullivan's Ledge	
EPA ID: MAD980731343	
Subject name: Dorothy Allen	**Subject affiliation:** MassDEP
Subject contact information: dorothy.t.allen@state.ma.us	
Interview date: 4/12/2023	**Interview time:** p.m.
Interview format (select one): In Person Phone Mail **Email X** Other:	
Interview category: State Agency	

1. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

   The treatment plant is aging and needs continued repairs and upgrades. Before shutdown it contained the plume and provided appropriate treatment. The active gas collection system needs monitoring but captures most of the disposal area gas. Since the shutdown the groundwater contamination has spread and no longer meets the performance standards. At present the treatment plant needs to re-start and to pump and treat adequate volume of groundwater to draw back and once again contain the plume of contamination. The Site is being properly re-used as a golf course, wetland habitat and PV electricity generating location.

2. What is your opinion of the current performance of the remedy in place at the Site?

   The current remedy of groundwater pump and treat at the site needs to be re-started. The recent shutdown, however, has demonstrated that the pump and treat remedy has not addressed the source of the contamination and that to contain the plume the treatment would need to operate for an indeterminate period of time to meet the performance standards stipulated in the ROD. Further, it is not clear if these standards are appropriate for the site since they are not risk based. A re-examination of the performance standards for the site and design of a more appropriate long-term remedy is necessary.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?

   No.

4. Has your office conducted any site-related activities or communications in the past five years? If so, please describe the purpose and results of these activities.

   No.

5. Are you aware of any changes to state laws that might affect the protectiveness of the Site's remedy?

   No.

6. Are you comfortable with the status of the institutional controls at the Site? If not, what are the associated outstanding issues?

   Yes.

7. Are you aware of any changes in projected land use(s) at the Site?

   No.

8. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

   EPA and MassDEP should negotiate with the PRPs to perform site specific risk assessment that will allow for the development of new performance standards that will be used to design and implement a new remedy in place of continuation of existing remedy. A ROD amendment and updated CD may be required in the future.

9. Do you consent to have your name included along with your responses to this questionnaire in the FYR report?

   Yes.

Sullivan's Ledge Superfund Site 2023 Five-Year Review

Response to Interview Questions – Marilyn Wade (Brown and Caldwell on behalf of the PMC)

1. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?
   Overall, the remedy has been successful in reducing contaminant levels at this historic disposal site and restoring the wetland area that was part of the remedial action.

2. What is your opinion of the current performance of the remedy in place at the Site?
   The overall remedy performance since the last 5-year review has been productive. The remedy components include the Groundwater Treatment Plant (GWTP), recovery wells, and landfill cap.

   The recovery wells, in concert with the landfill cap, provide plume capture and successful minimization of contaminant migration to the restored downgradient stream and wetland. The GWTP provides treatment of recovered groundwater prior to discharge to the sanitary sewer.

   The operation of the Site's GWTP, which began in December 1999, and landfill cap accomplished remedial goals and contaminant reduction to the point where GWTP operation was suspended on July 24, 2020 to begin a seven-year course of performance monitoring from 2020 to 2027. Based on data from the first two years of performance monitoring, groundwater chlorinated volatile organic solvent concentrations rebounded since GWTP suspension. In Fall of 2022, the PMC Group recommended that the GWTP restart because the plant's operation is demonstrated to effectively contain and reduce groundwater contaminants. The GWTP restart is scheduled for May 1, 2023.

3. What have been the effects of this Site on the surrounding community and neighborhood, if any?
   There are no known effects of this Site on the surrounding community and neighborhood.

4. Are you aware of any complaints or inquiries regarding environmental issues or the remedial action from residents since implementation of the cleanup?
   No.

5. What monitoring data do you regularly collect? What are the key trends in the data you're familiar with regarding contaminant levels and or system performance that are being documented over time at the Site?
   Regularly collected data includes depth to groundwater in the monitoring wells, groundwater samples for analysis of chlorinated volatile organic compounds and/or PCBs from selected monitoring well locations, and data associated with landfill gas monitoring (LFG).

   Data collected during the LFG monitoring events is consistent from quarter to quarter. While methane is detected at gas monitoring well GM-18, multiple lines of evidence from collected data support that the methane is from an off-site source. The remainder of the LFG monitoring data indicate that the LFG system continues to operate effectively and that no airborne impacts are observed in ambient air. Given the consistency and results obtained during multiple years of quarterly LFG monitoring, the Group suggests reducing the LFG monitoring events to semi-annual in the upcoming 5-year period.

   The key groundwater data trend at the beginning of the 5-year period showed stable concentrations in the groundwater wells being monitored and concentrations were consistently below the performance goal of 10,000 ug/L total VOCs. Once GWTP operations were suspended and the performance monitoring period began, groundwater VOC concentrations were observed

to increase in select wells and in particular subsurface depth horizons. The most significant rebounding has occurred in the deep bedrock fracture zone. However, while concentrations in select wells proximate to the recovery wells have been increasing, the downgradient sentinel wells remain unimpacted and have not exhibited extended lateral migration.

As a result, the GWTP is being turned back on-line. The anticipated resulting trend is a decrease in groundwater concentrations with time as the recovery wells' cone of influence is re-established and expands to provide containment.

In March 2023, EPA and the PMC collected groundwater samples for poly- and per-fluoroalkyl substances (PFAS) per the 2018 five-year review recommendation. No results were available when this report was submitted.

6. What is the approximate frequency of on-site O&M at this time? Please describe staff responsibilities and activities associated with it.
Operation and maintenance (O&M) of the Site and remedies is performed by the City's Department of Public Infrastructure (DPI). Prior to the plant suspension in 2020, the PMC group understood that DPI operated and maintained the GWTP in accordance with the GWTP O&M Manual (updated twice during this 5-year review period, in April 2019 and again in February 2020); inspected and maintained the LFG system, and inspected and maintained the landfill cap.

   During the shutdown period, from July 2020 to the present, DPI implemented a post-shutdown inspection, testing and maintenance program and quarterly reporting, the goals of which were to confirm that the plant remained viable and able to restart should the performance monitoring indicate that is necessary. We understand that the DPI is currently working through the steps to reinstall and test aspects of the system in preparation for a May 2023 restart. Once the GWTP is operating and following initial pre-and post-restart monitoring and calibration, it is anticipated that operation and maintenance by DPI and associated monitoring by the Group will return to pre-suspension levels.

7. Have there been any significant changes in site O&M requirements, maintenance schedules or sampling routines in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

   There have been no significant changes to the operation and maintenance requirements for the landfill gas system, the cap or the restored wetlands.

   The GWTP shutdown in 2020 resulted in significant changes to the required GWTP O&M. The treatment plant O&M transitioned from the scope of work in the February 2020 O&M manual to a post-shutdown scope and schedule that included quarterly reviews of the various GWTP system components, with the goal of assurance that they would be functional should the GWTP need to be restarted. In addition, the site monitoring schedule was significantly changed. The sampling round immediately prior to the shutdown included 18 sampling locations, four of which were surface water and sediment samples, which have since been replaced by the pore water samples. Between the time the plant started in 1999 and the 2018 sampling round, sampling frequency was reduced from quarterly to semi-annually by agreement with EPA.

   The seven years of performance monitoring that was established in connection with the GWTP shutdown (described in the *Post Suspension Performance Monitoring Sampling Plan* (June 12, 2020) (June 2020 PMP plan) included more sampling points, but a gradually decreasing

frequency of sampling and analysis. The June 2020 PMP plan required quarterly sampling in year 1, semiannual sampling in years 2 and 3, and annual sampling in years 4 to 7. Given the increasing trends in VOC results in year 1, the sampling regimen was increased in year 2 and the first part of year 3 to be quarterly sampling as well. The June 2020 PMP plan included significantly more sampling points than pre-GWTP shutdown sampling, with as many as 37 sampled in any one event. As part of the June 2020 PMP plan, a stream temperature survey was completed, and four pore water sampling locations were added to the program.

Since the plant shut down in June 2020, the Group has worked cooperatively with EPA and MassDEP to modify the sampling plan in response to their recommendations. Doing so was done with objective of maintaining a protective and effective remedy.

8. Have there been unexpected O&M difficulties or costs at the Site since in the last five years? If so, please provide details.

Sampling costs after the GWTP shutdown were higher than when the GWTP was operating. Pre GWTP shutdown, sampling was semi-annually, with 18 sampling locations included in the most recent (2018) O&M event. The final 2020 PMP plan provided for quarterly sampling during the first year after GWTP shutdown, followed by semi-annual monitoring in years 2, 3 and 4, dropping down to annual sampling in years 5, 6, and 7. There were as many as 37 points at each event. Monitoring costs escalated more when rather than semi-annual sampling in Year 2 and 3, quarterly monitoring was required by EPA, resulting in significant unexpected performance monitoring costs.

9. What are the annual system operation/O&M costs for OU1 (incurred by the Sullivan's Ledge Site Group) since the previous five-year review (2018 to present)?

The annual system costs for OU1 for the Five-Year Period are summarized in the table below. This does not include GWTP O&M undertaken by the City.

Approximate Monitoring, Engineering, Capital Improvement, Administrative and Legal Costs

Date	Cost
January 1 to December 31, 2018	$566,518.
January 1 to December 31, 2019	$373,090
January 1 to December 31, 2020	$327,598
January 1 to December 31, 2021	$315,240
January 1 to December 31, 2022	$529,869

10. Are you aware of any opportunities to optimize O&M activities or sampling efforts? Please describe changes and any resulting or desired cost savings or improved efficiencies.
We see an opportunity to optimize sampling efforts after the GWTP is restarted with semi-annual sampling at a similar subset of wells that were monitored prior to the GWTP shutdown.

11. Do you have any comments, suggestions or recommendations regarding O&M activities and schedules at the Site?
The PMC recommends the landfill gas monitoring be reduced from quarterly to semi-annually. Additionally, once the GTWP restart period is complete, the PMC recommends returning to a routine semi-annual monitoring program with a reduced number of locations.

12. Do you consent to have your name included along with your responses to this questionnaire in the FYR report?
Yes.

SULLIVAN'S LEDGE SUPERFUND SITE FIVE-YEAR REVIEW INTERVIEW FORM	
Site Name: Sullivan's Ledge	
EPA ID: MAD980731343	
Subject name: James Costa	**Subject affiliation:** Sullivan's Ledge GWTP, City of New Bedford
Subject contact information:	
Interview date: March 22, 2023	**Interview time:** Not applicable
Interview location: Not applicable	
Interview format (identify one): In Person Phone Mail **Email** Other:	
Interview category: Local Government	

1. Are you aware of the historic environmental issues at the Site and the cleanup activities that have taken place to date?

   Yes, for the past 20+ years, the City has been responsible for treating contaminated groundwater on the Site caused by improper dumping on the grounds in the past.

2. Do you feel well-informed regarding the Site's activities and remedial progress? If not, how might EPA convey site-related information in the future?

   Yes, the Site's activities and remediation are primarily handled internally by the City and information is reported by the EPA as relevant.

3. Have there been any problems with unusual or unexpected activities at the Site or the surrounding area, such as emergency response, vandalism or trespassing?

   There was one documented occurrence of the outer fence being damaged by car accident, but no vandalism was discovered.

4. Are you aware of any changes to state laws or local regulations that might affect the protectiveness of the Site's remedy?

   We are not aware of any changes to state laws or local regulations that might have this effect.

5. Are you aware of any changes in projected land use(s) at the Site?

   We are not aware of any changes in projected land use at the Site.

6. Are there any groundwater wells in addition to or instead of accessing city/municipal water supplies for the golf course? If so, for what purpose(s) is the well used?

   Unknown.

7. Has EPA kept involved parties and surrounding neighbors informed of activities at the Site? How can EPA best provide site-related information in the future?

   Yes, to the best of our knowledge.

8. What monitoring data do you regularly collect? What are the key trends in the data you're familiar with regarding contaminant levels and or system performance that are being documented over time at the Site?

   When the facility is operational, the sludge produced is tested for PCBs and the groundwater coming into and being treated within the plant is tested for PCBs, VOCs and metals. Monitoring is conducted on the collection trench quarterly for PCBs, suspended solids, metals, cyanide and VOCs. Data trends are not typically analyzed in-house.

9. What is the approximate frequency of on-site O&M at this time? Please describe staff responsibilities and activities associated with it.

   The facility is not currently operational but will be returned to operation in May 2023. Current O&M is being conducted consistently and is focused on repairs and maintenance required for the facility to function effectively. All components of the facility are being tested and repaired or replaced as appropriate.

10. Have there been any significant changes in site O&M requirements, maintenance schedules or sampling routines in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

    The facility was not operational for approximately two years. Sampling and maintenance have been conducted on a consistent schedule when the facility is operational, with sampling being conducted a minimum of once per month for the facility's effluent, and maintenance being conducted as needed. Parts requiring frequent preventative maintenance are incorporated in a monthly routine repair list.

11. Have there been unexpected O&M difficulties or costs at the Site since in the last five years? If so, please provide details.

    O&M difficulties and costs have arisen in the form of many parts reaching the end of their functional timeframe and the cost of numerous repairs and part replacements for many pieces of equipment that are now obsolete.

12. What are the annual system operation/O&M costs for OU1 (incurred by the City of New Bedford) since the previous five-year review (2018 to present)?

    This information is not readily available and a request will be made to the City's Purchasing Dept for historical records.

13. Do you have any comments, suggestions or recommendations regarding the project?

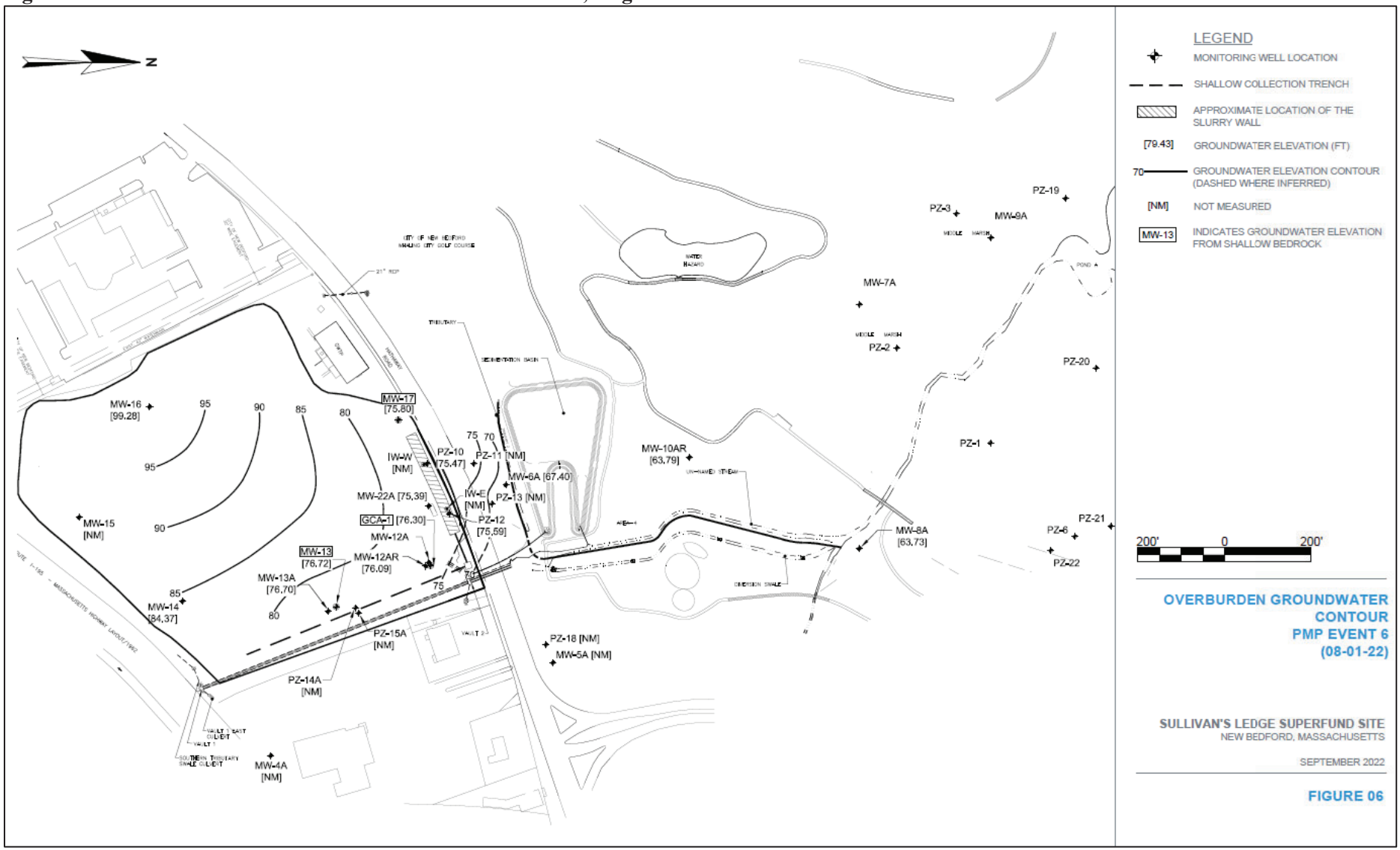
    The plant needs extensive repairs and part replacements due to its operational timeframe and would benefit from an overhaul or replacement of the facility.

14. Do you consent to have your name included along with your responses to this questionnaire in the FYR report?

    Yes, James Costa, Superintendent of Wastewater

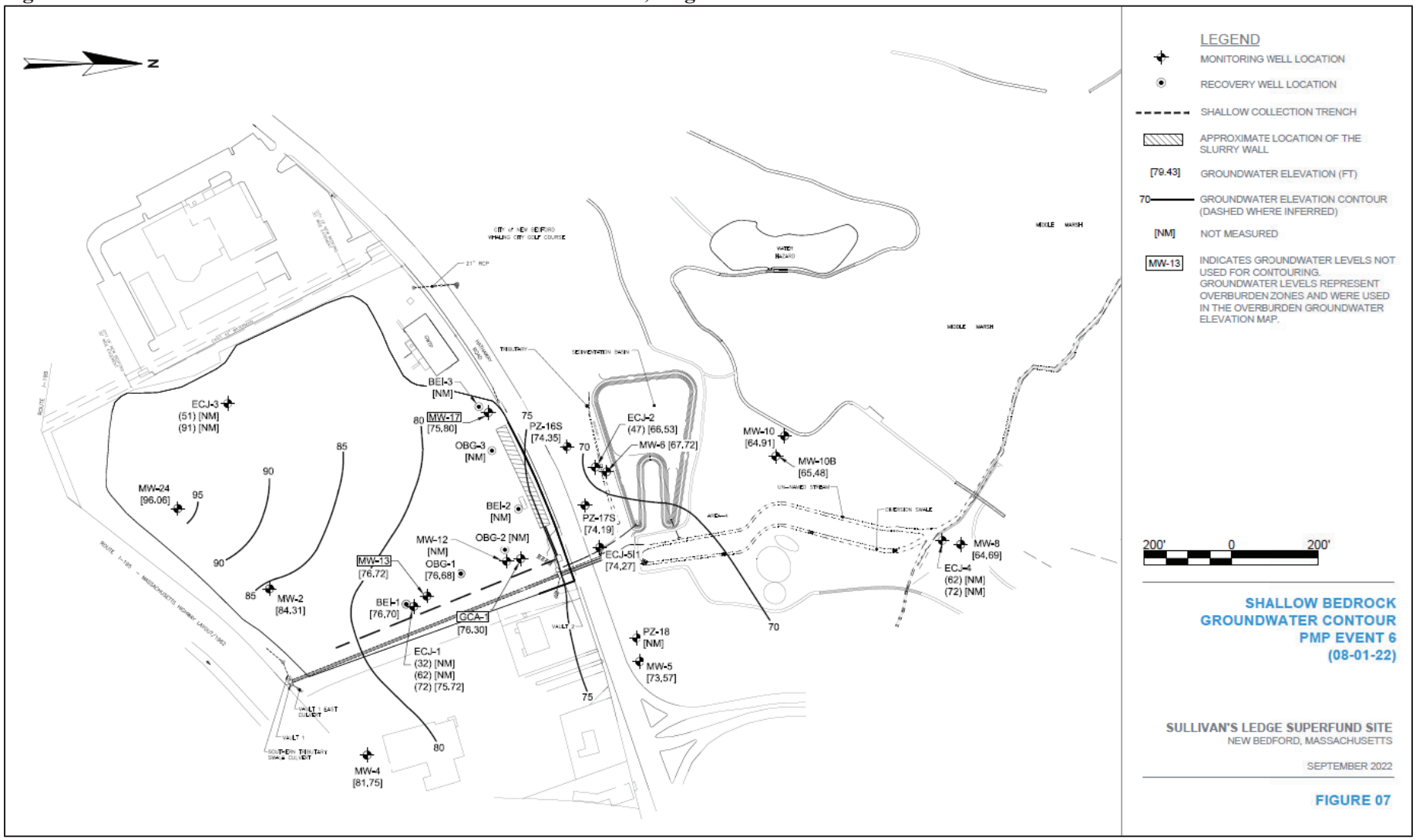
APPENDIX G – DATA REVIEW FIGURES

Figure G-1: Overburden Groundwater Contour PMP Event 6, August 2022



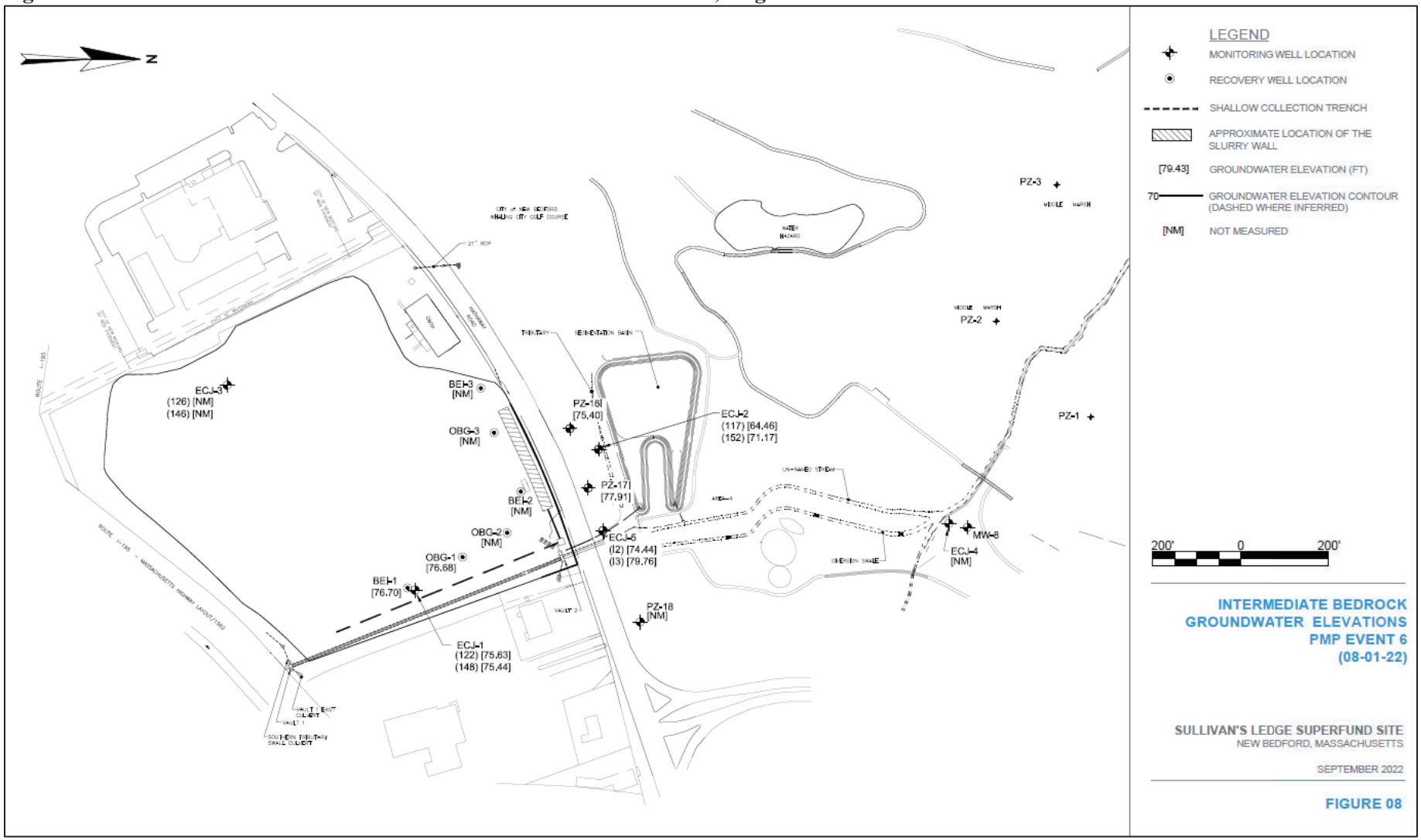
Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-2: Shallow Bedrock Groundwater Contour PMP Event 6, August 2022



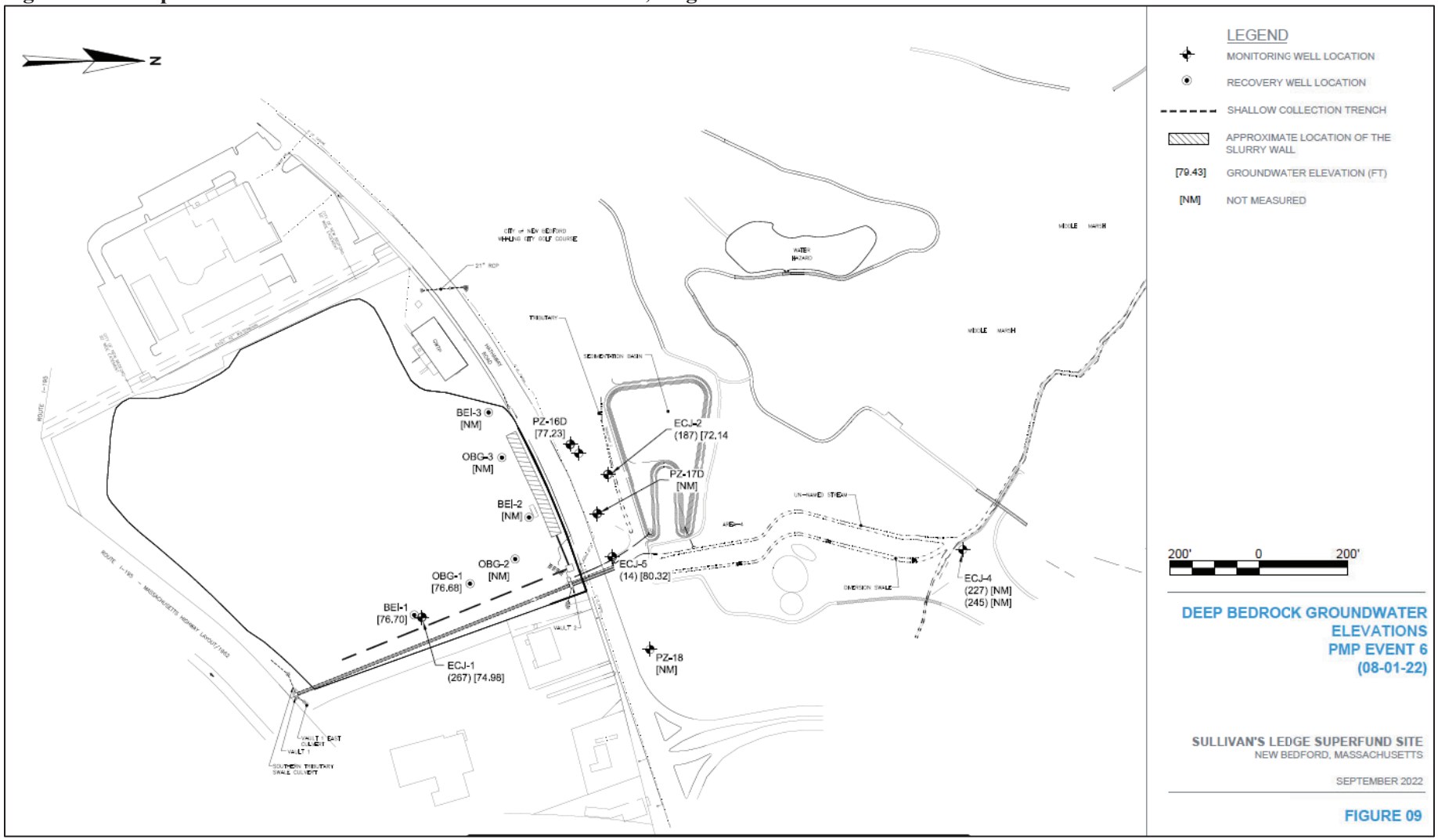
Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-3: Intermediate Bedrock Groundwater Elevations PMP Event 6, August 2022



Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-4: Deep Bedrock Groundwater Elevations PMP Event 6, August 2022



Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

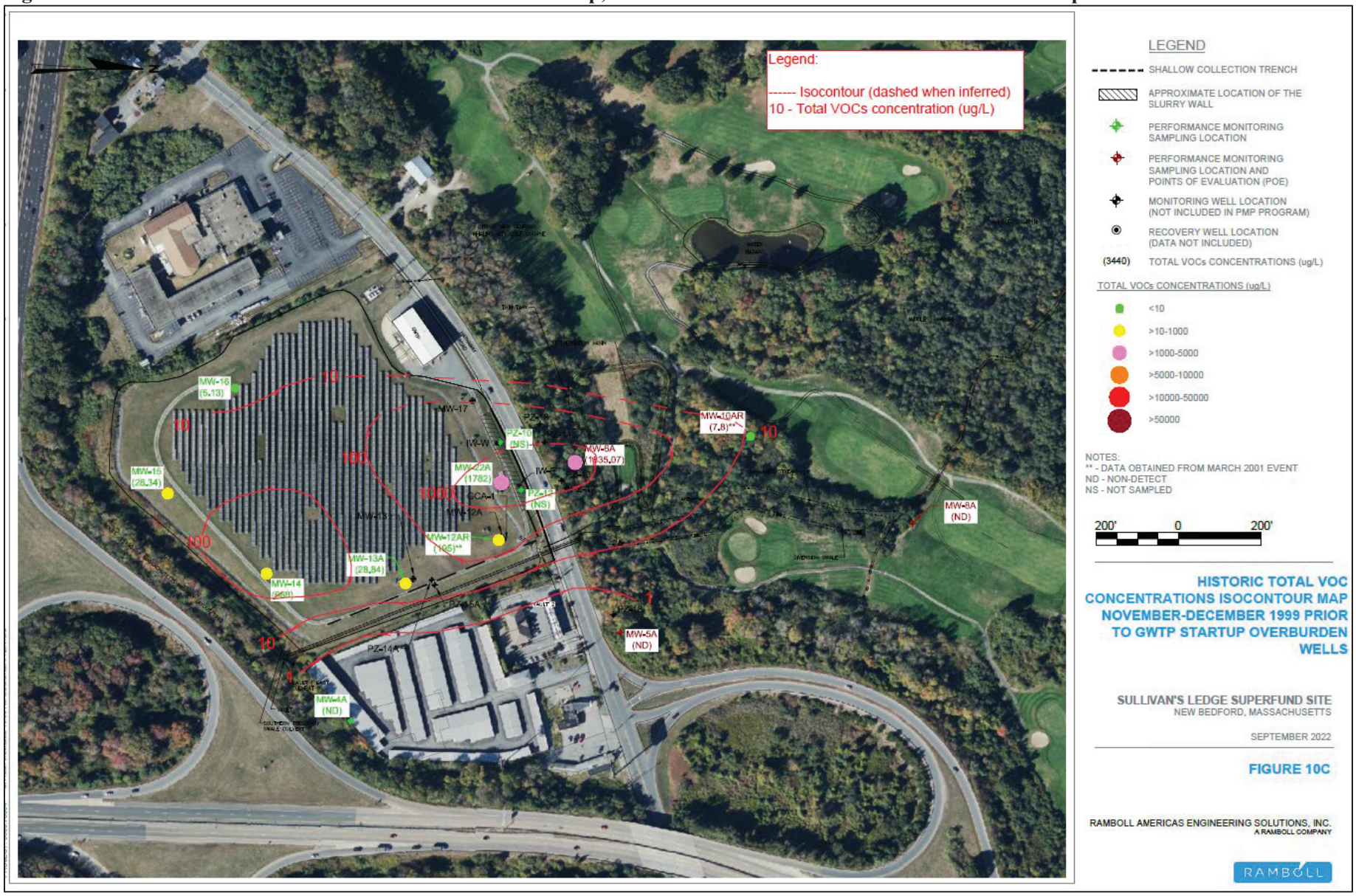
Figure G-5: Historic Total VOCs Prior to GWTP Startup, November-December 1999 – Overburden Wells

Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-6: Total VOCs Concentrations PMP Event 1, October 2020, and PMP Event 6, August 2022 – Overburden Wells

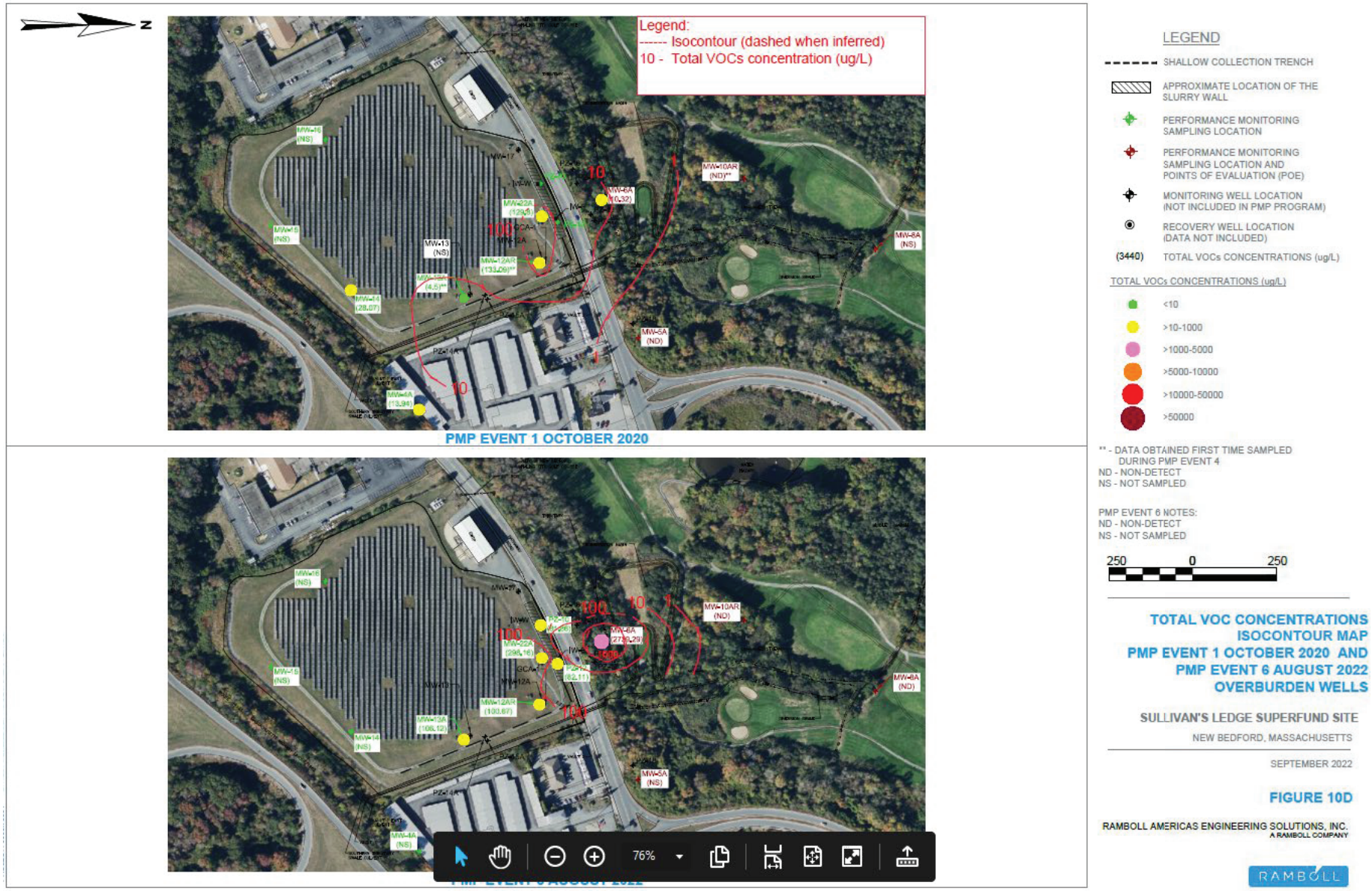
Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-7: Historic Total VOC Concentrations Isocontour Map, November-December 1999 Prior to GWTP Startup – Overburden Wells



Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-8: Total VOC Concentrations Isocontour Map, PMP Event 1, October 2020, and PMP Event 6, August 2022 – Overburden Wells

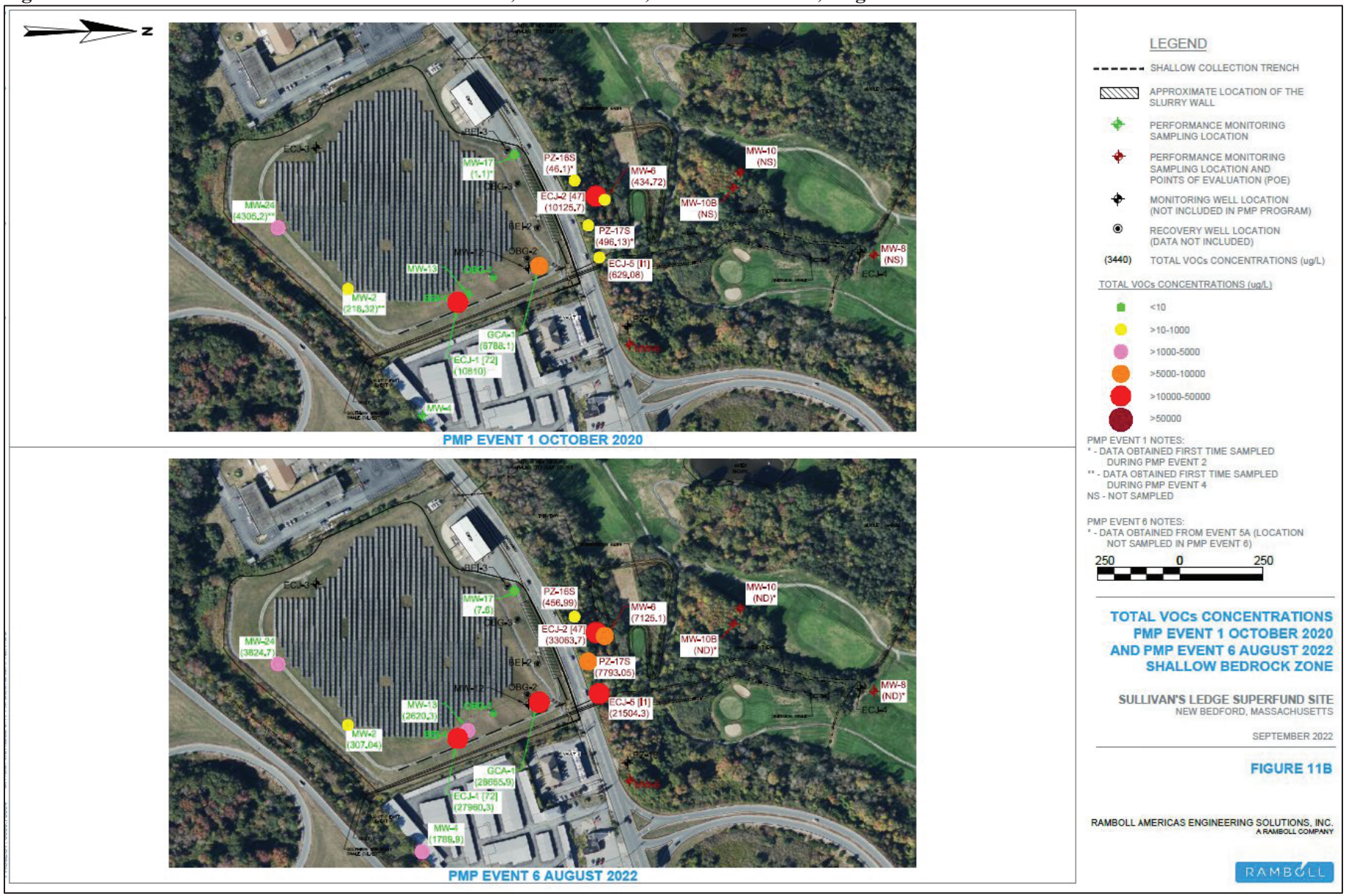


Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-9: Historic Total VOCs Prior to GWTP Startup, November-December 1999 – Shallow Bedrock Wells

Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-10: Total VOCs Concentrations PMP Event 1, October 2020, and PMP Event 6, August 2022 – Shallow Bedrock Wells



Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

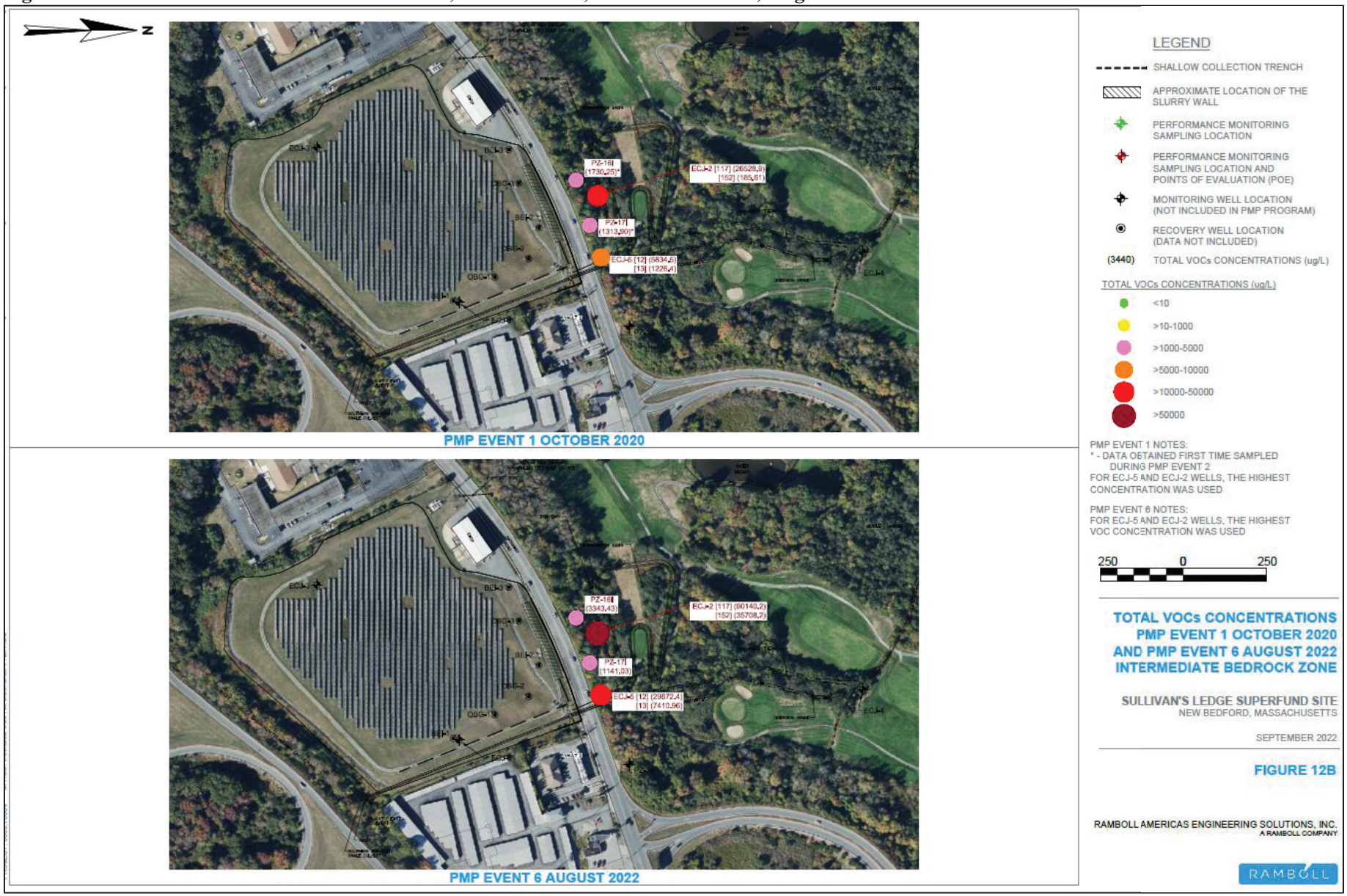
Figure G-11: Historic Total VOCs Prior to GWTP Startup, November-December 1999 – Intermediate Bedrock Zone

Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-12: Historic Total VOCs Prior to GWTP Startup, November-December 1999 – Intermediate Bedrock Zone

Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-13: Total Concentrations PMP Event 1, October 2020, and PMP Event 6, August 2022 – Intermediate Bedrock Zone

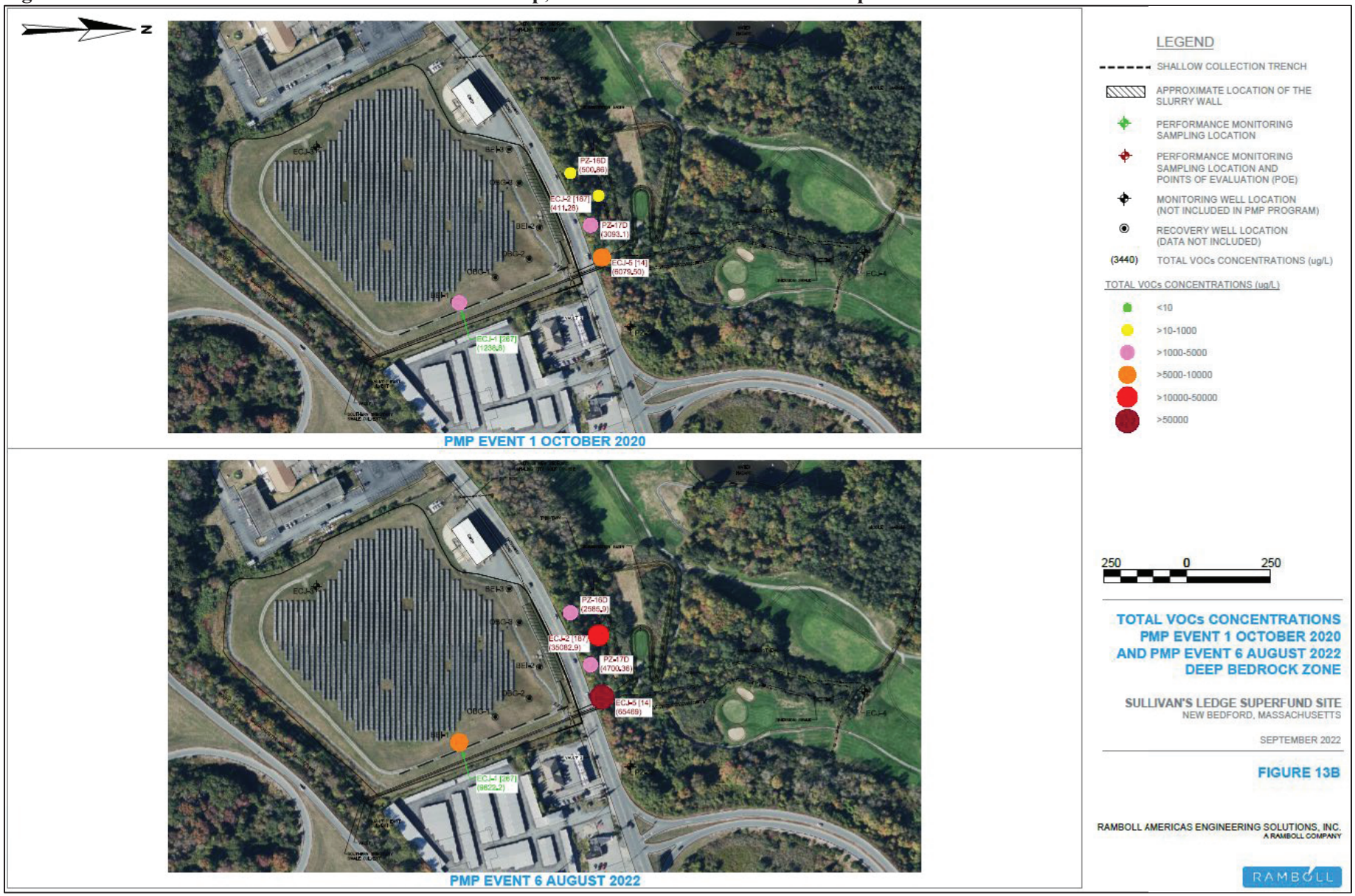


Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-14: Historic Total VOCs Prior to GWTP Startup, November-December 1999 – Deep Bedrock Zone

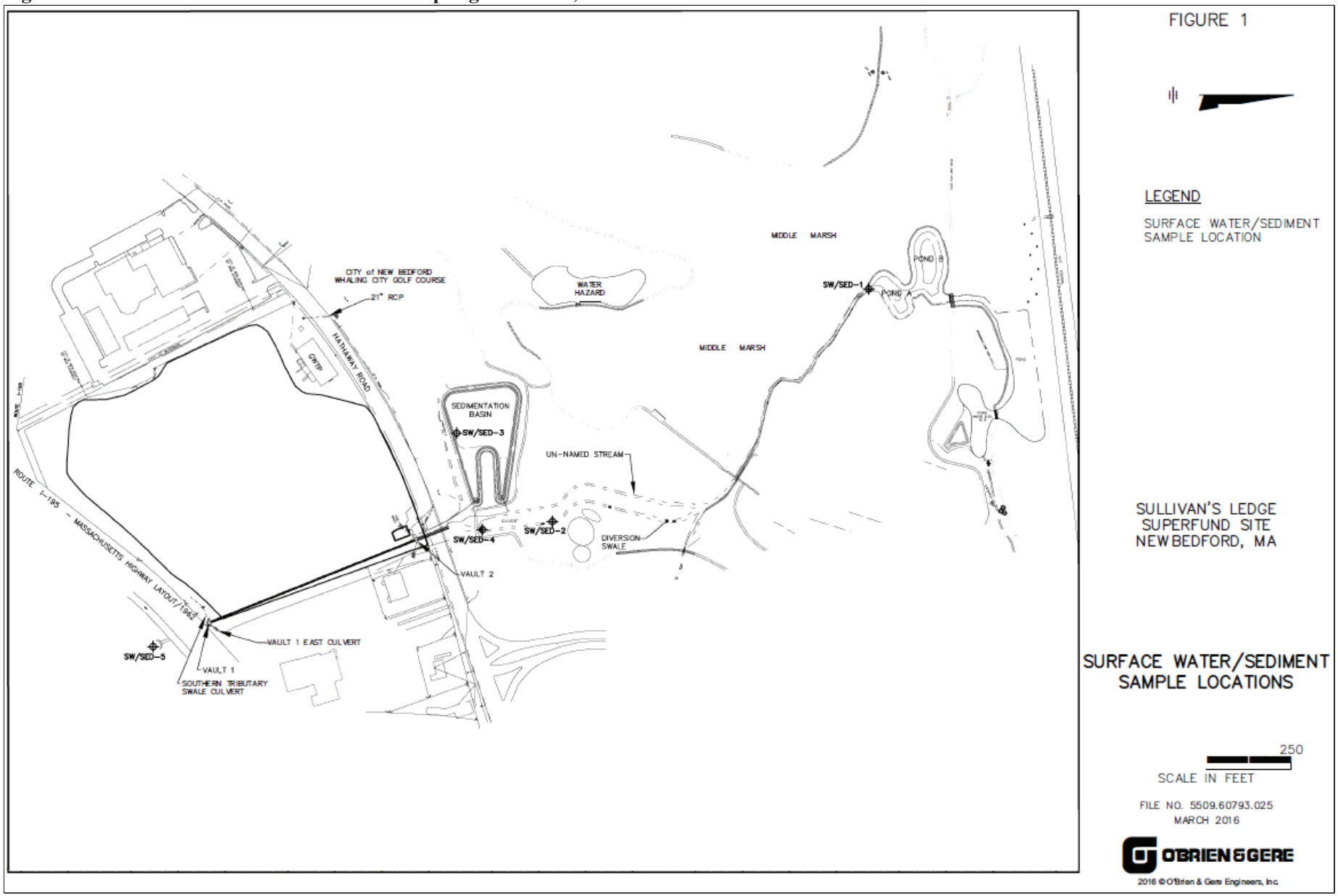
Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-15: Historic Total VOCs Prior to GWTP Startup, November-December 1999 – Deep Bedrock Zone



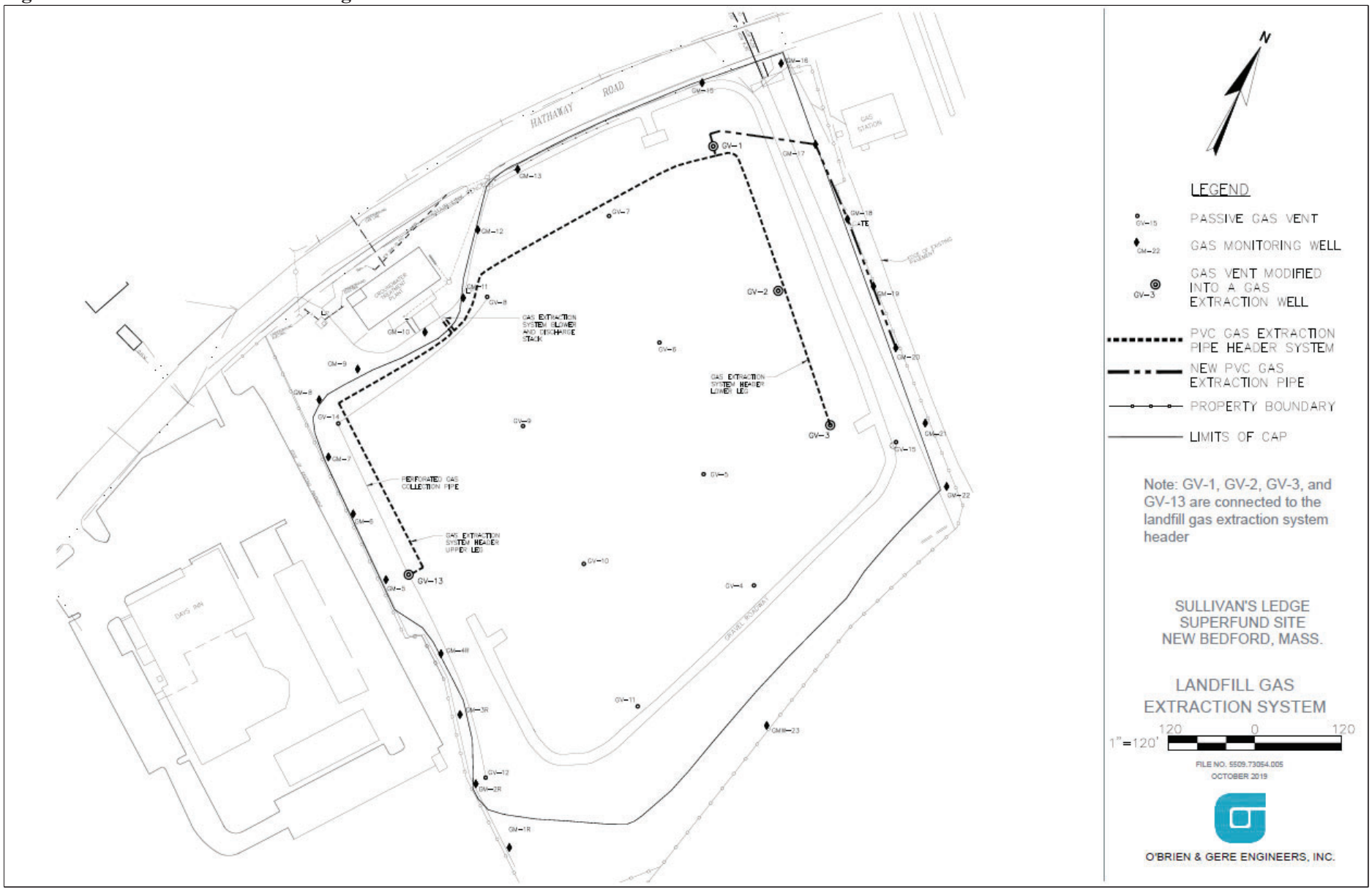
Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Figure G-16: Surface Water and Sediment Sampling Locations, 2019



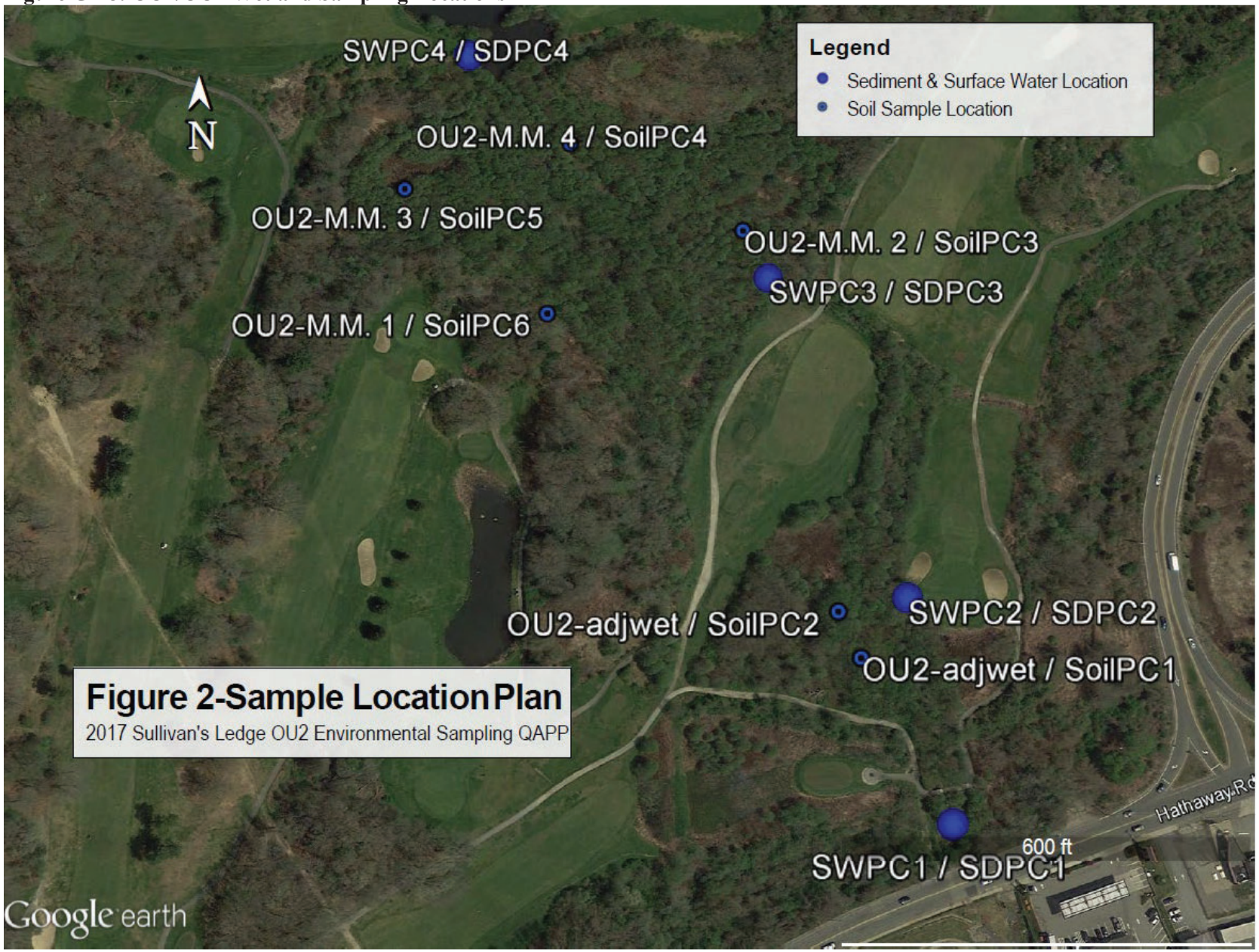
Source: Sullivan's Ledge Superfund Site – September 2019 Biennial Surface Water and Sediment Monitoring Report, prepared by Ramboll. February 6, 2020.

Figure G-17: Landfill Gas Monitoring Locations



Source: Sullivan's Ledge Superfund Site – December 2022 Landfill Gas Monitoring Report, prepared by O-Brien & Gere Engineers, Inc. December 21, 2022.

Figure G-18: OU1/OU2 Wetland Sampling Locations



Source: 2022 Environmental Monitoring Sampling and Results Report, Sullivan's Ledge Superfund Site, prepared by City of New Bedford. August 2022.

APPENDIX H – DATA REVIEW TABLES

Table H-1: PMP Event 6, Groundwater Data Summary, VOCs

RAMBOLL

Table 1
Sullivan's Ledge Superfund Site
Performance Monitoring Plan Event 6
Groundwater Data Summary
Volatile Organic Compounds[1]

Chemical Name	Number of Sample Locations	Number of Locations with Detects	Maximum Detected Concentration (ug/l)	Location of Maximum Concentration	Sample Zone of Maximum Detection
1,1-Dichloroethane	33	7	7.3	ECJ-1 (72)	Shallow Bedrock
1,1-Dichloroethene	33	20	327	ECJ-5-I4*	Deep Bedrock
1,2,4-Trichlorobenzene	33	2	5.8	ECJ-1 (72)	Shallow Bedrock
1,2,4-Trimethylbenzene	33	1	7.7	MW-22A	Overburden
1,2-Dichlorobenzene	33	8	28.3 J	GCA-1	Shallow Bedrock
1,2-Dichloroethane	33	6	4.9 J	ECJ-1 (72)	Shallow Bedrock
1,3,5-Trimethylbenzene	33	1	2.0	MW-22A	Overburden
1,3-Dichlorobenzene	33	12	223 J	OBG-1	Recovery Well
1,4-Dichlorobenzene	33	21	457	OBG-1	Recovery Well
Acetone	33	1	6.4 J	MW-22A	Overburden
Benzene	33	28	2810	MW-24	Shallow Bedrock
Chlorobenzene	33	19	795	MW-24	Shallow Bedrock
Chloroethane	33	5	7.0	PZ-17S*	Shallow Bedrock
cis-1,2-Dichloroethylene	33	27	101000	OBG-1	Recovery Well
Ethylbenzene	33	17	4470	OBG-1	Recovery Well
Isopropylbenzene	33	6	13.1	MW-24	Shallow Bedrock
M,P-Xylene	33	4	24.5	MW-22A	Overburden
Naphthalene	33	1	91	MW-22A	Overburden
n-Butylbenzene	33	1	1.9 J	MW-12AR	Overburden
n-Propylbenzene	33	5	8.7 J	MW-24	Shallow Bedrock
O-Xylene	33	4	11.7	MW-22A	Overburden
sec-Butylbenzene	33	2	1.3 J	MW-12AR	Overburden
Toluene	33	20	3200	OBG-1	Recovery Well
trans-1,2-Dichloroethene	33	18	91.4 J	BEI-1	Recovery Well
Trichloroethylene	33	14	940	MW-4	Shallow Bedrock
Vinyl Chloride	33	26	28900	OBG-1	Recovery Well

Notes:

1. VOCs analyzed using method 8260C. Only detected compounds shown
2. J = Estimated value
3. * = Point of Evaluation
4. Recovery wells are non operational

Source: Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

Table H-2: PMP Event 6, Groundwater Data Summary, PCBs

RAMBOLL

Table 2
Sullivan's Ledge Superfund Site
Performance Monitoring Plan Event 6
Groundwater Data Summary
PCBs[1]

Chemical Name	Number of Sample Locations	Number of Locations with Detects	Maximum Detected Concentration (ug/l)	Location of Maximum Concentration	Sample Zone of Maximum Detection
Unfiltered					
Aroclor 1254	32	6	192	ECJ-1 (267)	Deep Bedrock
Aroclor 1242	32	5	13.7 J+	DUP OBG-1	Recovery Well
Aroclor 1248	32	3	5.9	ECJ-1 (72)	Shallow Bedrock
Aroclor 1221	32	1	159	MW-24	Shallow Bedrock
Field filtered					
Aroclor 1221	10	1	20.2	MW-24-F	Shallow Bedrock
Aroclor 1254	10	1	1.8	ECJ-1 (267)-F	Deep Bedrock
Aroclor 1242	10	1	0.28	BEI-1-F	Recovery Well

Notes:

1. PCB compounds analyzed using method 8082A. Only detected compounds shown
2. Sample port depths are shown in ( ) for ECJ-1 Westbay well
3. PCB Aroclors exhibiting an altered pattern were identified by the laboratory to represent the closest match
4. F= Field-filtered sample, J = Estimated (+) Biased high
5. Recovery wells are non operational

Table H-3: Surface Water Data Summary, 2019

RAMBOLL

Table 1
Sullivan's Ledge Superfund Site
2019 Biennial Monitoring Event
Surface Water Data Summary
Metals Compounds

Constituent	Number of Sample Locations	Number of Detects	Maximum Detected Concentration (mg/l) in SW-1, SW-2 and SW-4	Location of High Concentration
Calcium	6	6	16.30	SW-2
Iron	6	6	2.72	SW-2
Manganese	6	6	0.410	SW-2-F[1]
Sodium	6	6	158	SW-2
Zinc	6	5	0.0253	SW-2

Notes:
1. Detected in the field duplicate of SW-4 at 0.413 mg/L.
2. Only detected compounds shown.
3. Field-filtered and unfiltered samples were obtained from each of the three sample locations.

RAMBOLL

Table 2
Sullivan's Ledge Superfund Site
2019 Biennial Monitoring Event
Surface Water Data Summary
PAHs Compounds

Constituent	Number of Sample Locations	Number of Detects	Maximum Detected Concentration (ug/l) in SW-1, SW-2 and SW-4	Location of High Concentration
Acenaphthene	3	1	0.0328 J	FDSW-4

Notes:
1. Only detected compounds shown.
2. J - Estimated value

Source: Sullivan's Ledge Superfund Site – September 2019 Biennial Surface Water and Sediment Monitoring Report, prepared by Ramboll. February 6, 2020.

Table H-4: Sediment Data Summary, 2019

RAMBOLL

Table 3
Sullivan's Ledge Superfund Site
2019 Biennial Monitoring Event
Sediment Data Summary
PAHs

Constituent	Number of Sample Locations	Number of Detects	Maximum Detected Concentration (ug/kg) in SD-1 through SD-5	Location of High Concentration
2-Methylnaphthalene	5	4	21.1	SD-2
Acenaphthene	5	5	84.7	SD-2
Acenaphthylene	5	5	33.3	SD-2
Anthracene	5	5	237	SD-2
Benzo[a]anthracene	5	5	895	SD-2
Benzo[a]pyrene	5	5	1070	SD-2
Benzo[b]fluoranthene	5	5	1650	SD-2
Benzo[g,h,i]perylene	5	5	825	SD-2
Benzo[k]fluoranthene	5	5	600	SD-2
Chrysene	5	5	1310	SD-2
Dibenzo[a,h]Anthracene	5	5	241 J	SD-2
Fluoranthene	5	5	2700	SD-2
Fluorene	5	5	104	SD-2
Indeno[1,2,3-cd]pyrene	5	5	946	SD-2
Naphthalene	5	5	49.4	SD-2
Phenanthrene	5	5	1380	SD-2
Pyrene	5	5	1910	SD-2

Notes:
1. J - Estimated value

RAMBOLL

Table 4
Sullivan's Ledge Superfund Site
2019 Biennial Monitoring Event
Sediment Data Summary
PCBs

Constituent	Number of Sample Locations	Number of Detects	Maximum Detected Concentration (mg/kg) in SD-1 through SD-5	Location of High Concentration
Aroclor 1248	5	1	0.112 J	FDSED-1
Aroclor 1254	5	2	0.124	FDSED-1

Notes:

1. Only detected compounds shown
2. J - Estimated value

RAMBOLL

Table 5
Sullivan's Ledge Superfund Site
2019 Biennial Monitoring Event
Sediment Data Summary
Metals

Constituent	Number of Sample Locations	Number of Detects	Maximum Detected Concentration (mg/kg) in SD-1 through SD-5	Location of High Concentration
Aluminum	5	5	12400 J	SD-3
Arsenic	5	3	12.1 J	SD-3
Barium	5	4	127 J	SD-3
Berylium	5	1	0.4	SD-2
Calcium	5	5	3630 J	SD-3
Chromium	5	5	51.3	SD-5
Copper	5	5	57.1	SD-5
Iron	5	5	49100 J	SD-3
Lead	5	5	120 J	SD-5[3]
Magnesium	5	5	4000 J	SD-3
Manganese	5	5	967	SD-4
Mercury	5	1	0.052	SD-2
Nickel	5	5	17.3 J	SD-3
Vanadium	5	5	28.5	SD-5
Zinc	5	5	313	SD-5

Notes:
1. J - Estimated value
2. Only detected compounds shown
3. Constituent detected at higher concentration (148 J mg/kg) in the duplicate sample for SD-1

RAMBOLL

Table 6
Sullivan's Ledge Superfund Site
2019 Biennial Monitoring Event
Sediment Data Summary
Total Organic Carbon

Constituent	SD-1	FDSD-1	SD-2	SD-3	SD-4	SD-5
TOC (%)	3.94	4.44	5.34	8.91	1.7	7.65
ug PCBs/g Carbon	1.07	5.3	1.1 U	1.3 UJ	5.49	0.6 U

Notes:
1. For samples SD-2, SD-3 and SD-5 where PCBs were classified as "U" and "UJ", the detection limits were utilized for the PCB concentrations

Source: Sullivan's Ledge Superfund Site – September 2019 Biennial Surface Water and Sediment Monitoring Report, prepared by Ramboll. February 6, 2020.

Table H-5: OU2 Surface Water and Sediment Sampling Results, 2021

Location	Coordinates*		Sample ID	Date	Sample Matrix	TOC (%)	TOC (ppm)	Δ Mean TOC	Temp. (°C)	pH or % Solids	Total PCBs (ppm)	Total PCBs (ppb)	µg PCB/g OC**
	Lattitude	Longitude											
SWPC1/SDPC1	41.65676917	-70.95589133	SWPC1	10/6/2021	Surface Water	---	---	---	16.8	6.68	< 0.0001	< 0.100	---
			SDPC1a	10/6/2021	Sediment	1.10	11000	13900	---	66.6	0.146	146	---
			SDPC1b	10/6/2021		1.52	15200	9700	---	65.1	0.229	229	---
			SDPC1c	10/6/2021		1.76	17600	7300	---	52.4	0.0381	38.1	2.16
			SDPC1d	10/6/2021		5.58	55800	-30900	---	45.9	0.0397	39.7	---
SWPC2/SDPC2	41.65770225	-70.95607767	SWPC2	10/6/2021	Surface Water				16.5	6.79	< 0.0001	< 0.100	---
			SDPC2a	10/6/2021	Sediment	2.02	20200	12075	---	70.6	< 0.0234	< 23.4	---
			SDPC2b	10/6/2021		3.37	33700	-1425	---	59.0	0.0430	43.0	1.28
			SDPC2c	10/6/2021		2.02	20200	12075	---	73.0	< 0.0232	< 23.2	---
			SDPC2d	10/6/2021		5.5	55000	-22725	---	49.8	0.0421	42.1	---
SWPC3/SDPC3	41.65915143	-70.9568164	SWPC3	10/6/2021	Surface Water	---	---	---	16.9	6.85	< 0.0001	< 0.100	---
			SWPC3 DUP	10/6/2021		---	---	---	16.9	6.85	< 0.0001	< 0.100	---
			SDPC3a	10/6/2021	Sediment	2.46	24600	8960	----	66.2	0.0896	89.6	2.67
			SDPC3a DUP	10/6/2021		2.20	22000	11560	---	65.5	0.0544	54.4	---
			SDPC3b	10/6/2021		5.63	56300	-22740	---	51.7	< 0.0347	< 34.7	---
			SDPC3c	10/6/2021		1.91	19100	14460	---	71.2	0.0294	29.4	---
			SDPC3d	10/6/2021		4.58	45800	-12240	---	51.8	0.0310	31.0	---
SWPC4/SDPC4	41.66026472	-70.95865036	SWPC4	10/6/2021	Surface Water	---	---		16.4	7.13	< 0.0001	< 0.100	---
			SDPC4a	10/6/2021	Sediment	2.63	26300	2275	---	60.3	< 0.0258	< 25.8	0.90
			SDPC4b	10/6/2021		2.35	23500	5075	---	67.8	< 0.0228	< 22.8	---
			SDPC4c	10/6/2021		2.62	26200	2375	---	66.1	< 0.0236	< 23.6	---
			SDPC4d	10/6/2021		3.83	38300	-9725	---	61.1	< 0.0258	< 25.8	---
OU2-adjwet	41.65745828	-70.95635421	SoilPC1	10/6/2021	Wetland Soil	3.83	38300	---	---	61.7	< 0.0250	< 25.0	0.65
OU2-adjwet	41.65765403	-70.95647222	SoilPC2	10/6/2021		1.99	19900	---	---	69.4	< 0.0222	< 22.2	1.12
OU2-M.M 1	41.65899691	-70.95814217	SoilPC6	10/6/2021		5.54	55400	---	---	45.3	< 0.0397	< 39.7	0.72
OU2-M.M 2	41.65939306	-70.95695853	SoilPC3	10/6/2021		3.77	37700	---	---	61.2	0.02870	28.7	0.76
OU2-M.M 3	41.65960523	-70.95902273	SoilPC5	10/6/2021		10.1	101000	---	---	31.8	< 0.0552	< 55.2	0.55
OU2-M.M 4	41.65982423	-70.95801035	SoilPC4	10/6/2021		4.71	47100	---	---	47.0	< 0.0410	< 41.0	0.87

< - Result was found to be less than the Reporting Level (RL) or Practical Quantitation Level by the laboratory.
--- - Sample not analyzed for this analysis.
* As Recorded by EPA during 2013 Sampling Event
** Calculated using result for PCBs in µg/kg divided by TOC in mg/kg and multiplied by a 1000 mg/g conversion factor, if PCBs were < RL, then calculated with RL.
BOLD and Underlined - Sediment sample concentration exceeds the mean sediment quality criterion for 20 ug PCB/g OC

Source: 2022 Environmental Monitoring Sampling and Results Report, Sullivan's Ledge Superfund Site, prepared by City of New Bedford. August 2022.

Table H-6: PFAS Results in Groundwater, March 2023

Location	Units	EPA RSL HQ = 0.1	MMCL	GCA-1	MW-6		MW-6A	MW-12AR	MW-24	PZ-11	PZ-15A	PZ-17S
Sample Type				**N**	**N**	**FD**	**N**	**N**	**N**	**N**	**N**	**N**
Per- and Polyfluoroalkyl Substances (PFAS)												
Perfluorobutanesulfonic acid (PFBS)	ng/L	600	--	2 UJ	2 U	2 U	1.9 U	**2.4**	**2.6**	2 U	**2.5**	2 U
Perfluorobutanoic Acid (PFBA)	ng/L	1,800	--	**12**	**9.1**	**8**	**17 J**	**5.8**	4 U	**18 J**	**5.3 J**	**7.3**
Perfluorodecanoic Acid (PFDA)	ng/L	--	--	2 UJ	2 U	2 U	1.9 U	2 U	2 U	2 U	2 U	2 U
Perfluoroheptanoic acid (PFHpA)	ng/L	--	--	**2**	2 U	2 U	1.9 U	**2.1**	**2**	2 U	**3.31**	2 U
Perfluorohexanesulfonic acid (PFHxS)	ng/L	40	--	2 U	2 U	2 U	1.9 U	**2.2**	2 U	2 U	2 U	**2.2**
Perfluorohexanoic Acid (PFHxA)	ng/L	990	--	**2.3 J**	2 UJ	2 U	**2.2 J**	**3.3 J**	**2.8**	2 U	**5.1 J**	**2.5 J**
Perfluorononanoic acid (PFNA)	ng/L	6	--	2 UJ	2 UJ	2 U	1.9 U	2 U	2 U	2 U	2 U	2 U
Perfluorooctanesulfonic acid (PFOS)	ng/L	4	--	**3.9 J**	**10**	**8.8**	**7.9**	**5.9**	**4**	**5.8**	**7.8**	**3.7**
Perfluorooctanoic acid (PFOA)	ng/L	6	--	**29 J**	**11**	**10**	**13**	**21**	**15**	**14**	**16.8**	**22**
Perfluoropentanoic Acid	ng/L	--	--	**2.2**	2 U	2 U	1.9 UJ	**2.6**	**2.2**	2 UJ	**4.7 J**	2 U
Total PFAS for MassDEP[a]		--	20	**34.9**	**21**	**18.8**	**20.9**	**31.2**	**21**	**19.8**	**27.9**	**27.9**

Notes:

a) *MassDEP MCL for PFAS based on sum of PFHxS, PFHpA, PFOA, PFOS, PFNA and PFDA. Only detected analytes included in total.

N = normal

FD = field duplicate

J = estimated

U = undetected at the reporting limit

Blue cell = exceeds RSL

Orange cell = exceeds MMCL

Table H-7: Landfill Gas Monitoring Results, December 2022

Weather Conditions: Rain, 50-55°F

Well Location[1]	Time Sampled	Differential Pressure (inWC)[8]	LGE System Cycle During Monitoring[5]	LandTec GEM 5000™ Serial Number	MiniRAE 3000 PID Serial Number	Methane (%)[2]			Methane (% LEL)[9]			Carbon Dioxide (%)[2]			Oxygen (%)[2]			Hydrogen Sulfide (ppm)[2]			VOCs (ppm)[2]		
						Ambient	Pre-Purge	Post-Purge[3]	Ambient	Pre-Purge	Post-Purge[3]	Ambient	Pre-Purge	Post-Purge[3]	Ambient	Pre-Purge	Post-Purge[3]	Ambient	Pre-Purge	Post-Purge[3]	Ambient	Pre-Purge	Post-Purge[3]
GM-1R	11:18	0.0	2	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.5	21.4	21.2	21.2	0	0	0	0.0	0.0	0.0
GM-2R	11:33	0.0	2	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	0.7	21.6	21.0	21.0	0	0	0	0.0	0.0	0.0
GM-3R	12:05	0.0	2	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8	0.9	21.5	20.8	20.8	0	0	0	0.0	0.0	0.0
GM-4R	12:20	0.0	2	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	21.5	21.5	21.7	0	0	0	0.0	0.0	0.0
GM-5	12:35	0.0	2	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	21.9	21.9	21.9	0	0	0	0.0	0.0	0.0
GM-6	12:50	0.0	2-1 (T)	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	22.0	21.9	21.9	0	0	0	0.0	0.0	0.0
GM-7	13:05	0.0	1	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	22.0	21.9	21.8	0	0	0	0.0	0.0	0.0
GM-8	13:20	0.0	1	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.2	1.4	22.0	20.9	20.8	0	0	0	0.0	0.0	0.0
GM-9	14:15	0.0	2	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	0.9	21.8	20.9	21.1	0	0	0	0.0	0.0	0.0
GM-10	13:58	0.0	2	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.4	1.3	21.4	20.7	20.6	0	0	0	0.0	0.0	0.0
GM-11	13:40	0.0	1	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	21.6	21.4	21.4	0	0	0	0.0	0.0	0.0
GM-12	9:11	0.0	2	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.7	2.7	20.4	17.7	18.1	0	0	0	0.0	0.0	0.0
GM-13	9:30	0.0	2	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.4	1.6	21.1	16.5	18.1	0	0	0	0.0	0.0	0.0
GM-15[6]	10:00	0.0	1	G507373	592-811762	0.0	NA	NA	0.0	NA	NA	0.1	NA	NA	20.4	NA	NA	0	NA	NA	0.0	NA	NA
GM-16	10:02	0.0	1	G507373	592-811762	0.0	0.0	0.0	0.0	0.0	0.0	0.1	4.1	4.3	20.6	2.6	3.0	0	0	0	0.0	0.0	0.0
GM-17[4]	10:22	-3.5	1	G507373	592-811762	0.0	0.0	0.0	0.0	0.0	0.0	0.1	4.7	5.0	21.7	0.0	0.0	0	0	0	0.0	2.2	0.0
GM-18[4][7]	10:39	-1.4	1	G503798	592-927273	0.0	4.6	4.6	0.0	92.0	92.0	0.1	2.3	2.3	21.2	0.1	0.1	0	4	4	0.0	0.2	PW
GM-19[4][7]	10:31	0.0	1	G503798	592-927273	0.0	PW	PW	0.0	PW	PW	0.1	PW	PW	21.7	PW	PW	0	PW	PW	0.0	PW	PW
GM-20[4][7]	10:14	0.0	1	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	7.4	7.3	21.4	7.8	7.8	0	0	0	0.0	0.0	PW
GM-21	9:58	0.0	1	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	4.1	3.5	21.2	15.0	16.1	0	0	0	0.0	0.0	0.0
GM-22	11:00	0.0	2	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.9	4.0	21.5	14.3	14.3	0	0	0	0.0	0.0	0.0
GM-23	11:48	0.0	2	G503798	592-927273	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	21.5	21.5	21.5	0	0	0	0.0	0.0	0.0

Notes:

inWC - inches of water column LEL - Lower Explosive Limit NA-Not Available inHg - inches of Mercury ppm - parts per million VOCs - Volatile Organic Compounds PW - Pulled Water from vapor port

1. Wells numbered sequentially from southwest corner of disposal area. Wells GM-1R through GM-8 are along western boundary, GM-9 through GM-16 are along northern boundary and wells GM-16 through GM-22 are along eastern boundary. GM-23 is located on southern boundary.

2. Landfill gas screening was completed using (2) Landtec Model Gas Extraction Monitor (GEM) 5000s™ and (2) MiniRAE 3000 Photoionization Detectors (PID). Equipment ranges of the Landtec Model GEM 5000™ with an internal hydrogen sulfide pod with a 0.2-micron filter Equipment ranges are as follows: Methane (0-100%), Carbon Dioxide (0-100%), Oxygen (0-25%), Hydrogen Sulfide (0-500 ppm). Equipment gas accuracy for Methane is 0-5% ± 0.3% (vol), 0-70% ± 0.5% (vol) and 70-100% ± 1.5%FS. Equipment gas accuracy for Carbon Dioxide is 0-5% ± 0.3% (vol), 0-60% ± 0.5% (vol) and 60-100% ± 1.5%FS. Equipment gas accuracy for Oxygen is 0-25% ± 1.0% (vol), Carbon Monoxide is 0-2000ppm ± 2.0%FS, and Hydrogen Sulfide is 0-500ppm ± 2.0%FS. Measurements were also taken using an MiniRae 3000 Photoionization Detector with a 0.45-micron external filter. Equipment ranges are as follows: VOCs (0-15,000 ppm). Equipment gas accuracy for Isobutylene is ± 5% of the display reading ± one digit.

3. Post-purge measurements were collected after at least 15 minutes of purging (except as noted). Measurement typically stabilized after 1-2 minutes of purging. "Time Sampled" records readings taken at start of purging.

4. Connected to LGE system by PVC piping, valves between system and GM points were closed at the time of monitoring.

5. The LGE system operates under two cycles: LGE Cycle #1 - pulled vacuum from lower leg only for 60 minutes; and LGE Cycle #2 - pulled vacuum from both legs simultaneously for 120 minutes. This cycle repeats continuously. "T" = transition between cycles.

6. GM-15 and associated monitoring port were submerged during event. Pre/post-purge readings were not recorded.

7. Instrument began pulling water from the port during purging (after 3 minutes at GM-18, after 9 minutes at GM-20, and after approx. 30 seconds at GM-19). The instrument fan was stopped before water reached the filter. Post-purge readings were recorded at GM-18 and GM-20. Pre/post-purge readings were not able to be recorded at GM-19.

8. Readings taken with Dwyer Handheld Digital Manometer 475-3-FM-BK with instrument range of 0-200 inWC and recorded to a tenth of a unit.

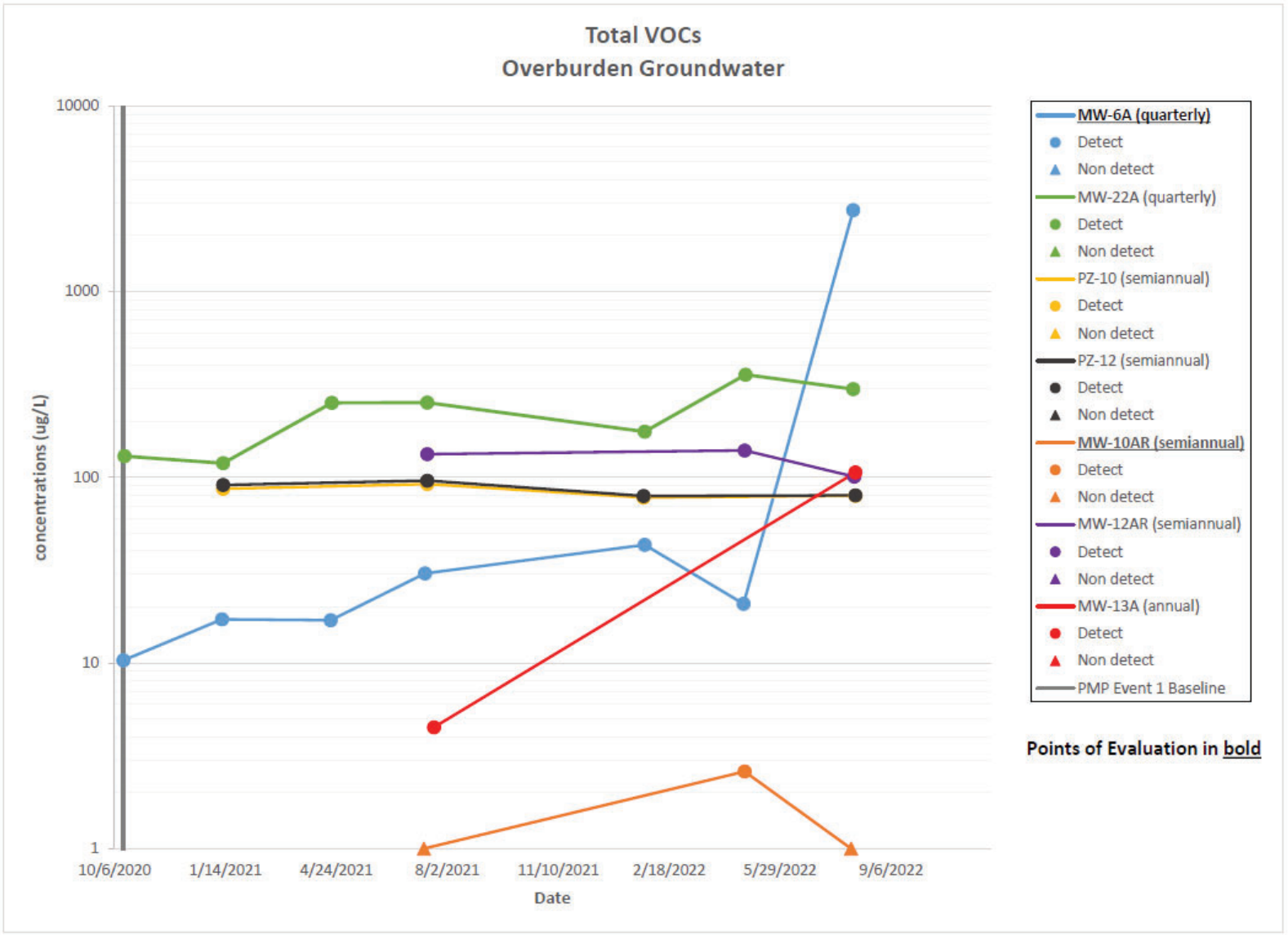
9. 25% LEL criterion per MassDEP Solid Waste Management Environmental Monitoring Requirements 310 CMR 19.132(5)(h).

Source: Sullivan's Ledge Superfund Site – December 2022 Landfill Gas Monitoring, dated December 2022. Prepared by Ramboll.

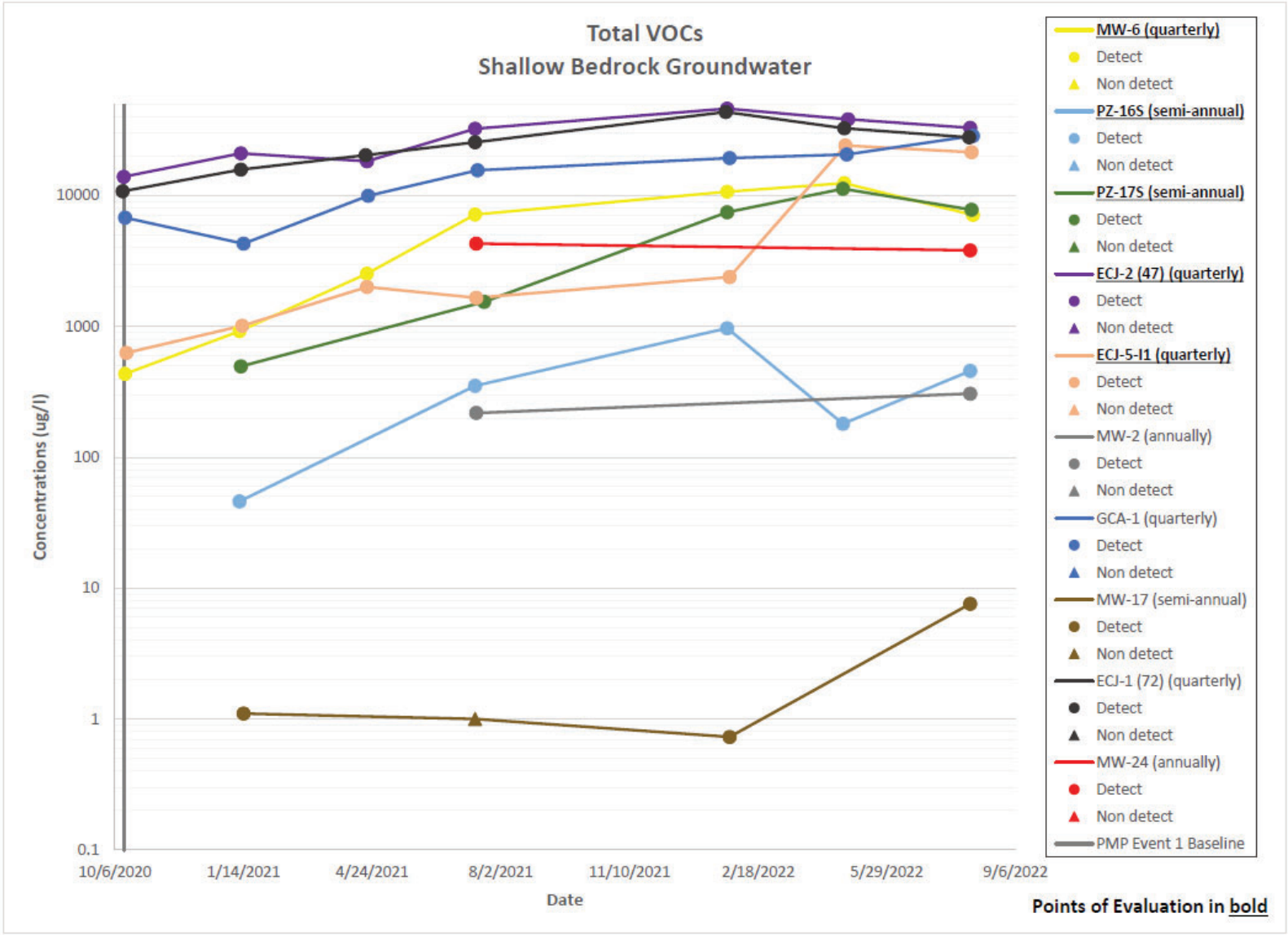
APPENDIX I – DATA TREND GRAPHS

All trend graphs are from Sullivan's Ledge Superfund Site PMP Event 6 Report, dated December 2022. Prepared by Ramboll.

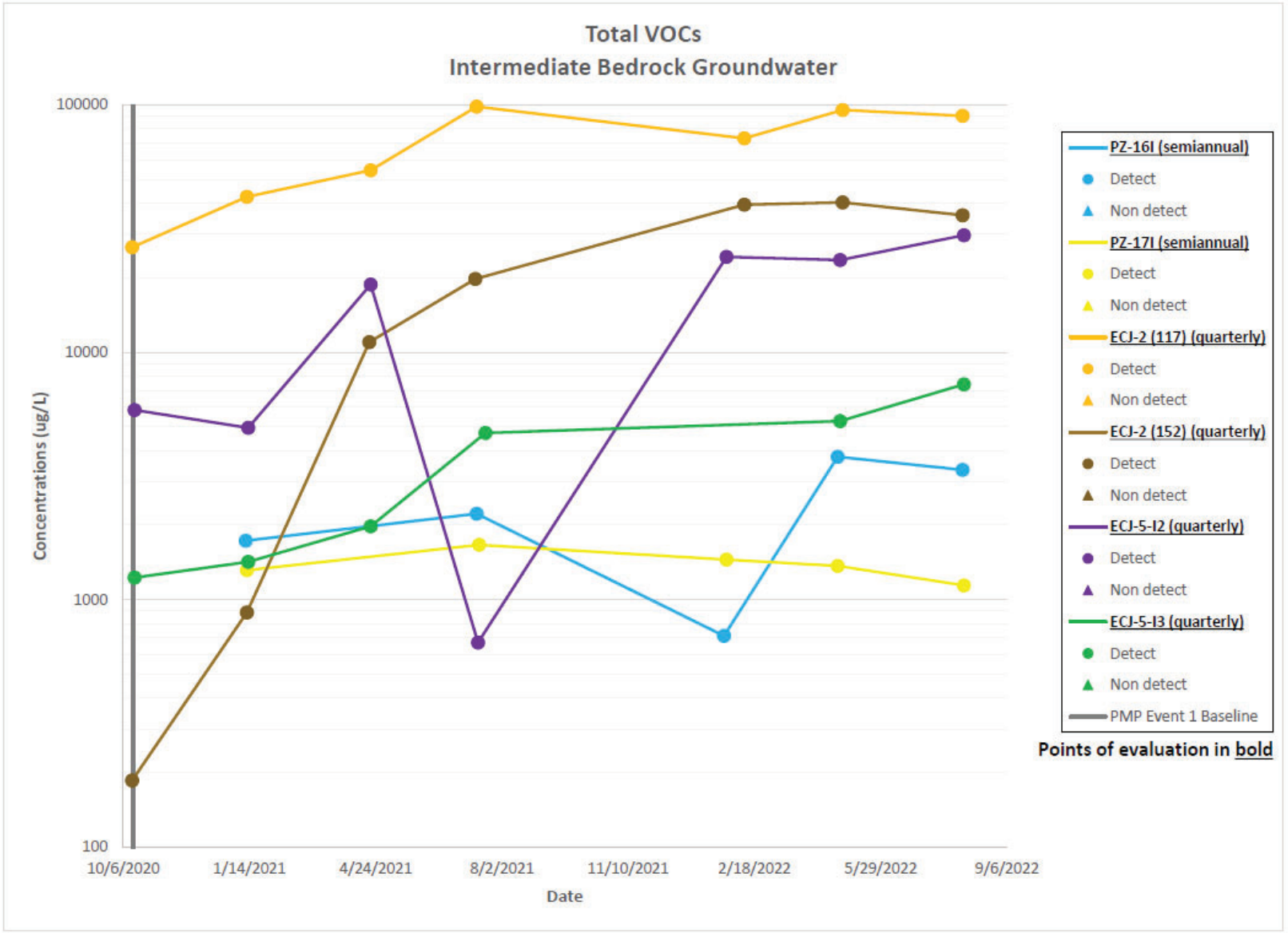
Graph I-1: Total VOCs Overburden Groundwater, PMP Events 1-6



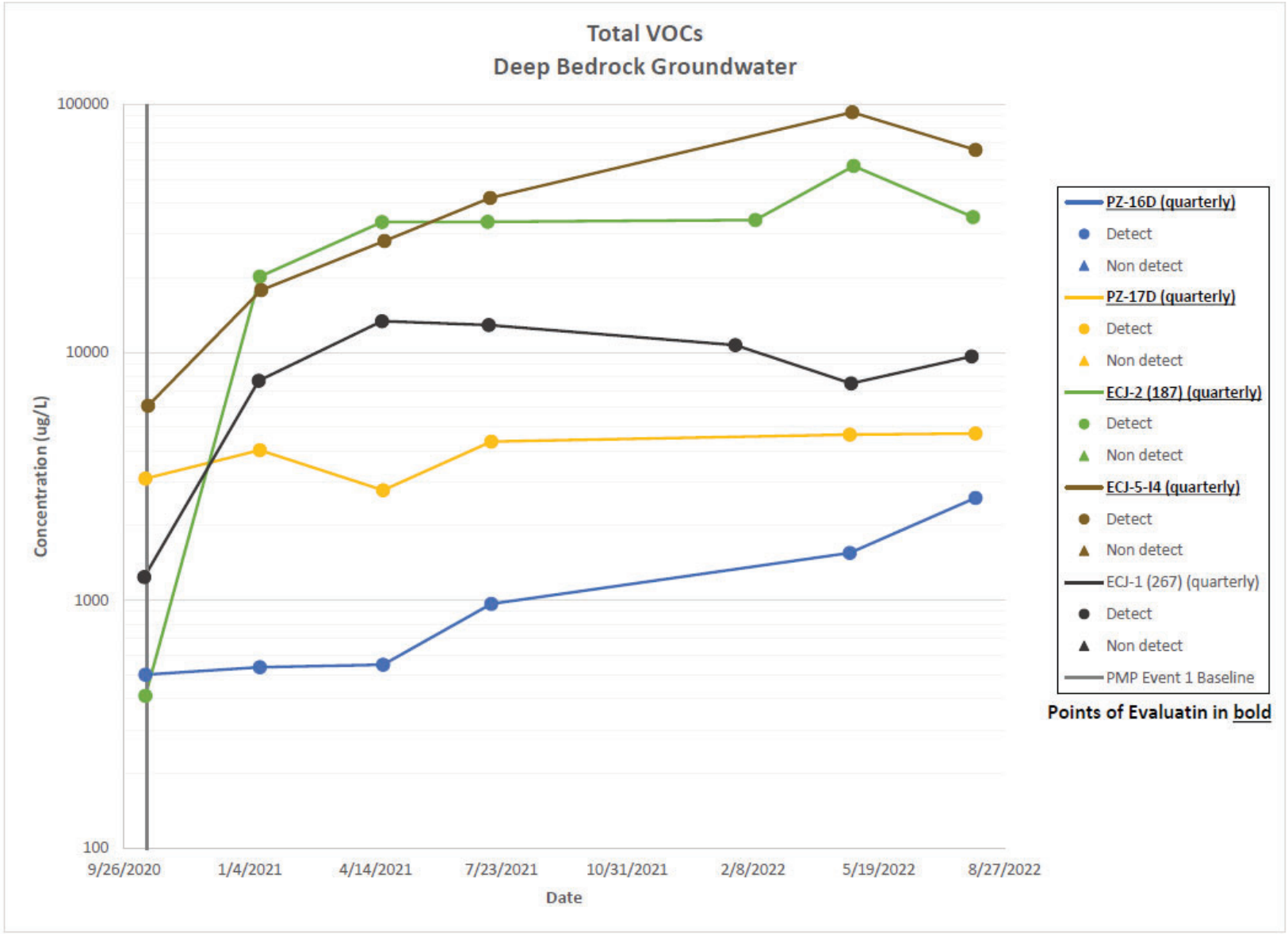
Graph I-2: Total VOCs Shallow Bedrock Groundwater, PMP Events 1-6



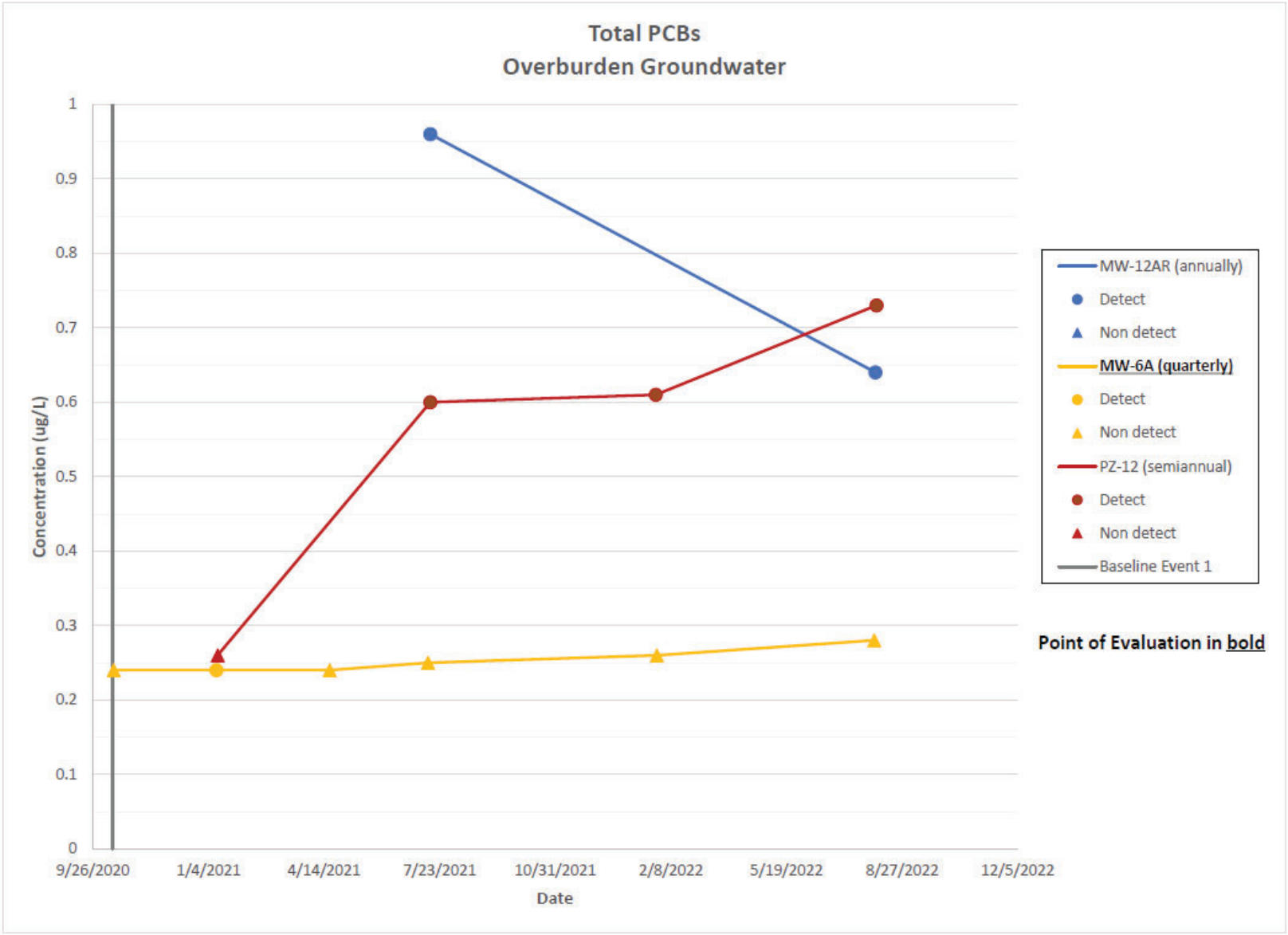
Graph I-3: Total VOCs Intermediate Bedrock Groundwater, PMP Events 1-6



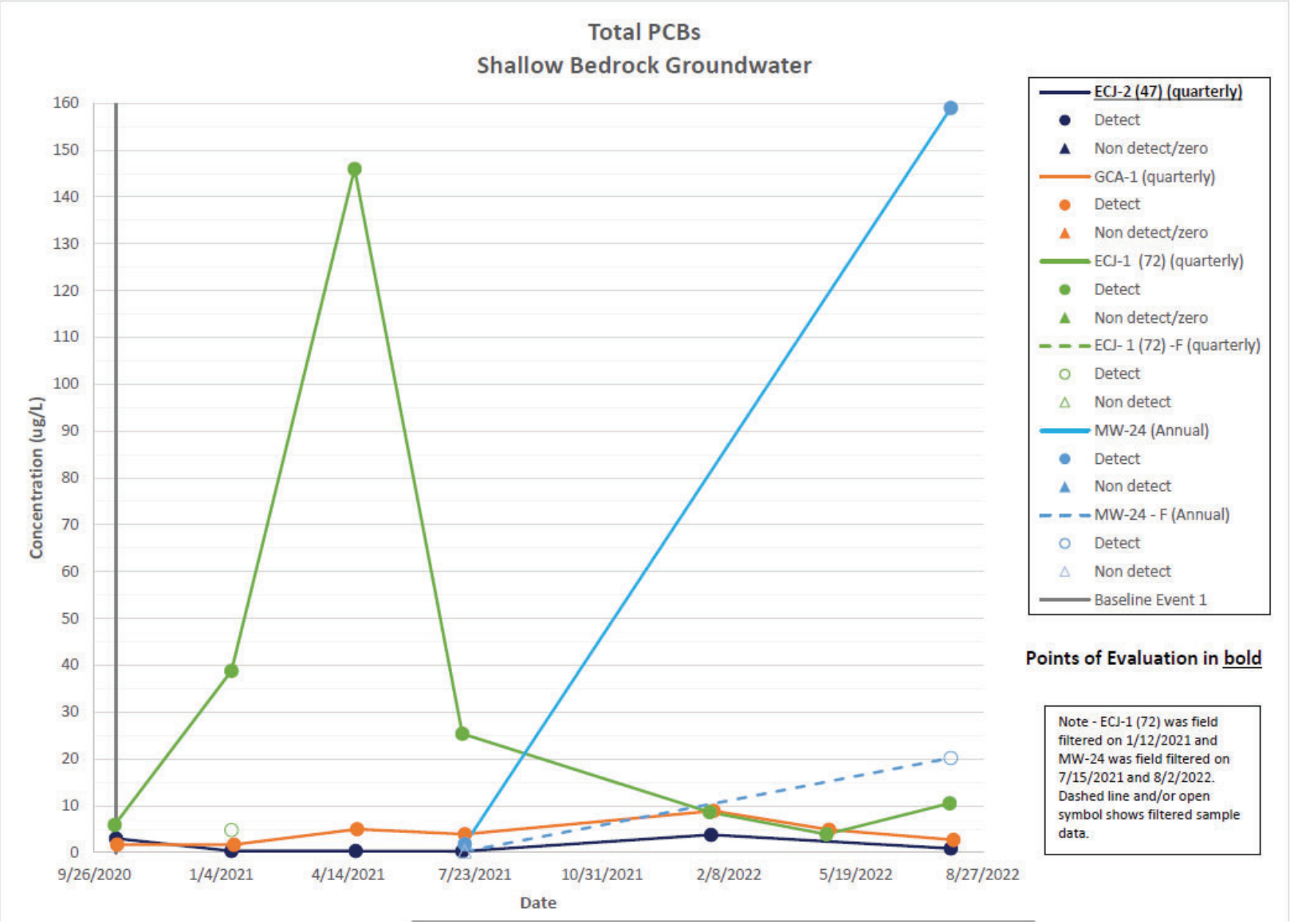
Graph I-4: Total VOCs Deep Bedrock Groundwater, PMP Events 1-6



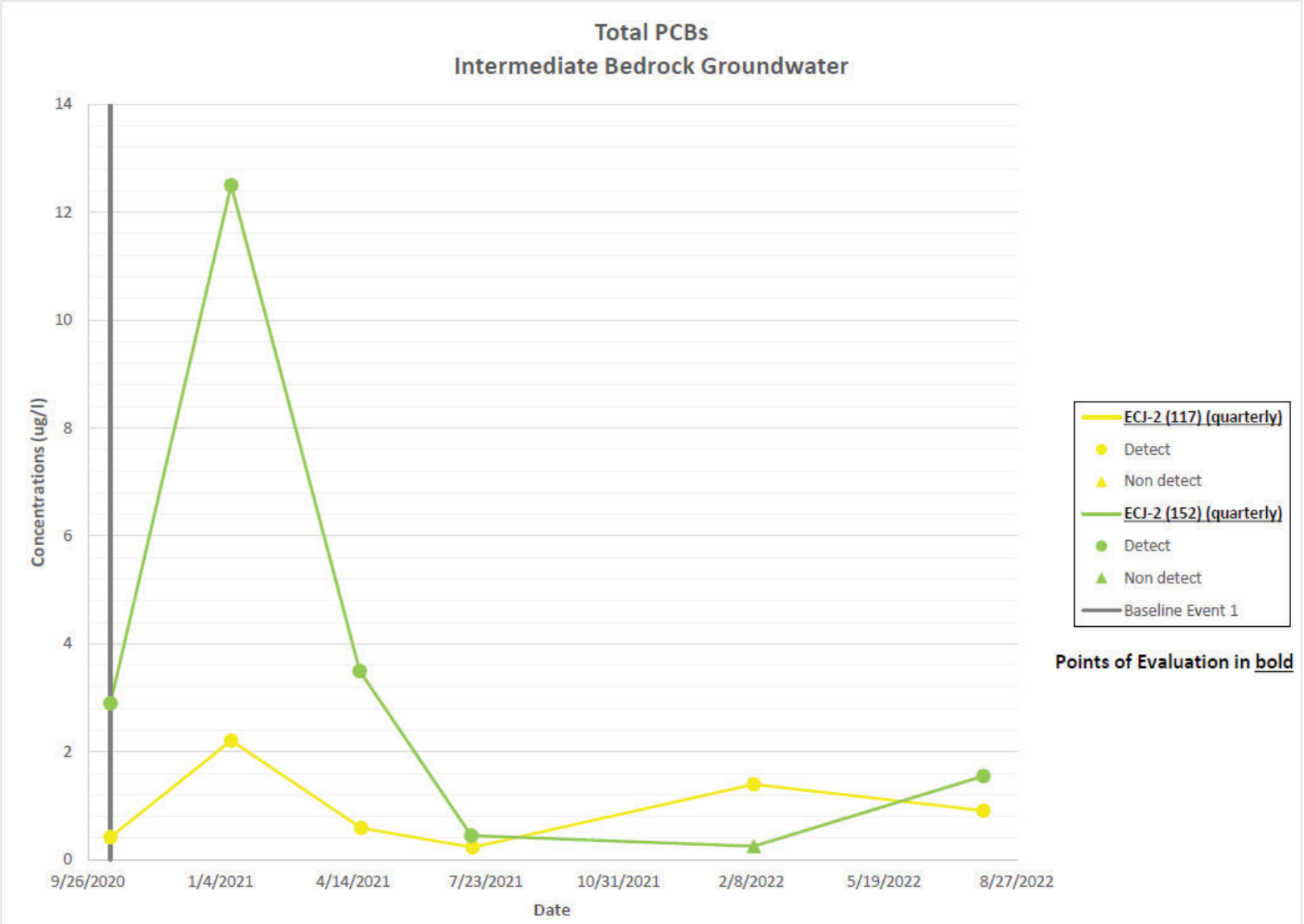
Graph I-5: Total PCBs Overburden Groundwater, PMP Events 1-6



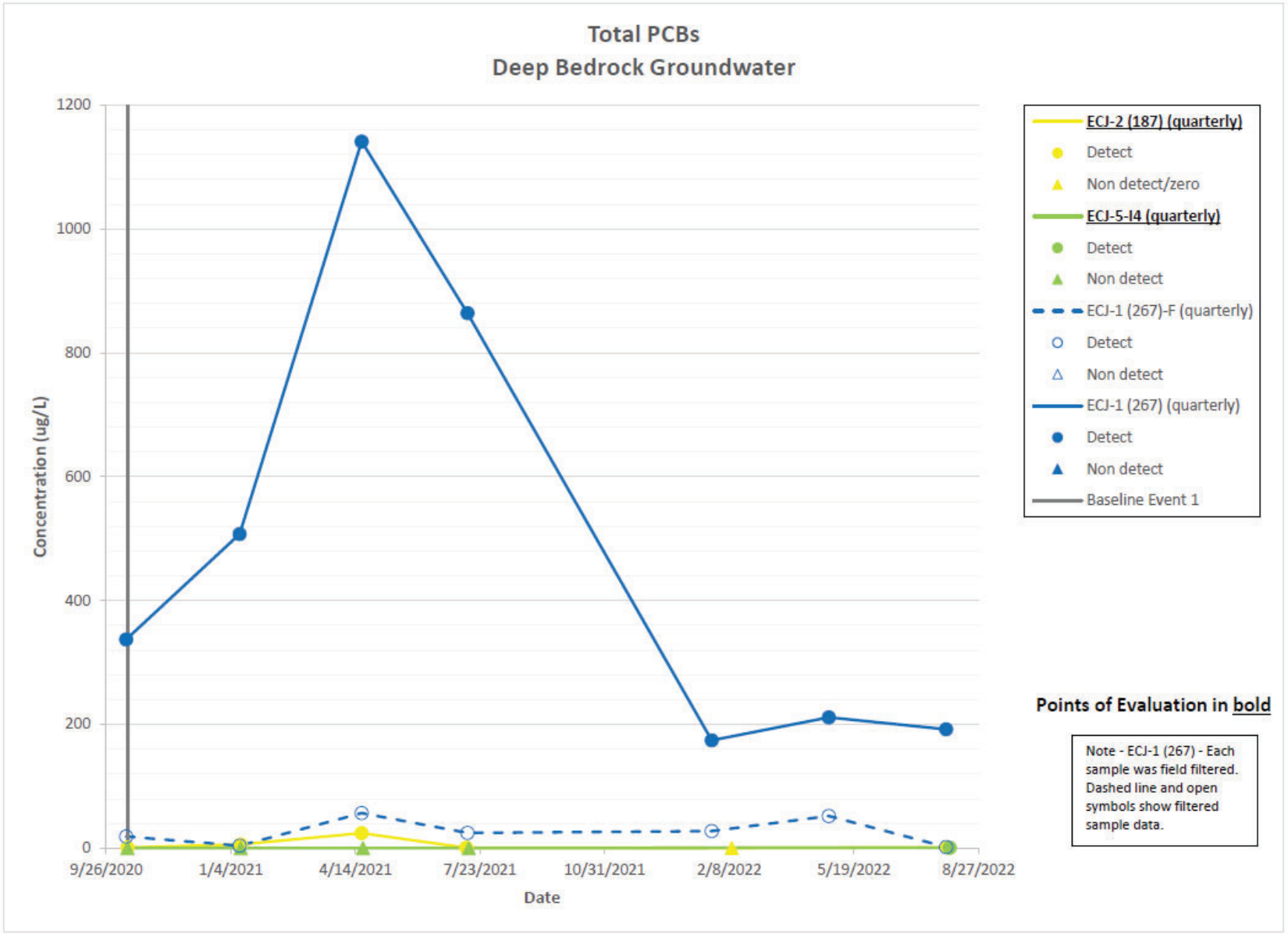
Graph I-6: Total PCBs Shallow Bedrock Groundwater, PMP Events 1-6



Graph I-7: Total PCBs Intermediate Bedrock Groundwater, PMP Events 1-6



Graph I-8: Total PCBs Intermediate Bedrock Groundwater, PMP Events 1-6



FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: Sullivan's Ledge	**Date of Inspection:** 03/22/2023
Location and Region: New Bedford, MA; Region 1	**EPA ID:** MAD980731343
Agency, Office or Company Leading the FYR: EPA Region 1	**Weather/Temperature:** Sunny, approx. 50 degrees F

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment (OU1)
- ☒ Access controls (OU1)
- ☒ Institutional controls (OU1, OU2)
- ☒ Groundwater pump and treatment (OU1)
- ☐ Surface water collection and treatment
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☒ Vertical barrier walls (slurry wall) (OU1)
- ☒ Other: construction of a culvert and construction of a passive underdrain collection system (OU1), wetlands restoration (OU2)

Attachments: ☒ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** _____ Name _____ Title _____ Date
   Interviewed ☐ at site ☐ at office ☐ by phone _____
   Problems, suggestions ☐ Report attached: _____

2. **O&M Staff** _____ Name _____ Title _____ Date
   Interviewed ☐ at site ☐ at office ☐ by phone _____
   Problems/suggestions ☐ Report attached: _____

3. **Local Regulatory Authorities and Response Agencies** (i.e., state and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices). Fill in all that apply.

   Agency City of New Bedford, Dept. of Public Infrastructure
   Contact Jim Costa (Name) Superintendent of Wastewater (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____ Name _____ Title _____ Date _____ Phone No.
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____ Name _____ Title _____ Date _____ Phone No.
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____ Name _____ Title _____ Date _____ Phone No.
   Problems/suggestions ☐ Report attached: _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone No.
Problems/suggestions ☐ Report attached: _____

4. **Other Interviews** (optional) ☐ Report attached: _____

III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)

1. **O&M Documents**

☒ O&M manual	☒ Readily available	☐ Up to date	☐ N/A
☒ As-built drawings	☒ Readily available	☐ Up to date	☐ N/A
☒ Maintenance logs	☒ Readily available	☒ Up to date	☐ N/A

Remarks: Once the groundwater system is running again, an O&M manual update is expected.

2. **Site-Specific Health and Safety Plan** ☐ Readily available ☐ Up to date ☒ N/A

☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

3. **O&M and OSHA Training Records** ☒ Readily available ☐ Up to date ☐ N/A

Remarks: The City and all contractors maintain their own OSHA training records.

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☐ N/A
☐ Effluent discharge	☐ Readily available	☐ Up to date	☐ N/A
☒ Waste disposal, POTW	☐ Readily available	☐ Up to date	☐ N/A
☐ Other permits: _____	☐ Readily available	☐ Up to date	☐ N/A

Remarks: When the groundwater treatment system is operating, the effluent is subject to the City of New Bedford's discharge requirements (permit #L-026A).

5. **Gas Generation Records** ☒ Readily available ☒ Up to date ☐ N/A

Remarks: Monitoring of blower stack for the landfill gas extraction system

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

7. **Groundwater Monitoring Records** ☒ Readily available ☒ Up to date ☐ N/A

Remarks: _____

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

9. **Discharge Compliance Records**

☐ Air	☐ Readily available	☐ Up to date	☐ N/A
☒ Water (effluent)	☐ Readily available	☐ Up to date	☐ N/A

Remarks: Sampling is only conducted when the system is in operation.

10. **Daily Access/Security Logs** ☒ Readily available ☐ Up to date ☐ N/A

Remarks: _____

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for state

☒ PRP in-house ☒ Contractor for PRP

☐ Federal facility in-house ☐ Contractor for Federal facility

☐ _____

2. **O&M Cost Records**

☒ Readily available ☐ Up to date

☒ Funding mechanism/agreement in place ☐ Unavailable

Original O&M cost estimate: _____ ☐ Breakdown attached

Total annual cost by year for review period if available

Costs provided by the PMC for OU1; they do not include costs associated with GWTP O&M undertaken by the City, which are provided separately below.

From:	To:		
01/01/2018 (Date)	12/31/2018 (Date)	$566,518 (Total cost)	☐ Breakdown attached
01/01/2019 (Date)	12/31/2019 (Date)	$373,090 (Total cost)	☐ Breakdown attached
01/01/2020 (Date)	12/31/2020 (Date)	$327,598 (Total cost)	☐ Breakdown attached
01/01/2021 (Date)	12/31/2021 (Date)	$315,240 (Total cost)	☐ Breakdown attached
01/01/2022 (Date)	12/31/2022 (Date)	$529,869 (Total cost)	☐ Breakdown attached

Cost provided by the City for the operation of the GWTP:

From:	To:		
01/01/2018 (Date)	12/31/2018 (Date)	$17,750 (Total cost)	☐ Breakdown attached
01/01/2019 (Date)	12/31/2019 (Date)	$93,513.43 (Total cost)	☐ Breakdown attached
01/01/2020 (Date)	12/31/2020 (Date)	$69,492.74 (Total cost)	☐ Breakdown attached
01/01/2021 (Date)	12/31/2021 (Date)	$35.743.97 (Total cost)	☐ Breakdown attached
01/01/2022 (Date)	12/31/2022 (Date)	$32,466.98 (Total cost)	☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs during Review Period**

Describe costs and reasons: _____

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing Damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A

Remarks: A section of fence along Hathaway Road appeared to have a temporary repair. Damage had occurred from an automobile. A permanent repair is expected soon.

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☐ N/A

Remarks: Signs are located on the outside of the landfill's perimeter fence.

C. Institutional Controls (ICs)

1. **Implementation and Enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive by): self-reporting

Frequency: _____

Responsible party/agency: City of New Bedford

Contact	Jim Costa	_____	_____	jcosta@newbedford-ma.gov
	Name	Title	Date	Email

Reporting is up to date	☐ Yes	☒ No	☐ N/A
Reports are verified by the lead agency	☐ Yes	☐ No	☒ N/A
Specific requirements in deed or decision documents have been met	☒ Yes	☐ No	☐ N/A
Violations have been reported	☐ Yes	☒ No	☐ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

Remarks: The City of New Bedford has not submitted annual compliance reports as required by the IC instrument.

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks: _____

2. **Land Use Changes On Site** ☐ N/A

Remarks: None

3. **Land Use Changes Off Site** ☐ N/A

Remarks: None

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads Damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks: _____

B. Other Site Conditions

Remarks: _____

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (low spots) ☐ Location shown on site map ☒ Settlement not evident
   Area extent: _____ Depth: _____
   Remarks: _____

2. **Cracks** ☐ Location shown on site map ☒ Cracking not evident
   Lengths: _____ Widths: _____ Depths: _____
   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
   Area extent: _____ Depth: _____
   Remarks: _____

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
   Area extent: _____ Depth: _____
   Remarks: Possible burrowing animal hole observed on the northern landfill slope near the roadway. Also, several holes were observed near the base of one of the solar panels.

5. **Vegetative Cover** ☒ Grass ☒ Cover properly established
   ☐ No signs of stress ☐ Trees/shrubs (indicate size and locations on a diagram)
   Remarks: _____

6. **Alternative Cover** (e.g., armored rock, concrete) ☒ N/A
   Remarks: _____

7. **Bulges** ☐ Location shown on site map ☒ Bulges not evident
   Area extent: _____ Height: _____
   Remarks: _____

8. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident

   ☐ Wet areas ☐ Location shown on site map Area extent: _____
   ☐ Ponding ☐ Location shown on site map Area extent: _____
   ☐ Seeps ☐ Location shown on site map Area extent: _____
   ☐ Soft subgrade ☐ Location shown on site map Area extent: _____
   Remarks: _____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map
   ☒ No evidence of slope instability
   Area extent: _____
   Remarks: _____

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mats, riprap, grout bags or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive

   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☒ Good condition

   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

   Remarks: The vents were capped previously due to implementation of the active gas collection system.

2. **Gas Monitoring Probes**

   ☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition

   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

   Remarks: _____

3. **Monitoring Wells** (within surface area of landfill)

   ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☐ Good condition

   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

   Remarks: _____

4. **Extraction Wells Leachate**

   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A

   Remarks: _____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☒ N/A

   Remarks: _____

E. Gas Collection and Treatment ☒ Applicable ☐ N/A

1. **Gas Treatment Facilities**

   ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse

   ☒ Good condition ☐ Needs maintenance

   Remarks: Active landfill gas extraction/blower system in place and operating.

2. **Gas Collection Wells, Manifolds and Piping**

   ☐ Good condition ☐ Needs maintenance

   Remarks: Most of the piping is underground.

3. **Gas Monitoring Facilities** (e.g., gas monitoring of adjacent homes or buildings)

   ☐ Good condition ☐ Needs maintenance ☐ N/A

   Remarks: _____

F. Cover Drainage Layer ☒ Applicable ☐ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A

   Remarks: _____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A

   Remarks: _____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident

   Area extent: _____ Depth: _____

   Remarks: _____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A

   ☒ Vegetation does not impede flow

   Area extent: _____ Type: _____

   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident

   Area extent: _____ Depth: _____

   Remarks: _____

4. **Discharge Structure** ☒ Functioning ☐ N/A

   Remarks: _____

VIII. VERTICAL BARRIER WALLS (slurry wall) ☒ Applicable ☐ N/A

1. **Settlement** ☐ Location shown on site map ☒ Settlement not evident

   Area extent: _____ Depth: _____

   Remarks: _____

2. **Performance Monitoring** Type of monitoring: _____

   ☒ Performance not monitored

   Frequency: _____ ☐ Evidence of breaching

   Head differential: _____

   Remarks: _____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable * ☐ N/A

*The groundwater treatment system was not in operation at the time of the inspection. It was expected to be restarted May 1, 2023.

A. Groundwater Extraction Wells, Pumps and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing and Electrical**

   ☐ Good condition ☐ All required wells properly operating ☐ Needs maintenance ☒ N/A

   Remarks: Not operating at time of inspection.

2. **Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☒ Needs maintenance

Remarks: The City recently replaced the wiring and hoses for the extraction wells in anticipation of the system restart. Some of the extraction well boxes were in poor condition. The City noted they may be replaced as funds allow.

3. **Spare Parts and Equipment**

☒ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: The City of New Bedford was in the process of preparing the system for a restart.

B. Surface Water Collection Structures, Pumps and Pipelines ☐ Applicable ☒ N/A

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (check components that apply)

☐ Metals removal ☐ Oil/water separation ☐ Bioremediation

☐ Air stripping ☐ Carbon adsorbers

☐ Filters:

☐ Additive (e.g., chelation agent, flocculent): _____

☐ Others: _____

☐ Good condition ☐ Needs maintenance

☐ Sampling ports properly marked and functional

☐ Sampling/maintenance log displayed and up to date

☐ Equipment properly identified

☐ Quantity of groundwater treated annually: _____

☐ Quantity of surface water treated annually: _____

Remarks: Not currently in operation.

2. **Electrical Enclosures and Panels** (properly rated and functional)

☐ N/A ☐ Good condition ☐ Needs maintenance

Remarks: Did not observe.

3. **Tanks, Vaults, Storage Vessels**

☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs maintenance

Remarks: _____

4. **Discharge Structure and Appurtenances**

☒ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

5. **Treatment Building(s)**

☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair

☒ Chemicals and equipment properly stored

Remarks: _____

6. **Monitoring Wells** (pump and treatment remedy)

☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: Monitoring well MW-8 in the OU2 area was not property secured. Some erosion was also observed beneath the well pad.

D. Monitoring Data

1. **Monitoring Data**

☒ Is routinely submitted on time ☒ Is of acceptable quality

2. **Monitoring Data Suggests:**

☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☒ N/A

Remarks: _____

X. OTHER REMEDIES – WETLANDS RESTORATION (OU2)

The OU2 wetlands appeared to be in good condition overall. Some invasive species, primarily phragmites, were observed in OU2. The City of New Bedford has plans to remove it.

The culvert that leads into OU2 had some iron-rich sedimentation.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions).
The OU1 remedy included excavation of contaminated soils/sediments from the Unnamed Stream, water hazards on the golf course property and other areas of OU1 with placement in the former disposal area, construction of an impermeable cap, collection and treatment of contaminated groundwater, construction of a landfill gas extraction system, wetlands restoration, long-term monitoring and institutional controls. The OU2 remedy included excavation of contaminated soils/sediment from parts of Middle Marsh and Adjacent Wetlands with placement under the OU1 cap, wetlands restoration, institutional controls and long-term monitoring. Most of the remedy components are effective and functioning as designed. Operation of the GWTP was suspended in July 2020 and a post-suspension monitoring began at that time. Data have shown that total VOC concentrations have rebounded since operation of the GWTP was suspended, so the system was turned back on in May 2023. Additional data evaluation will be needed to determine if the GWTP will regain hydraulic control.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.
O&M is adequate at this time.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.
None.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.
Opportunities for optimization will be evaluated as part of the FYR.

Site inspection participants:
Kimberly White, EPA (virtual attendance for the meeting start)
TaChalla Gibeau, EPA (virtual attendance for the meeting start)
Ayana Cunningham, EPA (virtual attendance for the meeting start)

Aaron Shaheen, EPA
Jennifer Lambert, Nobis Group
Erik Hall, Nobis Group
Chance Perks, City of New Bedford
Michele Paul, City of New Bedford
Laura Breig, City of New Bedford
David Nieves, City of New Bedford
Jim Costa, City of New Bedford
Johnny Zimmerman-Ward, Skeo
Jill Billus, Skeo

APPENDIX K – SITE PHOTOGRAPHS

Signage on the perimeter fence


GWTP building and parking lot

Signage on the perimeter fence


Interior of the GWTP building

Solar panels on landfill cap

Culvert under Hathaway Road

Unnamed Stream

Golf course near OU2

Phragmites near OU2 wetland areas

Erosion under well pad on golf course property

Signage on golf course property


Small animal burrow on northwest face of landfill cover

Landfill cover

Collection trench vaults

Perimeter fence along southern side of OU1

Soil gas monitoring point GM-4R

APPENDIX L – EVALUATION OF SOIL CLEANUP LEVELS

COC	ROD Soil Cleanup Level[a] (mg/kg)	Composite Worker Soil RSL[b] (mg/kg)		Cancer Risk[c]	Noncancer HQ[d]
		1 x 10^{-6} Risk	HQ = 1		
Total PCBs	10[e]	0.94[f]	--	1 x 10^{-5}	--
Total Carcinogenic PAHs	30	2.1[g]	220[g]	1 x 10^{-5}	0.1

Notes:

a) Cleanup levels from the 1989 ROD.

b) Current EPA RSLs, available at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables (accessed 5/17/2023).

c) The cancer risks were calculated using the following equation, based on the fact that RSLs are derived based on 1 x 10^{-6} risk: cancer risk = (cleanup level ÷ cancer-based RSL) × 10^{-6}.

d) The noncancer HQ was calculated using the following equation: HQ = cleanup goal ÷ noncancer-based RSL.

e) Most stringent of the soil cleanup levels for total PCBs.

f) RSL for PCBs high risk.

g) RSL for benzo(a)pyrene as a surrogate for total carcinogenic PAHs.

APPENDIX M – VISL CALCULATOR OUTPUT

Evaluated using April 2022 data from well MW-12AR

Commercial Vapor Intrusion Risk

4

Chemical	CAS Number	Site Groundwater Concentration C_{gw} (µg/L)	Site Indoor Air Concentration $C_{i,a}$ (µg/m³)	VI Carcinogenic Risk CDI (µg/m³)	VI Carcinogenic Risk CR	VI Hazard CDI (mg/m³)	VI Hazard HQ	IUR (ug/m³)⁻¹	IUR Ref
Benzene	71-43-2	30	6.81E+00	5.55E-01	4.33E-06	1.55E-03	5.18E-02	7.80E-06	U
Butylbenzene, n-	104-51-8	1.7	-	-	-	-	-	-	
Butylbenzene, sec-	135-98-8	1.4	-	-	-	-	-	-	
Chlorobenzene	108-90-7	66.6	8.47E+00	6.90E-01	-	1.93E-03	3.87E-02	-	
Cumene	98-82-8	9.8	4.61E+00	3.76E-01	-	1.05E-03	2.63E-03	-	
Dichlorobenzene, 1,2-	95-50-1	0.87	6.83E-02	5.57E-03	-	1.56E-05	7.80E-05	-	
Dichlorobenzene, 1,3-	541-73-1	2.6	-	-	-	-	-	-	
Dichlorobenzene, 1,4-	106-46-7	8.7	8.57E-01	6.99E-02	7.69E-07	1.96E-04	2.45E-04	1.10E-05	U
Dichloroethylene, cis-1,2-	156-59-2	1.1	1.83E-01	1.50E-02	-	4.19E-05	1.05E-03	-	
Ethyl Chloride	75-00-3	2.1	9.53E-01	7.77E-02	-	2.18E-04	5.44E-05	-	
Naphthalene	91-20-3	7.1	1.28E-01	1.04E-02	3.54E-07	2.92E-05	9.72E-03	3.40E-05	U
Propyl benzene	103-65-1	2.8	1.20E+00	9.80E-02	-	2.74E-04	2.74E-04	-	
Toluene	108-88-3	0.64	1.74E-01	1.42E-02	-	3.97E-05	7.93E-06	-	
Trimethylbenzene, 1,2,4-	95-63-6	1.4	3.53E-01	2.87E-02	-	8.05E-05	1.34E-03	-	
Vinyl Chloride	75-01-4	1	1.14E+00	9.27E-02	4.08E-07	2.59E-04	2.59E-03	4.40E-06	U
Xylene, o-	95-47-6	0.65	1.38E-01	1.12E-02	-	3.14E-05	3.14E-04	-	
Xylenes	1330-20-7	0.95	2.58E-01	2.10E-02	-	5.88E-05	5.88E-04	-	
*Sum		-	-	-	5.86E-06	-	1.09E-01	-	

Output generated 17MAY2023:13:50:59

Evaluated using October 2020 data from well MW-4A

Commercial Vapor Intrusion Risk

3

Chemical	CAS Number	Site Groundwater Concentration C_{gw} \ (µg/L)	Site Indoor Air Concentration $C_{i,a}$ \ (µg/m³)	VI Carcinogenic Risk CDI (µg/m³)	VI Carcinogenic Risk CR	VI Hazard CDI (mg/m³)	VI Hazard HQ	IUR (ug/m³)⁻¹	IUR Ref	Chronic RfC (mg/m³)	RfC Ref	Temperature (°C)\ for Groundwater Vapor Concentration	Mutagen?
Benzene	71-43-2	0.54	1.23E-01	9.99E-03	7.79E-08	2.80E-05	9.32E-04	7.80E-06	U	3.00E-02	U	25	No
Dichloroethylene, cis-1,2-	156-59-2	4.7	7.84E-01	6.39E-02	-	1.79E-04	4.47E-03	-		4.00E-02	U	25	No
Vinyl Chloride	75-01-4	8.7	9.89E+00	8.06E-01	3.55E-06	2.26E-03	2.26E-02	4.40E-06	U	1.00E-01	U	25	Mut
*Sum		-	-	-	3.63E-06	-	2.80E-02	-		-		-	

Output generated 17MAY2023:13:55:47

APPENDIX N – 2018 EPA MEMORANDUM

TECHNICAL MEMORANDUM

To: Kimberly White
From: Richard Sugatt
Date: August 8, 2018
RE: Development of Groundwater Risk-Based Concentrations (GW-RBCs) for protection of aquatic organisms at Sullivan's Ledge Superfund Site

The overall goal of this technical memorandum is to estimate Site contaminant concentrations in groundwater that will be protective of aquatic organisms in the sediment and surface water of the unnamed stream that receives groundwater from the Site. This technical memorandum provides the following: 1) compilation of benchmarks for protection of aquatic organisms for chemicals detected in groundwater at the Site, and 2) Site-specific Groundwater Risk-Based Concentrations (GW-RBCs) for protection of aquatic organisms in sediment pore water and surface water of the stream that receives groundwater from the Site.

Derivation of Benchmarks

Table 1 provides the aquatic toxicity benchmarks for the detected groundwater contaminants selected from the benchmarks provided in the Risk Assessment Information System (RAIS) (https://rais.ornl.gov/tools/eco_search.phpRL). The types of benchmarks are described on the website and abbreviated in the headings in Table 1, which also presents the minimum, maximum, and geometric mean of the benchmark concentrations.

The RAIS contains multiple benchmarks for specific organism groups, acute and chronic toxicity, lowest acute or chronic concentrations, water quality criteria, and different levels of effect (e.g. 20 percent effect concentration, EC20). Acute benchmarks were not used to be protectively conservative. The RAIS did not have a benchmark for one of the detected chemicals (carbazole), but a value was found on EPA's Ecotox database (https://cfpub.epa.gov/ecotox/). The aquatic toxicity benchmarks used for derivation of Massachusetts Contingency Plan (MCP) GW-3 groundwater standards were also included in Table 1. The GW-3 standards are intended to be protective for aquatic organisms after attenuation of the chemical in groundwater and dilution into surface water. These benchmarks were derived from an extensive search of the aquatic toxicity literature and the benchmark selection process identified in the MCP documentation: (http://www.mass.gov/eea/agencies/massdep/cleanup/regulations/documentation-for-gw3-standards.html).

Inspection of the benchmarks in Table 1 for individual chemicals indicates that they vary considerably (sometimes several orders of magnitude) for the same chemical and that some values are identical, indicating that they were not independently derived. To minimize both over- and under-protectiveness, as well as potential bias caused by multiple identical benchmarks, it was decided to use the geometric mean of the selected benchmarks as a reasonable estimate of the concentration that would have minimal aquatic toxicity. The geometric mean approach has been used for the widely accepted derivation of consensus-based sediment benchmarks by MacDonald, et al (2000).

An exception to the use of the geometric mean benchmark was made for chemicals that had chronic National Recommended Water Quality Criteria (NRWQC). The chronic NRWQC value is called the Criterion Continuous Concentration (CCC) and is derived from the results of many toxicity tests on multiple species of aquatic organisms; therefore, the CCC is more scientifically valid than any other benchmark. In addition, the CCC is used as the MA Surface Water Standard for protection of aquatic organisms. NRWQC values were available for pentachlorophenol, PCBs, aluminum, arsenic, chromium, copper, iron, lead, mercury, nickel, and lead. The 2004 CCC for copper (9 ug/L) was used because the current method for calculating the copper NRWQC uses a biotic ligand model that requires measurements of multiple non-toxicant water quality parameters. The new method could not be used because these parameters were not measured in Site surface water; therefore, the CCC published prior to the new methodology was used.

Derivation of GW-RBCs

The EPA GW-RBCs were calculated using an approach similar to the Massachusetts Contingency Plan (MCP) for derivation of GW-3 groundwater standards, except that it did not use a dilution factor from sediment pore water to surface water. The GW-3 standards are designed to be protective for aquatic organisms in surface water after attenuation of the chemical within the groundwater and dilution into surface water. The GW-3 groundwater standard is calculated by multiplying the selected toxicity benchmark by an Attenuation Factor (AF) that varies with the chemical and then by a Dilution Factor (DF) of 10. The GW-3 dilution factor of 10 was not used for the EPA GW-RBCs because the EPA GW-RBCs are designed to be protective of organisms living within the sediment exposed to sediment pore water. The EPA GW-RBC will also be protective of organisms in the surface water because the protective pore water concentration will be even lower after dilution in the surface water.

The documentation in the MCP indicates that the AF depends on the partitioning/absorption characteristics of the contaminant, with values of 2.5, 25, or 100, depending on the organic carbon partition coefficient (Koc) for organic contaminants or the soil absorption coefficient (Kd) for inorganic contaminants. In Table 1, the MCP AF was used if there was a GW-3 standard for a detected chemical. For chemicals that did not have a GW-3 standard, the AF was assigned based on professional judgement using the following approach:

1. Chemicals with Koc (organic carbon partition coefficient) less than 1000 were assigned an AF = 2.5
2. Chemicals with Koc between 1000 and 100,000 were assigned an AF = 25
3. Chemicals with Koc greater than 100,000 were assigned an AF = 100

For those Site chemicals that do not have GW-3 standards and are not included in the MCP documentation, Koc values were obtained from the following sources and were then assigned attenuation factors using the same approach described above:

1. Regional Screening Level (RSL) Chemical Specific Parameters Supporting Table, U.S. EPA, November 2015
2. U.S. EPA Estimation Programs Interface (EPI) Suite-TM

For inorganics, Kd soil partitioning coefficients were used instead of Koc values. Note that Kd values were not found for calcium, magnesium, and sodium. The derived values are provided in Table 2 below:

Table 2. Attenuation Factors for Chemicals that do not have MCP GW-3 Standards

Analyte	Kd (L/kg)	Koc (L/kg)	Koc Source	AF
2-methylphenol (o-cresol)		3.1E+02	(1)	2.5
4-methylphenol (p-cresol)		3.0E+02	(1)	2.5
carbazole		9.2E+03	(2)	25
2-chloronaphthalene		2.5E+03	(1)	25
n-nitrosodiphenylamine		2.6E+03	(1)	25
dibenzofuran		9.2E+03	(1)	25
di-n-butylphthalate		1.2E+03	(1)	25
isophorone		6.5E+01	(1)	2.5
carbon disulfide		2.2E+01	(1)	2.5
chloroethane		2.2E+01	(1)	2.5
aluminum (pH 6.5-9.0)	1.5E+03		(1)	25
copper (hardness=100 mg/L)	3.5E+01		(1)	2.5
Iron	2.5E+01		(1)	2.5
manganese	6.5E+01		(1)	2.5

There are uncertainties associated with attenuation and dilution within the groundwater itself because attenuation can vary based on soil absorption characteristics (e.g. organic matter, grain size, mineral type, redox, pH, etc.) and length of travel through this soil until it reaches the stream bed. Dilution within the groundwater can vary based on mixing with other sources of groundwater to a contaminant plume. There are also uncertainties associated with attenuation and dilution within the sediment as the groundwater moves into the surface water, as well as uncertainty in the dilution of groundwater into surface water. The actual amount of attenuation and dilution of groundwater will decrease as the groundwater monitoring point approaches the stream itself. Of course, these uncertainties can be reduced by measuring contaminant concentrations in monitoring points that are either in the stream (e.g. piezometers) or nearer to the stream than further up-gradient monitoring wells or piezometers.

The GW-RBC is calculated by multiplying the geometric mean benchmark or CCC by the chemical-specific Attenuation Factor (AF) according to the following equation:

GW-RBC = (geometric mean benchmark, or CCC) x AF

The EPA GW-RBCs are summarized in Table 3 along with the toxicity benchmarks and available MCP GW-3 for comparison purposes. The EPA GW-RBCs apply to groundwater monitored at any Site-related location other than at piezometers in the stream itself. The potential aquatic toxicity of contaminants in groundwater sampled from an in-stream piezometer would be evaluated by comparison with the geometric mean benchmark or CCC itself, that is, without attenuation or dilution factors.

The available historic data indicate that barium, iron, manganese and polychlorinated biphenyls (PCBs) may have exceeded the EPA GW-RBC. Barium, iron, and manganese are known to become elevated in groundwater under reducing conditions in which biodegradation of organic contaminants consumes oxygen, resulting in solubilization of these natural soil minerals into groundwater. These minerals have low solubility in oxygenated water so they will precipitate as the reduced groundwater becomes oxygenated as it emerges into surface water. Evidence for this phenomenon is often seen where rust-colored flocculent material accumulates where groundwater emerges into surface water. Such precipitation has been observed in the unnamed stream downgradient from the Site. The precipitation greatly reduces the dissolved concentrations of the inorganics in sediment pore water and surface water, thereby decreasing the bioavailability and resultant toxicity. Due to likely precipitation as the groundwater becomes oxygenated as it enters sediment pore water, it is unlikely that the dissolved concentration of these inorganics is as high as predicted using simple attenuation and dilution factors. It is concluded that the EPA GW-RBCs for these minerals are probably overprotective due to this phenomenon of precipitation, which cannot be adequately modeled by simple dilution and attenuation. These inorganics are unlikely to be able to cause aquatic toxicity in oxygenated sediment pore waters; therefore, any exceedance of the EPA GW-RBC for these inorganics is not of concern for chemical toxicity to aquatic organisms.

Reference

MacDonald, D. D., Ingersoll, C. G. and Berger, T. A. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxicol. 39(1): 20-31.

Table 3. EPA Region 1 Groundwater Risk-Based Concentrations (GW-RBCs)

Analyte	CAS Number	Toxicity Benchmark (mg/L)	AF (MCP or EPA)	EPA GW-RBC (mg/L)	MCP GW-3 Standard (mg/L)
VOCs					
Acetone	67-64-1	1.26E+01	2.5	3.15E+01	5.00E+01
Benzene	71-43-2	4.52E-01	2.5	1.13E+00	1.00E+01
Bis(2-chloroethyl)ether	111-44-4	6.01E+00	2.5	1.50E+01	5.00E+01
Bromodichloromethane	75-27-4	9.30E+00	2.5	2.33E+01	5.00E+01
Carbon Disulfide	75-15-0	1.17E-01	2.5	2.93E-01	NA
Chlorobenzene	108-90-7	1.80E-01	2.5	4.50E-01	1.00E+00
Chloroethane		NA	2.5	NA	NA
Chloroform	67-66-3	2.27E-01	2.5	5.68E-01	2.00E+01
Dichlorobenzene, 1,2-	95-50-1	1.08E-02	2.5	2.70E-02	2.00E+00
Dichlorobenzene, 1,3-	541-73-1	1.14E-01	2.5	2.85E-01	5.00E+01
Dichlorobenzene, 1,4-	106-46-7	2.93E-02	2.5	7.33E-02	8.00E+00
Dichloroethane, 1,1-	75-34-3	5.52E-01	2.5	1.38E+00	2.00E+01
Dichloroethane, 1,2-	107-06-2	2.33E+00	2.5	5.83E+00	2.00E+01
Dichloroethylene, 1,1-	75-35-4	8.55E-01	2.5	2.14E+00	3.00E+01
Dichloroethylene, 1,2-	540-59-0	2.67E+00	2.5	6.68E+00	NA
Dichloroethylene, 1,2-cis-	56-59-2	1.40E+01	2.5	3.50E+01	5.00E+01
Dichloroethylene, 1,2-trans-	156-60-5	2.21E+00	2.5	5.53E+00	5.00E+01
Ethylbenzene	100-41-4	4.32E-01	2.5	1.08E+00	5.00E+00
Methyl Ethyl Ketone	78-93-3	5.56E+01	2.5	1.39E+02	5.00E+01
Methyl Isobutyl Ketone	108-10-1	3.37E+00	2.5	8.43E+00	5.00E+01
Methylene Chloride	75-09-2	2.37E+00	2.5	5.93E+00	NA
Styrene	100-42-5	1.60E-01	2.5	4.00E-01	6.00E+00
Toluene	108-88-3	2.68E-01	2.5	6.70E-01	4.00E+01
Trichlorobenzene, 1,2,4-	120-82-1	5.98E-02	25	1.50E+00	5.00E+01
Trichloroethylene	79-01-6	3.44E-01	2.5	8.60E-01	5.00E+00
Vinyl Chloride	75-01-4	3.76E+00	2.5	9.40E+00	5.00E+01
Xylene, Mixture	1330-20-7	2.97E-01	2.5	7.43E-01	5.00E+00
SVOCs					
Acenaphthene	83-32-9	6.46E-02	25	1.62E+00	1.00E+01
Acenaphthylene	208-96-8	2.60E-02	25	6.50E-01	4.00E-02
Anthracene	120-12-7	1.95E-04	25	4.88E-03	3.00E-02
Benz[a]anthracene	56-55-3	1.74E-04	100	1.74E-02	1.00E+00
Benzo[a]pyrene	50-32-8	5.40E-05	100	5.40E-03	5.00E-01
Benzo[b]fluoranthene	205-99-2	1.95E-03	100	1.95E-01	4.00E-01
Benzo[g,h,i]perylene	191-24-2	3.91E-04	100	3.91E-02	2.00E-02
Benzo[k]fluoranthene	207-08-9	1.40E-04	100	1.40E-02	1.00E-01
Bis(2-chloroethyl)ether	111-44-4	6.01E+00	2.5	1.50E+01	5.00E+01
Bis(2-ethylhexyl)phthalate	117-81-7	1.27E-02	100	1.27E+00	5.00E+01

Bromodichloromethane	75-27-4	9.30E+00	2.5	2.33E+01	5.00E+01
Carbazole	86-74-8	9.30E-01	25	2.33E+01	NA
Chloronaphthalene, 2-	91-58-7	4.62E-03	2.5	1.16E-02	NA
Chlorophenol, 2-	95-57-8	6.11E-02	2.5	1.53E-01	7.00E+00
Chrysene	218-01-9	7.00E-04	100	7.00E-02	7.00E-02
Cresol, o-	95-48-7	1.52E-01	2.5	3.80E-01	NA
Cresol, p-	106-44-5	1.95E-01	2.5	4.88E-01	NA
Dibenz[a,h]anthracene	53-70-3	4.47E-04	100	4.47E-02	4.00E-02
Dibenzofuran	132-64-9	2.16E-02	25	5.40E-01	NA
Di-n-butyl Phthalate	84-74-2	6.38E-02	25	1.60E+00	NA
Dimethylphenol, 2,4-	105-67-9	1.93E-01	2.5	4.83E-01	5.00E+01
Fluoranthene	206-44-0	7.51E-03	25	1.88E-01	2.00E-01
Fluorene	86-73-7	3.27E-03	25	8.18E-02	4.00E-02
Indeno[1,2,3-cd]pyrene	193-39-5	7.77E-04	100	7.77E-02	1.00E-01
Isophorone	78-59-1	1.11E+00	2.5	2.78E+00	NA
Methylnaphthalene, 2-	91-57-6	6.13E-02	25	1.53E+00	2.00E+01
Naphthalene	91-20-3	1.14E-01	25	2.85E+00	NA
Nitrosodiphenylamine, N-	86-30-6	2.27E-01	25	5.68E+00	NA
Pentachlorophenol	87-86-5	1.50E-02	2.5	3.75E-02	2.00E-01
Phenanthrene	85-01-8	9.88E-03	25	2.47E-01	1.00E+01
Phenol	108-95-2	2.13E-01	2.5	5.33E-01	2.00E+00
Pyrene	129-00-0	1.63E-04	25	4.08E-03	2.00E-02
PCBs/Pesticides					
Polychlorinated Biphenyls	1336-36-3	1.40E-05	100	1.40E-03	1.00E-02
Inorganics					
Aluminum	7429-90-5	8.70E-02	25	2.18E+00	NA
Antimony	7440-36-0	2.96E-01	2.5	7.40E-01	8.00E+00
Arsenic, Inorganic	7440-38-2	1.50E-01	2.5	3.75E-01	9.00E-01
Barium	7440-39-3	3.62E-02	2.5	9.05E-02	5.00E+01
Chromium (trivalent)	16065-83-1	7.40E-02	2.5	1.85E-01	6.00E-01
Copper	7440-50-8	9.00E-03	2.5	2.25E-02	NA
Iron	7439-89-6	1.00E+00	2.5	2.50E+00	NA
Lead	7439-92-1	2.50E-03	2.5	6.25E-03	1.00E-02
Manganese	7439-96-5	3.27E-01	2.5	8.18E-01	NA
Mercury	7439-97-6	7.70E-04	2.5	1.93E-03	2.00E-02
Nickel	7440-02-0	5.20E-02	2.5	1.30E-01	2.00E-01
Silver	7440-22-4	2.87E-04	2.5	7.18E-04	7.00E-03
Vanadium	7440-62-2	5.80E-02	2.5	1.45E-01	4.00E+00
Zinc	7440-66-6	1.20E-01	2.5	3.00E-01	9.00E-01

GW RBC = Groundwater Risk-Based Concentration = toxicity benchmark X AF
NA = Not Available
AF = Attenuation Factor