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

Prepared by

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Date

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	Ambient Water Quality Criteria
CAA	Clean Air Act
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CONB	City of New Bedford
CWA	Clean Water Act
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
ESD	Explanation of Significant Differences
FS	Feasibility Study
FYR	Five-Year Review
GAC	Granular Activated Carbon
GERE	Grant of Environmental Restrictions and Easement
GWTP	Ground Water Treatment Plant
HASP	Health and Safety Plan
HDPE	High Density Polyethylene
ICs	Institutional Controls
LEL	Lower Explosive Limit
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NRWQC	National Recommended Water Quality Criteria
O&M	Operation and Maintenance
OU1	Operable Unit 1
OU2	Operable Unit 2
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCCP	Pre-stressed Concrete Cylinder Pipe
PFAS	Per- and Polyfluoroalkyl Substances
PMC	Project Management Committee (OU1 Settling Defendants)
POTW	Publicly Owned Treatment Works
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
SDWA	Safe Drinking Water Act
SQCV	Sediment Quality Criteria Values
SCT	Shallow Collection Trench
SVOC	Semivolatile Organic Compound
TBC	To be considered
TOC	Total Organic Carbon
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
TTO	Total Toxic Organics
UV/OX	Ultraviolet/Oxidation
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 five-year review 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 five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fourth FYR for the Sullivan's Ledge Superfund Site (Site). The triggering action for this statutory review is the signature date of the previous FYR on September 20, 2013. The FYR has been prepared due to the fact that 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), and both OUs will be addressed in this FYR. OU1 includes an impermeable cap over a former disposal area, an Unnamed Stream and other areas outside the disposal area that underwent sediment excavation with placement beneath the cap and subsequent restoration, collection and treatment of on-site groundwater, active methane gas collection to prevent off-site migration, long-term environmental monitoring, and institutional controls. OU2 refers to portions of the Middle Marsh and Adjacent Wetlands that underwent sediment and wetland soil excavation with disposal beneath the OU1 cap, wetlands restoration, long-term monitoring, and institutional controls.

The Sullivan's Ledge Superfund Site Five-Year Review was led by Kimberly White, EPA Remedial Project Manager, with support from AECOM (EPA contractor) and Dorothy Allen, of the MassDEP, as the representative for the support agency. The Project Management Committee (PMC) for the Sullivan's Ledge Site Group (formed by the OU1 Settling Defendants) and the City of New Bedford were notified of the initiation of the five-year review. The review began on 3/28/2018.

Site Background

Site Description

The Sullivan's Ledge Superfund Site (Site) is located in New Bedford, Massachusetts, Bristol County, near the intersection of Route 195 and Hathaway Road (see Figure 1, provided in Appendix B of this report). OU1 consists of a 12-acre historic disposal area and the adjacent Unnamed Stream (see Figure 2, provided in Appendix B of this report). The capped historic disposal area and currently operating groundwater treatment plant are located within a fenced area with restricted access. A solar array was constructed on the cap in 2014. The disposal area is bounded on the south by the highway interchange with Route 140 and I-195, on the east and west by commercial establishments, and on the north by Hathaway Road. The Unnamed Stream flows from the Site underneath Hathaway Road into the Whaling City Golf Course, which is owned by the City of New Bedford.

OU2 is located within the Whaling City Golf Course. OU2 includes a 13-acre wooded 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 (see Figure 4, provided in Appendix B of this report). OU2 is bounded on the south by the southern banks of the tributary of the Unnamed Stream, on the north by the Apponogansett Swamp, and on the east and west by fairways of the golf course.

Regional groundwater flow in the overburden, shallow bedrock, and deep bedrock is to the north. In the absence of the installed groundwater pump and treatment system, local groundwater flow in the overburden and shallow

bedrock is from the southwest to the northeast corner of the former disposal area. Flow from the southwest corner of the Site entered the quarry pits, which are where the historic waste disposal occurred. A portion of the groundwater discharged out of the pits into the overburden and the Unnamed Stream and the remainder discharged into the bedrock.

Prior to installation of the OU1 cap, most of the former disposal area was covered by a layer of fill which overlaid the bedrock and quarry pits. The thickness of the fill generally increased to the south and west across the property with the maximum observed thickness of 22.4 feet found in the southwest corner of the Site. Shallow bedrock is highly fractured, with fracture planes varying in frequency and orientation, which means that the shallow bedrock exhibits the properties of a porous medium, with groundwater flowing in the direction of the hydraulic gradient. The deep bedrock contains fewer fractures than the shallow bedrock and the fractures follow a regional north/northwest lineament trend. Thus, contaminant migration in the deep bedrock is controlled by the orientation of the fractures.

Site History

The OU1 disposal area was originally operated as a granite quarry that supplied building stone to the New Bedford area. Quarry operations began in the 1800s and continued until 1921. During that time, as many as four separate quarry pits were in use on the property.

After serving as a local swimming hole, the city of New Bedford assumed ownership of the property in 1935 through a tax title foreclosure. The pits and adjacent areas were operated by the City of New Bedford and used by local industry as a disposal site for wastes such as electrical transformers and capacitors, fuel oil, volatile liquids, old tires, glass, metal, steel tanks, smoke stack soot, and scrap rubber. The Site also was used for disposal of other types of debris such as brush and trees, cobblestones, bricks, and demolition materials. The pits and adjacent areas are referred to throughout this report as the disposal area.

In the early 1970s, a major fire erupted on-site, primarily involving the mass of tires disposed of in the quarry pits. This fire was difficult to control due to the presence of the tires, and created a dense, black smoke. Due to concern regarding possible recurrence of such fires, an effort was undertaken to backfill the remainder of the smaller pit and to regrade the Site, covering any exposed refuse. In early 1982, Massachusetts Department of Public Works, District 6, conducted test borings on-site in conjunction with a proposal for construction of a commuter parking lot, but recommended cancelling the project when borings indicated the presence of electrical capacitors.

EPA conducted an air monitoring program of the Greater New Bedford area in 1982 and installed groundwater monitoring wells around the Site in 1983. Based in part on the results of these studies, the Site was included in the National Priorities List (NPL) in September 1984.

A chronology of significant site events and dates is included in Appendix C.

FOURTH 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 ***[If "Other Federal Agency", enter Agency name]*:**		
Author name (Federal or State Project Manager): Kimberly White		
Author affiliation: US EPA, Region I		
Review period: 3/28/2018 - 7/31/2018		
Date of site inspection: 5/3/2018		
Type of review: Statutory		
Review number: 4		
Triggering action date: 9/20/2013		
Due date *(five years after triggering action date)*: 9/20/2018		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Based on results of the Phase I and Phase II Remedial Investigations (RIs), three source areas of contamination were identified for the Site: the quarry pits, site soils, and PCB-contaminated sediments. The RIs also determined that contaminants from the quarry pits had contaminated on- and off-site groundwater and surface water in the Unnamed Stream.

The following summarizes the contamination at the Site:

Soils. The Phase II RI and pre-design sampling confirmed semivolatile organic compound (SVOC) contamination within the disposal area and along the eastern site boundary. Polychlorinated biphenyls (PCBs) were also detected within the disposal area and along the eastern site boundary.

Sediment. PCBs were the only compound of concern in the sediments. PCB contamination was detected in sediments from the Unnamed Stream, Middle Marsh, golf course water hazards, and Apponagansett Swamp.

PCB concentrations occurred at levels above the Sediment Quality Criteria Values (SQCVs) in each of the four habitats.

Groundwater. The majority of on-site groundwater contamination is caused by volatile organic compounds (VOCs); less significant levels of SVOCs and PCBs were also reported. VOCs were identified in the overburden groundwater, shallow bedrock groundwater (less than 100 feet below ground surface), and deep bedrock groundwater (down to 200 feet below ground surface).

Surface Water. Relatively high concentrations of VOCs, SVOCs, and inorganics were reported in the Phase II RI at groundwater seeps located east and north of the disposal area. For several contaminants, the concentrations exceed the ambient water quality criteria (AWQC). Impacts to the Unnamed Stream, however, appeared minimal due to the effects of dilution by the large volume of water in the Unnamed Stream. There was no public health risk associated with surface water.

The human health risk assessment for OU1 estimated potential human health risks associated with exposure to contaminants of concern in surface soils, sediments, air, surface water, and groundwater. The risk assessment assumed that access to the Site is restricted and the land is zoned as commercial, but considered a proposed future use of the Site as a soccer field. PCBs and total PAHs contributed the majority of the total carcinogenic risk from direct contact with surface soils. Noncarcinogenic hazard from incidental ingestion of on-site soils by children was elevated due to the lead concentration in an on-site shallow soil sample. Though groundwater was not a current source of drinking water, carcinogenic risks and noncarcinogenic hazards from future ingestion of groundwater were estimated. Benzene, trichloroethene, vinyl chloride, and PCBs contributed over 99 percent of the total cancer risk. 1,1-Dichloroethene 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 ug/l) was greater than the water quality criteria concentration (0.014 ug/l).

The human health risk assessment for OU2 concluded that human exposure to contaminants in Middle Marsh and the golf course/wetland area through current and future pathways would not result in significant increases in carcinogenic risk, and that there are no significant risks to human health posed by exposure to noncarcinogenic contaminants under the assumption that current and future site use would be as a golf course. The OU2 Record of Decision (ROD) notes that if EPA had assumed that the future use would be residential, cleanup levels would be lower due to higher frequency of exposure. The OU2 ROD requires the use of institutional controls to prohibit residential use and restrict commercial use, thereby assuring the protectiveness of human health. The ecological risk assessment concluded that aquatic exposures and wetland/terrestrial exposures to PCB-contaminated sediments in portions of the Middle Marsh present an unacceptable risk to biota present in OU2. This is the primary basis of the OU2 remedial action.

Response Actions

Pre-ROD Response Activities. In September 1984, EPA issued the owner and operator of the Site, the City of New Bedford, an Administrative Order under Section 106 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). In compliance with this order, the City of New Bedford secured the disposal area by installing a perimeter fence and posting signs warning against unauthorized trespassing at the Site.

On November 29, 1988, EPA notified parties who owned or operated the facility, generated wastes that were shipped to the facility, or transported wastes to the facility, of their potential liability with respect to the Site.

A Remedial Investigation (RI) of the Site was completed in two phases. The Phase I RI completed by NUS in September 1987 under subcontracts to EBASCO (EBASCO, 1987), provided the data necessary for site characterization. The draft final Phase II RI and Feasibility Study (FS) was completed in March of 1988 by E.C. Jordan under subcontract to EBASCO (EBASCO, 1989).

In June 1989, EPA concluded that additional studies of the Middle Marsh and adjacent wetland were needed and these areas were grouped into a second operable unit. The Remedial Investigation - Additional Studies of Middle Marsh report was completed in April 1991 by Metcalf & Eddy, Inc (M&E, 1991a). The Feasibility Study of Middle Marsh was completed by Metcalf & Eddy, Inc. on May 29, 1991 (M&E, 1991b).

Remedial Action Objectives. The ROD for OU1 was issued on June 29, 1989 and included the following RAOs:

- 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 and 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; and
- Minimize the threat posed to the environment from contaminant migration in the groundwater and surface water.

The ROD for OU2 was issued on September 27, 1991 and included the following RAOs:

- 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 bio-accumulation;
- Prevent or reduce releases of PCBs to the Unnamed Stream and the Apponagansett Swamp; and
- Mitigate the impacts of remediation on wetlands.

Selected Remedies. The selected remedy for OU1, as identified in the OU1 ROD, consisted of the following components. Items related to soil/sediment excavation, treatment, and placement are source control measures. Items related to groundwater collection/treatment are management of migration measures.

- Site Preparation;
- Soil Excavation/Treatment;
- Sediment Treatment;
- Construction of an Impermeable Cap;

- Diversion and Lining of the Unnamed Stream;
- Collection and Treatment of On-site Groundwater;
- Wetlands Restoration/Enhancement;
- Long-term Environmental Monitoring and Five-Year Reviews; and
- Institutional Controls.

As stated in the ROD, the EPA determined that contaminants have contaminated on- and off-site groundwater and surface water in the Unnamed Stream. Due to technical impracticability, Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) were not used as cleanup goals. Rather significant reduction of the contaminant mass and protection of surface water bodies were used as cleanup goals. A two-part plan for the cleanup of on-site contaminated groundwater and seeps involved an active extraction system (bedrock extraction wells) and a passive collection system (shallow collection trench).

The selected remedy for OU2, as identified in the OU2 ROD, consisted of the following components:

- Site preparation;
- Excavation of contaminated sediments and soils from portions of Middle Marsh and the Adjacent Wetland;
- Dewatering and stabilization of the excavated sediment/soils;
- Disposal of the stabilized sediment/soils beneath the cap constructed over portions of the disposal area of the Site;
- Wetlands restoration;
- Institutional controls to prevent future residential use and restrict commercial use; and
- Long-term environmental monitoring.

Explanations of Significant Differences (ESDs). Three ESDs (USEPA, 1995, 2000, and 2003) have been issued to document changes to the OU1 ROD.

On July 26, 1995, EPA issued an ESD documenting changes to the remedial action specified in the OU1 ROD. The ROD called for excavation of soils within the disposal area down to the seasonal low water table, de-watering, solidification, and placement back within the disposal area under an impermeable cap. The revised remedy described in the ESD called for soils in the disposal area to remain in place, untreated, and covered by the cap. The ROD also called for soils and sediments from the Unnamed Stream, water hazards, and other areas of OU1 outside the disposal area that exceed cleanup standards to be excavated, treated, and disposed of under the impermeable cap within the disposal area. Under the revised remedy, excavated soils and sediments from these areas would remain untreated and would be disposed of under the impermeable cap within the disposal area.

Another ESD was issued by EPA on September 27, 2000, documenting additional changes to the remedial action specified in the OU1 ROD. The ROD described the concrete lining of about 750 feet of the Unnamed Stream in the portion parallel to the eastern boundary of the Site. As described, the revised remedy included the permanent placement of the stream channel in an underground 72-inch pre-stressed concrete cylinder (PCCP), the creation of a new stream channel on the golf course, and the planting of vegetation to recreate the habitat lost. Under the ROD, passive groundwater collection along the eastern and northern boundary of the Site consisted of an under-drain pipe within a shallow trench. The ESD substituted this collection system with a slurry wall along a portion of the northern boundary and two recovery wells adjacent to the slurry wall. Although not, part of the 2000 ESD, further modifications were also made to the passive collection system in 2015 and are discussed in the "Status of Implementation" section below.

A third ESD was issued by EPA on September 29, 2003. It incorporated methane gas collection into the remedy to comply with Massachusetts Solid Waste Management Regulations and to prevent the off-site migration of gas.

Cleanup Levels. Cleanup levels were identified in the OU1 and OU2 RODs for various media as summarized below:

OU1

Soil within Disposal Area – The OU1 ROD identified human health risk-based soil target levels for unsaturated soils within the disposal area of 50 ppm total PCBs and 30 ppm total carcinogenic PAHs.

Soil Outside Disposal Area – The OU1 ROD identified a separate human health risk-based soil cleanup level for unsaturated soils outside the disposal area at 10 ppm total PCBs.

Sediment – The OU1 ROD identified an ecological risk-based sediment target level for the Unnamed Stream, its tributaries, and golf course water hazards of 20 ug total PCBs/g carbon. The value was identified to protect uses of aquatic life, specifically the consumption of aquatic life by wildlife.

Active Groundwater Collection System – The cleanup goal identified in the ROD for the active collection system is the significant reduction in the mass of the bedrock contamination. Two criteria are used to evaluate this goal: (1) a concentration range of 1 to 10 ppm (1,000 to 10,000 ppb) of total VOCs; and/or (2) an asymptotic curve using groundwater monitoring data indicating that significant concentration reductions are no longer being achieved.

Passive Groundwater Collection System – The objective of the passive collection system is to prevent degradation of the Unnamed Stream by collecting shallow contaminated groundwater. The OU1 ROD states that cleanup levels for the passive system will be based on Ambient Water Quality Criteria (AWQC) and the designated uses of the receiving waters.

OU2

Sediment/Soil in Aquatic Areas in Middle Marsh – The OU2 ROD identified an ecological risk-based sediment/soil cleanup level for aquatic areas in the Middle Marsh of 20 ug total PCBs/g carbon.

Sediment/Soil in Non-Aquatic Areas in Middle Marsh and Adjacent Wetlands – The OU2 ROD identified an ecological-risk based sediment/soil cleanup level for non-aquatic areas in Middle Marsh and for the Adjacent Wetland of 15 mg/kg total PCBs.

Status of Implementation

This section summarizes the implementation of the remedial actions specified in the RODs for OU1 and OU2.

Operable Unit 1

The settling defendants for OU1 formed the Sullivan's Ledge Site Group led by a project management committee (PMC) and hired a design engineering firm, O'Brien & Gere Engineers, Inc. (OBG), to implement the EPA OU1 Statement of Work. In June 1997, EPA approved the 100% design, initiating the time track for remedial action. The PMC contracted with Harding Lawson and Associates, Inc. (HLA) to implement the remedial actions. On-site construction activities for OU1 were initiated in March 1998 with Phase I mobilization.

Implementation of the remedial action for OU1 is discussed below, by component, as identified in the ROD. The information below is based primarily on the Remedial Construction Report (OBG, 2002b) for OU1.

Site Preparation. Site preparation work that was conducted included the installation of fencing and gates, clearing of vegetative material and debris and placement on the disposal area, placement of drums of soil and personal protective equipment and various construction debris on the disposal area, demolition of the former car wash located adjacent to the Site and placement of the resulting debris on the disposal area, grading of the Site to remove high points, abandonment of monitoring wells in the disposal area, proof rolling (or ensuring there are no unstable areas) of the Site, and placement of a 12-inch ordinary borrow interim cover on the portion of the Site not scheduled for capping until a later phase.

Soil Excavation. Soil excavation was conducted in several areas of the Site. The approximate total volume of material removed from each area is provided as follows:

- Unnamed Stream bed and southern tributary soil and sediments - 950 cubic yards plus 50 cubic yards of rock
- East bank soils (south of car wash) - 140 cubic yards
- Soils east of stream channel - 910 cubic yards
- East bank soils (north of car wash) - 40 cubic yards

In each area, post-excavation confirmation samples were collected and compared to the clean-up criteria for soils of 10 ppm PCBs. When necessary, additional excavation was performed until confirmation sampling indicated that the clean-up criteria had been met. The excavated materials were placed in areas within the limits of the cap system in accordance with construction specifications.

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 PCCP. The 72-inch PCCP was installed during Phase I of the remedial action.

Collection and Treatment of On-Site Groundwater. This component of the remedy 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 groundwater treatment plant.

The active groundwater collection system was installed during Phase I of the remedial action and consisted of the installation of three bedrock recovery wells, conversion of three existing bedrock monitoring wells to recovery wells, installation of two high density polyethylene (HDPE) piping access vaults, installation of HDPE piping from each bedrock recovery well to a manifold in the groundwater treatment plant, and installation of pumps and controls in each of the six bedrock recovery wells.

The passive groundwater collection system was installed during Phase I of the remedial action and consisted of approximately 660 feet of shallow collection trench (12-inch diameter HDPE perforated collection pipe surrounded by crushed stone backfill), HDPE manholes, a pump station, a valve vault, and associated double-walled piping. Per the 2000 ESD, a portion of the passive collection system was substituted with a slurry wall that was constructed along the northern limits of the landfill cap and two recovery wells (called “Interim Wells”) with pumps, controls, and associated piping that were installed adjacent to the slurry wall. The slurry wall was installed to a depth of 20 to 25 feet and a width of 6 to 30 feet. As of 2015, the groundwater from the shallow collection trench discharges either directly by gravity to the city sewer system or is pumped to the groundwater treatment plant 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.

The groundwater treatment plant was constructed during Phase I of the remedial action. The start-up period and initial operations occurred from December 10, 1999 through October 19, 2000.

Construction of an Impermeable Cap. This component of the remedy involved the following activities:

- installation of the geogrids along the former quarry limits;
- construction of the gas venting system including placement of granular material, installation of gas vent risers and horizontal gas collection pipe, and installation of 22 gas monitoring wells around the perimeter of the landfill cap system;
- installation of the geosynthetic clay liner;
- installation of the flexible membrane (LLDPE) cover;
- installation of the synthetic drainage layer;
- placement of the barrier protection material;
- placement of topsoil;
- excavation and construction of the sedimentation basin;
- augmentation of the Hathaway Road culvert;
- construction of run-on/run-off controls including berms, lined swales, and culverts;
- construction of access roads; and
- installation of site security measures including fencing and gates.

Wetlands Restoration/Enhancement. The restoration of affected wetlands in OU1 was conducted concurrently with OU2 wetlands restoration. HLA subcontracted certain wetland restoration tasks (vegetation plantings, invasive control, monitoring, reporting) for both OUs to New England Environmental (NEE) of Amherst, Massachusetts.

Sediment Treatment. Sediment excavation was performed within a tributary of the Unnamed Stream (Tributary #2), and two golf course hazards (Ponds A and B). Post-excavation confirmation samples were collected and compared to the clean-up criteria of 20 µg PCBs/gram carbon. A total of approximately 7,590 cubic yards of sediment was excavated from these areas. Excavated sediments were transferred to the treatment pad, stabilization agents (lime kiln dust and sand) were added and mixed using an excavator, and then the material was spread out and moisture conditioned (treated with admixtures to dry the sediment and improve usability as fill). A total of approximately 9,340 cubic yards of stabilized sediment was placed within the limits of the cap system.

Construction Completion. The Sullivan's Ledge Superfund Site, Operable Unit 1, Remedial Construction Report was completed in March 2002 by OBG (OBG, 2002b). This report included a Certification of Completion of Construction, signed on March 8, 2002. This report was approved by EPA on January 23, 2003, which triggered the start of the O&M period.

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, in accordance with the Post-Construction Environmental Monitoring Plan (OBG, 1996), indicated that several gas monitoring wells had methane concentrations that exceeded 25% of the lower explosive limit (LEL) for methane. On-site landfill gas vents were also monitored and methane was found to be present. Methane was not detected in explosive gas screenings of subsurface structures and buildings, on and adjacent to the Site. Soil gas surveys were performed in spring and summer 2002, indicating that methane was present at greater than 25% LEL both east and west of the landfill but was not detected in any adjacent buildings or structures screened.

A Corrective Action Alternative Analysis was performed to mitigate the migration of explosive gases from the landfill which exceeded the concentrations specified in 310 CMR 19.132(4)(g) and (h). The corrective action chosen was active gas control concurrent with data collection to evaluate the effectiveness in removing landfill gas and reducing off-site migration of landfill gases above 25% LEL. On November 15, 2002 a revised

Corrective Action Design was submitted for approval on behalf of the Settling Parties by OBG. The PMC proposed to install a pilot gas extraction system consisting of a trailer mounted 8 horsepower blower with knockout tank and gauges to record stack discharge velocity and temperature. The pilot system was run initially for a three-month period, and then continued to operate until early 2004 when it was dismantled to allow for installation of the full-scale system as described below.

OBG, on behalf of the OU1 PMC, submitted a conceptual design for the full-scale landfill gas collection system dated May 8, 2003. The design was based on the results of the pilot system. The design included collection from the east, west, and north sides of the landfill via a 200 GPM blower and subsequent release to the atmosphere.

Installation of the full-scale landfill gas collection system was conducted during the beginning of 2004. The full-scale landfill gas collection system became operational on June 10, 2004. Since the initial startup in 2004, some 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 2006, a pneumatic valve was installed near the blower system and is operated on a timer, such that the valve is open for 60 minutes and closed for 120 minutes. When the valve is closed, vacuum is applied only to the lower leg of the piping, producing a higher vacuum which helps remove water or condensate from the piping and also provides a higher vacuum to the direct connection points in the eastern portion of the cap. When the valve is open, vacuum is applied to both the upper and lower legs.

Institutional Controls. Institutional controls have been implemented for both OU1 and OU2 in the form of a Grant of Environmental Restriction and Easement (GERE) as summarized in Table 1 below. The GERE was recorded with the Bristol County Registry of Deeds on May 30, 2014.

Operable Unit 2

On January 25, 1993, EPA gave notice that the Consent Decree (CD) for OU2 had been lodged in United States District Court in Massachusetts. The Consent Decree was entered into by AVX Corporation (AVX) as the lead Settling Party, the City of New Bedford, the OU1 Settling Parties, EPA, and the Massachusetts Department of Environmental Protection (MassDEP). AVX Corporation hired a design engineering firm, Dames & Moore (now known as URS Corporation) to implement the EPA Statement of Work.

The remedial action at OU2 was conducted between 1998 and 2001. The OU2 Settling Parties contracted with HLA to implement the RA.

Activities associated with soil/sediment removal were conducted from April 1999 through September 2000. The calculated volume of soil, sediment, and debris wastes that were removed from Middle Marsh and the adjacent wetland was 25,485 cubic yards. Activities associated with the stabilization of soil/sediment and placement in the disposal area were conducted from June 1999 through June 2000. Activities associated with wetlands restoration were conducted from July 1999 through September 2000.

The Final Remedial Construction Report, Sullivan's Ledge Superfund Site, Second Operable Unit was completed on August 13, 2001 by URS Corporation. The report included a Certification of Remedial Construction Completion, signed on August 13, 2001. This report was approved by EPA on January 23, 2003, which triggered the start of the O&M period.

The OU2 ROD called for zoning ordinances and/or deed restrictions to ensure that future uses of Middle Marsh and the Adjacent Wetland are limited to existing recreation and conservation purposes, and to prohibit residential and restrict commercial uses. Institutional controls required by both the OU1 and OU2 RODs have been implemented in the form of GERE as summarized in Table 1 below.

IC Summary Table

Table **1**: Summary of Planned and/or Implemented 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, Cap System and Buried Wastes, Landfill Gas Collection and Blower System, Groundwater Collection and Treatment System, Monitoring Wells, Middle Marsh and Adjacent Wetlands Sediments/Soils	Yes	Yes	Site-Wide, including Map 94, Lots 6, 9, 10, 55 ["Area 1", south of Hathaway Rd] Map 121, Lot 37 ["Area 2", north of Hathaway Rd]	For "Area 1" only: 1. Restrict excavation, removal or disposal of loam, peat, gravel, sand, rock or other mineral or natural resource. For "Area 1" and "Area 2": 1. Restrict extraction, excavation, dewatering, consumption or utilization of groundwater for any purpose, including without limitation extraction for potable, industrial, irrigation or agricultural use; 2. Restrict cultivation of plants or crops for human consumption; 3. Restrict residential, commercial or industrial activity or use; and 4. Restrict any use or activity that would disturb or interfere with, or would be reasonably likely to disturb or interfere with, the implementation, operation or maintenance of the Selected Remedy.	Grant of Environmental Restriction and Easement (GERE) (May 2014)

Systems Operations/Operation & Maintenance

Operable Unit 1

OU1 O&M Activities. Several O&M activities for OU1 have been ongoing since the last FYR and mainly relate to the O&M of landfill cap and groundwater collection and treatment system and monitoring of groundwater, landfill gas, sediment, and surface water.

The City of New Bedford performs monthly inspections of landfill cap and site security features in accordance with the Site Operations and Maintenance Manual (OBG, 2002a) and documents the inspections in monthly reports that also provide O&M information for the groundwater treatment plant. The monthly site inspections include:

- Inspections of the landfill cap to look for signs of vegetative stress, burrowing animals, settlement, erosion, slope instability, or any other damage;
- Inspections of three surveyed benchmarks for signs of damage;
- Inspections of the access road on the cap system;
- Site security inspections looking for breaches in fence integrity;
- Inspection of the gas vents and perimeter monitoring wells for signs of damage or obstruction; and
- Inspection of run-on/run-off controls, including swales, berms, catch basins, vaults, and headwall/basins.

Any significant repairs or maintenance conducted by the City are typically noted on maintenance logs in the monthly reports. Routine maintenance activities include mowing and clearing of vegetation from drainage swales. Other maintenance activities (e.g. filling of animal burrows, fence repairs, repair of vehicle ruts, etc.) are conducted as needed. Note that the Site Operations and Maintenance Manual also requires inspections of the culverted portion of the Unnamed Stream every five years to ensure its integrity. The City has indicated that inspection was completed, but additional information regarding when and how the work was completed is forthcoming..

The City of New Bedford is responsible for O&M of the groundwater collection and treatment system, which has been ongoing since the initial start-up was completed in 1999 – 2000. O&M activities are conducted as required by the Groundwater Treatment Plant (GWTP) Operation and Maintenance Manual (OBG, 2000b), which underwent some draft revisions in 2014 and 2015 to reflect the addition of the landfill gas blower system and the replacement of the ultraviolet-oxidation (UV/OX) system with an air stripper and activated carbon. As discussed in more detail in Section IV, the GWTP O&M Manual will be undergoing further updates to reflect various changes, including those associated with the recent replacement of the supervisory control and data acquisition (SCADA) system used to monitor, gather, and process real-time data from the GWTP. The City of New Bedford prepares monthly reports documenting effluent and other GWTP operating data, daily flow rates and water levels for the extraction wells and passive collection trench pump station, maintenance activities, and details regarding any plant shutdowns. In the event of an exceedance of an effluent limit (pretreatment discharge limit for the POTW) for the GWTP, the City provides a separate notification to EPA when they receive the laboratory data indicating non-compliance.

The Wetland Restoration Plan (OBG, 1997) specifies that wetlands monitoring be performed annually for the first three years after completion of the initial restoration, during the fifth year, and once every following five years. Monitoring activities include stream flow and elevation monitoring, groundwater elevation monitoring, and evaluation of percent cover of the restored and created wetlands. Prior wetland monitoring events had occurred in 2001 through 2006 and 2011. During this five-year review period, wetland monitoring was conducted in 2017 by the City of New Bedford and was documented in the Sullivan's Ledge 2017 Wetlands Report, OU1 and OU2 (CONB, 2018b). See discussion of the 2017 monitoring data in Section IV of this report.

OU1 monitoring activities that are being conducted in accordance with the Post-Construction Environmental Monitoring Plan have been provided in semi-annual monitoring reports prepared since the last five-year review (OBG, 2012, 2014, 2015, 2016a,b,c, 2017a,b, and 2018a,b) and include:

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

Groundwater compliance monitoring was conducted quarterly through 2008 and then reduced to semi-annually beginning with the March 2009 monitoring round. The Field Sampling Plan (OBG, 2015) which addresses the surface water, sediment, and landfill gas monitoring was updated in June 2015 primarily to reflect changes to the landfill gas extraction system since startup, including the cycling of the current system between two alternating modes of operation.

OU1 O&M Issues and Operational Modifications. The OU1 remedy has generally performed as designed since construction completion. O&M issues and operational modifications that have occurred during this review period, in relation to components of the OU1 remedy, are summarized below. Additional O&M issues are discussed in other sections of this report.

GWTP Operations

The most significant O&M activity that the City of New Bedford has conducted within the review period is the replacement of the SCADA system for the GWTP, which was completed in 2017. Because of the age of the GWTP which has been operating close to 20 years, the existing system had become outdated. During 2017, the City also experienced sporadic exceedances of the GWTP effluent limit for PCBs, which is a pre-treatment discharge limit for discharge to the City's POTW. Significant maintenance and repairs have been conducted by the City to work toward addressing the issue. Extensive downtimes and periods of more limited operation of the treatment plant occurred in late July through October 2017 while the final phase of the SCADA system upgrade was being completed. Significant repairs and maintenance were also conducted during that period including extensive cleaning of process piping and tanks, filter backwashes, and motor repair/replacement. In addition to the repairs and maintenance, the City installed a bag filter at the end of the treatment process in December 2017 to remove solids not removed earlier in the treatment process. In February 2018, the City of New Bedford installed a new chemical feed system to improve the flocculation process and therefore minimize solids moving through the process, which is presumed to also reduce PCB concentrations in the effluent. The GWTP has operated much more consistently thus far in 2018 and there have been fewer issues with effluent exceedances (CONB, 2013-2018).

Groundwater Collection System

On frequent occasions within the past 5 years, one or more of the six bedrock extraction wells has had downtime due to problems with the pumps that require repair or replacement. This is an ongoing maintenance issue that is addressed as needed. In April 2018, the average daily influent flow from the bedrock extraction wells (with all wells pumping) was 41 gpm and the average daily flow from the shallow collection trench pump station (when being pumped) was 18 gpm. More recently in July 2018, the average daily influent flow from the bedrock extraction wells (with all wells pumping) was 36 gpm and the average daily flow from the shallow collection trench pump station (when being pumped) was 13 gpm.

When the bedrock extraction wells are all operational, as was the case during the Spring and Summer 2017 synoptic water level measurements (OBG, 2017b), the groundwater elevation data shows flow in the shallow and intermediate bedrock zones toward the recovery wells from the north, south, west, and east due to the hydraulic gradient generated by the bedrock extraction wells. In the deep bedrock zone, groundwater elevation data for those events showed flow toward the recovery wells from the north and northeast due to the hydraulic gradient generated by the bedrock recovery wells. Overburden groundwater flows from the upgradient portion of the Site in a northerly direction.

One of the two interim wells that are part of the passive groundwater collection system has not operated since July 2015 due to pump failure and a bend in the well casing that prevents removal/replacement of the pump. The PMC indicated in January 2016 that they would like to defer a decision on whether to replace the interim well and EPA subsequently concurred.

Solar Array Construction on Impermeable Cap

In 2014, a 1.76-megawatt photovoltaic solar array was constructed across the impermeable cap. EPA reviewed the work plans with respect to any potential impacts to the remedy, including the integrity of the impermeable cap and provided approval of the installation in 2013. Solar array racks were mounted on at-grade concrete ballast

blocks and underground cables connect the solar panels to off-landfill inverters/transformers. The work plans included an evaluation of the potential for landfill settlement caused by the solar array and addressed the need to not impact the integrity of the landfill cover, cap components, and monitoring systems, however these changes have not been incorporated into the O&M plan. Limited issues, such as settlement of backfill where cables were buried in certain areas, have been noted during EPA oversight inspections, but were not noted in the inspection forms used as a part of the O&M. Although, settlement issues have been addressed, improved documentation of the cap conditions is needed. The grass cover on the cap does not appear to have been negatively impacted by the presence of the panels and increased shading.

Direct Connection from Shallow Collection Trench to Sewer
In September 2015, the City of New Bedford installed a gravity pipe connecting the shallow collection trench to the main sewer pipe running underneath Hathaway Road. The connection to the shallow collection trench was made at manhole MH-4, which is the point where the shallow collection trench running south to north along the eastern boundary of the cap turns to the west toward the pump station. A gate valve and backflow preventer were installed along the pipe allowing the flow to the sewer to be regulated. The gravity pipe connects to the sewer at elevation 72.6 feet and acts as a high-level overflow pipe. The City currently relies on part to all of the flow from the shallow collection trench to supplement the flow from the bedrock extraction wells and allow for continuous operation of the GWTP. However, during wetter times of year when the water level in the shallow collection trench is higher, a portion of the shallow collection trench water does flow by gravity directly to the City's sewer system through this connection. The flow to the sewer is monitored at manhole MH-4 in accordance with the City's Industrial Pre-treatment Discharge Permit for the discharge and sampling is conducted periodically to ensure compliance with the discharge limits. Refer to the discussion of the discharge data in Section IV of this report.

Operable Unit 2

OU2 O&M Activities. Post-construction environmental monitoring and long-term wetlands monitoring activities are currently being performed in accordance with the Final Operation and Maintenance Plan for the Second Operable Unit, dated January 13, 1999. The O&M period officially began on January 23, 2003 (the date of approval of the Construction Completion Report). However, some O&M activities did occur prior to that date to maintain the integrity of the restored wetlands.

Post-construction environmental monitoring activities are required to be conducted once per year during the first three years, in year five, and then once every five years. The most recent environmental monitoring event was conducted in 2017 by the City of New Bedford (CONB, 2018a) and included the following activities:

- Collection of four surface water samples from reaches of the Unnamed Stream and analysis for pH and PCBs;

- Collection of four sediment samples from the reaches of the Unnamed Stream, within the area of OU2 impacted by remedial action construction and analysis for PCBs and total organic carbon (TOC); and

- Collection of two wetland sediment/soil samples from the adjacent wetland and four sediment/soil samples from the Middle Marsh and analysis for PCBs.

Post-construction wetland monitoring has been completed and long-term wetland monitoring is being conducted to ensure the long-term effectiveness of the wetland restoration program. 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. During this five-year review period, wetland monitoring for OU1 and OU2 was conducted in 2017 by the City of New Bedford and was documented in the Sullivan's Ledge 2017 Wetlands Report, OU1 and OU2 (CONB, 2018b). See discussion of the 2017 OU1 and OU2 wetlands monitoring data and OU2 environmental monitoring data in Section IV of this report.

Optimization Review and Related Activities

The EPA conducted an optimization review of the Sullivan's Ledge site in 2015/2016, with a focus on OU1 of the Site. The optimization review was intended to provide suggestions for potential changes to the remedy that will improve protectiveness, reduce cost, and improve progress toward attaining cleanup goals. The review focused on OU1. The recommendations of the optimization review are documented in the Optimization Review Report for the Sullivan's Ledge Superfund Site, which was finalized in March 2016 (USEPA, 2016). Since the review was completed, activities have been undertaken to implement some of the recommendations. Also, in 2016, Lockheed Martin/SERAS, under contract to USEPA, conducted preliminary desktop catchment water modeling for the Sullivan's Ledge Superfund Site (Lockheed Martin/SERAS, 2016). Modeling was conducted with the objectives of providing a better understanding of the groundwater flow dynamics and plume fate and transport at the Site, evaluating the performance of the existing remedial systems, and explaining the reasons behind the periodic total volatile organic compounds (TVOC) spikes in monitoring wells.

A summary of the findings and recommendations from the preliminary catchment water modeling are summarized below and are followed by a summary of the recommendations of the optimization review and actions taken to date to address the recommendations.

Desktop Catchment Water Modeling Preliminary Findings and Recommendations

A summary of the preliminary findings is as follows:

- Modeling indicates that the existing groundwater recovery wells may have performed effectively for the plume containment in the deeper fractured rock aquifer zones under normal and drier conditions, while the shallow intercept trenches are less effective for plume containment in the shallow aquifer zones. While the southern portion of the eastern recovery trench works effectively, the report stated that the northern tip of it can lose water to the north, and while the western portion of the west trench can be effective, with the help of the slurry wall, the report stated that the eastern portion can leak a small amount of water to the north;
- Modeling indicates that higher than normal plume attenuation is occurring the wetlands, where the plumes from the Site are heading;
- Modeling indicates that the slow-moving PCB plumes have not reached a steady state and without the remedial system operation, the PCB plumes may migrate further off-site;
- Modelling indicates the consistent PCB detection at the upgradient well MW-24 can be caused by a downgradient source within the former quarry as far as 250 feet away, because heavier PCBs can travel on top of less permeable surfaces such as the bottom of the former quarry or along a bedrock bedding slope.
- Relatively consistent mass recovery rates of existing recovery wells over the past decade indicate that persistent TVOC sources are DNAPL, which have not been reduced significantly, and the TVOC plume will gradually return to its 1999 levels and extents before the remediation;
- Recovery wells are less effective in wetter El Nino years; the modelling indicates that persistent wet seasons can cause TVOCs at ECJ-2 to exceed 10,000 ug/L.

The following recommendations were made:

- A new well or piezometer was recommended to be added at a location north or the space between the slurry wall and original stream bed east of the quarry where modeling indicated vulnerable spots for plume migration under the existing remedial system. Also, PZ-17, which is located on the western fringe of this area and is used for water level measurement, was recommended for future sampling.
- Sampling of wells MW-5 and PZ-18 may not be necessary as their long historical data are all ND and the modeling indicates that they receive background flow from east-and-southeast and not from the quarry

area. Instead, it was concluded that sampling from MW-6 and MW-10 is more valuable, as these wells had TVOCs detected and a recent PCB hit.

Optimization Review Recommendations and Actions Taken

The recommendations were divided into categories as follows: 1) recommendations pertaining to the site-specific groundwater remedy completion strategy; 2) recommendations for modifying groundwater remedy components; and 3) recommendations for gas migration control and wetlands monitoring. The following is a summary of the recommendations of the optimization review and actions taken to date to address the recommendations.

Recommendations and Actions Taken Pertaining to the Site-Specific Groundwater Remedy Completion Strategy

Revisit the ROD Groundwater Criteria for the Disposal Pits and Downgradient Bedrock Groundwater based on Groundwater Use and Value. The optimization team recommended that the State reevaluate the use and value of the groundwater in and downgradient of the disposal pits because the current cleanup standards for the area are conservative for the known risk at the Site. If the state concluded that groundwater in the area would not be used for drinking water or lead to vapor intrusion, then EPA could develop site-specific cleanup standards based on ecological risks, similar to the MassDEP groundwater cleanup standards (Massachusetts Contingency Plan, MCP, GW-3). The optimization team observed that the VOC concentrations at the extraction wells have easily exceeded the OU1 ROD criteria of 1 to 10 ppm for the active extraction system and therefore, it is likely that VOC concentrations in downgradient wells would exceed the 1 ppm to 10 ppm criteria if groundwater extraction were discontinued. Also, if EPA-calculated cleanup levels were similar to MassDEP GW-3 standards, they would result in higher cleanup levels for PCBs and GW-3 standards for VOCs have not been exceeded since the beginning of 2007. Additionally, PCBs have been detected at concentrations significantly above the GW-3 standard of 10 ug/L. The optimization team concluded based on these observations that adoption of EPA ecological-based cleanup standards (if similar to GW-3 standards) would allow for discontinuation of the active groundwater extraction system due to VOC concentrations still protecting human health and the environment. However, it was also concluded that the PCB concentrations in extracted groundwater would still be a potential concern that merits further evaluation as further described below.

MassDEP issued a Final Groundwater Use and Value Determination for the Site in March 2016 (MassDEP, 2016) (see Appendix D of this report for the document). 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 of harm to aquatic organisms should be considered in evaluating risk and remedy performance.

EPA has since been working on the development of groundwater risk-based concentrations (RBCs) for protection of aquatic organisms in surface water that receives groundwater from the Site. Details on how the groundwater RBCs would be applied to the Site, including modifications to: (i) the groundwater Points of Compliance, (ii) the requirements for Performance Monitoring that would be conducted following shutdown of the groundwater extraction system, and (iii) the criteria that would trigger re-start of the groundwater extraction system and/or additional evaluations remains in progress.

Collect Additional PCB Groundwater Data. Because high levels of PCBs are at times present in the groundwater extraction wells, the EPA Optimization Review Report suggested the possibility that PCBs could be mobile in groundwater. To further evaluate the PCB concentrations detected in the active system extraction wells and potentially rule out PCB mobility, the optimization team recommended sampling of the active system extraction wells and the shallow collection trench over multiple sampling events with analysis

of unfiltered samples for PCB Aroclors and filtered samples for PCB Aroclors and PCB congeners. Due to "weathering" of the PCB mixtures over time in the subsurface, it was suggested that the PCB Aroclor data may be overestimating actual total PCB concentrations and also that the PCB congener data might be helpful in evaluating ecological risk. It was recommended that the turbidity of the samples be measured to determine if PCB concentrations are correlated to turbidity. It was also recommended that the dissolved PCB concentrations for the blended extracted groundwater (with and without contributions from the shallow collection trench) be calculated for comparison to the EPA ecological risk-based cleanup standards. If the blended PCB concentrations for the active extraction system groundwater were below the standard, then multiple lines of evidence would suggest that PCBs are not mobile and that PCBs meet the potential new cleanup standard in groundwater downgradient of the disposal pits. If the dissolved PCB concentrations for the active extraction system groundwater were above the standard, then there is evidence that PCBs are mobile and could be migrating downgradient at unacceptable concentrations. In this case, it was stated that the current monitoring network may not be adequate for monitoring PCBs and two additional multi-level wells would be needed side-gradient of well ECJ-2 for monitoring both before and after shutdown of the active extraction system.

In response to this recommendation, O'Brien & Gere, on behalf of the OU1 PMC, conducted a three-month PCB sampling program in 2016 following procedures developed in the PMC's February 23, 2016 work plan as approved by EPA. The results were documented in a memorandum attached to a May 31, 2017 letter from the OU1 PMC (PMC, 2017). The blended PCB concentration for the active extraction system groundwater for one of the three monthly sampling events exceeded the potential ecological risk-based cleanup standard. (A detailed discussion of the three-month PCB evaluation is provided in Section IV of this report under Data Review.) As a result of the findings, the PMC recommended that the monitoring well network be effectively expanded by the addition of existing multi-level bedrock piezometers PZ-16, PZ-17, and PZ-18, which would need to be redeveloped and resurveyed (OBG, 2016b). After some review and comment, EPA concurred with the PMC's recommendation and, in addition, required that one new multi-level well be installed.

In 2018, the OU1 PMC provided a work plan for the rehabilitation of piezometers PZ-16 and PZ-17 and for the installation of a new nested set of piezometers side-gradient to the east of PZ-17 and west of the Unnamed Stream. Following some revisions to the work plan, EPA determined in a June 8, 2018 letter to the OU1 PMC that the work plan was adequate for proceeding with the piezometer redevelopment and new piezometer nest installation. It is expected that this work will begin in August 2018. The proposed new nested set of piezometers includes four individual bedrock piezometers to be installed in one 8-inch borehole with screen depths and lengths to be determined based on field determination of fracture zones and yields utilizing geophysical methods.

Discontinue the Active Extraction System and Conduct Post-Shutdown Monitoring if Conditions Allow. This recommendation states that if new cleanup standards based on ecological risk are adopted instead of the current ROD criteria based on total VOCs, then the active extraction system could be shutdown on a trial basis as long as VOCs and PCBs meet the potential new standards, including at the new sampling locations just north of Hathaway Road where potential gaps in the monitoring network exist. If VOC and PCBs do not meet the potential new standards, then the active system will need to be enhanced to improve source control and continue to operate. The recommendation includes some suggestions regarding monitoring if the system is shut down and recommends seven years of performance monitoring instead of the three years of quarterly monitoring in the Consent Decree. Although the duration would increase, it is suggested that the frequency could be reduced over time as follows so that the total number of events is unchanged: one year of quarterly monitoring, followed by two years of semi-annual monitoring, and four more years of annual monitoring. Because the above activities have not been completed, no determination has been made yet as to whether the active extraction system can be discontinued; however, these suggestions are being considered as a plan for performance monitoring is being developed.

Recommendations and Actions Taken for Modifying Groundwater Remedy Components

Streamline the Treatment System. The optimization review noted that the current groundwater treatment plant was designed and constructed to meet POTW discharge limits that included a limit for total toxic organics (TTO), but the revised POTW discharge limits do not include a TTO limit due to improvements in the POTW treatment process. The only constituent in the GWTP influent that requires treatment to meet the current POTW discharge limits is PCBs. The optimization review suggested that the treatment system could be streamlined by eliminating the metals removal system and air stripper and instead relying on bag filters and granular activated carbon (GAC) units to remove PCBs, although oxygen would need to be kept out of the system to keep the iron and other metals in solution. The City of New Bedford conducted an informal pilot study in 2016 with the main goal of evaluating the ability to prevent fouling of the GAC units due to iron precipitation. When the pilot system was operating, flow from the six extraction wells was diverted to flow through two bag filters followed by two GAC canisters in series, prior to directing the treated water to a floor sump where it was redirected back to the influent tank. Sampling ports were installed at different points in the pilot system for collection of samples to evaluate the process. Although the full results of the pilot study were not provided to EPA, the City also engaged a consultant to evaluate and provide recommendations on streamlined treatment of groundwater from the bedrock extraction wells and the consultant's evaluation was provided to EPA and MassDEP. The City concluded that based on their consultant's recommendations for treatment of the bedrock groundwater, which would require continued operation of the treatment processes currently in use with some modifications, that the operating costs would not be significantly reduced and the that the City did not plan to further pursue an alternate treatment process at that time, but may reconsider in the future.

Install the Gravity Line from the Passive System Collection Trench to the Sewer System. The gravity pipe connecting the shallow collection trench to the main sewer pipe running underneath Hathaway Road was installed in September 2015 prior to finalization of the Optimization Review Report and is further discussed above under OU1 O&M Issues and Operational Modifications.

Recommendations and Actions Taken for Gas Migration Control and Wetlands Monitoring

Address Methane at Eastern Property Boundary. The optimization review recommended that a bar hole probe study be conducted to better understand the methane in the vicinity of well GM-18 where methane exceedances of 25% LEL have been observed since at least 2011. Based on the results of this study, it was suggested that a new gas extraction well may be needed. In response to this recommendation, the OU1 PMC prepared a plan (PMC, 2016a and 2016b) for conducting a soil gas evaluation in the area of GM-18 and the plan was approved by EPA on May 5, 2016. Subsequently, the work was delayed for many months while the PMC was working to gain access to two adjacent properties and then until spring of this year when the ground was no longer frozen. The study was completed in June 2018. EPA is reviewing the findings submitted by the PMC on August 31, 2018 to determine whether additional information and /or a new gas extraction well will be needed.

Wetlands Monitoring. With regard to sediment and surface water sampling in the wetlands, the optimization team suggested that the sampling could likely be discontinued. Instead of conducting sediment and surface water sampling in the wetlands, the optimization team suggested that existing piezometers in the wetlands could be sampled for PCBs and VOCs to identify if PCB-impacted groundwater affected the wetlands and based on those findings, the Site team could determine if additional sediment sampling is justified. The Site Team is currently evaluating the installation of additional piezometer locations as part of the evaluations that would be required should the operations of the treatment plant be discontinued. Meanwhile, OU1 and OU2 sediment and surface water sampling has continued in accordance with existing requirements and the most recent monitoring rounds occurred in the Fall of 2017. Review of this data is provided in Section IV of this report under Data Review.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last five-year review as well as the recommendations from the last five-year review and the current status of those recommendations.

Table 2: Protectiveness Determinations/Statements from the 2013 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Short-term Protective	The remedy for OU1 is currently protective of human health and the environment because the construction of the remedy is complete, and operation and maintenance and monitoring of the remedy is being performed. However, in order for the remedy to be protective in the long-term, the following actions need to be taken: • Implement Institutional Controls; • Monitor and correct landfill gas levels of concern and modify monitoring and extraction system as necessary; • Replace bedrock monitoring well ECJ-2; and • Potential intermittent seepage noted at cap during inspection will be investigated and corrected as appropriate.
2	Short-term Protective	The remedy for OU2 is currently protective of human health and the environment because the construction of the remedy is complete, and operation and maintenance and monitoring of the remedy is being performed. However, in order for the remedy to be protective in the long-term, the following actions need to be taken: • Implement Institutional Controls and • Monitor PCB concentrations in sediment for comparison to cleanup levels.
Sitewide	Short-term Protective	Because the remedial actions at the Site are protective in the short-term, the Site is protective of human health and the environment in the short-term. However, in order for the remedy to be protective in the long-term, the following actions need to be taken: <u>OU1</u> • Implement Institutional Controls; • Monitor and correct landfill gas levels of concern and modify monitoring and extraction system as necessary; • Replace bedrock monitoring well ECJ-2; and • Potential intermittent seepage noted at cap during inspection will be investigated and corrected as appropriate. <u>OU2</u> • Implement Institutional Controls and • Monitor PCB concentrations in sediment for comparison to cleanup levels.

Table 3: Status of Recommendations from the 2013 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
1	Implement Institutional Controls	Finalization of Institutional Controls	Completed	A Grant of Environmental Restriction and Easement (GERE) was recorded with the Bristol County Registry of Deeds in 2014.	5/30/2014
1	The landfill gas monitoring, collection, and extraction system may require modification to ensure it is meeting its objectives.	Monitoring of landfill gas will continue with objective to ensure gas is not migrating beyond the boundaries of the landfill. Monitoring points shall be capable of yielding representative air samples for analysis and consist of a sufficient number of wells properly located to detect the presence and migration of landfill gases. The sampling plan should be updated to reflect the most current monitoring procedures. Corrective actions to the monitoring, extraction, and collection system will be taken if necessary.	Ongoing	Landfill gas monitoring has continued to be conducted quarterly over the past five years. The Field Sampling Plan (OBG, 2015) was updated in June 2015 to reflect changes to the landfill gas extraction system since startup. Four monitoring wells which had previously been directly connected to the landfill gas extraction system via piping to the lower leg of the system were disconnected by closing valves in 2014 in order to return the wells to being appropriate as monitoring locations and avoid drawing landfill gas toward these wells. Elevated methane has continued to be frequently detected in one or more perimeter monitoring wells along the eastern property boundary. A soil gas study is being conducted to better understand the potential source of the methane in the vicinity of well GM-18 where exceedances of 25% LEL have been observed. EPA approved the OU1 PMC's plan for the study on May 5, 2016, but the work was delayed for many months while the PMC was working to gain access to two adjacent properties and then until spring of this year when the ground was no longer frozen. The study was completed in June 2018. EPA is reviewing the findings submitted by the PMC on August 31, 2018 to determine whether additional information and/or a new gas extraction well will be needed.	Ongoing

1	Bedrock groundwater compliance monitoring well ECJ-2 is damaged and needs replacement in order to assess compliance with cleanup levels for the active extraction system.	Replace multi-port bedrock groundwater monitoring well ECJ-2	Completed	Westbay well ECJ-2 was rebuilt in the same borehole. With EPA's approval, sampling ports were set at 4 depth intervals, instead of the 5 depth intervals that existed previously. The well was subsequently returned to being part of the compliance groundwater monitoring program.	9/18/2013
1	Potential intermittent seepage noted at cap during inspection will be investigated and corrected as appropriate.	Potential intermittent seepage noted at cap during inspection will be investigated and corrected as appropriate.	Completed	The City has not reported any additional potential seepage events or runoff onto the adjacent sidewalk and Hathaway Road since the 2013 five-year review and no events have been observed by EPA oversight contractor staff. In September 2015, the City of New Bedford installed a gravity pipe connecting the shallow collection trench to the main sewer pipe running underneath Hathaway Road. This controls shallow groundwater levels during particularly wet weather conditions by acting as a high-level overflow for the shallow collection trench.	9/10/2015
2	Implement Institutional Controls	Finalization of Institutional Controls.	Completed	A Grant of Environmental Restriction and Easement (GERE) was recorded with the Bristol County Registry of Deeds in 2014.	5/30/2014
2	Monitoring of sediments has indicated some PCB concentrations above the TOC normalized clean-up levels, while an equal number have been found below the cleanup levels. Further monitoring is warranted.	Continue to monitor and implement corrective actions if needed.	Ongoing	OU2 sediment monitoring has continued with the most recent round having occurred in the fall of 2017. There continue to be clean-up level exceedances at some monitoring locations, but the locations with exceedances in 2017 were not associated with increased total (non-normalized) PCB concentrations (see Data Review in Section IV). Corrective action has not been recommended at this time, but further monitoring is recommended.	Ongoing

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

A public notice was made available by an EPA press release titled "EPA Begins Reviews of 24 New England Site Cleanups during Current Fiscal Year" issued on 2/16/2018, stating that there was a five-year review and inviting the public to submit any comments to the U.S. EPA. The results of the review and the report will be made available at the Site information repository located at New Bedford Public Library, 613 Pleasant Street, New Bedford, MA 02740 and on U.S. EPA's website at https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100744.

During the FYR process, interviews were conducted to document any perceived problems or successes with the remedy that has been implemented to date**.** Several stakeholders were interviewed, including the MassDEP Project Manager, a Sullivan's Ledge Site Group PMC representative, two City of New Bedford Department of Public Infrastructure staff involved with O&M of the groundwater collection and treatment system and impermeable cap, and the General Manager for the Whaling Inn and Suites, which is located on Hathaway Road, adjacent to the Site. An attempt was made while on-site for the site inspection to interview staff at a self-storage facility abutting the Site and a questionnaire was sent via email; however, the staff did not express interest in responding. Finally, an interview questionnaire was sent to two City of New Bedford Office of Environmental Stewardship staff involved with O&M of the restored wetlands and streams, but a response has not yet been provided. Appendix E includes the interview questions and responses.

Data Review

OU1 Groundwater Treatment Plant Effluent Monitoring

Effluent from the GWTP is discharged to the City of New Bedford publicly-owned treatment works (POTW). The New Bedford POTW has established discharge criteria that must be met by the GWTP for discharge to the municipal sewer system. Treatment plant effluent sample results are included in the City of New Bedford's monthly reports. Treatment plant effluent results are evaluated to determine if pre-treatment discharge limitations have been met. PCB analyses are typically conducted on a weekly basis and VOCs, metals, and cyanide analyses are typically conducted on a monthly or bi-weekly basis. SVOCs and pesticides are analyzed on a less frequent basis. While there was historically a pre-treatment discharge limit for total toxic organics (TTO), that limit no longer exists. Also, there are currently no pre-treatment discharge limits for specific VOCs, SVOCs, or pesticides. Pre-treatment discharge limits do exist for several metals and cyanide and no exceedances have been reported for those analytes. PCBs have periodically exceeded the pre-treatment discharge limit of 5 ug/L. Where there were effluent exceedances in past years, they were typically attributed to temporary operational problems or maintenance within the treatment plant.

Table F-1 in Appendix F provides a summary of total PCB concentrations reported in the GWTP effluent for 2017 and available data for 2018. Concentrations that exceeded the pre-treatment discharge limit are bolded on the table. During weeks when effluent samples were not collected and no data is shown on Table F-1, it was nearly always because the plant was down at the time sampling would typically occur.

Based on the City's monthly reports, PCB effluent exceedances in mid- to late-2017 appeared to be primarily related to inadequate removal of solids within the treatment process due to issues with clarifier and sludge pumps and multi-media filter feed pumps. Also, extensive downtimes and periods of more limited operation of the treatment plant occurred in late July through October 2017 while the final phase of the SCADA system upgrade was being completed and significant repairs and maintenance were also conducted. A bag filter was installed at the end of the treatment process in December 2017 to remove solids not removed earlier in the treatment process.

In February 2018, the City of New Bedford installed a new chemical feed system to improve the flocculation process and therefore minimize solids moving through the process. Less frequent exceedances of the pre-treatment discharge limit for PCBs have occurred thus far in 2018 and operation of the GWTP has been much more consistent. The exceedances in early March 2018 were attributed to failure of components of the polymer system that were replaced and subsequent effluent samples were compliant.

OU1 Monitoring of Direct Discharge to Sewer

Since the City's installation of a gravity pipe connecting the shallow collection trench at manhole MH-4 directly to the New Bedford POTW in September 2015, 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 Pre-treatment Discharge Permit. The discharge is monitored at manhole MH-4 and results have been included in the City's monthly reports. Analytical results have been included for samples collected on 12/16/15, 4/6/16, 5/4/17, 10/19/17, and 3/1/18 for PCBs, total suspended solids (TSS), VOCs, 6 metals, and cyanide. PCBs were not detected in any of the MH-4 samples and reporting limits have been multiple orders of magnitude below the discharge limit of 5 ug/L. Detected concentrations of VOCs, metals, TSS, and cyanide have been below the discharge limits for the POTW.

Although not required for demonstrating compliance with the permit for direct discharge to the POTW, the City collected samples every other week from the shallow collection trench pump station for PCB and TSS analysis. There have been a limited number of instances in the past few years where PCB were detected in the pump station above 5 ug/L. A PCB sample collected on 2/3/16 contained 8.2 ug/L PCBs and the City responded by closing the discharge valve from 2/16/16 to 3/1/16, until subsequent sample results showed PCB levels below the discharge limit. PCBs were also detected above the discharge limit in pump station samples from 12/7/16 (96 ug/L) and 3/2/17 (9.11 ug/L); however, in both of these instances, water level data for the pump station showed that direct discharge to the sewer would not have been occurring during those periods.

OU1 Groundwater Compliance Monitoring

Groundwater compliance monitoring is being conducted while the groundwater treatment plant is operating until the groundwater clean-up standards are achieved in accordance with the OU1 ROD and the requirements of the CD with the OU1 Settling Parties. Once performance standards are met, the OU1 ROD and the CD currently require that performance monitoring be conducted for a period of three years, in order to evaluate whether achievement of the cleanup standards is sustained. After performance monitoring, long-term monitoring will be conducted (OBG, 1996).

The Post-Closure Environmental Monitoring Plan (PCEMP) (OBG, 1996) describes compliance monitoring requirements for both the active extraction system and the passive collection system. With regard to the active extraction system, the plan specifies that bedrock and Westbay monitoring wells be sampled on a quarterly basis and that overburden monitoring wells be sampled on a quarterly basis for the first four quarters and annually thereafter. Since the PCEMP was developed, certain modifications and reductions have been made to the sampling program with EPA's approval. Most significantly, the frequency of groundwater monitoring was reduced from quarterly to semi-annually beginning with the March 2009 monitoring round. Water level measurements continue to be conducted on a quarterly basis.

The current sampling program includes a March sampling event and a more comprehensive September (annual) sampling event. The March events include the sampling of the recovery system components (bedrock extraction wells and shallow collection trench), eight conventional monitoring wells and multiple zones in two Westbay monitoring wells. The September events include the sampling of the recovery system components, 21 conventional monitoring wells, and multiple ports in 4 Westbay monitoring wells.

To date, a Post-Construction Baseline Groundwater Sampling Event report (OBG, 2000a) followed by quarterly groundwater monitoring reports through 2008, and semi-annual groundwater reports from 2009 through 2017 have been submitted. The Fall/Winter monitoring reports (Winter monitoring reports prior to 2009) are annual reports that provide additional discussion of historical data and data trends.

In addition to the routine compliance monitoring, a separate three-month PCB sampling program was conducted in 2016 in response to one of the recommendations in EPA's Optimization Review (see Section II of this report for additional details) and data from that program is discussed below.

Active Collection System. The active collection system has been delivering contaminated groundwater to the treatment plant since startup in 1999. The bedrock cleanup goal identified in the ROD for the active collection system is the significant reduction in the mass of the bedrock contamination. Two criteria are used to evaluate this goal: (1) a concentration range of 1 to 10 ppm (1,000 to 10,000 ppb) of total VOCs; and/or (2) an asymptotic curve using groundwater monitoring data indicating that significant concentration reductions are no longer being achieved. Several bedrock monitoring wells serve as points of compliance and were established in the PCEMP. While potential new cleanup standards have been identified, those standards have not yet been formally adopted in place of the existing cleanup goal; therefore, the data review in this section is focused on discussion relative to the current cleanup goal. A summary of total VOC data for the points of compliance from 1999 through 2017 is presented in Table F-2 (located in Appendix F) and summarized below. Total VOC concentrations are based on totals provided in the Fall and Winter 2017 Monitoring Event report (OBG, 2018a). Note that the "ECJ" series well are multi-level Westbay wells and in the following discussion, the depth in the well of the individual sample port is provided in parentheses after the well name.

Point of compliance wells ECJ-1, GCA-1, MW-13, and MW-17 are located within the former disposal area on the downgradient side. In general, total VOC concentrations in most zones of Westbay monitoring well ECJ-1 and wells GCA-1, MW-13, and MW-17 have decreased since plant startup. Total VOC concentrations in ECJ-1(267), in the deep bedrock zone have increased since plant startup and concentrations over the past 2 years are the highest concentrations to date for this sample port, with three out four total VOC results greater than 1,000 ppb. Total VOC concentrations in ECJ-1(122) and ECJ-1(148) have decreased considerably since 2006 and did not exceed 1,000 ppb during this five-year review period. Similarly, total VOC concentrations in ECJ-1(37), ECJ-1(62), and ECJ-1(72) continue to fluctuate, but concentrations in ECJ-1(37) have not exceeded 1,000 ppb since 1999 and concentrations in ECJ-1(62) and ECJ-1(72) have not exceeded 1,000 ppb since 2008. Total VOC concentrations in well GCA-1 have fluctuated primarily between 100 and 400 ppb since 2003. Total VOC concentrations in wells MW-13 and MW-17 have shown concentrations below 10 ppb since 2002, with one exception. The total VOC concentration in well MW-13 in the fall of 2010 was 699 ppb (significantly higher than typical levels) and appears to be anomalous, although no sampling or reporting error was identified.

Point of compliance wells located within the former disposal area on the upgradient side include ECJ-3, MW-2, and MW-24. Total VOC concentrations in each zone of Westbay well ECJ-3 have generally been low and have been below 10 ppb since 2005, with the exception of some higher concentrations up to 43 ppb in Fall 2013 and Fall 2014. Total VOC concentrations in well MW-24 appeared to decrease following plant startup through the Winter 2004 round, then showed an increasing trend through the fall 2013 round (historic high of 9,048 ppb) and have since decreased to concentrations ranging between 4,000 and 7,000 ppb over the past five years. Since MW-24 is located within the former disposal area, the apparent increasing trend does not indicate an off-site source or other concern. Total VOC concentrations in well MW-2 generally decreased through the spring 2006 round, then showed a slight increasing trend through the spring 2010 round, and have since decreased with concentrations between 100 and 500 ppb over the past five years.

Point of compliance wells ECJ-2, MW-4, MW-5, and MW-6 are located outside of the former disposal area. As discussed elsewhere, Westbay well ECJ-2 experienced damage in mid-2009, but the well was reconstructed and returned to the monitoring program in the fall of 2013. With EPA approval, sampling port ECJ-2(82) was not replaced. In the shallow bedrock interval ECJ-2(47), concentrations have fluctuated since start-up with no clear trend and ranged from 169 to 2,915 ppb over the past five years. At ECJ-2(117), concentrations have decreased

since start-up, but have fluctuated considerably over the past five years, with concentrations in Spring 2015 and Fall 2016 exceeding 10,000 ppb. In the two deepest intervals at ECJ-2(152) and ECJ-2(187), concentrations have been much lower, with just one detection over 1,000 ppb in the past five years. Total VOC concentrations in well MW-4 have appeared to fluctuate with no overall trend and concentrations have ranged between 800 and 2,500 ppb over the past 10 years. Total VOC concentrations in well MW-5 have been not detected or detected at very low (less than 10 ppb) concentrations relative to other point of compliance wells since plant startup with no apparent increasing or decreasing trend. Total VOC concentrations in well MW-6 have decreased significantly since plant startup but have remained relatively steady over the past several years of monitoring.

For the most part, concentrations of total VOCs have decreased significantly since treatment plant startup conditions in 1999. However, well ECJ-2(117) has shown recent concentrations greater than 10,000 ppb in the Spring 2015 and Fall 2016 monitoring rounds. As discussed elsewhere in this report, effort is underway to potentially replace the current cleanup level for the active collection system with site-specific ecological risk-based standards.

Passive Collection System. The objective of the passive collection system is to prevent degradation of the Unnamed Stream by collecting shallow contaminated groundwater. Cleanup levels are to be determined based on AWQC and the designated uses of the receiving waters. Compliance is measured at the influent to the treatment plant. Semi-annual groundwater monitoring includes collection of groundwater from the passive collection system for chemical analysis.

During the most recent September 2017 monitoring round, groundwater from the shallow collection trench was analyzed for VOCs, PCBs, and metals. Total VOCs were detected at 135.53 ug/L, with cis-1,2-dichloroethene, chlorobenzene, and benzene concentrations contributing to the majority of that total VOC concentration. Total PCBs were detected at 8.18 ug/L. Detected metals included barium, calcium, iron, lead, magnesium, manganese, sodium, and zinc. In general, levels of VOCs, PCBs, and metals have remained relatively consistent since treatment plant startup. Note that the total PCB concentration was above 5 ug/L, which is atypical, although there have been a small number of previous compliance monitoring events that showed PCB levels over 5 ug/L.

The passive collection system continues to collect shallow contaminated groundwater. Flow from the collection system is providing essential additional flow to the treatment plant to ensure continuous/semi-continuous operation. Refer to the discussion above regarding review of data associated with monitoring of the direct discharge of a portion of the shallow collection trench water to the City's POTW, as is now occurring during wetter times of the year. During dry weather periods and the resultant lower than expected flow rate from the passive collection system vault, the treatment plant has been operating intermittently.

Three-Month PCB Evaluation for Active and Passive Extraction System. In response to a recommendation in EPA's Optimization Review Report (EPA, 2016), O'Brien & Gere, on behalf of the OU1 PMC, conducted a three-month PCB sampling program following procedures developed in the PMC's February 23, 2016 work plan as approved by EPA. The results were documented in a memorandum attached to a May 31, 2017 letter from the OU1 PMC (PMC, 2017). Three consecutive monthly groundwater sampling events were conducted at the site in August, September, and October 2016 in accordance with the Optimization Review recommendations. During each of the three sampling events, groundwater samples were obtained from the six recovery wells (OBG-1, OBG-2, OBG-3, BEI-1, BEI-2, and BEI-3) and the shallow collection trench (SCT) using the sample taps inside the GWTP. From each of the seven sample taps, filtered and unfiltered groundwater samples were obtained and analyzed for PCB Aroclors (USEPA Method 8082A). The filtered groundwater samples were additionally analyzed for 209 PCB congeners (USEPA Method 1668C). A turbidity measurement was obtained from each sample port following sample collection and the flow rates coming into the GWTP were also recorded for each of the six recovery wells and the shallow collection trench. Table F-3 in Appendix F provides a summary of the data collected from each of the extraction system points as provided in the memorandum transmitted by the PMC (PMC, 2017) and also calculates blended PCB concentrations for each sampling event, both with and without consideration of the shallow collection trench.

PCB concentrations were generally the highest in samples from well OBG-1. Comparison of the filtered total PCB Aroclor concentrations to the filtered total PCB Congeners concentrations indicates that at high concentrations well above the potential ecological-risk based standard (14 ug/L), the Aroclor results are higher than Congener results, whereas, at lower concentrations near and below the potential standard, the results are inconsistent.

Filtered total PCB Aroclors and filtered total PCB Congeners concentrations exceeded 14 ug/L in samples from well OBG-1 from August, September, and October 2016 and well OBG-3 in September 2016. Additionally, the filtered total PCB Aroclor concentration from well OBG-2 exceeded 14 ug/L in September 2016. The blended concentrations were not consistent across the sampling events, but the blended total PCB concentration (using filtered Congener results) without input from the shallow collection trench exceeded the potential 14 ug/L standard in September 2016. The potential PCB groundwater standard is based on achieving the NRWQC of 0.014 ug/L after an attenuation factor of 100 and a dilution factor of 10.

OU1 Long-Term Sediment Monitoring

During this five-year review period, OU1 bi-annual sediment sampling was performed in September 2013, September 2015, and September 2017 (OBG, 2014, 2016, 2018a, and 2018b). During each event, sediment samples were collected from the Unnamed Stream just upstream of Pond A, OU1 diversion swale, sedimentation basin, and the Unnamed Stream just downstream of the Hathaway Road culvert. During the 2015 and 2017 events, a sediment sample was also collected from upstream of the former disposal area at the OU1 cap swale. Sediment samples were analyzed for PCBs, PAHs, TOC, metals, and percent solids. Table F-4 in Appendix F provides a summary of upstream and maximum downstream concentrations for detected PCBs, PAHs, and metals, including normalized PCB concentrations based on TOC content.

In 2013 and 2015, all sediment samples were compliant with sediment target level of 20 ug PCB/g carbon. In 2017, one sediment sample from the sedimentation basin (37.0 ug PCB/g carbon) exceeded the sediment target level of 20 ug PCB/g carbon. All other sediment samples from September 2017 showed concentrations below the sediment target level. A review of total PCB concentrations for sedimentation basin sample location over the past two five-year review periods showed total PCB concentrations of 1.4 mg/kg in 2009, no detection (<0.0271 mg/kg per Aroclor) in 2011, 2.41 mg/kg in 2013, 0.535 mg/kg in 2015, and 1.257 mg/kg in 2017. While the PCB concentrations have fluctuated, there does not appear to be any increasing trend that would cause concern about any issues with the integrity of the impermeable cap.

During each of the 2013, 2015, and 2017 sediment sampling events, PAHs were detected at all sample locations including the location upstream of the former disposal area at the OU1 cap swale (sampled in 2015 and 2017). Concentrations of PAHs were generally highest in the sediment samples collected from just downstream of the Hathaway Road culvert and from the OU1 diversion swale further downstream. OBG has attributed the higher concentrations at these locations to runoff from Hathaway Road. Similarly, several metals were detected in all sediment samples including the upstream samples from the OU1 cap swale. While the downstream metals concentrations were generally higher than the upstream metals concentrations, there do not appear to be any sharp upward trends between monitoring events. Also, the highest metals concentrations were not consistently detected at one sample location.

During the Fall sampling events in 2013 through 2017, an additional sediment sample was collected from within a culvert pipe at the headwall just north of Hathaway Road and analyzed for PCBs, PAHs, and metals. PCBs are typically detected at concentrations less than 1 mg/kg and PAHs and metals are typically also detected, although PAHs were not detected in 2015.

OU1 Long-Term Surface Water Monitoring

Bi-annual surface water sampling was performed in September 2013, September 2015, and September 2017 (OBG, 2014, 2016, and 2018a). Surface water samples were generally collected from the Unnamed Stream, OU1 diversion swale, sedimentation basin, and downstream of the Hathaway Road culvert. Historically, an additional sample has been collected from the designated upstream location in the OU1 cap swale; however, this location was reported as dry during the past three sampling events and no surface water samples were obtained. The surface water samples were analyzed for VOCs, PAHs, PCBs, metals, and pH. Table F-5 in Appendix F provides a summary of the maximum detected concentrations in downstream samples for each of the three sampling events along with the most recent upstream sample results from October 2011 (OBG, 2012).

Generally, surface water data showed similar results for each of the three sampling events. PCBs were not detected in any surface water samples (detection limits ranged from 0.476 to 0.588 ug/L). Very low concentrations of VOCs, primarily chlorinated VOCs, were detected at multiple downstream locations with no increasing trends. Metals concentrations were generally similar between the three monitoring events. PAHs were not detected during the 2013 and 2015 events, but were detected slightly above reporting limits in 2017 at one sample location within the sedimentation basin.

OU1 Landfill Gas Monitoring

As described above, a full scale active landfill gas collection system has been operating since June 2004. Landfill gas monitoring is conducted on a quarterly basis in accordance with the 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 in the vicinity of the gas extraction unit are screened for VOCs, methane, carbon dioxide, oxygen, and hydrogen sulfide. See Figure 3, provided in Appendix B, for the locations of the landfill gas monitoring wells and discharge stack. Ambient air, along the fence line and within catch basins at the gas station (formerly Rosie's Restaurant) located next to the former disposal area, is also screened for landfill gases.

During the recent December 2017 monitoring event, methane was detected in two of the landfill gas monitoring wells located on the eastern side of the landfill cap prior to purging at levels of 168% and 298% of the lower explosive limit (LEL). Post-purge methane levels at these gas monitoring wells were not able to be measured because the equipment began pulling water from the sample port. The methane concentrations at wells GM-17 and GM-18 are not in compliance with the Massachusetts Solid Waste regulations, since methane was present at the property boundary above 25% LEL. VOCs were detected in well GM-17 at a trace level of 0.1 parts per million (ppm), but were not detected in other gas monitoring wells. Hydrogen sulfide was detected in three of the gas monitoring wells, including 1 ppm at well GM-1R (post-purge), 1 ppm at well GM-17 (pre-purge), and 19 ppm at well GM-18 (pre-purge). As frequently occurs, one landfill gas monitoring well on the southern perimeter of the landfill cap was not monitored because the area around the well was submerged with water. Methane was detected at the discharge stack of the landfill gas extraction system at a concentration of 4% LEL. Methane was detected at 2% LEL at two locations near the discharge stack and corner of the treatment building, but the results were believed to be biased high. As is typical of previous monitoring events, no methane, hydrogen sulfide, or VOCs were detected in ambient air along the fence line near the gas station or in catch basins on the gas station property. Indoor air was not monitored at the adjacent gas station during the Winter 2017 event or previous events (OBG, 2018a).

Methane has typically been detected in one or more landfill gas monitoring wells at levels above 25% LEL. The following list summarizes the locations of these elevated methane levels for the past 8 monitoring rounds (2016 and 2017) as documented in the semi-annual monitoring reports (OBG, 2016c, 2017a, 2017b, 2018a) (note that exceedances are based on post-purge data, except when only pre-purge data was collected):

Monitoring Date	Monitoring Wells Containing Methane at >25% LEL
March 2016	GM-18
June 2016	GM-18
September 2016	GM-17, GM-20
December 2016	GM-17, GM-18
March 2017	None
July 2017	GM-18
September 2017	GM-17
December 2017	GM-17, GM-18

As shown on Figure 3 in Appendix B, gas monitoring wells GM-17, GM-18, and GM-20 are located along the eastern property boundary near the northern (lower) leg of the gas collection header. The elevated methane in this area of the property boundary is typical of what has been measured during previous five-year review periods.

It should be noted that between 2005 and 2009, gas monitoring wells GM-17, GM-18, GM-19, and GM-20 were piped directly to the lower leg of the gas collection system in an effort to improve landfill gas removal. While connected to the gas collection system, they were no longer appropriate as monitoring locations for assessing compliance with Massachusetts Solid Waste regulations at the property boundary. The reason for this is that when the system is in operation, landfill gas is drawn to these directly connected wells and it is expected that they would contain methane. The valves connecting gas monitoring wells GM-17, GM-18, GM-19, and GM-20 to the lower leg of the gas collection system were closed by September 2014 and have since remained closed.

As discussed in earlier sections of this report, a soil gas evaluation was completed from June 25 – 28, 2018 to better understand the potential source of the elevated methane along the eastern property boundary. EPA is reviewing the findings submitted by the PMC on August 31, 2018 to determine whether additional information and/or a new gas extraction well will be needed.

OU1 and OU2 Long-Term Wetlands Monitoring

The goal of the wetland and stream restoration was to replicate the wetalnds present prior to remediation. Pre-remediation habitats within Middle Marsh consisted primarily of a mature forested wetland dominated by red maple (*Acer rubrum*) and characterized by a distinctive hummock and hollow topography. After remediation was complete, the topography was restored to approximate the existing hummock and hollow characteristics to the extent feasible, and the area was planted with native wetland trees and shrubs. The unnamed stream that flows under Hathaway Road and through the center of Middle Marsh also had a forested canopy and was restored to replicate this habitat. The unnamed stream discharged to two ponds present just downstream of the forested portion of Middle Marsh. These ponds included aquatic bed habitat and emergent wetland vegetation along the banks, which was re-created. Monitoring post-remediation has included assessment of biological and physical attributes of the restored areas to evaluate whether Middle Marsh, the unnamed stream, and the ponds are progressing on a trajectory to achieve wetland habitat characteristics that existed prior to remediation efforts. The biological and physical goals for wetland restoration in OU1 areas were modified to align with the goals established for the OU2 area. Therefore, monitoring for OU1 and OU2 areas was combined and the data has been presented in single reports. During this five-year review period, monitoring was conducted in the summer and fall of 2017 by the City of New Bedford (CONB, 2018b).

Monitoring data were collected and compared to the various biological and physical indicators that were established prior to remediation to monitor the progress towards reaching the goal of wetland restoration. The biological wetland attributes assessed during the monitoring are summarized in the Table below and include: plant survival and growth rates, plant community diversity and percent cover, and presence of the state-listed Mystic Valley Amphipod. Physical attributes assessed are also provided in the table below, and included evaluation of presence of hummocks, hydric soil features, and wetland hydrology. The first two columns of the following table identify the goals that were established and described in the O&M Plan for OU2 (Dames & Moore, 1999) and subsequently adopted by OU1.

Wetland Attributes	Goals	Comments
Biological Indicators		
Survival Rates of Planted Trees and Shrubs	At least 80% of the original number of plantings of each species should be viable five years after planting. The 80% may be comprised of both plantings and volunteers of the species.	In the majority of the site, there is a well established tree canopy and shrub layer, which suggests that survival of planted species combined with colonization by volunteer species has resulted in the survival of a sufficient number of individuals to approximate 80% of the original planting design. In addition, the CONB data document that in 2018 there were more saplings and trees than were present in 2011. There are three isolated areas of concern where invasive species represent the dominant species present rather than the planted species. These areas are the OU1 Mitigation Area West and the OU2 Middle Marsh northwestern and southeastern corners. In these areas, prevalence of extended surface saturation and/or abundant phragmites has likely decreased survival of planted woody species and favored herbaceous species. An additional area of concern is the OU1 diversion swale, where abundant multiflora rose may have diminished survival of planted species. However, overall the majority of the site includes a sufficient number of desired plantings.
Tree Growth	Mean tree height and diameter (dbh) for planted trees should increase at least 20% from the original planting height and dbh every 5-year interval.	The height and dbh of all planted tree species was not well documented at the time of planting. However, the 2011 data do document this data and provide a basis of comparison with the 2017 data.. The data from the 2018 CONB report show that dbh and height of planted species have overall increased since 2011.
Vegetative Diversity	Demonstrate an ever-increasing trend up from the 15 woody and 10 herbaceous planted species, by providing at least one additional woody and one additional herbaceous non-invasive wetland species every 5 years.	The Middle Marsh area is functioning as a forested wetland community as expected, with a high diversity of vegetation present. Therefore, the intent of this goal has been achieved. Addition of new plant species has slowed over the last ten years. This is expected as the plant community reaches maturity. The 2018 Wetland Monitoring Report (CONB, 2018b) does not comprehensively survey species present throughout the OU1 and OU2 areas, so it is not possible to determine if one additional woody species and one additional non-invasive herbaceous wetland species have been introduced since 2011; however, addition of new species in perpetuity is not realistic, and it is possible that the wetland system has reached a plateau in terms of vegetative diversity, which is acceptable.

Wetland Attributes	Goals	Comments
Plant Community	(a) Herbaceous, shrub, and woody relative cover at the end of the second growing season must achieve an overall 75% areal coverage of wetland plant species. (Also, a Performance Standard) (b) To ensure the area continues to meet the federal wetland definition, greater than 50% of the dominant plants, exclusive of invasive species, should be wetland species.	The 2018 CONB report indicates that wetland species cover at least 75% of the restored wetland areas. The plot data indicate that all sampling plots met the criteria of greater than 50% dominance by non-invasive wetland plants. Although still present at the site, invasive species are becoming less prevalent. In 2005, 10 plots included greater than 50% dominance by invasive wetland species, compared to 6 plots in 2011 and no plots in 2017, which demonstrates a trend toward reduction in dominance by invasive species. As indicated below in the site inspection results, there are a few areas where invasive species are abundant, and the CONB is in the process of addressing invasives at these locations.
Mystic Valley Amphipod	The Mystic Valley Amphipod (MVA) must occur within areas of the Second Operable Unit by the end of the third year after wetland construction. (Also, a Performance Standard)	The MVA was observed in the OU2 MM in 2003. Since 2003, no confirmation sampling has been performed to indicate the maintenance of this species in the wetlands; however, site conditions have remained stable over the 10-year period since the initial sampling and therefore the conditions to support the species remain.
Physical Indicators		
Hummocks	Maintain greater than 25% mean areal coverage of hummocks in the sampling plots.	The 2018 CONB plot data indicate that on average the Middle Marsh area does include greater than 25% coverage when viewed as a whole. No significant erosion has been noted over the 5-year period. In four of the six plots monitored, the percent of hummocks was established at greater than 25%. Two of the plots had only 20% hummock coverage. One of these, OU2-MM2, is in an area documented as very wet prior to remediation, and most likely always had a low percent cover of hummocks. Although additional fill could be imported to create additional hummocks in this area, the benefit is not believed to outweigh the impact to adjacent well-established areas with high cover of canopy woody vegetation.

Wetland Attributes	Goals	Comments
Hydrology	Groundwater and/or saturated soils should be within 12 inches of the wetland surface for two weeks in each piezometer in the restored wetlands at least three of every five years.	This attribute is intended to document that hydrology in the restored wetlands is sufficient to support wetland plants. Given the high percentage of wetland plants growing throughout the restored areas, sufficient hydrology has been qualitatively confirmed. However, two rounds of data have not been collected within a two-week period since the project's inception and it can't be confirmed that water levels have been within 12 inches of the wetland surface for two weeks. One round of groundwater data elevation was collected in Fall 2017. Observations in Fall 2017 indicate that groundwater was within 12 inches of the ground surface for three locations at the ponds and adjacent mitigation areas, as well as an area south of Middle Marsh. The OU1 Middle Marsh plots did not indicate that groundwater was present within 12 inches of the surface. However, in areas where the monitoring well data did not indicate presence of groundwater within 12 inches of the surface on the one date sampled, other indications of a high groundwater table were present, such as presence of redoximorphic features and drainage patterns.
Soil Development	Soils from all ten borings should show a trend to meet the definition of hydric within 10 years.	Soil data indicates that hydric characteristics are present throughout the site, indicating a trajectory towards meeting the definition for a hydric soil in the future.

Overall, data collected by CONB in 2017 show that the restored wetland areas meet the intent of the wetland restoration goals. Comments regarding the trajectory towards meeting these goals are provided in the third column of the preceding table. The CONB collected vegetation and soil data in 19 sampling plots. In addition, percentage of hummocks present was assessed in the subset of 6 plots where hummocks had been planned. The CONB collected groundwater elevation data on one date in July 2017. Refer to Figure 4 in Appendix B for the locations of the OU1 and OU2 wetland and stream restoration areas. Data collection sheets and a figure showing the OU1 and OU2 wetland plot locations, as provided in the City's 2017 Wetlands Report (CONB, 2018b), is included as Appendix G of this report.

The CONB data show that the vegetation in the data plots illustrate that all plots had greater than 75% cover by non-invasive wetland plant species, all plots exhibited greater than 50% dominance by non-invasive wetland plants and that dBH of shrubs/saplings/trees, as well as total numbers of woody individuals, have increased since 2011. The forested canopy is well established in the majority of the site, which suggests that at a substantial portion of originally planted individuals have survived. In addition, the CONB report notes that a number of volunteer woody species have become established, such as Bebb willow. In regard to vegetative diversity, a variety of species are present similar to a natural wetland system. Hummock and soil data presented illustrate that these physical parameter goals are being met.

In regard to wetland hydrology, the CONB did not collect data at the frequency or time of year necessary to quantitatively demonstrate that the hydrology goal has been met; however, the plant species present and qualitative observations recorded by the CONB support the conclusion that wetland hydrology is present throughout the site. It is recommended that the CONB increase the frequency of well monitoring such that a

minimum of two groundwater elevation readings are recorded during a 14-day period in either mid-April to mid-June or September. The OU1 Middle Marsh diversion swale is an area of particular note that exhibited low groundwater levels, but these data were collected in July, which is typically a period of low groundwater levels.

As noted by the CONB's report and discussed during the May 2018 site inspection, there are a few sub-areas of the overall site in which invasive species are noted to be an issue. These areas include the northwest corner of Middle Marsh near MM OU2 monitoring plot 2, the southeast corner of Middle Marsh near MM OU2 plot 3, and the OU1 Mitigation Area west. These areas include an abundance of phragmites, which should be addressed, and are discussed below in more detail in the Site Inspection section of this report. In addition, the MM OU1 Diversion Swale had been invaded by the invasive species multiflora rose. The CONB is currently addressing the presence of multiflora rose, as discussed below in more detail in the Site Inspection section of this report.

OU2 Long-Term Sediment and Soil Monitoring

Since the previous five-year review, sediment/wetland soil sampling was performed in September 2017 by the City of New Bedford in order to meet the long-term monitoring requirements for OU2 (CONB, 2018a). Table F-6 in Appendix F provides a summary of the sediment and wetland soil results relative to the cleanup levels.

Sediment samples were collected from areas of OU2 impacted by the remedial action construction, including three locations within the unnamed stream and a fourth location further downstream along the edge of Pond A. At each unnamed stream/pond location, four individual samples were collected and analyzed for TOC and then the sample with the TOC concentration closest to the mean TOC was analyzed for PCBs. Normalized total PCB concentrations ranged from 3.56 to 45.40 ug PCBs/g carbon. Results for two out of three sediment samples from the Unnamed Stream exceed the sediment target level of 20 ug PCBs/g carbon, with PCB concentrations of 45.40 ug PCBs/g carbon (240.6 ug/kg PCBs at 0.53% TOC) at location SDPC2 and 28.6 ug PCBs/g carbon (57.1 ug/kg PCBs at 0.20% TOC) at location SDPC3.

Compared to the previous monitoring round in 2013, both the total PCB and normalized PCB concentrations at SDPC2 have decreased from 530 ug/kg PCBs and 64 ug PCB/g carbon (at 0.82% TOC). The 2013 results for SDPC2 also represented a decrease in the total (unadjusted) PCB concentration from the previous sampling event in 2006 as reported in the previous five-year review.

Compared to the previous monitoring round in 2013, the total (unadjusted) PCB concentration at SDPC3 has decreased from 120 ug/kg PCB and the normalized PCB concentration at SDPC3 has increased from 14 ug PCBs/g carbon (at 0.89% TOC).

Although the total (unadjusted) PCB concentrations at SDPC2 and SDPC3 have actually decreased from the previous monitoring event, the normalized PCB concentrations exceed the cleanup level and continued monitoring of sediments in the unnamed stream should be conducted to continue to evaluate the protectiveness of the remedy.

Wetland soil samples were collected from four locations within non-aquatic plot areas in the Middle Marsh and two locations within the adjacent wetlands and analyzed for PCBs. PCBs were detected in wetland soil samples from the adjacent wetlands at a maximum concentration of 18.4 ug/kg and PCBs were detected in the Middle Marsh at a maximum concentration of 219 ug/kg. All detected PCB concentrations were well below the 15 mg/kg total PCBs cleanup level for non-aquatic soil/sediment.

OU2 Long-Term Surface Water Monitoring

Since the previous five-year review, surface water sampling was performed in September 2017 by the City of New Bedford in order to meet the long-term monitoring requirements for OU2 (CONB, 2018a). Surface water samples were collected from four locations within the unnamed stream and Pond A and analyzed for PCBs and

pH. PCBs were not detected above the detection limits, which ranged from 0.100 to 0.112 ug/L, in any of the samples collected.

Site Inspection

The inspection of the Site was conducted on 5/3/2018. In attendance were Kimberly White of the US EPA and Cindy Castleberry and Jennifer Doyle-Breen (part time) of AECOM. Also present was Richard Sugatt of the US EPA, Dorothy Allen of the MassDEP, and Steve Wood of the Sullivan's Ledge Site Group (the "Group") Project Management Committee (PMC) (representing the OU1 Settling Defendants). Several representatives of the City of New Bedford (responsible for O&M of the Site) were present for inspection of the groundwater treatment plant, disposal area cap, and other site features on the south side of Hathaway Road, including Jamie Ponte, James Ricci, Jim Costa, and Laura Thomas. Two additional representatives of the City of New Bedford were present for inspection of the OU1 and OU2 wetland restoration areas and Unnamed Stream and ponds on the north side of Hathaway Road, including Michele Paul and Sarah Porter. The purpose of the inspection was to assess the protectiveness of the remedy. The site inspection checklist and photos are included in Appendix H.

OU1 Groundwater Extraction and Treatment System, Landfill Gas Extraction System, and other Site Features (South of Hathaway Road)

The groundwater extraction and treatment system was operational at the time of the inspection; however, one of the bedrock extraction wells (well BEI-1) was not operational and City staff indicated that they are planning to replace the pump due to declining performance. City staff also reported that one of the multi-media feed pumps was not working and a new pump was on order; however, this did not impact treatment plant operations because the 2nd multi-media feed pump was operational. It was discussed that the City has been experiencing sporadic violations of the pre-treatment discharge limit for PCBs in the effluent that is discharged to the POTW. The most recent exceedances in March were attributed to the polymer system having stopped dispensing into the clarifier. The polymer system was cleaned and certain parts were replaced and the subsequent effluent samples in March were compliant with pre-treatment discharge limits. Also, a bag filter was installed at the end of the treatment process in December 2017 to provide additional solids removal, since it is presumed that elevated PCBs in the effluent are associated with solids not removed earlier in the treatment process. The City staff indicated that the bag filter is being changed out much less frequently than when it was first installed.

It was discussed with City staff during the inspection that the Groundwater Treatment Plant O&M Manual (OBG, 2000b), which had been revised in draft form in 2014 and 2015, will be undergoing updates to reflect various changes, including those associated with the recent replacement of the SCADA system, and also in anticipation of possible groundwater treatment plant shutdown. The City stated that the updated O&M Manual would likely not be completed for several months (December 2018 or later).

A number of the groundwater monitoring wells on both the south and north sides of Hathaway Road were observed. A handful of wells were not locked, although the locks were present either on the well cap or on the concrete pad near the ground. With one exception (well ECJ-4), these wells were located within the fenced and gated portion of the Site. Personnel conducting quarterly water level measurements and semi-annual groundwater sampling should ensure that the wells are left secure.

The landfill gas extraction/blower system was operational during the site inspection. A number of the gas vents were inspected and a couple of issues were noted that require maintenance. The pipe coupling for GV-3, which connects the gas vent directly to the gas extraction system piping, was cracked and was resulting in an audible leak of ambient air into the system. Also, the pipe coupling connecting GV-11 to its vent cap had shifted and may be impacting the seal. Additionally, some of the vent caps were missing the plugs that are temporarily removed to allow for monitoring. The plugs should be replaced so that the caps are sealed and personnel conducting landfill gas monitoring should ensure the plugs are replaced following future landfill gas monitoring events.

Overall, the grass cover across the impermeable cap cover was in good condition and drainage swales were free of significant vegetation. Minor areas of rutting along the edges of cap access road, small animal holes in one area, and a small area of low vegetation/minor erosion are anticipated to be addressed by the City as part of routine O&M activities. The access road, run-on/run-off controls, site security features (fencing, gates, signage) all appeared in good condition.

Per the Site Operations and Maintenance Plan (OBG, 2002a), the culverted portion of the Unnamed Stream is to be inspected once every five years to ensure its integrity. It was discussed with the City and PMC representative that the interior of the concrete pipe has not been inspected since its completion. The City indicated that the inspection has been completed, however additional information on when and how is forthcoming.

Unnamed Stream and OU1 Wetland Areas

Invasive Species. Purple loosestrife plants appear to have decreased significantly since the 2013 inspection. Very few purple loosestrife plants were observed. In 2013, sporadic plants were observed, which was noted to be substantially less as compared to 2005. It appears that the Galerucella sp. beetles released in 2007 and 2008 have been successful in controlling purple loosestrife at the site. Invasive species in general are very low in cover, or absent, in most wetland and stream locations on the site. Common reed (*Phragmites australis*) remains present at a high percent cover in the northeastern and southwestern portions of Middle Marsh, which was also noted in the CONB 2017 monitoring. As discussed further below, it is recommended that phragmites in the mitigation area be controlled and further monitored.

In 2013, multiflora rose (*Rosa multiflora*) was observed to have increased in abundance along the area of the former OU1 diversion swale as well as along the margins of the OU2 Middle Marsh. The City of New Bedford recently undertook an effort to engage a contractor to cut and herbicide multiflora rose along the margins of the OU2 middle marsh and the OU1 diversion swale, as noted in the 2018 CONB report and discussed with CONB on the day of the site visit. On the day of the site visit, extensive areas of cut multiflora rose were observed in the OU1 diversion swale. It was suggested that the multiflora rose debris either be removed completely, or at a minimum be consolidated into a few piles at either end of the diversion swale so that there is a greater amount of exposed soil where new, desirable species can germinate and flourish. The City of New Bedford Conservation Agent, Sarah Porter, indicated that areas where multiflora rose had been removed will be replanted this spring with approximately 80 shrub species, including maple (*Acer sp.*) and blueberry (*Vaccinium corymbosum*).

OU1 Unnamed Stream. Sediment has accumulated in the Unnamed Stream just upstream of the double box culvert. The CONB Conservation Agent, Sarah Porter, indicated that the City Department of Public Works (DPW) has not recently cleaned out the catch basins on Hathaway Road. Subsequent communications in September 2018 from the City indicate that the catch basins were cleaned. It is believed that these catch basins are the primary source of sediment entering the Unnamed Stream. It is suggested that, when the DPW's schedule permits, the accumulated sediment in the stream be removed by hand so as not to disturb the vegetation present, and that the catch basins be cleaned on a regular basis once sediment has accumulated in approximately half of the available depth of the catch basin. The stream banks both upstream and downstream of the double box culverts contain significant shade trees due to the presence of alder (Alnus incana), green ash (Fraxinus pennsylvanica), and willow (Salix spp.). Overall, the banks of the Unnamed Stream are very well vegetated with desirable species, and the areas appear no different than a natural stream channel and banks. These observations are consistent with the results reported by CONB in their 2018 report.

Some multiflora rose was observed along the northern upland border of the Unnamed Stream, just beyond where the stream turns sharply to the west before entering the OU2 Middle Marsh area, near Plot OU1STRM 4. It is recommended that this area of multiflora rose be cut, treated with herbicide, and removed, similar to the above discussion regarding multiflora rose present along the OU1 diversion swale.

The rope fence protecting the restored wetlands appeared intact and in well-maintained condition (see site inspection photo in Appendix H).

OU1 Middle Marsh (i.e. Diversion Swale). Wetland species were observed at the OU1 MM area, including speckled alder (*Alnus sp.*), red osier dogwood (*Cornus stolonifera*), red maple (*Acer rubrum*), and jewelweed (*Impatiens capensis*). The canopy cover in this area was lower than the OU2 MM area. Purple loosestrife was not observed nor was live multiflora rose. However, indicated above, an abundance of multiflora rose debris was observed at the eastern and western ends of the OU1 MM area due to removal efforts which occurred after the CONB 2017 monitoring data were collected. The extensive areas of multiflora rose debris are currently covering soil that might otherwise be colonized by desirable wetland species. It is suggested that the multiflora rose debris either be removed completely, or at a minimum be consolidated into a few piles at either end of the diversion swale so that there is a greater amount of exposed soil where new, desirable species can germinate and flourish. An alternative approach discussed during the site visit was that the multiflora rose stems could be chipped in place, and the debris again consolidated into one or two stockpiles. The City of New Bedford indicated that replanting of desirable wetland woody species would occur in the OU1 MM areas in which multiflora rose was removed.

OU1 Ponds. Desirable wetland herbaceous plants and woody seedlings are present along the banks of the ponds, including arrow-wood, speckled alder, willow, red-osier dogwood, blue flag iris, spike rush, and tussock sedge. Most of the rope fencing is in place, with a few areas of fencing that have fallen and should be reestablished. However, it appears that mowing has successfully been excluded along the pond shore. A turtle was observed basking in the sun on a rock in the center of the pond, and a blue heron was observed in the vicinity. Overall, the pond shores appear well vegetated with desirable wetland species. These observations are consistent with the 2017 monitoring data reported by CONB.

OU1 Mitigation Area East. The area contains a variety of herbaceous wetland species, with silky dogwood, speckled alder, and sweet pepperbush being the predominant shrubs present. Overall, the area appeared to be functioning well as a wetland habitat. The rope fence adjacent to the Mitigation Area was present. These observations are consistent with the 2017 monitoring data reported by CONB.

OU1 Mitigation Area West. The area was observed to be dominated by phragmites, with few shrubs visible through the dense phragmites. The spring 2018 CONB report noted the presence of phragmites, but also reported a number of woody individuals present and stated that this area is on a trajectory to a forested wetland. According to the CONB, the phragmites in this area had been treated with herbicide. However, AECOM observations indicated that a substantial stand of phragmites remained in place. In addition, multiflora rose was observed on the edge of the wetland. It is recommended that the phragmites that was treated with herbicide be cut and removed in order to provide open ground area and light to facilitate growth of other species that may be present in amongst the phragmites. In addition, it is recommended that additional wetland seed mix be sown in this area after removal of the phragmites stems, to assist with quick establishment of a desirable wetland plant community in the herbaceous layer. Woody vegetative progress in this area should be observed after removal of the phragmites stems. If desirable wetland vegetation does not extend its coverage in the mitigation area after removal of the phragmites stems, then it is recommended that additional shrubs be planted. It is also recommended that multiflora rose be controlled/removed on the wetland edge.

OU2 Wetland Areas

Observations regarding invasive species in both OU1 and OU2 are discussed above. Additional observations regarding the OU2 wetlands areas are provided below.

OU2 Middle Marsh. Overall, the woody canopy of the OU2 Middle Marsh is well established and most of the area appears similar to an undisturbed forested wetland with a dense canopy layer and some herbaceous species present in the understory. The vegetation in many areas is very dense, making it difficult to walk into some areas. Hydrology appears well established, with saturated soils obvious and some surface water inundation evident. The woody coverage has increased and is adequate within the majority of the OU2 Middle Marsh area; a woody canopy layer is well-established. Willow is abundant throughout the area, and red maple is also present in the

canopy. These observations are consistent with the findings of CONB as reported in their spring 2018 monitoring report. Common reed (*Phragmites australis*) remains in the northeastern and southwestern corners of the Middle Marsh, and the CONB indicated that these areas would be treated this spring. It was recommended, similar to the above recommendations, that treated stems be removed or at least concentrated in a few piles so that most of the forest floor can be available for growth of desirable species. The survivability of woody tree species should continue to be monitored in accordance with the O&M plan wetland attributes to assess the long-term trajectory of the restoration project.

OU2 Adjacent Wetland. This area has developed a substantial amount of woody vegetation since the last five-year report. A diverse emergent plant population also exists between the primary woody species (alder). Dominant species observed include red maple, willow, speckled alder, cottonwood, and red osier dogwood.

V. TECHNICAL ASSESSMENT

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

Question A Summary:

Operable Unit 1

Yes, a review of documents, ARARs, risk assumptions and site inspection results indicates that the remedy has been constructed as intended by the ROD, as modified by the ESDs.

Institutional controls have been implemented in the form of a Grant of Environmental Restrictions and Easement (GERE) and no violations have been reported.

The excavation of sediments and soils has been performed to comply with soil and sediment cleanup standards set in the ROD and the ESD, thus removing the source of contamination to sediment and surface water and reducing risk to human health and aquatic organisms. However, there continue to be periodic exceedances of sediment clean-up criteria for a limited number of sampling points during some bi-annual sampling events, including the most recent Fall 2017 event, performed in OU1. Therefore, continued sediment sampling is necessary to monitor the effectiveness of the remedy.

Operation and maintenance of the cap, GWTP, and extraction system has been effective. When there have been operating issues in the groundwater treatment plant such as equipment failures or malfunctions, they have been addressed by the Settling Parties and the City of New Bedford.

Remedial actions of the Unnamed Stream, its banks, and the other OU1 wetland restoration areas were completed in accordance with the ROD and ESDs. Continued monitoring, maintenance, and replantings are necessary to check that the wetlands restoration effort satisfies the requirements of the site Wetlands Operation and Maintenance Plan. OU1 O&M activities have emphasized and should continue to emphasize the control of invasive species to facilitate the survival of wetlands plantings. In addition, accumulated sediment in the Unnamed Stream at Hathaway Road should be removed and potential future build-up should be monitored to maintain the design elevation of the streambed and should include continued attention to maintenance of the roadway and drainage system. Accumulated sediment could have the effect of altering flow patterns, increasing water temperature, and altering dissolved oxygen levels. The OU1 Mitigation Area West has become dominated by common reed (phragmites), which has likely decreased survival of planted woody species and favored herbaceous species. Another invasive species, multiflora rose, was observed during the site inspection on the edge of the wetland. It is recommended that additional measures be implemented for the Mitigation Area West to improve the functions of the wetland habitat.

The migration of landfill gas in soil is being addressed. The OU1 Settling Parties installed and are operating a long-term active landfill gas collection system to prevent migration of landfill gas to off-site receptors. The landfill gas extraction system has generally been effective in reducing landfill gas levels along the perimeter of the cap; however, one or more landfill gas monitoring wells generally exhibit methane levels above 25% LEL, primarily along the eastern boundary of the cap. EPA's Optimization Review Report recommended a bar hole study to better understand the source of the methane along the eastern site boundary and the PMC has prepared a plan to conduct a study (see Table 3 for additional details). Depending on the outcome of the study, it is possible that the landfill gas extraction system may need to be enhanced. Continued operation of the landfill gas extraction system and monitoring of perimeter gas monitoring wells and nearby structures is necessary as a human health protectiveness measure.

Operable Unit 2

Yes, a review of documents, ARARs, risk assumptions, and site inspection results indicates that the remedy is functioning as intended by the ROD. Sediment excavation and treatment has been performed to meet the site performance standards, thereby minimizing the risk to aquatic organisms. However, exceedances of sediment clean-up criteria have been noted for some monitoring points in the Unnamed Stream during the most recent monitoring event performed for OU2. Therefore, continued sediment sampling is necessary to monitor the effectiveness of the remedy.

Institutional controls have been implemented in the form of a Grant of Environmental Restrictions and Easement (GERE) and no violations have been reported.

The OU2 wetland restoration areas have continued to develop over the past five years and overall are functioning well with woody canopy layers established in most areas, as well as a diverse herbaceous community of non-invasive wetland species. The OU2 Middle Marsh northwestern and southeastern corners remain lower in elevation, wetter, and with less microtopography diversity than the rest of Middle Marsh. In these areas, prevalence of extended surface saturation has likely decreased survival of planted woody species and favored herbaceous species. These observations are similar to those documented by the previous five-year report. Common reed (phragmites) remains present at a high percent cover in the northeastern and southwestern portions of the Middle Marsh and should be treated. The survivability of woody tree species should continue to be monitored in accordance with the O&M plan wetland attributes to assess the long-term trajectory of the restoration project.

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

No. There have been some changes in exposure assumptions, toxicity factors, regulatory limits, and risk assessment methodology. However, these changes do not have any significant impact on the protectiveness of the remedy as discussed below.

Question B Summary:

In order to answer Question B in EPA's Comprehensive Five-Year Review Guidance (June 2001), the OU1 and OU2 RODs Applicable or Relevant and Appropriate Requirements (ARARs) and subsequent ESDs were reviewed and the site-specific risk assessments were revisited to evaluate the impact of any changes in standards, toxicity factors, exposure assumptions, or site conditions on remedy protectiveness.

Review of OU1/OU2 Risk Assessments and Toxicity Factors Serving as the Basis for the Remedies

An evaluation of changes in toxicity values and other contaminant characteristics, changes to the risk assessment methodology, and changes to exposure assumptions used in the human health and ecological risk assessments for the site was performed. The overall conclusion of this evaluation was that the OU1/OU2 remedies, as implemented, are protective of human health and the environment. A discussion of the results and conclusions of the evaluation are provided below.

Review of Human Health Risk Assessments. As discussed during the first, second, and third five-year reviews (September 2003, 2008, and 2013, respectively), the Phase I and Phase II human health risk assessments (OU1; Ebasco 1987; 1989) and the human health risk assessment for Middle Marsh (OU2; M&E, 1991) were conducted using methodology which would partially comply with current EPA risk assessment guidance. The primary discrepancies between current guidance and previous guidance, as noted in the first, second, and third five-year reviews and requiring re-evaluation during this five-year review, exist in the areas of toxicity values and exposure pathways. The following provides an evaluation of these discrepancies, based on changes that have occurred since 2013 (the date of the last five-year review), and their impact on the protectiveness of the remedy.

Changes in Exposure Pathways/Assumptions

OU1

The Phase I and Phase II human health risk assessments (Ebasco, 1987; 1989) evaluated an older child exposure scenario for the area south of Hathaway Road and the Unnamed Stream extending north of Hathaway Road (OU1). This scenario assumes that the site will be used, to some degree, for recreational purposes. No changes in land use have occurred on or near the site (beyond installation of a solar array on the landfill cap), and no changes are anticipated in the near future. Therefore, the land use assumptions used in the risk assessments continue to be valid for OU1. Institutional controls regulating land use are in place and are necessary to assure that land use changes resulting in more intense human exposures than under current conditions do not occur in the future.

The landfill cap and perimeter fencing remain intact, based on recent inspections. Because contamination is present beneath the cap, prevention of a complete exposure pathway between human receptors (e.g., trespassers) and subsurface contamination is necessary. Continued maintenance of the landfill cap and perimeter fencing is required to assure that human exposure to the capped material does not occur.

The risk assessment also evaluated future residential groundwater use. The risk assessment assumed that groundwater was not currently used as a source of potable water, but may be used as a future resource. Unacceptable risk was estimated for this future exposure scenario using methods and exposure assumptions

largely consistent with current guidance. Future use was the primary basis for the groundwater containment and institutional control components of the remedy. The groundwater collection and treatment system and the slurry wall are in place. Contaminant concentrations continue to be present in groundwater at levels that would be associated with unacceptable risk, should groundwater be used as a source of drinking water in the future. However, institutional controls are in place and prevent the completion of an exposure pathway between future human receptors and groundwater contaminants. Also, MassDEP issued a Groundwater Use and Value Determination for the Site in March 2016, which identified groundwater beneath and in close proximity to the site as not being a current or potential drinking water source area (MassDEP, 2016). MassDEP designated the aquifer to meet criteria for protection from migration of vapors from groundwater to above ground structures and for protection against migration and eventual discharge of groundwater to surface water at concentrations that could pose a risk of harm to aquatic organisms.

In the risk assessment, the older child receptor was evaluated for exposures in a manner consistent with current EPA guidance. The exposure pathways evaluated include ingestion and dermal contact with soil and sediment, dermal contact with surface water while wading, and inhalation of volatile compounds and particulates. The method used to estimate dermal doses differs from the current method, but, overall, resulted in an overestimate of dermal risk. However, the exposure assumptions selected were, in general, lower than current recommended values resulting in an underestimate of risk.

In 2014, EPA finalized a Directive to update standard default exposure factors and frequently asked questions associated with these updates (USEPA, 2014; https://www.epa.gov/risk/superfund-risk-assessment-human-health-topics [items # 22 and #23 of this web link]). Many of these exposure factors differ from those used in the risk assessment(s) supporting the ROD(s). These changes in general would result in a slight decrease of the risk estimates for most chemicals.

Because the remedy required the excavation of contaminated sediment and bi-annual monitoring of surface water and sediment for polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and metals, along with volatile organic compounds (VOCs) in surface water, post-remediation levels of contaminants in sediment and surface water are available and most appropriate to consider when evaluating remedy protectiveness. Therefore, to determine the risk and hazard associated with current recreational exposures, should they be occurring, an assessment of contaminant concentrations in surface water and sediment within OU1 using samples collected between 2013 and 2017 has been performed as documented in the following paragraphs. OU1 sediment and surface water were obtained from three monitoring reports prepared by O'Brien & Gere (OBG, 2014; OBG, 2016a; and OBG, 2018a). Additionally, laboratory reports for the Fall 2017 sediment and surface water data were provided separately to EPA via email and were used to verify certain data reported in the Fall/Winter 2017 Monitoring Report (OBG, 2018a).

Current contaminant levels in OU1 surface water (see Table F-5 in Appendix F) would not be associated with an elevated risk or hazard to humans because: (1) PCBs have not been detected; (2) detected VOCs (acetone, benzene, chlorobenzene, cis-1,2-dichloroethene, toluene, and vinyl chloride) are present only at trace levels (0.11 to 6.83 ug/L) and would volatilize quickly from the skin, limiting dermal exposure; (3) total metals, though elevated in concentration up to 10-fold above upstream background levels (last collected in October 2011 and presented in Table F-5 in Appendix F), are poorly absorbed through the skin, again limiting dermal exposure; and (4) four PAHs (benzo(b)fluoranthene [0.181 ug/L], fluoranthene [0.221 ug/L], phenanthrene [0.103 ug/L], and pyrene [0.16 ug/L]) were detected at a downstream location (SW-3) in 2017 at concentrations that would not be associated with a level of concern for the dermal exposure pathway.

For OU1 sediment (see Table F-4 in Appendix F), concentrations of noncarcinogenic PAHs range from 0.004 mg/kg to 4.5 mg/kg and levels of carcinogenic PAHs range from 0.008 mg/kg to 3 mg/kg. These PAH concentrations would be associated with a cancer risk of approximately 7E-07 and a hazard index of less than 0.01, based on a recreational exposure scenario using maximum detected concentrations, current toxicity values, and current default exposure assumptions (see Appendix I). While the original risk assessment evaluated exposure to an older child recreator, to be conservative, the current calculations were performed

assuming a lifetime exposure (young child and adult). However, the exposure frequency was maintained at the original assumption of 12 exposures per year. Sediment metal concentrations within OU1 generally exceed upstream concentrations (more often in 2015 than 2017), but also generally fall within the range of levels typically seen in background sediments. Two metals of concern for human exposures are arsenic and lead which were detected at maximum sediment concentrations of 7.6 mg/kg and 136 mg/kg, respectively. The maximum detected arsenic concentration would be associated with a cancer risk of 4E-07 and a noncarcinogenic hazard of less than 0.01 (see Appendix I), and the lead level is significantly less than that considered currently acceptable for a residential setting (200 mg/kg). See below for further discussion of lead exposures. Total PCBs were detected in on-site sediments at a maximum concentration of approximately 2.4 mg/kg (SD-3 in 2013), which would be associated with a cancer risk of 4E-07 and a noncarcinogenic hazard of less than 0.1 based on a recreational scenario. Therefore, implementation of the remedy for OU1 has resulted in surface water and sediment contaminant levels that are not of concern for human exposures, considering current land use.

OU2

As discussed in the first, second, and third five-year reviews, the Phase I and Phase II human health risk assessments completed in 1987 and 1989, respectively, which evaluated portions of Middle Marsh, and the OU2 human health risk assessment (completed in 1991) evaluated older child trespasser and adult golfer scenarios for the area north of Hathaway Road. This area is currently part of or adjacent to the Whaling City Golf Course. This portion of the site will continue to be used as a golf course or for other recreational purposes in the foreseeable future. Therefore, the land use assumptions used in the risk assessments continue to be valid for OU2. Additionally, institutional controls have been implemented and will assure that land use changes resulting in more intense human exposures than under current conditions do not occur in the future.

The older child exposure pathways evaluated included ingestion and dermal contact with soil and sediment, dermal contact with surface water while wading, and inhalation of volatile compounds and particulates. The same exposure assumptions used for the older child receptors at OU1 were applied to OU2. The adult receptor was evaluated for dermal contact with soil, sediment and surface water along with inhalation of volatile compounds and particulates. Contrary to current guidance, incidental ingestion of soil and sediment was not evaluated, resulting in an underestimate of risk. Consistent with OU1, the method used to estimate dermal doses differs from the current method, but overall, resulted in an overestimate of dermal risk. However, the exposure assumptions selected were, in general, lower than current recommended values resulting in an underestimate of risk. As discussed for OU1, current levels of contaminants in sediment and surface water are available and most appropriate to consider when evaluating remedy protectiveness. Therefore, to determine the risk and hazard associated with current recreational exposures, should they be occurring, an assessment of PCB concentrations in surface water and sediment within OU2 using samples collected in 2017 and reported by the City of New Bedford (CONB, 2018a) has been performed as documented in the following paragraph.

Surface water exposure pathways would not be associated with an elevated risk or hazard to humans because PCBs have not been detected. For sediment (see Table F-6 in Appendix F), total PCBs were detected in sediment at a maximum concentration of approximately 0.24 mg/kg, which would be associated with a cancer risk of 4E-08 and a noncarcinogenic hazard of less than 0.01 (both results a factor of 10 below the OU1 results) based on a recreational scenario described for OU1 exposures above. There were also wetland soil samples collected and analyzed for PCBs in 2017 (see Table F-6 in Appendix F). As the maximum detected concentration (approximately 0.22 mg/kg) is below that of sediment and exposures would be similar, risks/hazards would be below those presented for sediment. Therefore, implementation of the remedy for OU2 has resulted in surface water, sediment, and soil contaminant levels that are not of concern for human exposures, considering current land use.

Changes in Toxicity

Some toxicity values have changed since the human health risk assessments were prepared. Because a complete exposure pathway does not exist between site groundwater and human receptors for current site use, and the slurry wall, the groundwater collection system, and the institutional controls will prevent future exposure, changes in toxicity values of groundwater contaminants have not been evaluated for protectiveness.

Significant differences were noted in the cancer slope factors used in the human health risk assessments for PCBs, PAHs, and vinyl chloride during the first five-year review. In all cases, the toxicity values used in the OU1 and OU2 risk assessments were at least two-fold more conservative than the current values. As discussed in the second five-year review, a change that occurred since the first five-year review is the inclusion of an early-life cancer risk for compounds with a mutagenic mode of action, including PAHs and vinyl chloride. The early-life assessment can increase the cancer risk associated with exposure for older children by up to three-fold. However, this difference in toxicity does not affect remedy protectiveness since most of the affected areas have been capped, and current surface water and sediment sampling in areas where exposures could occur indicates acceptable concentrations (see above; note that current toxicity values were utilized in the Appendix I calculations).

- **2016 PFOA/PFOS** non-cancer toxicity values

In May 2016, EPA issued final lifetime drinking water health advisories for perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), which identified a chronic oral reference dose (RfD) of $2x10^{-5}$ mg/kg-day for PFOA and PFOS (USEPA, 2016a and USEPA, 2016b). These RfD values should be used when evaluating potential risks from ingestion of contaminated groundwater at Superfund sites where PFOA and PFOS might be present based on site history. Potential estimated health risks from PFOA and PFOS, if identified, would likely increase total site risks due to groundwater exposure, however there is no current exposure to site-impacted groundwater. Further evaluation of potential risks from exposure to PFOA and PFOS in other media at the Site might be needed based on site conditions and can also affect total site risks.

- **2014 PFBS** non-cancer toxicity value

Perfluorobutanesulfonic acid (PFBS) has a chronic oral RfD of 2E-02 mg/kg-day based on an EPA Provisional Peer Reviewed Toxicity Value (PPRTV) (USEPA, 2014a). This RfD value should be used when evaluating potential risks from ingestion of contaminated groundwater at Superfund sites where PFBS might be present based on site history. Potential estimated health risks from PFBS, if identified, would likely increase total site risks due to groundwater exposure, however there is no current exposure to site-impacted groundwater. Further evaluation of potential risks from exposure to PFBS in other media at the Site might be needed based on site conditions and can also affect total site risks.

PFOA, PFOS, and PFBS belong to a group of compounds known as PFAS, which are used in a variety of industrial applications. PFAS has not been included in any sampling at the Site. Given the nature of waste at landfills, PFAS should be considered in a future sampling round. Nearby residences are connected to a municipal water source, therefore there would not be any current exposure to PFAS contamination if identified. These new toxicity values do not affect the current protectiveness of the remedy.

2016 Lead in Soil Cleanups

EPA's 2016 OLEM memorandum "Updated Scientific Considerations for Lead in Soil Cleanups" (OLEM Directive 9200.2-167) indicates that there is sufficient evidence that adverse health effects are associated with blood lead levels (BLLs) at less than 10 µg/dL. The memo mentioned that several studies have observed "clear evidence of cognitive function decrements in young children with mean or group BLLs between 2 and

8 µg/dL." Any soil screening, action or cleanup level developed based on previous BLL of 10 µg/dL may not be protective.

EPA Region 1's approach to evaluate potential lead risks is 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 blood lead level (BLL). This is based on updated scientific information and agrees with the Lead Technical Review Workgroup's current support for using a BLL of 5 µg/dL as the level of concern in the Integrated Exposure Uptake Biokinetic Model (IEUBK) and Adult Lead Methodology (ALM). 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. These updates are based on the analysis of the NHANES 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 IEUBK and ALM parameters at a target BLL of 5 µg/dL, site-specific lead soil screening levels (SLs) of 200 mg/kg and 1,000 mg/kg are developed for residential and commercial/industrial exposures, respectively.

A review of historical soil and sediment samples collected during the RI 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. As noted earlier, the maximum detected lead concentration in OU1 sediment (sampled/analyzed between 2013 and 2017) is below 200 mg/kg. Therefore, no further assessment is necessary related to lead.

Potential for Vapor Intrusion

While there has been some historical evaluation of landfill gas migration to neighboring properties, vapor intrusion of volatiles from groundwater has not been evaluated previously. Buildings are located to the east of the landfill in an area where groundwater is approximately 15 feet below the ground surface. This section reviews recent groundwater sampling results for overburden wells in this area and performs comparisons to EPA Vapor Intrusion Screening Levels (VISLs). As the area is currently commercial, Commercial VISLs are utilized. If future residential development is planned, additional evaluation, including installation of additional wells and/or soil gas monitoring points, maybe warranted. It should also be noted that the areal coverage of the existing groundwater monitoring wells is not ideal relative to the gas station/convenience store and self-storage buildings to the east of the former disposal area; however, the two overburden monitoring wells located closest to the eastern edge of, but still within, the formal disposal area are evaluated below and it not expected that concentrations on the neighboring properties would be higher than the highest concentrations along the eastern edge of the formal disposal area.

Appendix J presents volatile organic compound (VOC) detections for the most recent five years in four overburden wells (MW-4A, MW-5A, MW-13A, and MW-12AR) on the eastern side of the landfill. Target groundwater concentration VISLs were developed using EPA's VISL online calculator (May 2018 version; https://epa-visl.ornl.gov/cgi-bin/visl_search) for a commercial scenario with a target cancer risk (TCR) level of 1E-06 and a target hazard quotient (THQ) of 0.1. Appendix J also presents output from the VISL calculator. The table compares maximum detected concentrations over the five years to the VISLs. Results are discussed below.

Well MW-4A is located in the area of the self-storage buildings to the east of the site. During the last five years, there were detected concentrations of benzene, cis-1,2-dichloroethene, trichloroethene, and vinyl chloride. There was one exceedance of a VISL (vinyl chloride in 2016). However, the VISL presented for vinyl chloride was based on a TCR of 1E-06. The detected concentration of vinyl chloride is below a TCR of 1E-05. Based on groundwater elevation measurements in the available monitoring reports, it appears that groundwater is less than 15 feet below the ground surface in the MW-4A area.

Well MW-5A is located over 100 feet downgradient of the gas station/convenience store to the east of the site and therefore, may not be representative of potential vapor intrusion. Reviewing the VOC detections (benzene, chlorobenzene, and chloroform) over the last five years shows that no VISLs were exceeded.

MW-13A is located within the disposal area, but near the eastern boundary of the site. It appears to be located more than 100 feet from an existing building. During the five most recent monitoring rounds, three VOCs (benzene, chlorobenzene, and cis-1,2-dichloroethene) were detected at concentrations ranging from 0.11 to 0.53 ug/L. VISLs were not exceeded. The water table appears to be around 15 feet below the ground surface at this location.

MW-12AR is also an overburden well located within the disposal area, but relatively near the northeastern corner of the site. It appears to be located more than 100 feet from an existing building. During the five most recent monitoring rounds, the following VOCs were detected: 1,1-dichloroethane, benzene, chlorobenzene, chloroethane, cis-1,2-dichloroethene, ethylbenzene, toluene, and total xylene. The benzene detections were above the VISL. However, the VISL presented for benzene was based on a TCR of 1E-06. The detected concentrations of benzene are below a TCR of 1E-05. The other VOC concentrations were below corresponding target VISL groundwater concentrations.

Based on the available groundwater data and current commercial use of the area, the remedy appears to be protective with regards to vapor intrusion risk.

Review of Ecological Risk Assessments. As discussed for the human health risk assessments, the Phase I and Phase II ecological risk assessments (ERAs) (Ebasco 1987; 1989) and the ERA for Middle Marsh (OU2; M&E, 1991) were conducted using methodology which would generally comply with current EPA risk assessment guidance. The primary discrepancies between current guidance and previous guidance, as noted in the previous 5-year reviews, exist in the areas of benchmarks and toxicity values utilized. The following provides an evaluation of these discrepancies, based on changes that have occurred since 2013 (the date of the last 5-year review), and their impact on the protectiveness of the remedy for ecological receptors. Recent compliance monitoring data are also reviewed to evaluate the protectiveness of the remedy.

Changes in Ecological Benchmarks and Standards

As discussed in the 2003 5-Year Review, VOCs, semivolatile organic compounds (SVOCs), and metals were eliminated as contaminants of concern (COCs) in the Phase II ERA based on comparison to background concentrations and comparison to interim sediment quality criteria. Although there are more recent benchmarks and standards that would be used in a present-day ERA, the previous five-year reviews have established that SVOCs (measured as PAHs) and metals were correctly eliminated as contaminants of concern in the ERA. Comparison of recent sampling results (OU2 sediment data) to current benchmarks confirms that few exceedances of screening level benchmarks are observed. For both metals and total PAH values, where Probable Effect Concentrations (PECs, MacDonald, et al., 2000) are available, all of the metals and total PAH measurements were below PEC benchmark values, at each sediment location. A few maximum PAH values exceed individual PAH PECs, but the total PAH concentration in each sediment sample from 2013 to 2017 was below the PEC benchmark values, indicating PAHs at the sample locations are unlikely to have an adverse effect on sediment organisms.

Since 2013, there have not been any significant changes in recommended benchmarks utilized for sediment and soil and only a limited number of changes in National Recommended Water Quality Criteria (NRWQC) values for surface water. The NRWQC changes include new standards for aluminum, cadmium, selenium, and ammonia. Of these, only aluminum was detected in surface water at this site. The revised NRWQC for aluminum cannot be calculated with the updated NRWQC formula, as the site surface water hardness and dissolved organic carbon (DOC) was not measured. However, assuming a hardness value of 100 mg/L and DOC of 1 mg/L, the maximum observed aluminum would be below the freshwater chronic value. There were no detections of PCBs in surface water samples in OU1 or OU2 from 2013, 2015 or 2017 samples. There were no detections of PAHs, with the exception of one sample in OU1 which had detected concentrations of benzo(b)fluoranthene (0.181 ug/L), fluoranthene (0.221 ug/L), phenanthrene (0.16 ug/L), and pyrene (0.16 ug/L). There are no NRWQC values for these compounds. However, three of these exceed the corresponding screening values provided by USEPA Region 3 (2006). The number and magnitude of these exceedances represent a low risk to aquatic receptors. Consequently, a review of the standards and the current surface water and sediment data indicate there are no newly promulgated standards, relevant to the site in either OU1 or OU2, which bear on the protectiveness of the remedy.

Changes in Risk Assessment Methods, Exposure Pathways and Consideration of Recent Monitoring Data

OU1

OU1 consists of a 12-acre historic disposal area and the adjacent Unnamed Stream. The Unnamed Stream flows from the site underneath Hathaway Road and through the OU2 Middle Marsh and Adjacent Wetlands: OU1 includes the Unnamed Stream and sedimentation basin north of Hathaway Road. There are no major changes in site conditions or exposure assumptions on which the risk assessment was based that would result in increased exposure or risk. The principal contaminants of concern for ecological receptors in OU1 identified in the risk assessment were PCBs. Target cleanup levels, protective of ecological receptors, were established for the site for sediments, surface water and soils.

As discussed in the last 5-year review, backfilled stream sediments and wetland soils act as a barrier between remaining contaminants (including PCBs) and potential aquatic and benthic receptors, thus creating an incomplete exposure pathway to aquatic and semi-aquatic organisms. The sediment cleanup level was established as 20 µg of PCBs per gram of carbon (µg/gC). 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/gC. The water quality criterion upon which the clean-up level was based has not changed. 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.

Because contaminated sediment and soil has been removed or isolated, and the disposal area capped, the exposure pathway to surface water has also been eliminated for most of the area of OU1. The remaining area for potential aquatic or semi-aquatic receptors in OU1 is within the Unnamed Stream and the sedimentation basin north of Hathaway Road. During the sediment monitoring conducted between 2003 and 2008, total PCBs in OU1 were measured in sediments at a maximum concentration of approximately 3.5 mg/kg. In 2009, the mean PCB concentration for 5 sediment samples in OU2 of 25.6 µg/gC, was just above the target of 20 µg/gC. In 2011, five sediment samples were collected as part of the routine monitoring program and the PCB concentrations at all locations were below the target level of 20 µg/gC. These data have been evaluated in the prior 5 Year Reviews. To determine the ongoing risk to aquatic organisms and wildlife receptors an assessment of contaminant concentrations in sediment within OU1 using samples collected between 2013 and 2017 has been performed and is documented in the following paragraphs.

Routine monitoring included measurements of PCBs in OU2 at 4 locations in 2013 (upstream location SED-5 was not sampled) and at five locations in 2015 and 2017. During this time interval, total PCBs in OU1 sediments were measured at a maximum concentration of 2.41mg/kg in 2013, less than 1.0 mg/kg in 2015 and 1.26 mg/kg in 2017. The maximum concentration of Aroclor 1254 of 2.41 mg/kg at SD-3 corresponded to 17.5 µg/gC, and in 2017, the total PCB concentration at SD-3 was 1.26 mg/kg, which corresponds to 37 ug/gC. Only the 2017 PCB value exceeded the sediment cleanup level of 20 µg/gC. As discussed in the previous 5-Year Review, the monitored sediment PCB concentrations in 2009 showed minor exceedances of the risk-based ecological target levels. However, based on these data, the monitored sediment PCB concentrations in 2010, 2011 and 2013 to 2015 showed no exceedances of the risk-based ecological target levels, with one minor exceedance in 2017. Therefore, the selected remedy is considered generally protective with regard to sediment; however, continued monitoring data should be evaluated to check compliance with the PCB clean-up goal. Since the average site-wide concentrations of PCBs in sediments are below the target level, the remedy continues to be protective of benthic organisms as well as aquatic and semi-aquatic organisms.

In surface water, the standard identified in the risk assessment and ROD was 0.014 µg/L total PCBs, based on the ambient water quality criteria for the protection of aquatic life. This standard has not changed, with the 2018 National Recommended Water Quality Criteria (NRWQC, chronic) still set at 0.014 µg/L. Current contaminant levels in OU1 surface water would not be associated with an elevated risk or hazard to ecological receptors because PCBs have not been detected in surface water. During the most recent 2013, 2015 and 2017 sampling events, PCBs were not detected at a detection limit of approximately 0.5 µg/L for each Aroclor, which is the lowest practicable detection limit. Although there is some uncertainty associated with the detection limit exceeding NRWQC, it is assumed that any non-detected levels of PCBs in surface water are unlikely to cause ecologically significant risk to ecological receptors.

Soils east of the stream channel were generally excavated to a depth of 2 to 6 feet and capped. East bank soils (both north and south of the car wash) were excavated to a depth of several feet and capped. Because the cap creates a barrier to the contaminated layer, the exposure pathway in soil is incomplete. Thus, the potential risk to terrestrial receptors is minimal and the remedy continues to be protective.

Although the method used to perform the ecological risk assessments differs from current methods and guidance, target clean-up levels and the selected remedy for OU1 appear to still be valid.

OU2

Similar to OU1, there are no major changes in site conditions or exposure assumptions on which the risk assessment was based that would result in increased exposure or risk to ecological receptors. The primary basis for action in OU2 was the risk related to ecological receptors from PCBs in sediments of Middle Marsh. As discussed in the previous five-year review, the Phase I and Phase II investigations demonstrated that the primary source of contamination was the OU1 disposal area. Before the implementation of the remedial action, flood waters from the disposal area could transport contaminants downstream. Because the remedy at OU1 consisted of capping the upstream disposal area, and the remedy at OU2 consisted of excavating sediment from the Middle Marsh to the edge of the flood plain and restoring wetlands, the source of contaminants has been eliminated. Thus, flood water will no longer transport contaminants via surface water or sediment. Furthermore, the clean fill and wetland soil used to reconstruct the Middle Marsh and the Adjacent Wetland act as a barrier to any residual contaminants below the excavation area, effectively eliminating the exposure pathway into sediment pore water. Therefore, the selected remedy is protective of benthic organisms as well as aquatic and semi-aquatic organisms.

The sediment quality criterion (20 µg PCB/gC) was established as the cleanup level of aquatic areas in the Middle Marsh. The risk-based sediment/soil cleanup levels for non-aquatic areas in Middle Marsh and for the adjacent wetland were established using site specific food chain modeling and set at 15 mg/kg total PCBs to

be protective of wildlife. As with OU1, the surface water standard of 0.014 µg/L was used, and is consistent with current water quality criteria.

As discussed for OU1, current levels of contaminants in sediment, wetland soil, and surface water are available and most appropriate to consider when evaluating remedy protectiveness. In the period from 2008 to 2013, documented in the previous 5 Year Review, no exceedances of water and soil cleanup levels were detected in Middle Marsh or the Adjacent Wetlands. Exceedances of sediment clean-up criteria were noted for two of the monitoring points in Unnamed Stream during the most recent monitoring event performed for OU2 (CONB, 2018a). The maximum PCB concentrations measured in sediments from the Unnamed Stream were 0.24 mg/kg or 45 µg/gC (at 0.53% TOC) at SDPC-2 and 0.057 mg/kg or 29 µg/gC (at 0.2% TOC) at SDPC-3, which are both above the 20 µg/gC cleanup level. However, during the same monitoring event in 2017, two other sediment samples from the Unnamed Stream (SDPC-1 and SDPC-4) contained PCB concentrations lower than the 20 µg/gC cleanup level. Although a limited number of exceedances of the selected sediment target level of 20 µg/gC, have been observed in the Unnamed Stream sediment, these were most often associated with very low TOC. No consistent pattern of increasing PCB concentrations has been observed for any locations in the Unnamed Stream and the PCB levels in the OU2 monitoring have remained below 1 ppm total PCBs, which indicates that the remedy remains protective. Continued monitoring of sediments in OU2 should be conducted to continue to evaluate the protectiveness of the remedy.

The maximum concentration of total PCBs in non-aquatic soil/sediment samples from the Middle Marsh and Adjacent Wetlands for monitoring data from 2017 were all below the cleanup level of 15 mg/kg. The maximum concentration of total PCBs in wetland soils was less than 1 mg/kg, indicating that the remedy is protective for non-aquatic soils/sediments.

Like OU1, contaminant levels in surface water measured for OU2 would not be associated with an elevated risk or hazard to ecological receptors because PCBs have not been detected in surface water, although the RLs are above the NRWQC value of 0.014 ug/L. During the most recent 2017 sampling event, PCBs were not detected with reporting limits of 0.10 ug/L to 0.112 ug/L for each individual Aroclor, which is the lowest practicable detection limit.

Based on removal of contaminated sediments in Middle Marsh and wetland soils, and the capping of the upstream disposal area in OU1, the source of PCBs for exposure of ecological receptors has been eliminated. Monitoring data since 2002 have indicated that the total PCB concentrations in the surface water and sediment/soils of OU2 are generally meeting the levels established to be protective of ecological receptors, although individual sediment samples have at times exceeded the sediment cleanup level on a total carbon basis. Continued monitoring is recommended to continue to evaluate the protectiveness of the remedy.

ARARs Review

A review of Applicable or Relevant and Appropriate Requirements was performed to check the impact on the remedy of changes in standards that were identified as ARARs in the ROD, newly promulgated standards for chemicals of potential concern, and TBCs (to be considered) that may affect the protectiveness of the remedy. The tables in Appendix K provide the review. The review is summarized below.

OU1

The 1989 ROD for OU1 (USEPA, 1989) set forth the following ARARs for the selected remedy:

- Safe Drinking Water Act
- Toxic Substances Control Act (TSCA)
- Resource Conservation and Recovery Act (RCRA)
- Clean Water Act (CWA)

- Clean Air Act (CAA)
- Occupational Safety and Health Administration (OSHA)
- U.S. Department of Transportation
- 310 CMR 22.00 - Massachusetts Drinking Water Regulations
- 314 CMR 6.00 - Massachusetts Groundwater Quality Standards
- 310 CMR 30.00 - Massachusetts Hazardous Waste Management Regulations
- 314 CMR 8.00 - Massachusetts Supplemental Requirements for Hazardous Waste Management Facilities
- 314 CMR 4.00 - Massachusetts Surface Water Quality Standards
- 310 CMR 10.00 - Massachusetts Wetlands Protection Regulations
- 310 CMR 6.00 - Massachusetts Ambient Air Quality Standards
- 454 CMR 21.000 - Massachusetts Right to Know Regulations
- 310 CMR 7.00 - Massachusetts Air Pollution Control Regulations

In addition, Executive Order 11988 (Floodplain Management), Executive Order 11990 (Protection of Wetlands), and Interim Sediment Quality Criteria were identified in the ROD as To Be Considered (TBC).

Table 1 of Appendix K provides an evaluation of ARARs for OU1 using the regulations and requirement synopses listed in the ROD as a basis. The evaluation includes a determination of whether the regulation is currently ARAR or TBC and whether the requirements have been met.

As indicated in the previous five-year reviews, the Massachusetts Solid Waste Management Regulations (310 CMR 19.117, 19.132(4), and 19.150) were not included in the ROD, but are now considered applicable because they provide a means to detect, monitor, and address landfill gas at property boundaries at concentrations greater than 25% LEL. These regulations require that the MassDEP be notified when concentrations of landfill gases at the property boundary are measured above 25% LEL. They also mandate the control of landfill gases to concentrations less than 25% LEL to prevent public health and safety concerns. These ARARs were the topic of the ESD issued by EPA on September 29, 2003. Since the ESD was issued, an active landfill gas extraction system has been implemented at the site and quarterly landfill gas monitoring is conducted in order to evaluate the effectiveness of the system in controlling landfill gas migration.

The requirements of many of the ARARs identified in the ROD were met during remedy construction.

OU2

The 1991 ROD for OU2 (USEPA, 1991) set forth the following ARARs for the selected remedy:

Location-specific:

- Clean Water Act (CWA)
- Executive Order 11988 (Floodplain Management)
- Executive Order 11990 (Protection of Wetlands)
- Fish and Wildlife Coordination Act
- Resource Conservation and Recovery Act (RCRA)
- 990 CMR 1.00 - Hazardous Waste Facility Siting Regulations
- 310 CMR 10.00 - Massachusetts Wetlands Protection Act Regulations
- 321 CMR 10.00 - Massachusetts Endangered Species Act Regulations

Action-specific:

- Clean Water Act (CWA)
- Executive Order 11988 (Floodplain Management)
- Executive Order 11990 (Protection of Wetlands)

- Fish and Wildlife Coordination Act
- Toxic Substances Control Act (TSCA)
- Clean Air Act (CAA)
- Federal Noise Control Act
- 314 CMR 4.00 - Massachusetts Surface Water Quality Standards
- 310 CMR 10.00 - Massachusetts Wetlands Protection Act Regulations
- 321 CMR 9.00 - Massachusetts Endangered Wildlife and Wild Plants Regulations
- 314 CMR 9.00 - Massachusetts Certification for Dredging, Dredged Material Disposal, and Filling in Waters
- 314 CMR 8.00 - Massachusetts Supplemental Requirements for Hazardous Waste Management Facilities
- 310 CMR 30.00 - Massachusetts Hazardous Waste Management Regulations
- 310 CMR 6.00 - Massachusetts Ambient Air Quality Standards
- 310 CMR 7.00 - Massachusetts Air Pollution Control Regulations

Additional policies, criteria, and guidance were identified in the ROD as TBC, including:

- Massachusetts Wetlands Protection Policy 90-2
- TSCA Subpart G PCB Spill Cleanup Policy
- Interim Sediment Quality Criteria, Massachusetts Allowable Ambient Air Limits - Annual (AALs) and Massachusetts Threshold Effects Exposure Levels (TELs)
- Guidance on Remedial Actions for Superfund Sites with PCB Contamination
- EPA Interim Policy for Planning and Implementing CERCLA Response Actions

Tables 2 and 3 of Appendix K provide an evaluation of location-specific and action-specific ARARs for OU2 using the regulations, requirement synopses, and descriptions of actions to be taken that were listed in the ROD as a basis. The evaluation includes a determination of whether the regulation is currently ARAR or TBC and whether the requirements have been met. In some cases, the description of actions to be taken to attain the location-specific ARARs differed for the selected and contingency remedies. In these cases, both descriptions were provided in Table 3 of Appendix K.

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

No other information has come to light that could call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
None

Issues and Recommendations Identified in the Five-Year Review:

OU(s): 1	**Issue Category**: Operations and Maintenance			
	Issue: Elevated methane levels were detected along the eastern property boundary above 25% LEL and is therefore not in compliance with the goals of the 2003 ESD and the Post-Construction Environmental Monitoring Plan.			
	Recommendation: 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.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	9/30/2020

OU(s): 1	**Issue Category**: Monitoring			
	Issue: PCBs in groundwater within the disposal area may be mobile and the current monitoring network may not be adequate for monitoring PCBs.			
	Recommendation: Enhance the monitoring network on the north side of Hathaway Road and conduct and sample the new locations for VOCs and PCBs.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	9/30/2019

OU(s): 1	Issue Category: Monitoring. **Note**: Potential presence of PFAS.			
	Issue: It is unknown if Perfluorobutanesulfonic acid, Perfluorooctanic acid or Perfluorooctansulfonic acid were released at the Site.			
	Recommendation: Include per- and polyfluorinated substances that include PFOA, PFOS and PFBS in an upcoming groundwater monitoring event to determine if these compounds are associated with the Site.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	6/30/2019

OU(s): 2	Issue Category: Monitoring			
	Issue: Sediment monitoring indicates some PCB concentrations above the 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.			
	Recommendation: Collect the required sediment samples and implement corrective actions as needed.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	9/30/2022

OTHER FINDINGS

In addition, the following are recommendations that were identified during the FYR and may improve performance of the remedy, reduce costs, and accelerate site close out, but do not affect current and/or future protectiveness:

- *There is uncertainty if PCBs are present in the OU1 Unnamed Stream at concentrations above the NRWQC of 0.014 ug/L, because long-term monitoring results have shown no detections with reporting limits exceeding the NRWQC. Consideration should be given to sampling surface water for PCBs using methods that can achieve lower detection limits during the next five-year review period.*

- *Site O&M Manual Compliance:*
  - *The landfill cap is now outfitted with an solar array system, however the O&M manual has not been updated in consideration of this and inspection reports do not document conditions associated with the solar array system. The O&M manual should be updated to include changes to the cap and necessary monitoring requirements.*
  - *Inspections and some corrective actions as required by the O&M manual have been completed, however regular corrective actions are necessary. Inspection of the culverted portion of the Unnamed Stream should be conducted to ensure its integrity and sediment that has accumulated in the Unnamed Stream just upstream of the double box culvert and in catch basins on Hathaway Road should be cleaned on a regular basis.*

- *The landfill gas extraction system should be evaluated and modified, as needed, based on the findings of the bar hole investigation and other ongoing gas vent issues. The maintenance procedures should be updated to ensure operation of the system.*

- *Wetland O&M Manual Compliance:*
  - *The Wetlands O&M manual requires the collection of the groundwater monitoring data to evaluate whether wetland hydrology goals are being met, however this data has not been collected consistent with the manual. It is recommended that monitoring requirements be reviewed and followed.*
  - *Additional management of multiflora rose and phragmites is needed to ensure the integrity of the wetland. It is recommended that ground areas covered by these invasive species be removed and disposed off –site. Cleared areas should be seeded with a wetland seed mix, and planted with additional woody shrubs and saplings and/or herbaceous plant plugs, as agreed to by EPA.*

VII. PROTECTIVNESS STATEMENT

Protectiveness Statement(s)		
Operable Unit: 1	*Protectiveness Determination:* Short-term Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: 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 PFOA, PFOS and PFBS contaminants.		

Protectiveness Statement(s)		
Operable Unit: 2	*Protectiveness Determination:* Short-term Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: 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 Protectiveness Statement	
Protectiveness Determination: Short-term Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: 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.	

VIII. NEXT REVIEW

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

APPENDIX A – REFERENCE LIST

City of New Bedford (CONB). 2018a. 2017 Environmental Monitoring Sampling and Results Report, Sullivan's Ledge Superfund Site, Operable Unit 2, EPA ID: MAD980731343, New Bedford, Massachusetts. January 2018.

City of New Bedford (CONB). 2018b. Sullivan's Ledge 2017 Wetlands Report, OU1 and OU2. April 6, 2018.

City of New Bedford (CONB). 2013-2018. Sullivan's Ledge Monthly Reports for September 2013 through April 2018. Multiple dates from October 9, 2013 through May 10, 2018.

Dames & Moore, Inc. (Dames & Moore). 1999. Final Operation and Maintenance Plan, Second Operable Unit, Sullivan's Ledge Superfund Site, New Bedford, Massachusetts. Prepared for AVX Corporation. January 13, 1999.

EBASCO Services Incorporated (EBASCO). 1987. Phase I Draft Final Remedial Investigation, Sullivan's Ledge Site, New Bedford, Massachusetts. September 1987.

EBASCO Services Incorporated (EBASCO). 1989. Volume I Draft Final Remedial Investigation, Sullivan's Ledge, New Bedford, Massachusetts. January 1989.

EBASCO Services Incorporated (EBASCO). 1989. Volume II Draft Final Feasibility Study Report, Sullivan's Ledge, New Bedford, Massachusetts. January 1989.

Lockheed Martin/SERAS. 2016. Final Desktop Catchment Water Modeling for Sullivan's Ledge Superfund Site, August 25, 2016.

Massachusetts Department of Environmental Protection (MassDEP). 2016. Groundwater Use and Value Determination, Sullivan's Ledge Superfund Site, New Bedford, MA. March 2016.

Metcalf & Eddy, Inc. (M&E). 1991a. Final Remedial Investigation, Additional Studies of Middle Marsh, Sullivan's Ledge Site, New Bedford, Massachusetts. Prepared for US Environmental Protection Agency Region I. April 1991.

Metcalf & Eddy, Inc. (M&E). 1991b. Feasibility Study of Middle Marsh. Prepared for US Environmental Protection Agency Region I. May 1991.

O'Brien & Gere Engineers, Inc. (OBG). 1996. Post-Construction Environmental Monitoring Plan, Sullivan's Ledge Superfund Site, New Bedford, Massachusetts. October 1996.

O'Brien & Gere Engineers, Inc. (OBG). 1997. Wetlands Restoration Plan, Sullivan's Ledge Superfund Site, New Bedford, Massachusetts. July 1997.

O'Brien & Gere Engineers, Inc. (OBG). 2000a. Post-Construction Baseline Ground Water Sampling Event, Sullivan's Ledge Superfund Site, New Bedford, Massachusetts. April 2000.

O'Brien & Gere Engineers, Inc. (OBG). 2000b. Ground Water Treatment Plant Operation and Maintenance Manual. August 2000.

O'Brien & Gere Engineers, Inc. (OBG). 2002a. Sullivan's Ledge Superfund Site, New Bedford, Massachusetts, Site Operations and Maintenance Manual. February 2002.

O'Brien & Gere Engineers, Inc. (OBG). 2002b. Sullivan's Ledge Superfund Site Operable Unit 1 Remedial Construction Report. March 2002.

O'Brien & Gere Engineers, Inc. (OBG). 2012. Sullivan's Ledge Superfund Site Fall and Winter 2011 Monitoring Report. May 2012.

O'Brien & Gere Engineers, Inc. (OBG). 2014. Sullivan's Ledge Superfund Site Fall and Winter 2013 Monitoring Report. April 2014.

O'Brien & Gere Engineers, Inc. (OBG). 2015. Sullivan's Ledge Superfund Site, Field Sampling Plan, Surface Water, Sediment, Landfill Gas Monitoring. Revised June 2015.

O'Brien & Gere Engineers, Inc. (OBG). 2016a. Sullivan's Ledge Superfund Site Fall and Winter 2015 Monitoring Report. March 2016.

O'Brien & Gere Engineers, Inc. (OBG). 2016b. Memorandum regarding Sullivan's Ledge Superfund. April 21, 2016.

O'Brien & Gere Engineers, Inc. (OBG). 2016c. Sullivan's Ledge Superfund Site Spring and Summer 2016 Monitoring Report. August 2016.

O'Brien & Gere Engineers, Inc. (OBG). 2017a. Sullivan's Ledge Superfund Site Fall and Winter 2016 Monitoring Report. February 2017.

O'Brien & Gere Engineers, Inc. (OBG). 2017b. Sullivan's Ledge Superfund Site Spring and Summer 2017 Monitoring Report. August 2017.

O'Brien & Gere Engineers, Inc. (OBG). 2018a. Sullivan's Ledge Superfund Site Fall and Winter 2017 Monitoring Report. March 2018.

O'Brien & Gere Engineers, Inc. (OBG). 2018b. Letter regarding Sullivan's Ledge Superfund Site Fall and Winter 2017 Monitoring Report. June 1, 2018.

Sullivan's Ledge Site Group Project Management Committee (PMC). 2016a and 2016b. Letters regarding Sullivan's Ledge Superfund Site, Optimization Report – Soil Gas Evaluation. March 16, 2016 and May 5, 2016.

Sullivan's Ledge Site Group Project Management Committee (PMC). 2017. Letter to Kimberly White, US EPA Region 1, regarding PCB Sampling and Monitoring Plan (including attached Memorandum dated May 31, 2017 from O'Brien & Gere). May 31, 2017.

URS Corporation (URS). 2001. Final Remedial Construction Report Sullivan's Ledge Superfund Site, Second Operable Unit. Prepared for AVX Corporation. August 13, 2001.

United States Environmental Protection Agency Region I (USEPA). 1989. ROD Decision Summary, Sullivan's Ledge Superfund Site, New Bedford, Massachusetts. June 28, 1989.

United States Environmental Protection Agency Region I (USEPA). 1991. Record of Decision Summary, Sullivan's Ledge Superfund Site, Middle Marsh Operable Unit. September 27, 1991.

United States Environmental Protection Agency Region I (USEPA). 1995. Explanation of Significant Differences, Sullivan's Ledge Superfund Site, Operable Unit 1. Issued July 26, 1995.

United States Environmental Protection Agency Region I (USEPA). 2000. Explanation of Significant Differences, Sullivan's Ledge Superfund Site, Operable Unit 1. Issued September 27, 2000.

United States Environmental Protection Agency (USEPA). 2001. Comprehensive Five-Year Review Guidance.

June 2001.

United States Environmental Protection Agency Region I (USEPA). 2003. Explanation of Significant Differences, Sullivan's Ledge Superfund Site, Operable Unit 1. Issued September 29, 2003.

United States Environmental Protection Agency (USEPA). 2013. Third Five-Year Review Report for Sullivan's Ledge Superfund Site, Bristol County, Massachusetts. September 2013.

United States Environmental Protection Agency (USEPA). 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 6, 2014.

United States Environmental Protection Agency (USEPA), 2014a. *Provisional Peer-Reviewed Toxicity Values for Perfluorobutane Sulfonate and Related Compound Potassium Perfluorobutane Sulfonate*. Office of Research and Development. EPA 690-R-14-012F. July 17, 2014.

United States Environmental Protection Agency (USEPA). 2016. Optimization Review Report, Post-Construction Completion Stage, Operation and Maintenance, Sullivan's Ledge Superfund Site, New Bedford, Bristol County, Massachusetts, EPA Region 1. March 2016.

United States Environmental Protection Agency (USEPA), 2016a. *Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)*. Office of Water. EPA 822-R-16-005. May 2016.

United States Environmental Protection Agency (USEPA), 2016b. *Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)*. Office of Water. EPA 822-R-16-004. May 2016.

APPENDIX B – SITE MAPS

FIGURE 1.
SITE LOCATION MAP
SULLIVANS LEDGE SITE
NEW BEDFORD MASSACHUSETTS

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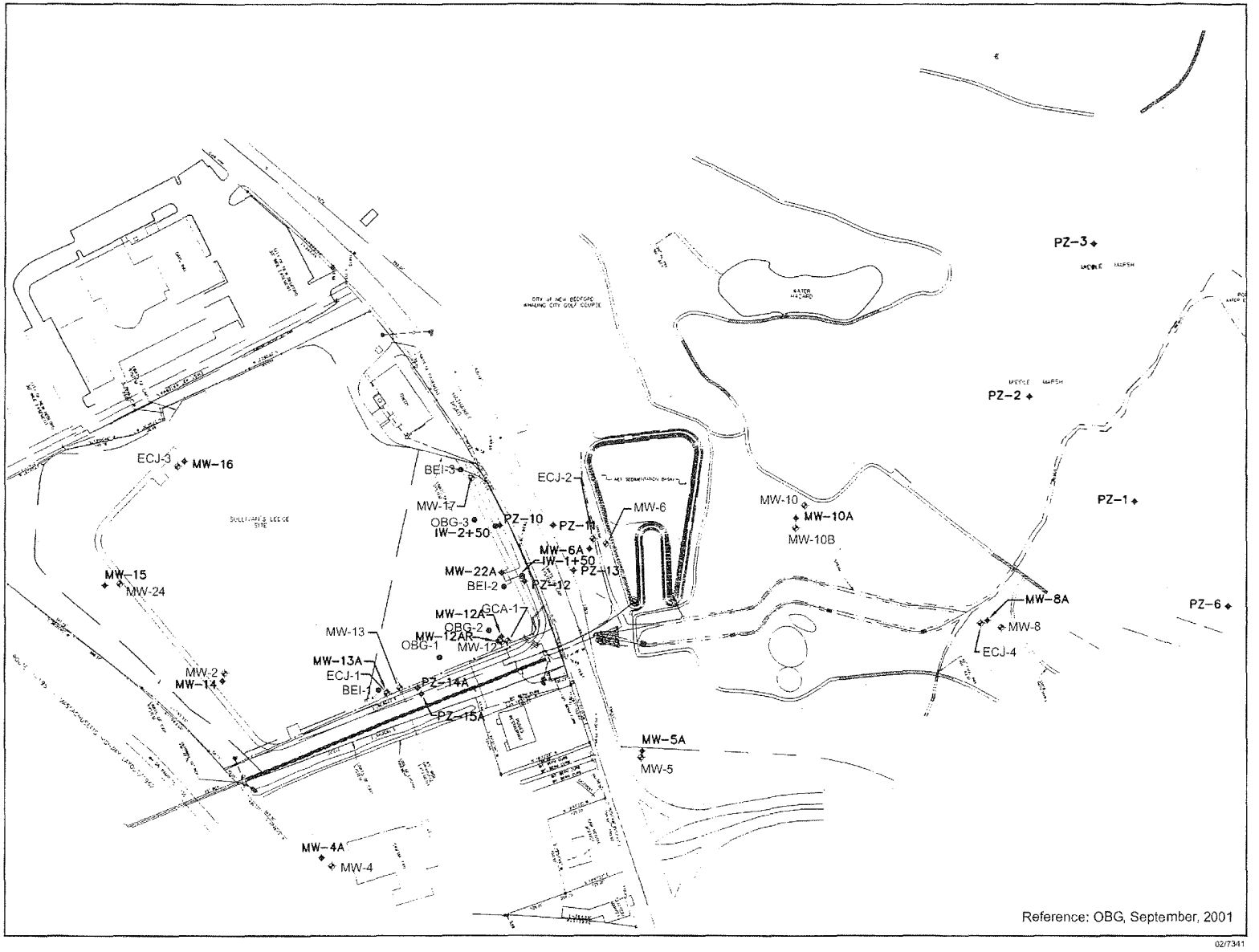
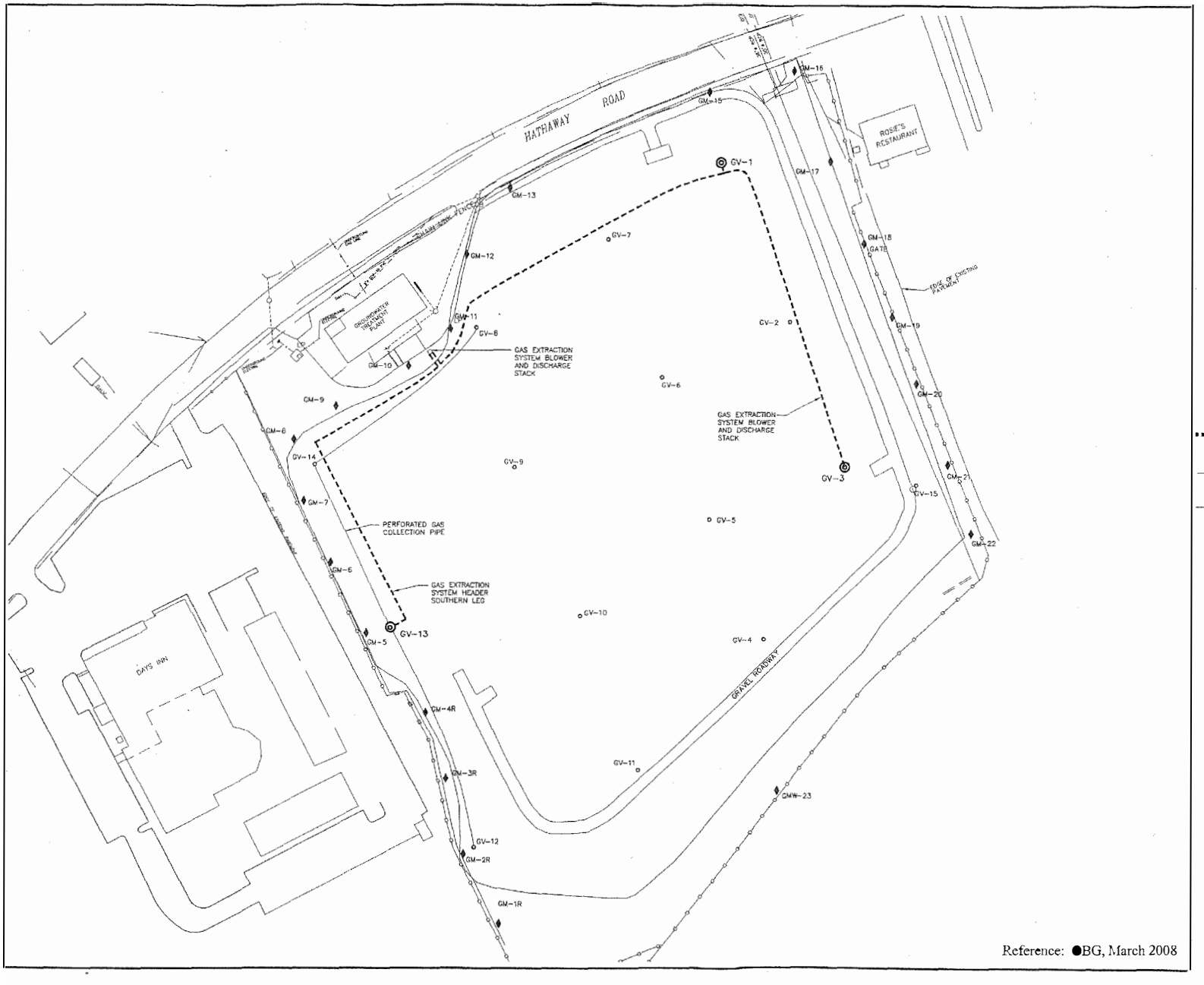


FIGURE 2.
GROUNDWATER WELL LOCATIONS
SULLIVAN'S LEDGE SUPERFUND SITE
NEW BEDFPORD, MASSACHUSETTS



Reference: BG, March 2008

FIGURE 3.
LANDFILL GAS VENT AND MONITORING WELL LOCATIONS
SULLIVAN'S LEDGE SUPERFUND SITE
NEW BEDFORD, MASSACHUSETTS

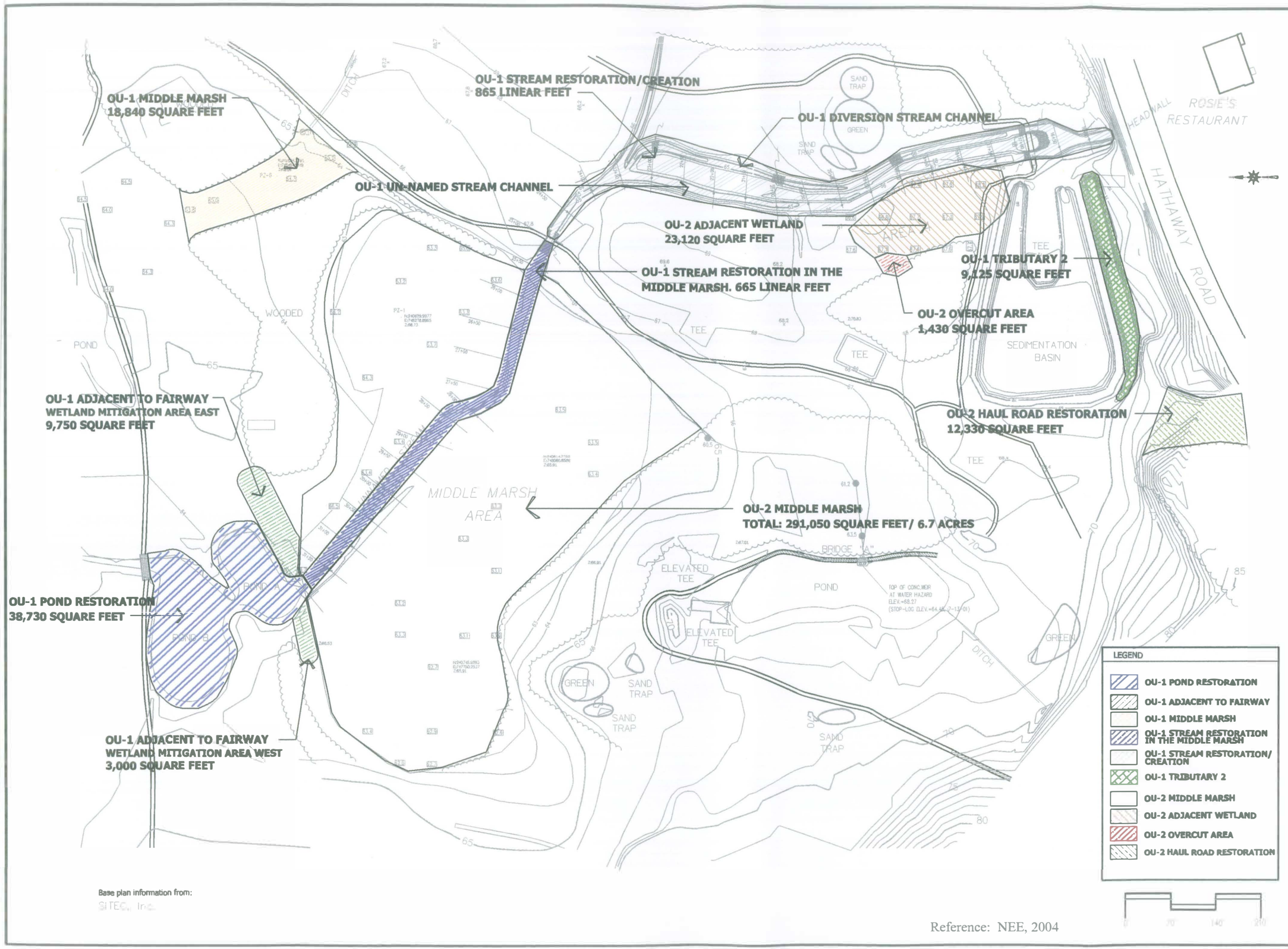


FIGURE 4.
OU1 AND OU2 WETLAND RESTORATION AREAS
SULLIVAN'S LEDGE SUPERFUND SITE
NEW BEDFORD, MASSACHUSETTS

APPENDIX C – SITE CHRONOLOGY

Chronology of Site Events	
Event	**Date**
Quarrying operations conducted at the Site	prior to 1846 through 1921
Land acquired by the City of New Bedford through tax title foreclosure	1935
Pits used for waste disposal	1930's through early 1970's
Fires in quarry pits lead to backfilling of one pit	early 1970's
Geotechnical borings by Massachusetts Department of Public Works indicate presence of capacitors in subsurface	1982
EPA conducted air monitoring program of the Greater New Bedford Area	1982
EPA installed groundwater monitoring wells around the site	1983
NPL Listing	September 21, 1984
OU1 Phase I Remedial Investigation report by NUS Corporation	September 1987
OU2 Final Remedial Investigation/Feasibility Study report by Ebasco Services Inc.	January 1989
ROD issued by EPA for OU1	June 29, 1989
OU2 Final Remedial Investigation - Additional Studies of Middle Marsh report by Metcalf & Eddy, Inc.	April 1991
OU2 Feasibility Study of Middle Marsh report by Metcalf & Eddy, Inc.	May 1991
ROD issued by EPA for OU2	September 27, 1991
Consent Decree for OU2 was lodged in U.S. District Court in Massachusetts	January 25, 1993
ESD issued by EPA, modifying the remedy so that treatment would no longer be required for OU1 soil and sediments to be covered by the OU1 landfill cap.	July 26, 1995
100% remedial design approved by EPA for OU1	June 1997
Start of on-site construction at Operable Unit 1	March 2, 1998
Start of on-site construction at Operable Unit 2	April 8, 1999
Start-up of the OU1 groundwater collection and treatment system	December 10, 1999

Chronology of Site Events	
Event	**Date**
ESD issued by EPA 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 a concrete lining	September 27, 2000
Final Remedial Construction Report, OU2 by URS Corporation and Certification of Remedial Construction Completion	August 13, 2001
Remedial Construction Report, OU1 by O'Brien & Gere Engineers, Inc. and Certification of Construction Completion	March 8, 2002
Approval of OU2 Construction Completion Report	January 23, 2003
Approval of OU1 Construction Completion Report	January 23, 2003
ESD issued by EPA adding Solid Waste regulations as an ARAR and requiring mitigation of a landfill gas migration issue	September 29, 2003
Completion of first five-year review	September 29, 2003
Start-up of the full-scale landfill gas extraction system	June 10, 2004
Fifth year of post-construction wetland monitoring	2006
Completion of second five-year review	September 23, 2008
First year of long-term wetland monitoring	2011
Completion of third five-year review	September 20, 2013
Completion of Optimization Review Report	March 2016

APPENDIX D – GROUNDWATER USE AND VALUE DETERMINATION

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

One Winter Street Boston, MA 02108 • 617-292-5500

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

March 14, 2016

Kimberly White, Remedial Project Manager
US EPA Region 1
Mail Code OSRR07-1
5 Post Office Square, Suite 100
Boston, MA 02109-3912

Subject: Sullivan Ledge Superfund Site, New Bedford, Massachusetts
Groundwater Use and Value Determination

Dear Kimberly:

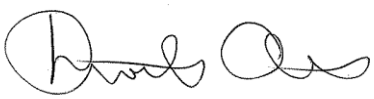
Attached please find the Groundwater Use and Value Determination (Determination) prepared by the Department (MassDEP) for the Sullivan Ledge Superfund Site (Site) located in New Bedford, MA. This Determination was developed pursuant to the MOA between EPA and MassDEP and is consistent with EPA's Groundwater Use and Value Determination Guidance (Guidance).

In determining the use and value of the groundwater in the vicinity of the Site, MassDEP referred to the aquifer classification contained in the Massachusetts Contingency Plan (MCP). The classification in the MCP gives consideration to all of the factors in the EPA's Guidance.

Enclosed with the Determination are the GIS resource maps (0.5 and 2 mile radii) that were used to develop the Determination and provide a variety of information, including; the USGS aquifer yield classification, the locations of public water supplies, zones of protection and areas of sensitive ecological resources.

If you have any questions regarding this letter, please feel free to contact me at 617-292-5795.

Very truly yours,



Dorothy Allen
Project Manager/Sullivan Ledge

GROUNDWATER USE AND VALUE DETERMINATION
Sullivan Ledge Superfund Site, New Bedford, MA
March 2016

Pursuant to the Memorandum of Agreement ("MOA") between the EPA and MassDEP concerning Ground Water Use and Value Determinations, and consistent with EPA's 1996 Final Ground Water Use and Value Determination Guidance, MassDEP has developed this Use and Value Determination ("Determination") of the groundwater beneath and in the vicinity of the Sullivan Ledge Superfund Site located in New Bedford, MA ("Site"). The purpose of the Determination is to identify whether the local area groundwater is of high, medium, or low use and value. These are designations contained in EPA's guidance. In the development of this Determination, as agreed to in the MOA, MassDEP has applied the criteria for groundwater classification promulgated in the Massachusetts Contingency Plan ("MCP"). The classification contained in the MCP considers criteria similar to those recommended in EPA's Groundwater Use and Value Determination Guidance.

MassDEP assigns a medium use and value to the groundwater at the Sullivan Ledge Superfund Site. This Determination is based on the non-drinking water status of the groundwater beneath and in the close proximity to the Site, along with the nearby presence of sensitive ecological receptors. This recommendation is explained in more detail below.

For the purposes of this Determination, the groundwater under evaluation is defined as that underlying the Site and the surrounding area extending in a two mile radius from the central portion of the Site. The groundwater, surface water, ecological resources and other features in the review area are identified in the MassGIS maps that were prepared for and accompany this Determination.

The Sullivan Ledge Superfund Site is located near the intersection of Route 195 and Hathaway Road in New Bedford. It consists of two operable units ("OUs"). The OU1 is a 12-acre area and includes historic disposal pits and a bordering Unnamed Stream that flows underneath Hathaway Road into OU2. The OU2 is located within the *Whaling City Golf Course* and includes a 13-acre wooded wetland called Middle Marsh and a 1.5 acre wetland area bordering the Unnamed Stream referred to as the Adjacent Wetlands. The OU2 is bounded on the north by the Apponogansett Swamp and solid waste handling facilities.

The OU1 disposal area was originally a granite quarry that discontinued operations in 1921 and became a local swimming hole until the city of New Bedford assumed ownership in 1935 through a tax foreclosure. The quarry pits and the surrounding area were used by the city and local industry as a disposal site for wastes such as electrical transformers and capacitors, fuel oil, volatile liquids, tires, glass, metals steel tanks, smoke stack soot and scrap rubber. After a major fire erupted at the location in early 1970 disposal was discontinued. In 1983 EPA installed monitoring wells around the disposal area and as a result of the monitoring at these wells in September of 1984 the area was included on the National Priority List as the Sullivan Ledge Superfund Site. After the Remedial Investigations in 1989 the Middle Marsh and the Adjacent Wetlands were included as OU2 of the Site.

Contaminants of concern identified in the OU1 soils, OU2 soils and sediments, and in the groundwater beneath both OUs included volatile organic compounds ("VOCs"), semi-volatile organic compounds and polychlorinated biphenyls ("PCBs").

The Records of Decision for OU1 and OU2 were issued in 1989 and 1991, respectively. The source control portion of the cleanup for OU1 had several components, including soil excavation and treatment, sediment treatment, construction of impermeable cap, diversion and lining of unnamed stream, collection and treatment of groundwater, construction of landfill gas collection system, wetland restoration, long-term environmental monitoring and institutional controls. The remediation components for OU2 included the excavation, dewatering, stabilization of soils and sediments and disposal beneath the OU1 cap, wetland restoration, long-term environmental monitoring and institutional controls. The EPA approved the completion of remedial action at both OUs in 2003 which triggered the start of the operations and maintenance period and environmental monitoring. The institutional controls for both OUs were recorded at *Bristol County Registry of Deeds* in 2014 in the form of Grants of Environmental Restrictions and Easements ("GEREs").

Groundwater compliance monitoring was conducted quarterly through 2008 and was reduced to semi-annually in the beginning of 2009. In addition, surface water, sediment and soil sampling of wetlands is conducted annually. The 1989 Record of Decision for OU1 recognized the groundwater beneath the site and its vicinity to be a potential drinking water resource, however, EPA did not identify the Maximum Contaminant Levels as the clean-up goals for the Site. Instead, due to technical impracticability, the agency established the clean-up goal for the Site groundwater to be the significant reduction in the mass of bedrock contamination evaluated by using two criteria: a concentration range of 1 to 10 mg/l (ppm) total VOCs and/or achieving an asymptotic curve using groundwater data showing significant VOC concentration reductions.

EPA completed a third Five Year Review in 2013 and an Optimization Review in 2015. Both studies evaluate the remedy from the perspective of providing continued protectiveness and progress towards achieving the groundwater clean-up goals.

The land use surrounding the Site is zoned as residential, business and municipal open space. The nearest residence is located approximately 500 feet southwest of the Site boundary. The closest businesses are located within 100 feet to the west and east of the Site boundary. The city of New Bedford maintains solid waste handling facilities within the one mile radius of the Site. Drinking water supply within two mile radius of the Site is provided by the *New Bedford Water/Wastewater Department*. The Site groundwater has been restricted for any use including without limitation potable, industrial, irrigation and agricultural use for both OU1 and OU2 by the GERE.

Sensitive ecological areas within the two mile radius to the north of the Site include Habitat of Rare Species, Estimated Rare Wildlife Habitat, Vernal Pools, and Natural Communities at the Apponogansett Swamp. In addition, wetlands and surface water comprise a large portion of OU2 of the Site.

The MCP contains three groundwater classifications; GW-1, GW-2, and GW-3. In general, areas that are located within a Current or Potential Drinking Water Source area are classified as GW-1. This includes, among other criteria, groundwater that is currently used for drinking water supply, aquifers that are identified as medium or high yield by the USGS, and areas that fall within an interim or delineated Zone II wellhead protection area.

The groundwater beneath and in close proximity to the Site does not meet the criteria for GW-1 and is therefore not considered a Current or Potential Drinking Water Source Area. MCLs would not be identified by MassDEP as Applicable or Relevant and Appropriate Requirements in this area. The closest GW-1 areas are the municipal water supply wells located in Dartmouth 3.5 miles to the southwest of the Site, the Zone II Wellhead Protection Area for these wells located 1.8 miles to the southwest, and the medium yield aquifer associated with these wells, located 1.2 miles from the Site. To the north another medium yield aquifer is 1.3 miles from the Site although a portion of that aquifer is classified as a Non-Potential Drinking Water Source Area due to incompatible land use. Contaminant concentrations would have to meet MCLs at these GW-1 locations.

Groundwater category GW-2 is intended to address the potential for migration of vapors from groundwater to occupied or planned structures. The classification applies to locations where groundwater has an average annual depth of 15 feet or less and where there is an occupied or planned building or structure within a 30-foot surface radius of the groundwater. Groundwater at the Site may meet this criteria and potential vapor migration risk should be considered in evaluating risk and remedy performance.

All groundwater in Massachusetts is category GW-3. The GW-3 standards are intended to provide some protection against the migration and eventual discharge of groundwater contaminants to surface water at concentrations that could pose a significant risk of harm to aquatic organisms. As noted above, there are surface water and wetland areas on and in the vicinity of the Site. Impacts of groundwater discharge on these receptors should be considered in any evaluation of risks and remedy performance.

Considering the issues presented in this Determination the evaluation of the groundwater risks and remedy performance at the Sullivan Ledge Superfund Site should include, but not be limited to, the following:

Human Health:

a) vapor seepage into building
b) potential exposures resulting from discharge to surface water
c) other non-consumptive exposures (e.g. utility/construction worker exposure)

Ecological:

a) ecological risks posed by discharge of groundwater to nearby surface water and wetland soils and sediments

GROUNDWATER USE AND VALUE FACTORS	RATING	SULLIVAN LEDGE SUPERFUND SITE SITE-SPECIFIC DETERMINATION
1.) Quantity	• low	• No Medium or High Yield Aquifers are located on or near proximity of the Site • Closest Medium Yield Aquifers are 1.2 miles southwest (up-gradient) and 1.3 miles north of Site
2.) Quality	• medium	• Water quality, other than that impacted by site contaminants, is believed to be good • Solid waste handling facilities are within the one mile radius of the Site • Medium Yield Aquifer 1.3 miles north of the Site lies beneath *New Bedford Regional Airport*
3.) Current Public Water Supply Wells	• low	• Closest Zone II Wellhead Protection area 1.8 miles south of Site • Drinking water within 2 miles of Site provided by city of *New Bedford Water/Wastewater Department*
4.) Current Private Drinking Water Supply Wells	• low	• No known private drinking water wells within 2 miles of Site
5.) Likelihood and Identification of Future Drinking Water Use	• low	• Groundwater directly beneath and in vicinity of Site is not suitable for public water supply development • Medium Yield Aquifer located 1.2 miles southwest of Site is already used for public water supply • No known plans to develop Medium Yield Aquifer located 1.3 miles north of Site • Area surrounding Site zoned residential and business
6.) Other Current or Reasonable Expected Ground Water Use in Review Area	• low	• No other uses of groundwater are known within 2 miles of Site • No changes to groundwater use are expected within 2 miles of Site
7.) Ecological Value	• high	• Shallow groundwater discharge to wetlands and surface water • Deeper groundwater discharge is unknown • Potential receptors of contaminated groundwater are aquatic and terrestrial biota inhabiting the wetlands and surface water • Endangered species habitat does not exist on Site or within 2 miles of the Site
8.) Public Opinion	•	• Public opinion on review area groundwater use was not obtained

MassDEP - Bureau of Waste Site Cleanup

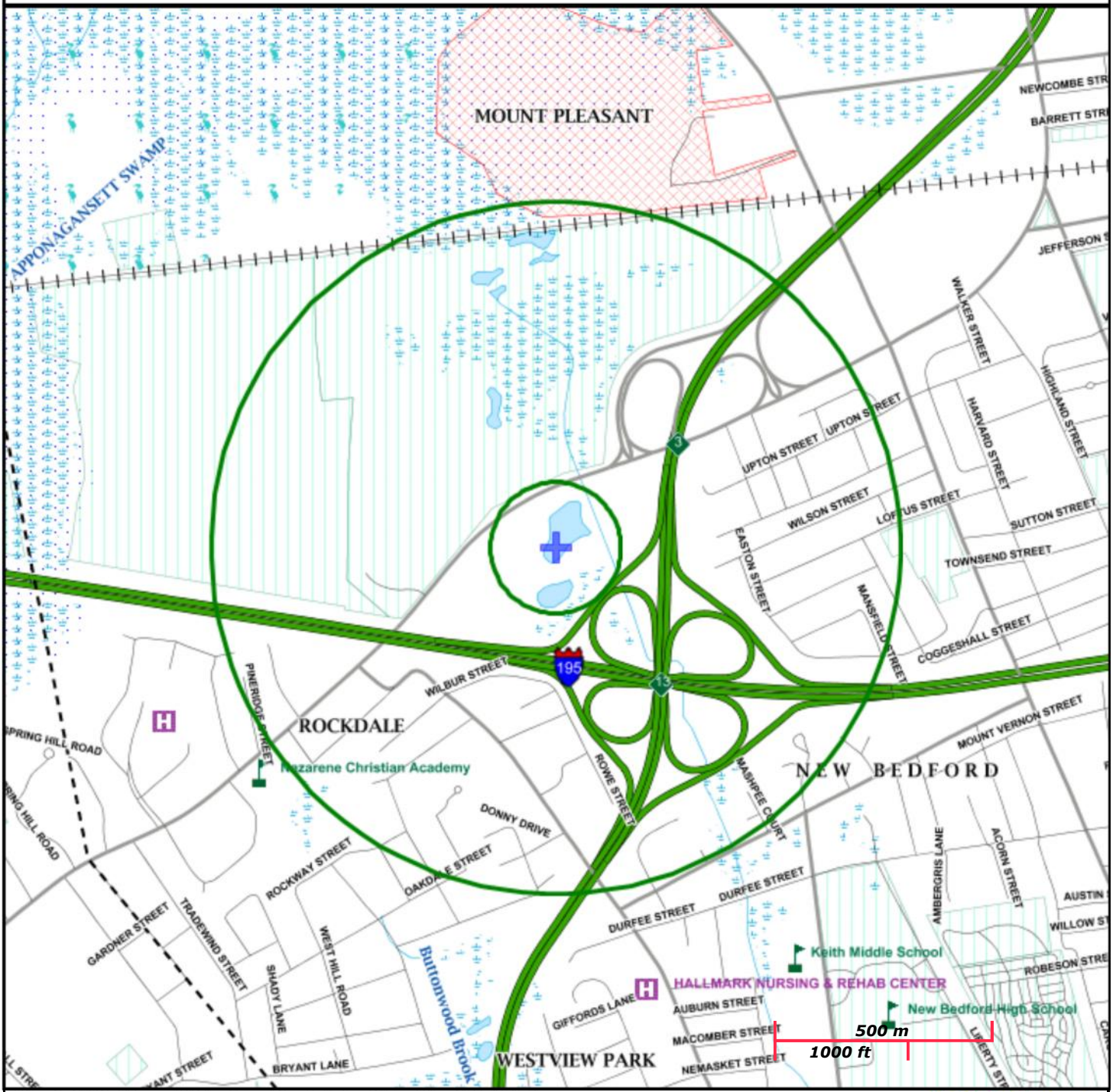
Phase 1 Site Assessment Map: 500 feet & 0.5 Mile Radii

Site Information:
HATHAWAY ROAD NEW BEDFORD, MA

NAD83 UTM Meters:
5109454mN , -7898830mE (Zone: 18)
January 7, 2016

The information shown is the best available at the date of printing. However, it may be incomplete. The responsible party and LSP are ultimately responsible for ascertaining the true conditions surrounding the site. Metadata for data layers shown on this map can be found at:
http://www.mass.gov/mgis/.

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection



Roads: Limited Access, Divided, Other Hwy, Major Road, Minor Road, Track, Trail

Boundaries: Town, County, DEP Region; Train; Powerline; Pipeline; Aqueduct

Basins: Major, PWS; Streams: Perennial, Intermittent, Man Made Shore, Dam

Aquifers: Medium Yield, High Yield, EPA Sole Source

Non Potential Drinking Water Source Area: Medium, High (Yield)

PWS Protection Areas: Zone II, IWPA, Zone A

Hydrography: Open Water, PWS Reservoir, Tidal Flat

Wetlands: Freshwater, Saltwater, Cranberry Bog

FEMA 100yr Floodplain; Protected Open Space; ACEC

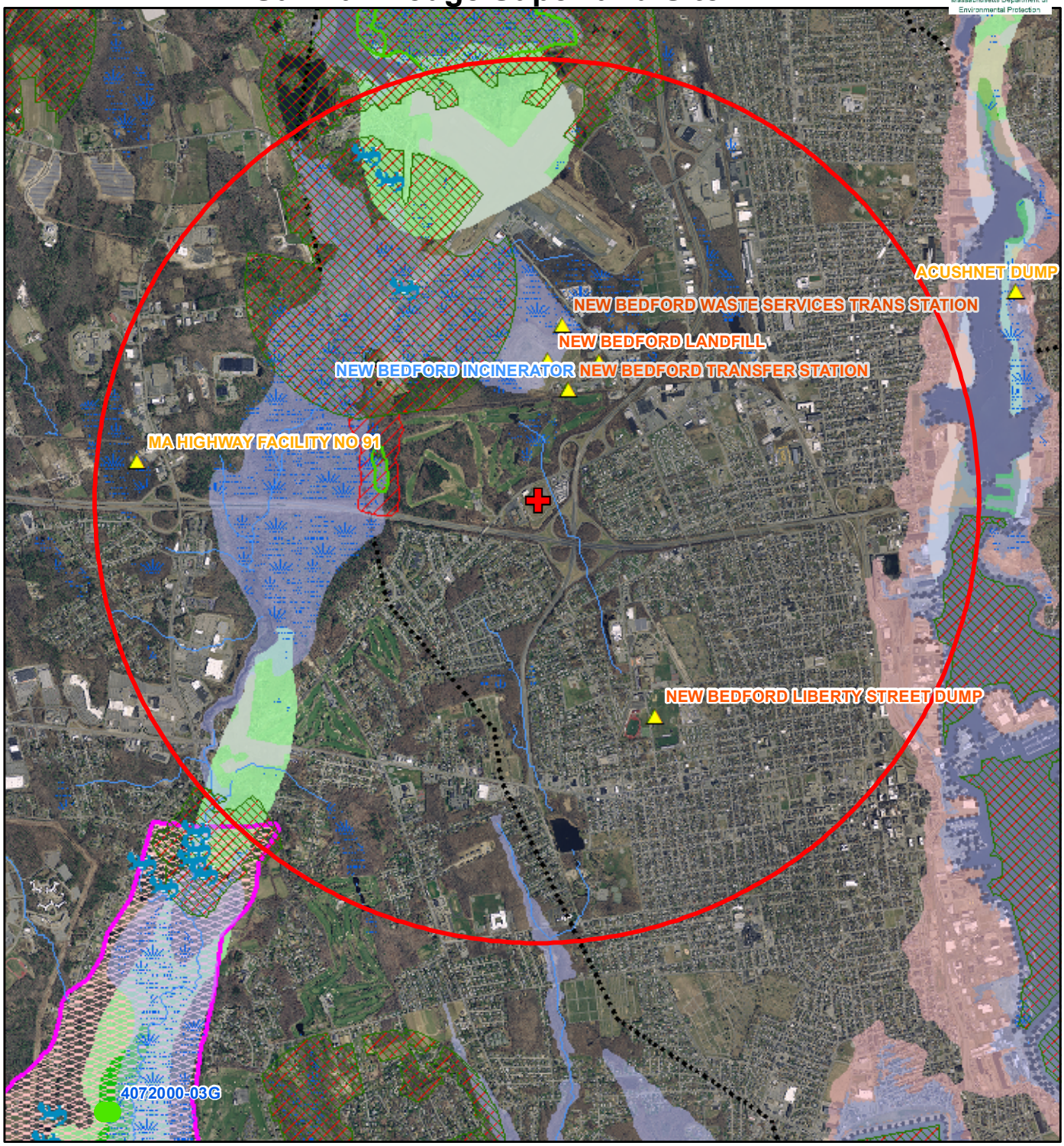
Est. Rare Wetland Wildlife Hab; Vernal Pool: Cert., Potential

Solid Waste Landfill; PWS: Com.GW,SW, Emerg., Non-Com.

MassDEP - Bureau of Waste Site Cleanup

Groundwater Use and Value Determination: 2 Mile Radius

Sullivan Ledge Superfund Site



MCP: Non Potential Drinking Water Source
- High Yield
- Medium Yield

MCP: Aquifers
- High Yield
- Medium Yield
- FEMA 1% Annual Chance Flood Hazard
- FEMA 0.2% Annual Chance Flood Hazard

- Community Groundwater Well
- IWPAs
- Zone II Wellhead Protection Area
- ZONE A
- Perennial Stream
- Wetland

- NHESP Certified Vernal Pool 2011
- NHESP Natural Communities
- NHESP Est Habitats of Rare Wildlife 2008
- NHESP Priority Habitats Rare Species 2008
- ACECs
- BWP Solid Waste Facility

Data Sources - MassGIS & MassDEP

January 6, 2016

APPENDIX E – INTERVIEW RECORDS

INTERVIEW RECORD

Site Name: Sullivan's Ledge Superfund Site	**EPA ID No.:** MAD980731343	
Subject: Five Year Review	**Time:**	**Date:** 5/22/18
Type: ☐ Telephone ☒ E-mail ☐ Other	☐ Incoming ☒ Outgoing	
☐ Visit **Location of Visit:**		

Contact Made By:

Name:	**Title:**	**Organization:**

Individual Contacted:

Name: Dorothy Allen	**Title:** State Project Manager	**Organization:** MassDEP
Telephone No: **617-292-5795**	**Street Address:** 1 Winter Street	
Fax No:	**City, State, Zip:** Boston, MA 02108	
E-Mail Address: Dorothy.t.allen@state.ma.us		

Summary of Conversation

1. **What is your overall impression of the project?**

Source plume at the former disposal area is effectively controlled by pump and treat system. The system is old and needs frequent maintenance and upgrades which were recently performed.

2. **Have there been routine communications or activities conducted by your office regarding the site? If so, please give purpose and results.**

In the past two years MassDEP performed a Groundwater Use and Value Determination for the site and participated in the development of risk based ecological clean-up criteria applicable to the pump and treat system shut-down and potential subsequent restart.

3. **Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.**

MassDEP has been monitoring the pump and treat system performance with respect to the sporadic violations of the treatment standards for discharge of PCBs to the city's sanitary sewer system.

4. **Do you feel well informed about the site's activities and progress?**

Yes

5. **Do you have any comments, suggestions, or recommendations regarding the site's management or operation?**

If the system is shut down and the plume is allowed to migrate beyond the former disposal area then the risk based ecological criteria should become the clean-up criteria for the site. The use of clean-up criteria found in the CD and the SOW that are not related to ecological risks should be discontinued.

6. **General Comments:**

No additional comments.

INTERVIEW RECORD

Site Name: Sullivan's Ledge Superfund Site		**EPA ID No.:** MAD980731343	
Subject: Five Year Review		**Time:** 2:00 pm	**Date:** 05/03/2018
Type: ☐ Telephone ☒ E-mail ☐ Other		☐ Incoming ☒ Outgoing	
☒ Visit **Location of Visit:** Whaling Inn and Suites			

Contact Made By:

Name:	Kimberly White	**Title:**	Remedial Project Manager	**Organization:**	U.S. EPA
	Cindy Castleberry		Project Manager		AECOM (EPA contractor)

Individual Contacted:

Name:	Jamie Hart	**Title:**	General Manager	**Organization:**	Whaling Inn and Suites

Telephone No:	**Street Address:** 500 Hathaway Road
Fax No:	**City, State, Zip:** New Bedford, MA
E-Mail Address:	

Summary of Conversation

1. **What effects, if any, have the Sullivan's Ledge Site operations had on the surrounding community?**

No.

2. **Are you aware of any community concerns regarding the Sullivan's Ledge Site or its operation and administration? If so, please give details.**

No. No tenants who stay at the inn have asked about it. There doesn't seem to be any interest. People just assume it is something to do with the city and they see the solar panels.

3. **Are you aware of any events, incidents, or activities at the Sullivan's Ledge Site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details.**

No.

4. **Do you have any comments, suggestions, or recommendations regarding the site's management or operation?**

No. There doesn't seem to be much going on other than mowing and that sort of thing. Again, nobody asks questions about the site.

5. **General Comments:**

None.

INTERVIEW RECORD

Site Name: Sullivan's Ledge Superfund Site		**EPA ID No.:** MAD980731343	
Subject: Five Year Review	**Time:** 10:00	**Date:** 04/18/2018	
Type: ☒ Telephone ☐ E-mail ☐ Other		☐ Incoming ☒ Outgoing	
☐ Visit **Location of Visit:**			

Contact Made By:

Name: Cindy Castleberry	**Title:** Project Manager	**Organization:** AECOM (Oversight Contractor to EPA Region I)

Individual Contacted:

Name: Jamie Ponte, Jim Ricci	**Title:** Commissioner, Consultant	**Organization:** Department of Public Infrastructure, City of New Bedford

Telephone No: 508-979-1550	**Street Address:** 1105 Shawmut Avenue
Fax No:	**City, State, Zip:** New Bedford, MA 02746
E-Mail Address: Jamie.ponte@newbedford-ma.gov; JamesR@newbedford-ma.gov	

Summary of Conversation

1. **What is your overall impression of the project?**

The facility is close to 20 years old, but has been functioning well overall. The groundwater treatment and O&M activities that the City has been responsible for have gone well. The City is hopeful that there will be approval to shut down the groundwater treatment plant soon and enter the next phase of groundwater performance monitoring, but realize it is yet to be determined what the outcome of that monitoring will be and whether the groundwater treatment can stop in the long-term.

2. **Is the remedy functioning as expected? How well is the remedy performing?**

Yes, it is functioning as expected. It is performing as expected.

3. **Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, give details.**

There isn't anything unexpected, but more just continued repair and replacement of existing equipment. If plant had been able to shut down earlier, the new computer system ($65,000) for the groundwater treatment plant may not have been needed. It is expected that there will be wear and tear over 20 years, but the City thinks that because of the efforts they are putting in now, the plant will be in a better state of readiness if they need to turn back on/keep running after potential shutdown.

4. **Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.**

Summary of Conversation

The City is continuing to use same treatment process, but have put some effort into looking into options for more long-term planning. The City has been asked to do more sampling of treatment process than had been in the past and is therefore spending more money on that, but they realize it provides some useful information.

5. Are the O&M activities being performed consistently with the approved O&M and monitoring plans?

Yes.

6. Have there been any security issues in the last five years? Has there been any evidence of vandalism or trespassing? If yes, please describe.

No security issues.

7. Have there been any complaints, violations, or other incidents related to the site in the last five years? If so, please give details of the events and results of the responses.

No complaints or incidents. In terms of violations, there have been some exceedances of the pretreatment discharge limits that apply to the groundwater treatment plant effluent, but not significant.

8. Have there been any unusual or unexpected activities or events at the site (e.g. flooding) in the last five years? If so, has this resulted in any damage or had an impact on operations at the site?

No.

9. What are the annual system operation/O&M costs for OU1 (incurred by the City of New Bedford) since the previous five-year review (2013 to present)?

Year	Total Cost
FY2013	$154,803.51
FY2014	$94,826.80
FY2015	$64,190
FY2016	$215,298 (includes new SCADA system)
FY2017	$160,581

The City does not track labor costs in a way that they can break out labor associated with this site, so no labor is included in the costs above. The City estimates that labor is probably on the order of at least $100,000 per year. Costs above include expenses only (supplies, subcontractor costs, parts, etc.)

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

They are looking forward to the next phase of shutting down and going into the Performance Monitoring period. They are hoping the outcome is positive, but realize some treatment may be needed in the future. They would look at more streamlined treatment if needed in the future.

11. General Comments:

None.

INTERVIEW RECORD

Site Name: Sullivan's Ledge Superfund Site		**EPA ID No.:** MAD980731343	
Subject: Five Year Review		**Time:**	**Date:**
Type: ☐ Telephone ☒ E-mail ☐ Other		☐ Incoming ☒ Outgoing	
☐ Visit **Location of Visit:**			
Contact Made By:			
Name:	**Title:**	**Organization:**	
Individual Contacted:			
Name: Steve Wood	**Title:** Vice President (Representative of Sullivan's Ledge Site Group, Project Management Committee)	**Organization:** ESS Group	
Telephone No: 401-330-1206		**Street Address:** 10 Hemingway Drive	
Fax No:		**City, State, Zip:** East Providence, RI 02915	
E-Mail Address: swood@essgroup.com			

Summary of Conversation

1. **What is your overall impression of the project?**

Overall the project has been successful in reducing GW contaminant levels and restoring the wetland area that was part of the remedial action. The involved parties have worked cooperatively to advance the overall goals at the site toward site closure.

2. **Is the remedy functioning as expected? How well is the remedy performing?**

The remedy is working well. Significant reductions have been made in the contaminates in the recovery and monitoring wells. In fact, the Group and its consultants believe that the groundwater quality has satisfied the criteria for water treatment plant shut-down in the Consent Decree and initiation of the performance monitoring provisions and has requested EPA concurrence.

3. **Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, give details.**

No unexpected O&M difficulties have been encountered

4. **Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.**

Summary of Conversation

For many years, testing showed water quality from the shallow collection trench (SCT) met or was lower than the discharge standards necessary to discharge to the City of New Bedford POTW. The Group requested that EPA authorize the tie in of the SCT to the POTW to avoid the unnecessary and expensive treatment in the onsite treatment plant which EPA approved in 2015. An IPT permit was issued by the City for the discharge. Also, in the last five years the air stripper system installed to replace the UV oxidation system in 2010 has operated effectively and helped reduce the overall operating cost of the GWTP and resulted in less complex operations for the plant with no loss of performance in treatment of the discharge effluent. A new SCADA system was installed in 2017 to insure continued reliable operations since the original system had become outdated and in certain cases replacement parts were becoming hard to obtain.

5. Are the O&M activities being performed consistently with the approved O&M and monitoring plans?

Yes

6. What does the monitoring data (landfill gas, groundwater, surface water, sediment) show?

The Group has been in discussions with EPA for a number of years regarding the suspension of operations at the GWTP and the initiation of performance monitoring. The Group provided information to support achievement of the cleanup criteria starting in mid-2012. EPA expressed concern that because of failed packing rings in a single point of compliance well, the sample from that well may not be reliable. The Group repaired the well in 2013, subsequently sampled the well and provided information to EPA in early 2015 indicating the current criteria in the SOW were achieved. EPA subsequently notified the Group in early/mid 2015 of the intention to undertake an Optimization review which was finalized in early 2016. A number of recommendations were made in the Optimization report, and the Group has conducted additional monitoring, prepared various plans and other document to advance the process and continue to pursue the next milestone. The Group, City and EPA have continued to work to advance the suspension of operation of the GWTP and commencement of the performance monitoring, the next major milestone for the site. The Group continues to believe that the data supports advancing to this stage and that it is important to move expeditiously to achieve this milestone.

The gas monitoring has been ongoing since the system was installed which shows it is effectively controlling landfill gas. Intermittent exceedances of the limit have been reported at discreet locations and a monitoring program is being implemented in 2018 to examine this further as the source could be offsite.

7. Have there been any complaints, violations, or other incidents related to the site in the last five years? If so, please give details of the events and results of the responses.

No, except for a \ a few small exceedances of the discharge limit under the GWTP IPT permit for PCB. The City (as GWTP operator) has taken steps to resolve the issues thru increased O&M activities.

Summary of Conversation

8. **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 (2013 to present)?**

Approximate 5-year cost for the Group are below. Does not include GWTP O&M undertaken by the City.

Year	Total Cost
2013	$391,600
2014	$357,200
2015	$389,100
2016	$346,100
2017	$430,100

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

The process to suspend operation of the GWTP and initiate performance monitoring has and continues to be a protracted process that the Group (and the City of New Bedford) believes has taken more time than necessary. It has been almost six years since the Group initiated this process in June 2012. Although progress has been made and the Group and EPA have a good working relationship, it will be at least another 6 months before this suspension can occur given EPA's request that the Group perform 2 quarterly rounds of sampling from a new well before the GWTP suspension can occur and the approval of the well installation remains pending.

The Group hopes all the parties work diligently toward achieving this important goal.

10. General Comments:

APPENDIX F – MONITORING DATA

Table F-1
Groundwater Treatment Plant Effluent Total Polychlorinated Biphenyls Data
January 2017 through April 2018

Date	Total PCBs (mg/L)
1/6/2017	0.00038 U
1/11/2017	0.00040 U
1/19/2017	0.00048
1/26/2017	0.00040 U
2/2/2017	0.00040 U
2/8/2017	0.00038 U
2/15/2017	0.00038 U
2/23/2017	0.00038 U
3/2/2017	0.000417 U
3/8/2017	0.000377 U
3/16/2017	0.000385 U
3/22/2017	0.000777
3/30/2017	0.000433
4/6/2017	0.000385 U
4/12/2017	0.000385 U
4/19/2017	0.001454
4/26/2017	0.002117
5/4/2017	0.000377 U
5/10/2017	0.000377 U
5/17/2017	**0.00816**
5/24/2017	0.002464
6/1/2017	0.003705
6/14/2018	0.00475
6/22/2017	**0.00744**
6/29/2017	**0.00987**
7/6/2017	**0.0247**
7/19/2017	**0.00629**
8/30/2017	**0.0385**
10/26/2017	**0.01122**
10/31/2017	**0.01481**
11/2/2017	**0.01501**
11/22/2017	0.000671
1/11/2018	0.002004
1/18/2018	0.001803
1/25/2018	0.00284
2/1/2018	0.000759
2/7/2018	0.00068
2/15/2018	0.001609
2/21/2018	0.003477
3/2/2018	**0.00885**
3/7/2018	**0.00525**
3/17/2018	0.00195
3/22/2018	0.002515
3/28/2018	0.00125
4/4/2018	0.00297
4/12/2018	0.000953
4/19/2018	0.002562
4/26/2018	**0.00544**

Notes
Bolded exceed the pre-treatment discharge limit of 0.005 mg/L.
Reference: City of New Bedford GWTP Monthly Reports

Nominal DL = 0.0004 mg/L (actual is adjusted for sample size)

Table F-2
OU-1 Active Recovery System
Points of Compliance - Bedrock Monitoring Wells

Well	Well Screen Location	Total Volatile Organic Compounds (ug/L)										
		Winter 1999	Spring 2001	Summer 2001	Fall 2001	Winter 2001	Spring 2002	Summer 2002	Fall 2002	Winter 2002	Spring 2003	Summer 2003
ECJ-1 (37)	Shallow Bedrock	2,297.6	109.0	64.0	83.0	64.0	64.2	53.2	46.1	37.4	20.3	45.9
ECJ-1 (62)	Shallow Bedrock	72,950.1	9,410	5,383	3,180	1,860	1,164.5	2,017.3	1,505	1,060	1,350	1,120
ECJ-1 (72)	Shallow Bedrock	145,337.1	26,780	37,050	38,330	41,770	66,900	60,690	56,710	33,550	60,800	77,200
ECJ-1 (122)	Intermediate Bedrock	71,911.5	8,532	8,220	6,670	13,263	42,400	8,155	32,760	10,937	6,290	6,570
ECJ-1 (148)	Intermediate Bedrock	36,477.2	74,600	104,600	16,270	18,520	49,550	36,390	71,750	34,900	33,180	27,000
ECJ-1 (267)	Deep Bedrock	106.5	52.1	39.8	37.5	52.5	-	-	-	39.5	-	-
ECJ-2(47)	Shallow Bedrock	2,533	1,920	2,468	1,511	2,171	1,150	2,130	3,167	2,970	1,690	2,530
ECJ-2(82)	Intermediate Bedrock	15,942	16,080	23,990	15,740	18,810	23,470	27,060	22,840	21,200	14,400	13,100
ECJ-2(117)	Intermediate Bedrock	55,380	29,730	51,600	37,600	48,800	31,680	31,800	27,610	29,600	35,410	38,800
ECJ-2(152)	Intermediate Bedrock	400.4	4,594	6,180	11,330	19,570	18,840	38,640	46,030	58,500	62,100	89,300
ECJ-2(187)	Deep Bedrock	3,605.8	4,440	76.4	43,460	5,200	19,220	2,011	29,191	80,240	24,610	25,480
ECJ-3(51)	Shallow Bedrock	-	15.0	ND	12.0	0.6	-	-	-	ND	-	-
ECJ-3(91)	Shallow Bedrock	-	ND	1.0	ND	1.1	-	-	-	ND	-	-
ECJ-3(126)	Intermediate Bedrock	-	ND	1.0	0.9	1.2	-	-	-	ND	-	-
ECJ-3(146)	Intermediate Bedrock	-	-	-	ND	ND	-	-	-	ND	-	-
MW-2	Shallow Bedrock	3,440	2,181	905	1,139	963	1,003	1,163	1,257	1,205	1,349	403.6
MW-12	Shallow Bedrock	106.1	-	-	-	-	-	-	-	-	-	-
MW-13	Shallow Bedrock	991.6	7.1	2.1	13.1	26.9	-	-	-	10.5	-	-
MW-17	Shallow Bedrock	36.4	1.2	20.2	18.4	28.8	-	-	-	0.6	-	
MW-24	Shallow Bedrock	3,843.3	6,530	3,480	6,370	6,040	4,600	3,145	6,052	5,600	3,640	3,860
GCA-1	Shallow Bedrock	13,946.0	172.9	229.6	321.9	284.5	960.0	300.7	822.3	1,054	269.1	207.1
MW-4	Shallow Bedrock	1,271.9	1,034.2	1,113.2	1,149	753.9	1,260	1,193	1,393	1,078	912.4	1,664.5
MW-5	Shallow Bedrock	ND	6.8	3.6	3.9	3.6	-	-	-	2.0	-	-
MW-6	Shallow Bedrock	4,837.2	2,950	3,998	2,137	4,533	4,728	6,081	9,469	6,100	4,000	4,725

Notes
- = Not sampled
ND = Not detected above detection limits
Reference: OBG, 2018

Table F-2
OU-1 Active Recovery System
Points of Compliance - Bedrock Monitoring Wells

Well	Well Screen Location	Total Volatile Organic Compounds (ug/L)										
		Fall 2003	Winter 2003	Spring 2004	Summer 2004	Fall 2004	Winter 2004	Spring 2005	Summer 2005	Fall 2005	Winter 2005	Spring 2006
ECJ-1 (37)	Shallow Bedrock	80.97	55.33	73.51	41.98	60.07	21.1	9.36	512	293.03	40.1	478.58
ECJ-1 (62)	Shallow Bedrock	196.1	100.1	122.77	46.32	50.37	19.39	28.12	61.86	111.82	43.86	72.99
ECJ-1 (72)	Shallow Bedrock	54,200	44,920	39,614	51,170	1378.9	612.5	209.48	611.76	392.3	203.4	244.75
ECJ-1 (122)	Intermediate Bedrock	13,975	3,694	29,582	7,927	23,210	23,990	23,880	55,510	62,480	87,990	118,080
ECJ-1 (148)	Intermediate Bedrock	25,060	29,150	63,170	41,550	54,530	43,420	27,160	55,140	71,040	83,680	108,880
ECJ-1 (267)	Deep Bedrock	-	40.2	-	-	-	45.6	-	-	-	23.63	-
ECJ-2(47)	Shallow Bedrock	1,661	1,466	1,233.9	1,263.7	977.2	403.7	508.8	864.2	785.6	1,005	885.8
ECJ-2(82)	Intermediate Bedrock	25,500	23,100	18,810	13,960	7941.3	2,481.2	1,992.5	2,050	1,885	1,160.5	603
ECJ-2(117)	Intermediate Bedrock	47,100	13,120	9,244	4,638.3	4196.1	3,430.5	1,492	841.5	1,069.5	683.8	1,029.5
ECJ-2(152)	Intermediate Bedrock	50,700	60,100	34,298	27,081	29483	7,004.1	5,341	4,215.5	3,125	3,966	4,048.5
ECJ-2(187)	Deep Bedrock	21,770	17,050	15,692	12,900	15,394	5,047.4	1,769	2,273.8	2,869	2,108.5	2,792
ECJ-3(51)	Shallow Bedrock	-	12	-	-	-	0.13	-	-	-	0.13	-
ECJ-3(91)	Shallow Bedrock	-	ND	-	-	-	28	-	-	-	ND	-
ECJ-3(126)	Intermediate Bedrock	-	6	-	-	-	57	-	-	-	ND	-
ECJ-3(146)	Intermediate Bedrock	-	45.47	-	-	-	0.2	-	-	-	1.06	-
MW-2	Shallow Bedrock	494.8	546.3	596.6	558.4	561.8	553.9	649.5	374.5	313.5	578.6	238.58
MW-12	Shallow Bedrock	-	-	-	-	-	-	-	-	-	-	-
MW-13	Shallow Bedrock	-	3	-	-	-	0.91	-	-	-	0.94	-
MW-17	Shallow Bedrock	-	2.2	-	-	-	0.17	-	-	-	0.86	-
MW-24	Shallow Bedrock	3,222	4,150	3,122	2,879	2,778	2,037	2,467	4,362	3,800	3,050	3,576
GCA-1	Shallow Bedrock	282.6	253.7	292.3	206.6	219.61	164.78	164.25	285.1	203.3	167.65	166.85
MW-4	Shallow Bedrock	2,449	1,019.8	1,495.6	1,532.1	1,373.7	1,172.4	1,122.3	1,774	1,016.5	1,725.25	2,588.05
MW-5	Shallow Bedrock	-	ND	-	-	-	0.15	-	-	-	ND	-
MW-6	Shallow Bedrock	1,001	1,639	1,615.2	992	1,055.3	1,321.9	1,858.2	2,012	1,804.5	1,979.5	1,801.3

Notes
- = Not sampled
ND = Not detected above detection limits
Reference: OBG, 2018

Table F-2
OU-1 Active Recovery System
Points of Compliance - Bedrock Monitoring Wells

Well	Well Screen Location	Total Volatile Organic Compounds (ug/L)									
		Summer 2006	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Fall 2007	Winter 2007	Spring 2008	Summer 2008	Fall 2008
ECJ-1 (37)	Shallow Bedrock	274.4	199.9	36.13	-	-	-	21.19	-	30.5 J	-
ECJ-1 (62)	Shallow Bedrock	62.51	48.1	113.3	107.55	-	-	69.1	1809.7 J	187.95 J	81.08 J
ECJ-1 (72)	Shallow Bedrock	249.8	303.05	620.9	814.1	708.75	289.3	650.8	1787.4 J	731.8 J	328
ECJ-1 (122)	Intermediate Bedrock	111,880	113,980	487	984.65	902.05	227.3	658.4	1900.4 J	730.4 J	418
ECJ-1 (148)	Intermediate Bedrock	111,860	118,020	635.4	944	814.6	260.3	635.4	486.4 J	643.4 J	484.2
ECJ-1 (267)	Deep Bedrock	-	-	116.05	-	-	-	416.85	-	-	-
ECJ-2(47)	Shallow Bedrock	688.8	1,859	1,210.2	552	1,601.5	881.15	391.2	553.5 J	2447.2 J	580.6 J
ECJ-2(82)	Intermediate Bedrock	774.8	1,710	1,101.6	820.7	1,708	969	265	645 J	2583.8 J	758.3 J
ECJ-2(117)	Intermediate Bedrock	981.5	2,542	3,102.4	3,110.5	4,114.5	9,901.5	4,414	3380 J	20416 J	5766 J
ECJ-2(152)	Intermediate Bedrock	2,966	6,014	2,322.5	2,739.5	2,451	1,932.5	2,448	874.5 J	1,158	1685 J
ECJ-2(187)	Deep Bedrock	3,493.5	6,502	1,722	2,024	1,737.5	1,775	1,345.5	858 J	1,471.5	1341 J
ECJ-3(51)	Shallow Bedrock	-	-	ND	-	-	-	0.51	-	-	-
ECJ-3(91)	Shallow Bedrock	-	-	ND	-	-	-	1.61	-	-	-
ECJ-3(126)	Intermediate Bedrock	-	-	0.11	-	-	-	0.24	-	-	-
ECJ-3(146)	Intermediate Bedrock	-	-	0.24	-	-	-	1.95	-	-	-
MW-2	Shallow Bedrock	244.92	246.92	329.19	426.7	408.4	492.1	527.2	504.4	187 J	213.3 J
MW-12	Shallow Bedrock	-	-	-	-	-	-	-	-	-	-
MW-13	Shallow Bedrock	-	-	0.88	-	-	-	1.72	-	-	-
MW-17	Shallow Bedrock	-	-	1.07	-	-	-	6.61	-	-	-
MW-24	Shallow Bedrock	4,056	7,192	6,708	5,743	6,696	8,337.5	8,056	5082 J	3728 J	5782 J
GCA-1	Shallow Bedrock	206.35	191.3	204.05	171.95	157.1	177.3	193.4	141.1	127.45 J	172.15 J
MW-4	Shallow Bedrock	2,110	2,207	1,553.5	1,220.5	982.5	967.75	639.6	1630	1926.2 J	1480.8 J
MW-5	Shallow Bedrock	-	-	4.64	-	-	-	8.28	-	-	-
MW-6	Shallow Bedrock	1,694.5	2,074.5	2,061.5	1,777.5	1,579.5	1,603	1,359	1264.5 J	1147 J	1,047.5

Notes
- = Not sampled
ND = Not detected above detection limits
Reference: OBG, 2018

Table F-2
OU-1 Active Recovery System
Points of Compliance - Bedrock Monitoring Wells

Well	Well Screen Location	Total Volatile Organic Compounds (ug/L)									
		Winter 2008	Spring 2009	Fall 2009	Spring 2010	Fall 2010	Spring 2011	Fall 2011	Spring 2012	Fall 2012	Spring 2013
ECJ-1 (37)	Shallow Bedrock	26.45 J	483.7	245.24	75.21	277	42.77	14.6	40.32	309	-
ECJ-1 (62)	Shallow Bedrock	63.58 J	462	241	287.4	187.4	104.35	82	439.3	279.5	200
ECJ-1 (72)	Shallow Bedrock	45 J	595	265.2	435.1	292.5	583.6	339.4	441	223.54	385.1
ECJ-1 (122)	Intermediate Bedrock	282.2 J	598.8	278	556.8	1562.4	566.8	325.1	813	55.69	591.05
ECJ-1 (148)	Intermediate Bedrock	305.8 J	534.6	278.2	691.2	1509.4	518.4	486.2	1093.55	138.15	620.45
ECJ-1 (267)	Deep Bedrock	218 J	262.6	236.8	-	283.1	-	219.8	-	-	-
ECJ-2(47)	Shallow Bedrock	399.4 J	4341.2	-	-	-	*	*	*	*	*
ECJ-2(82)	Intermediate Bedrock	444.8	3624	-	-	-	*	*	*	*	*
ECJ-2(117)	Intermediate Bedrock	-	28795.5 J	-	-	-	*	*	*	*	*
ECJ-2(152)	Intermediate Bedrock	832.2 J	35,912.5	-	-	-	*	*	*	*	*
ECJ-2(187)	Deep Bedrock	584.2	2,982.5	-	-	-	*	*	*	*	*
ECJ-3(51)	Shallow Bedrock	0.12 J	-	1.22	-	0.49 J	-	0.59	-	0.32	-
ECJ-3(91)	Shallow Bedrock	0.13 J	-	3.14	-	0.50 J	-	1.15	-	0.34	-
ECJ-3(126)	Intermediate Bedrock	2.7 J	-	1.49	-	0.35 J	-	1.29	-	0.3	-
ECJ-3(146)	Intermediate Bedrock	9.97 J	-	4.7	-	0.31 J	-	1.35	-	0.35	-
MW-2	Shallow Bedrock	296.25 J	386.7	950.4	1367.2	636.95	923.2	868.2	851.4	729.6	820.0
MW-12	Shallow Bedrock	-	-	-	-	-	-	-	-	-	-
MW-13	Shallow Bedrock	0.57 J	-	1.72	-	699.31	-	0.42	-	2.67	-
MW-17	Shallow Bedrock	0.46 J	-	-	-	6.87	-	2.49	-	3.66	-
MW-24	Shallow Bedrock	5532 J	4,650	5,596	5,264	6,990	8,348	4,772	6016	9048	7610
GCA-1	Shallow Bedrock	171.4 J	127.85	213.95	149.92	177.36	191.34	143.81	263.8	221.8	151.46
MW-4	Shallow Bedrock	1501.4 J	1791.4	2160.5	2463.5	2412	2270.5	894.65	2087.5	2106.5	1784
MW-5	Shallow Bedrock	5.58 J	-	1.77	-	U	-	0.25	-	1.75	-
MW-6	Shallow Bedrock	1007.5 J	740.25	2,018.8	2,053.5	3,341	1,382.5	561.5	685.5	367.4	301.8

Notes
- = Not sampled
ND = Not detected above detection limits
Reference: OBG, 2018
* = Well damaged. Data inconclusive and not reported.

Table F-2
OU-1 Active Recovery System
Points of Compliance - Bedrock Monitoring Wells

Well	Well Screen Location	Total Volatile Organic Compounds (ug/L)								
		Fall 2013	Spring 2014	Fall 2014	Spring 2015	Fall 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2017
ECJ-1 (37)	Shallow Bedrock	-	90.4	113.94	50.94	32.22	21.87	-	22.62	187.12
ECJ-1 (62)	Shallow Bedrock	57.34	113.47	220.74	119.7	27.54	171.11	93.99	101.58	231
ECJ-1 (72)	Shallow Bedrock	400.1	172.4	319.6	300	112	427.55	376.31	262.29	414.4
ECJ-1 (122)	Intermediate Bedrock	437.85	181.35	455.7	499.35	200.65	550.16	374.8	514	617.81
ECJ-1 (148)	Intermediate Bedrock	436.05	284.75	445.55	497.6	247.6	601	376.8	558.61	543.21
ECJ-1 (267)	Deep Bedrock	-	-	-	-	-	1084.8	830.8	1027.1	1181.41
ECJ-2(47)	Shallow Bedrock	169.3	471.6	702.6	2034.2	2914.5	630.51	2603.93	473.82	1362.12
ECJ-2(82)	Intermediate Bedrock	-	-	-	-	-	-	-	-	-
ECJ-2(117)	Intermediate Bedrock	3095	25.71	2922	20050	3507	2447.68	11997.9	2381.1	5552.8
ECJ-2(152)	Intermediate Bedrock	90.14	12.81	21.4	9.91	355.75	12.2	1032.5	47.38	398.63
ECJ-2(187)	Deep Bedrock	56.18	14.78	43.41	49.95	145.6	58.5	228.6	34.76	284.14
ECJ-3(51)	Shallow Bedrock	11.49	5.93	0.33	0.56	2.06	U	0.94	0.61	U
ECJ-3(91)	Shallow Bedrock	3.03	5.55	17.97	0.75	1.86	0.6	1.7	U	0.59
ECJ-3(126)	Intermediate Bedrock	43.3	4.88	12.58	1.03	2.02	U	2	U	0.3
ECJ-3(146)	Intermediate Bedrock	3.23	3.33	40.84	1.52	0.13	3.3	U	U	0.64
MW-2	Shallow Bedrock	206.50	287.15	365.3	468.95	105.78	222.76	269.26	340.89	175.38
MW-12	Shallow Bedrock	-	-	-	-	-	-	-	-	-
MW-13	Shallow Bedrock	0.76	0.29	0.56	0.86	1.71	U	U	U	U
MW-17	Shallow Bedrock	0.67	1.22	U	U	3.11	2.91	1.79	U	1.2
MW-24	Shallow Bedrock	7300	4954	7370	6200	5168	4594	5895	5788	4518
GCA-1	Shallow Bedrock	165.05	559.55	458.45	195.05	171	187.37	159.44	143.01	372.39
MW-4	Shallow Bedrock	1229.25	1876	2059.25	1641.5	1801.55	1476.03	2163.8	1862.3	1055.54
MW-5	Shallow Bedrock	0.14	-	0.12	-	U	U	U	U	U
MW-6	Shallow Bedrock	217.4	377.2	468.1	586.8	159.6	445.6	368.1	308.95	363.6

Notes
- = Not sampled
ND = Not detected above detection limits
Reference: OBG, 2018

Table F-3

Summary of Three-Month PCB Evaluation Results for the Extraction System and Blended PCB Concentration Calculations

Date	Well ID *	Turbidity (NTU)	Total PCB Aroclors (ug/L)	Filtered PCB Aroclors (ug/L)	Total Filtered PCB Congeners (ug/L)	Extraction Rate (gpm)
8/19/16						
	OBG-1	131	14980	1250.2	13.64	2.01
	OBG-2	164	17.88	1.64	2.79	4.19
	OBG-3	3.75	14.41	ND (0.25)	3.14	0.72
	BEI-1 *	86.7	48.7/51.3	ND (0.27/0.26)	0.74/0.14 (avg 0.44)	2.07
	BEI-2	390	12.1	ND (0.26)	6.12	0.66
	BEI-3	25.9	4.1	0.41	0.31	0.71
	SCT	56.3	2.9	ND (0.26)	1.53	13.45

	With SCT	W/O SCT
Total Extraction Rate (gpm)	23.81	10.36
Total Blended Concentration (ug/L)	**2.8**	**4.5**

Date	Well ID *	Turbidity (NTU)	Total PCB Aroclors (ug/L)	Filtered PCB Aroclors (ug/L)	Total Filtered PCB Congeners (ug/L)	Extraction Rate (gpm)
9/20/16						
	OBG-1 *	349	7140/1516	504/177.2	145.11/41.25 (avg 93.18)	2.24
	OBG-2	112	49.8	42.7	10.12	4.86
	OBG-3	>1000	589	18.7	29.07	0.74
	BEI-1	176	24.75	0.58	0.73	1.95
	BEI-2	97.7	12.4	2.05	5.78	0.68
	BEI-3	30.6	41.5	ND (0.25)	0.08	0.64
	SCT	7.41	12.19	5.3	0.42	15.71

	With SCT	W/O SCT
Total Extraction Rate (gpm)	26.82	11.11
Total Blended Concentration (ug/L)	**10.9**	**25.6**

Date	Well ID *	Turbidity (NTU)	Total PCB Aroclors (ug/L)	Filtered PCB Aroclors (ug/L)	Total Filtered PCB Congeners (ug/L)	Extraction Rate (gpm)
10/19/16						
	OBG-1 *	464	3140/2360	51.2/526	52.71/30.10 (avg 41.41)	2.04
	OBG-2	15.8	8.77	2.86	9.53	4.03
	OBG-3	11.1	20.7	ND (0.27)	0.11	0.62
	BEI-1	>800	40	0.305	1.01	2.52
	BEI-2	26.4	6.78	1.54	3.80	0.68
	BEI-3	6.72	6.9	ND (0.27)	1.87	0.60
	SCT	82.9	1.3	ND (0.29)	2.87	15.13

	With SCT	W/O SCT
Total Extraction Rate (gpm)	25.62	10.49
Total Blended Concentration (ug/L)	**6.7**	**12.3**

NOTES

* average of sample and field duplicate used

Reference: Data obtained from PMC, 2017.

Table F-4
Summary of OU1 Bi-Annual Sediment Sampling Data with Comparison to OU1 Cleanup Levels

	Upstream and Maximum Downstream Concentrations for OU1 Sediment Samples [1,2]						Cleanup Level for OU1 Sediments
	September 2013		September 2015		September 2017		
	Upstream Location (SD-5)	Maximum Downstream Concentration	Upstream Location (SD-5)	Maximum Downstream Concentration	Upstream Location (SD-5)	Maximum Downstream Concentration	
Polychlorinated Biphenyls (ug/kg)							
Aroclor 1248	--	ND	ND	ND	140	85	
Aroclor 1254	--	2,410	ND	535	462	952	
Aroclor 1260	--	ND	ND	ND	190	220	
ug Total PCBs/g Carbon	--	17.5	ND	13.7	18.0	37.0	20
Polycyclic Aromatic Hydrocarbons (ug/kg)							
1,2-Benzphenanthracene	--	800	--	--	--	--	
2-Methylnaphthalene	--	ND	ND	ND	20.1	ND	
Acenaphthene	--	ND	ND	ND	23.8	27.4	
Acenaphthylene	--	ND	ND	ND	55.9	14.2	
Anthracene	--	220 J	ND	ND	114	119	
Benzo(a)anthracene	--	590	130	1,900	244	527	
Benzo(a)pyrene	--	1,200	150	1,400	318	672	
Benzo(b)fluoranthene	--	3,000 J	380	3,000	545	1,100	
Benzo(g,h,i)perylene	--	730	84	1,000	598	539	
Benzo(k)fluoranthene	--	800	130	1,400	179	324	
Chrysene	--	ND	200	1,800	464	820	
Dibenzo(a,h)anthracene	--	140	ND	ND	105	196	
Fluoranthene	--	2,800	420	4,500	701	1,570	
Fluorene	--	ND	ND	ND	29.4	34	
Indeno(1,2,3-cd)pyrene	--	570	83	950	363	460	
Naphthalene		ND	ND	ND	42	6.47	
Phenanthrene	--	1,300	ND	ND	349	657	
Pyrene	--	2,000	350	3,400	533	1,360	
Metals (mg/kg)							
Aluminum	--	12,000	2,700	9,300	5,910	9,060	
Antimony	--	1.5	ND	1.3	ND	ND	
Arsenic	--	4.5	2.5	7.6	3.9	2.6	
Barium	--	60	49	86	36.5	50.1	
Beryllium	--	ND	ND	1.3	ND	0.33	
Cadmium	--	ND	ND	ND	ND	0.27 J	
Calcium	--	2,000	1,700	2,200	2,200	1,950	
Chromium	--	32	9.1	74	40.3	14.6	
Cobalt	--	8.2	ND	8.7	ND	2.9 J	
Copper	--	24	12	21	40.4	21.1	
Iron	--	19,000 J	36,000 J	15,000 J	14,200	13,500	
Lead	--	40	23 J	52 J	91.7 J	136 J	
Magnesium	--	5,500	1,200	7,200	3,380	2,200	
Manganese	--	430	1,500	360	191	612	
Mercury	--	ND	ND	ND	0.074	0.048	
Nickel	--	19	5	32	14.2	8.3	
Potassium	--	3,200	460	2,600	ND	359 J	
Selenium	--	ND	ND	1.3	ND	ND	
Sodium	--	270	380	350	ND	204 J	
Thallium	--	ND	ND	2.5	ND	1.2 J	
Vanadium	--	31	11	27	27.4	20.6	
Zinc	--	75	110 J-	120 J-	375	90.7	

NOTES

1. Samples were collected from the OU1 cap swale (upstream of the former disposal area) and from four locations downstream of the former disposal area including the unnamed stream, sedimentation basin, OU1 diversion swale, and a location just downstream of the Hathaway Road culvert.
2. Only detected analytes are shown.

ND - Not Detected

J - Estimated value; J- - Estimated value that is biased low

Reference: (OBG, 2014; OBG, 2016; OBG, 2018a; and OBG, 2018b)

Table F-5
Summary of OU1 Bi-Annual Surface Water Sampling Data

	Maximum Downstream Concentrations for OU1 Surface Water Samples [1,2]			Most Recent Upstream Concentrations for OU1 Surface Water (Location SW-5) [1,2,3]
	September 2013	September 2015	September 2017	October 2011
Volatile Organic Compounds (ug/L)				
Acetone	ND	6.83 J	ND	ND
Benzene	0.11 J	ND	0.32 J	ND
Chlorobenzene	0.27 J	ND	0.53 J	ND
Chloroform	ND	ND	ND	0.1 J
Cis-1,2-dichloroethene	0.24 J	0.4 J	0.66 J	ND
Toluene	ND	ND	0.38 J	ND
Vinyl chloride	ND	0.42 J	ND	ND
Polychlorinated Biphenyls (ug/L)				
None Detected				
Polycyclic Aromatic Hydrocarbons (ug/L)				
Benzo(b)fluoranthene	ND	ND	0.181	ND
Fluoranthene	ND	ND	0.221	ND
Phenanthrene	ND	ND	0.103 J	ND
Pyrene	ND	ND	0.16	ND
Dissolved Metals (mg/L)				
Aluminum	ND	ND	ND	ND
Barium	ND	0.23	0.205	ND
Calcium	21	42	37.7	22
Cobalt	ND	ND	0.0018 J	ND
Copper	ND	ND	0.0032 J	ND
Iron	0.84	1.8	2.26	0.47
Magnesium	6.1	10	8.2	6
Manganese	0.5	0.55	2.67	0.37
Nickel	ND	ND	0.0018 J	ND
Potassium	5.3	8.5	9 J	6.4
Sodium	140 J	390	369	150
Zinc	0.03	0.02	0.02	ND

NOTES

1. Downstream surface water samples are collected from four locations downstream of the former disposal area including the unnamed stream, sedimentation basin, OU1 diversion swale, and a location just downstream of the Hathaway Road culvert. The upstream surface water sample location is within the OU1 cap swale (upstream of the former disposal area).
2. Only detected analytes are shown.
3. Upstream sample location SW-5 was reported as dry during the September 2013, September 2015, and September 2017 monitoring events and thus, no surface water samples were collected.

ND - Not Detected
J - Estimated value
Reference: (OBG, 2012; OBG, 2014; OBG, 2016; OBG, 2018a)

Table F-6
Summary of OU2 Sediment and Soil Data with Comparison to OU2 Cleanup Levels

Concentrations for Unnamed Stream Sediment Samples, September 2017 Monitoring Event [1,2]					Cleanup Level for
Sample ID:	**SDPC1b**	**SDPC2a**	**SDPC3a**	**SDPC4b**	**Aquatic Sediments**
Polychlorinated Biphenyls (ug/kg)					
Aroclor 1016	17.8	85.6	16.0	36.3	
Aroclor 1254	64.1	155	41.1	85.6	
Total PCBs	81.9	240.6	57.1	121.9	
TOC (ppm)	23000	5300	2000	17000	
ug Total PCBs/g Carbon	3.56	**45.40**	**28.6**	7.2	20

	Maximum Concentrations in September 2017 Wetland Soil Samples [1,2]		Cleanup Level for
	Adjacent Wetlands	**Middle Marsh**	**Non-Aquatic Soil/Sediment**
Polychlorinated Biphenyls (ug/kg)			
Aroclor 1254	18.4	177	
Aroclor 1260	ND	42.1	
Total PCBs	18.4	219.1	15,000

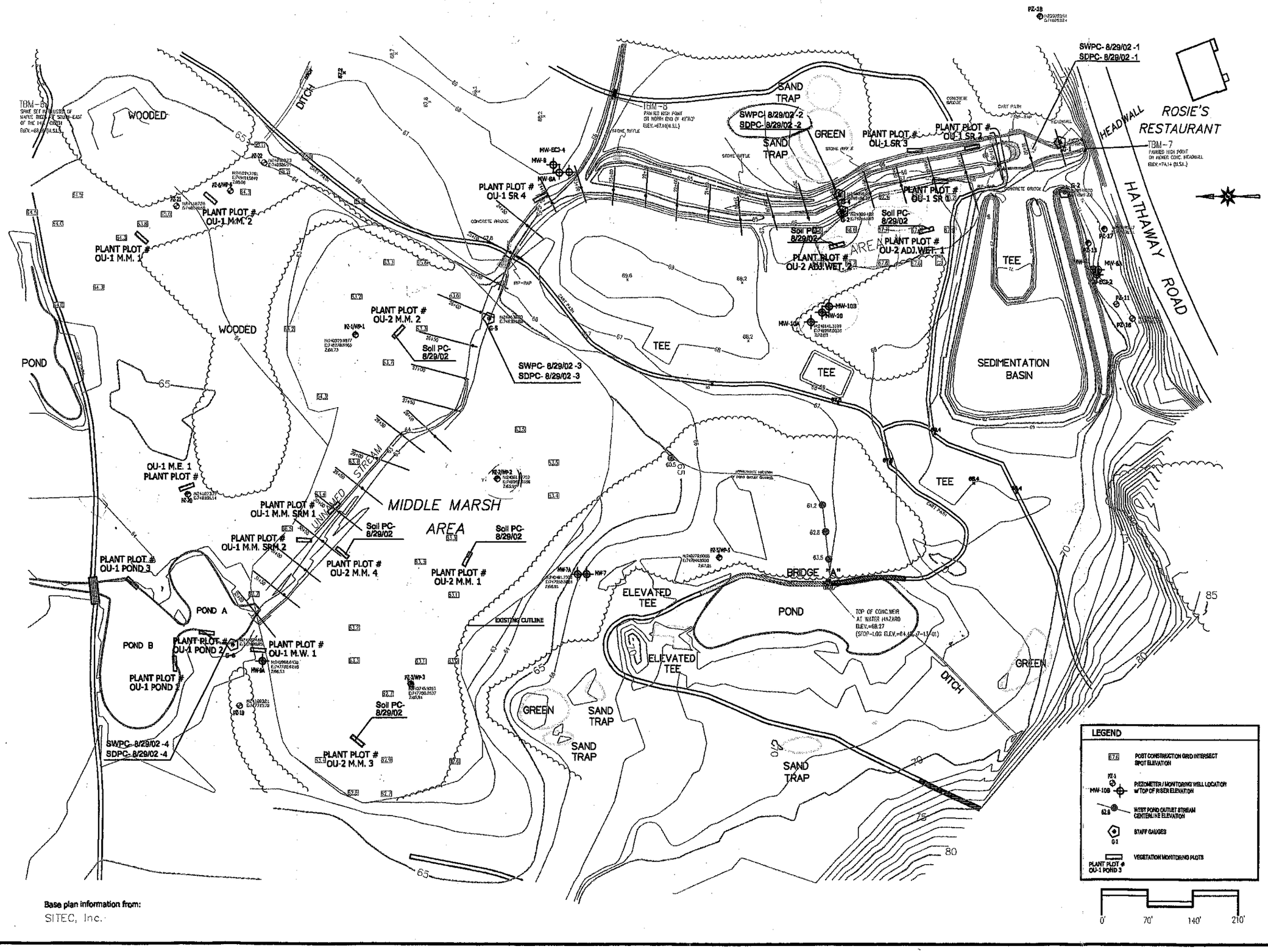
NOTES

1. Samples were collected from four locations within the unnamed stream, three locations within the Middle Marsh, and two locations within the Adjacent Wetland.
2. Only detected Aroclors are shown.

ND - Not Detected

Reference: (CONB, 2018a)

APPENDIX G – 2017 WETLANDS MONITORING DATA SHEETS AND FIGURE
(EXCERPTED FROM CONB, 2018b)



Base plan information from:
SITEC, Inc.

NEW ENGLAND ENVIRONMENTAL, INC.
ENVIRONMENTAL CONSULTING SERVICES
9 Research Drive • Amherst, MA 01002
(413) 256-0202 • Fax: (413) 256-1092

MACTEC Constructors, Inc.
A MACTEC Company
MACTEC Constructors, Inc.
1627 Cole Boulevard
Golden, CO 80401-3305
(303) 278-3100

Date: 1/29/03
Scale: 1"=140'-0"
Drawn by: GSL
Checked by: MJM
NEE File # 02-1944 & 02-1945
DEP #

VEGETATION MONITORING

AS-BUILT LOCATIONS OF PIEZOMETERS, MONITORING WELLS, STAFF GAUGES AND VEGETATION MONITORING PLOTS.

SULLIVAN'S LEDGE SUPERFUND SITE
Hathaway Road
New Bedford, MA

REVISIONS	DATE	BY

Fig 1

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU1 SR1 Date: 9/18/17

Tree Growth and Plant Survivorship

Herb.	Common name	scientific name	USFW	% cover	% Dom.	Dom. Plant	Dom Wetl. Species
	Ground Ivy	*Glechoma hederacea*	FacU	20%	50%	Y	N
	Ox Eye Sunflower	*Heliopsis helianthoides*	FacU	15%	38%	Y	N
	Jewelweed	*Impatiens capensis*	FacW	5%	13%	N	
Shrub	**Common Name**	**Scientific Name**	**USFW**	**total # of Indiv.**	**% Dom.**	**Dom plant**	**Dom Wetl. Species**
	Bankers Dwarf Willow	*Salix x cotteti*	NC*	22	42%	Y	Y
	Winterberry	*Ilex verticillata*	FacW	11	21%	Y	Y
	Speckled Alder	*Alnus incana*	FacW	5	10%	N	
	Red Osier Dogwood	*Cornus sericea*	FacW	4	8%	N	
	Arrowwood	*Viburnum recognitum*	Fac	3	6%	N	
	Possumhaw	*Viburnum nudum*	FacU	3	6%	N	
	Elderberry	*Sambucus canadensis*	FacW	2	4%	N	
	Tatarian Honeysuckle	*Lonicera tatarica*	FacU	2	4%	N	
	* Not Classified - growing on banks of the unamed stream = at least a Fac designation						

Sapling	Common name	scientific name	USFW	Hgt	DBH	Basal Area	% Dom	Dom plant	Dom Wet. Species
				feet	inches	sq. inches			
	Speckled Alder	*Alnus incana*	FacW	30	1.9	2.8			
	Speckled Alder	*Alnus incana*	FacW	30	1.7	2.3			
	Speckled Alder	Alnus incana	FacW	30	0.9	0.6			
	Speckled Alder	*Alnus incana*	FacW	30	1.2	1.1			
	Speckled Alder	*Alnus incana*	FacW	25	1.2	1.1			
	Speckled Alder	*Alnus incana*	FacW	25	0.8	**0.5**			
	Speckled Alder	*Alnus incana*	FacW	25	0.7	0.4			
	Speckled Alder	*Alnus incana*	FacW	25	2.4	4.5			
		Sum of *Alnus* B.A.				**13.3**	**73%**	**Y**	**Y**
	Bebb Willow	*Salix bebbiana*	FacW	20	2.5	4.9			
				Sum of *Salix* B.A.		**4.9**	**27%**	**Y**	**Y**

Tree	Common name	scientific name	USFW	Hgt	DBH	Basal Area	% Dom	Dom species	Dom Wet. Species
				feet	inches	sq. inches			
	Green Ash	*Fraxinus pennsylvanica*	FacW	30	5.3	22.1			
	Green Ash	*Fraxinus pennsylvanica*	FacW	30	5.8	26.4			
				Sum of *Fraxinus* B.A.:		**48.5**	**62%**	**Y**	**Y**
	Bebb Willow	*Salix bebbiana*	FacW	25	6.1	29.2			
				Sum of *Salix* B.A.		**29.2**	**38%**	**Y**	**Y**

Total number of Dominant wetland species: 6; Total number of Dominant upland species :2

Soil Survey of Bristol County - South, 1981									
soil type mapped: UD									
hydric soil inclusions-yes									
field observations consistent with Soil Survey:									
No, Superfund site with wetland remediation monitoring									
Soil Description									
Horizon	**Depth**	**Matrix Color**		**Mottles color**					
O	1/4"-0								
A	0-8"	10YR2/1		none					
B	8"-16"	10YR4/1		10YR4/6					
Is Soil Hydric?	yes								
Other Indicators Of Hydrology:									
site inundated									
depth to free water in observation hole:12"									
depth to soil saturation in observation hole: 8"									
water marks									
drift lines									
sediment deposits									
drainage patterns in BVW									
oxidized rhizospheres: YES									
water stained leaves:									
other:									
VEGETATION AND HYDROLOGY CONCLUSION									
# of wetland plants greater than non wetland indicator plants			yes						
hydric soil present			yes						
other indicators of hydrology present			yes						
Sample is located in a BVW			yes						

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU1 SR2 Date: 8/3/2017

Tree Growth and Plant Survivorship

Herb.	Common name	scientific name	USFW	% cover	% Dom.	Dom. Plant	Dom Wetl. Species
	Jewelweed	*Impatiens capensis*	FacW	15%	20%	Y	Y
	Purple Loosestrife	*Lythrum salicaria*	Obl	15%	20%	Y	Y
	Horsetail	*Equisetum arvense*	Fac	15%	20%	Y	Y
	White Wood Aster	*Aster divaricatus*	FacW	10%	13%	N	
	Multiflora Rose	*Rosa multiflora*	FacU	10%	13%	N	
	Duckweed	*Lemna sp.*	Obl	5%	7%	N	
	Red Osier Dogwood	*Cornus sericea*	FacW	5%	7%	N	
Shrub	**Common Name**	**Scientific Name**	**USFW**	**total # of Indiv.**	**% Dom.**	**Dom plant**	**Dom Wetl. Species**
	Bebb Willow	*Salix bebbiana*	FacW	28	72%	Y	Y
	Speckled Alder	*Alnus incana*	FacW	5	13%	N	
	Arrowwood	*Viburnum dentatum*	Fac	5	13%	N	
	Tatarian Honeysuckle	*Lonicera tatarica*	FacU	1	3%	N	

Sapling	Common name	scientific name	USFW	Hgt	DBH	Basal Area	% Dom	Dom species	Dom Wetl.
				feet	inches	sq. inches			**Species**
	Bebb Willow	*Salix bebbiana*	FacW	20	3.1	7.6			
	Bebb Willow	*Salix bebbiana*	FacW	20	4.3	14.5			
	Bebb Willow	*Salix bebbiana*	FacW	20	3	7.1			
	Bebb Willow	*Salix bebbiana*	FacW	20	2.9	6.6			
		sum of *Salix* B.A.				**35.8**	**62%**	**Y**	**Y**
	Red Maple	*Acer rubrum*	Fac	20	3.1	7.6			
	Red Maple	*Acer rubrum*	Fac	20	4.20	13.9			
		sum of *Acer* Basal Area				**21.50**	**38%**	**Y**	**Y**
Tree	**Common name**	**scientific name**	**USFW**	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom species**	**Dom Wetl**
				feet	inches	inches			**Species**
	Eastern Cottonwood	*Populus deltoides*	Fac	40	13.7	147.4			
	Eastern Cottonwood	*Populus deltoides*	Fac	30	8.3	54.1			
		sum of *Populus* B.A.				**201.5**	**81%**	**Y**	**Y**
	Black Locust	*Robinia psuedoac.*	FacU	25	5.60	24.6			
	Black Locust	*Robinia psuedoac.*	FacU	25	5.50	23.8			
		sum of *Robinia* B.A.				**48.4**	**19%**	**N**	

Total number of Dominant wetland species: 7; Total number of Dominant upland species:0								
Indicators of Hydrology								
Hydric Soil Interpretation								
Soil Survey of Bristol County - South, 1981								
soil type mapped: UD								
hydric soil inclusions-yes								
field observations consistent with Soil Survey:								
No, Superfund site with wetland remediation monitoring								
soil description								
Horizon	**depth**	**matrix color**		**Mottles color**				
O	1/4"-0							
A	0-8"	10YR 2/1						
B	8"-12"	2.5YR 5/1		5YR 4/8				
Is Soil Hydric?	yes							
other indicators of hydrology								
site inundated:								
depth to free water in observation hole: 4"								
depth to soil saturation in observation hole: Surface								
water marks								
drift lines								
sediment deposits								
drainage patterns in BVW: YES								
oxidized rhizospheres								
water stained leaves								
other								
VEGETATION AND HYDROLOGY CONCLUSION								
# of wetland plants greater than non wetland indicator plants			yes					
hydric soil present			yes					
other indicators of hydrology present			yes					
Sample is located in a BVW			yes					

Sullivan's Ledge
Summer/Fall 2017
Plot ID:OU1 SR3 **Date: 9/18/2017**

Tree Growth and Plant Survivorship

Herb.	**Common name**	**scientific name**	**USFW**	**% cover**	**% Dom.**	**Dom. Plant**	**Dom Wetl. Species**
	Jewelweed	*Impatiens capensis*	FacW	20%	67%	Y	Y
	Horesetail	*Equisetum arvense*	Fac	5%	17%	N	
	Multiflora Rose	*Rosa multiflora*	FacU	5%	17%	N	

Shrub	**Common Name**	**Scientific Name**	**USFW**	**total #**	**% Dom.**	**Dom plant**	**Dom Wetl. Species**
				of Indiv.			
	Arrowwood	*Viburnum recognitum*	Fac	10	33%	Y	Y
	Sweet Pepperbush	*Clethra alnifolia*	Fac	8	27%	Y	Y
	Red Osier Dogwood	*Cornus sericea*	FacW	5	17%	N	
	Bebb Willow	*Salix bebbiana*	FacW	3	10%	N	
	Speckled Alder	*Alnus incana*	FacW	2	7%	N	
	Red Maple	*Acer rubrum*	Fac	2	7%	N	

Sapling	**Common name**	**scientific name**	**USFW**	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom species**	**Dom Wetl.**
									Species
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.3	1.3			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.4	1.5			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.6	2			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.2	1.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.2	1.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.4	9.1			
			Sum of *Salix* B.A.			**16.1**	**85%**	**Y**	**Y**
	Red Maple	Acer rubrum	Fac	20'	1.50	1.8			
	Red Maple	Acer rubrum	Fac	20'	1.2	1.1			
			Sum of *Acer* B.A.			**2.9**	**15%**	**N**	

	Common name	**scientific name**	**USFW**	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom species**	**Dom Wetl**
Tree									**Species**
	Black Locust	*Robinia psuedoac.*	FacU	25'	6.9	37.4			
	Black Locust	*Robinia psuedoac.*	FacU	25'	7.1	39.6			
				Sum of *Robinia* B.A.		**77**	**37%**	**Y**	**N**
	Eastern Cottonwood	***Populus deltoides***	**Fac**	**25'**	**8.8**	**60.8**	**29%**	**Y**	**Y**
	Bebb Willow	Salix bebbiana	FacW	20'	**6.1**	**29.2**			
	Bebb Willow	*Salix bebbiana*	FacW	20'	5.7	25.5			
				Sum of Salix B.A.		**54.7**	**26%**	**Y**	**Y**
	Green Ash	Fraxinus pennsylvanica	FacW	30'	5.1	20.4	10%	N	
				Sum of *Fraxinus* B.A		**20.4**	**10%**	**N**	

Total number of Dominant wetland species: 5 ; Total number of Dominant upland species 1:

Indicators of Hydrology
Hydric Soil Interpretation
Soil Survey of Bristol County - South, 1981
soil type mapped: UD
hydric soil inclusions-yes
field observations consistent with Soil Survey:
No, Superfund site with wetland remediation monitoring

soil description

Horizon	**Depth**	**Matrix Color**	**Mottles Color**
O	1/4"-0		
A	0-6"	10YR2/1	
B	6-16"	10YR5/1	10YR4/4

Is Soil Hydric? Yes

other indicators of hydrology
site inundated
depth to free water in observation hole
depth to soil saturation in observation hole: 10"
water marks
drift lines
sediment deposits
drainage patterns in BVW
oxidized rhizospheres
water stained leaves
other

VEGETATION AND HYDROLOGY CONCLUSION
# of wetland plants greater than non wetland indicator plants: yes
hydric soil present : yes
other indicators of hydrology present: yes
Sample is located in a BVW : yes

Sullivan's Ledge
Summer/Fall 2017
Plot ID:OU1 SR4 **Date: 10/4/2017**

Tree Growth and Plant Survivorship

Herb.	**Common name**	**scientific name**	**USFW**	**% cover**	**% Dom.**	**Dom. Plant**	**Dom Wetl. Species**	
	Ox Eye Sunflower	*Heliopsis helianthoides*	FacU	35%	78%	Yes	No	
	Joe Pye Weed	*Eupatorium maculatum*	Obl	10%	22%	Yes	Yes	
Shrub	**Common Name**	**Scientific Name**	**USFW**	**total #**	**% Dom.**	**Dom plant**	**Dom Wetl. Species**	
				of Indiv.				
	Basket Willow	*Salix purpurea*	FacW	8**	44%	**Yes**	Yes	
	Banker's Dwarf Willow	*Salix x cotteti*	NC*	10**	56%	**Yes**	Yes	
	* Not Classified - growing on banks of the unamed stream = at least a Fac designation							
	** Individual willow stems are cut 2' above-ground and many suckers sprout from stems which provide dense cover.							
	Cutting is permitted to allow golfers to see and eliminate safety hazard							

Sapling	**Common name**	**scientific name**	**USFW**	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom species**	**Dom Wetl**
None									**Species**
Tree	**Common Name**	**scientific name**	**USFW**	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom species**	**Dom Wetl**
									Species
	Black Willow	*Salix nigra*	Obl	25'	5	19.6			
	Black Willow	Salix nigra	Obl	25'	6.3	31.2			
	Black Willow	Salix nigra	Obl	25'	6.1	29.2			
	Black Willow	Salix nigra	Obl	20'	5.5	23.6			
				Sum of Salix B.A.		**103.6**	**84%**	**Yes**	**Yes**
	Speckled Alder	*Alnus incana*	FacW	20'	5	19.6	16%	No	
				Sum of Alnus B.A.		19.6	16%	No	

Total number of Dominant wetland species:4 ; Total number of Dominant upland species 1:								
Indicators of Hydrology								
Hydric Soil Interpretation								
Soil Survey of Bristol County - South, 1981								
soil type mapped: UD								
hydric soil inclusions-yes								
field observations consistent with Soil Survey:								
No, Superfund site with wetland remediation monitoring								
soil description								
Horizon	**Depth**	**Matrix Color**		**Mottles Color**				
O: N/A								
A	0-6"	10YR 2/1						
B	6"-18"	Gley 5/10G		10YR 4/6				
Is Soil Hydric? Yes								
other indicators of hydrology								
site inundated:								
depth to free water in observation hole: 15"								
depth to soil saturation in observation hole: 10"								
water marks								
drift lines: Along Stream Bank								
sediment deposits								
drainage patterns in BVW								
oxidized rhizospheres: in B Horizon								
water stained leaves								
other:								
VEGETATION AND HYDROLOGY CONCLUSION								
# of wetland plants greater than non wetland indicator plants: Yes								
hydric soil present : yes								
other indicators of hydrology present: yes								
Sample is located in a BVW : yes								

Sullivan's Ledge
Summer/Fall 2017
Plot ID:OU1 MM SRM1 **Date: 10/23/2017**

Tree Growth and Plant Survivorship

Herb.	Common name	scientific name	USFW	% cover	% Dom.	Dom. Plant	Dom Wetl. Species	
	Sensitive Fern	*Onoclea sensiblis*	FacW	20%	40%	Y	**Y**	
	Horsetail	*Eqisetum arvense*	Fac	20%	40%	Y	Y	
	Goldenrod	*Solidago canadensis*	FacU	10%	20%	Y	N	
Shrub	**Common Name**	**Scientific Name**	**USFW**	**total # of Indiv.**	**% Dom.**	**Dom plant**	**Dom Wetl. Species**	
	Speckled Alder	*Alnus incana*	FacW	6	36%	**Y**	**Y**	
	Sweet Pepperbush	*Clethra alnifolia*	Fac	5	29%	**Y**	**Y**	
	Tatarian Honeysuckle	*Lonicera tatarica*	FacU	4	24%	**Y**	**N**	
	Multiflora Rose	*Rosa multiflora*	FacU	2	12%	N		

Sapling	Common name	scientific name	USFW	Hgt	DBH	Basal Area	% Dom	Dom species	Dom Wetl. Species
	Bebb Willow	*Salix bebbiana*	FacW	25'	2.1	3.5			
	Bebb Willow	*Salix bebbiana*	FacW	25'	2.2	3.8			
	Bebb Willow	*Salix bebbiana*	FacW	25'	3	7.1			
	Bebb Willow	*Salix bebbiana*	FacW	25'	2.4	4.5			
	Bebb Willow	*Salix bebbiana*	FacW	25'	2.4	4.5			
	Bebb Willow	*Salix bebbiana*	FacW	25'	2.3	**4.2**			
	Bebb Willow	*Salix bebbiana*	**FacW**	25'	1.9	**2.8**			
	Bebb Willow	*Salix bebbiana*	FacW	25'	4.2	13.9			
	Bebb Willow	*Salix bebbiana*	FacW	25'	3	7.1			
				sum of *Salix* B.A.		**51.4**	**68%**	**Y**	**Y**
	Speckled Alder	*Alnus incana*	**FacW**	25'	2	**3.1**			
	Speckled Alder	*Alnus incana*	**FacW**	25'	2	**3.1**			
	Speckled Alder	*Alnus incana*	**FacW**	25'	1.8	**2.5**			
	Speckled Alder	*Alnus incana*	**FacW**	25'	1.3	**1.3**			
	Speckled Alder	*Alnus incana*	**FacW**	25'	1.7	**2.3**			
	Speckled Alder	*Alnus incana*	**FacW**	25'	3.9	**11.9**			
				sum of *Alnus* B.A.		**24.2**	**32%**	**Y**	**Y**

	Common name	scientific name	USFW	Hgt	DBH	Basal Area	% Dom	Dom species	Dom Wetl Species
Tree									
	Speckled alder	*Alnus incana*	FacW	35'	11.2	**98.5**	55%	**Y**	Y
	River birch	Betula nigra	FacW	30'	5.8	**26.4**			
	River birch	Betula nigra	*/	30'	8.3	**54.1**			
				sum of *Betula* B.A.		**80.5**	45%	**Y**	Y

Total number of Dominant wetland species: 8; Total number of Dominant upland species 2:

Indicators of Hydrology					
Hydric Soil Interpretation					
Soil Survey of Bristol County - South, 1981					
soil type mapped: UD					
hydric soil inclusions-yes					
field observations consistent with Soil Survey:					
No, Superfund site with wetland remediation monitoring					
soil description					
Horizon	**Depth**	**Matrix Color**	**Mottles Color**		
O - none					
A	**0-5"**	**10YR 3/2**	**10YR 3/6**		
B1	**5"-8"**	**10YR 5/1**	**5YR 4/6**		
B2	**8"-20"**	**10YR 6/1**	**5YR5/6**		
Is Soil Hydric? Yes					
other indicators of hydrology: yes					
site inundated					
depth to free water in observation hole		**12"**			
depth to soil saturation in observation hole: 8"					
water marks					
drift lines					
sediment deposits					
drainage patterns in BVW					
oxidized rhizospheres					
water stained leaves					
other					
VEGETATION AND HYDROLOGY CONCLUSION					
# of wetland plants greater than non wetland indicator plants:			**Yes**		
hydric soil present :			**Yes**		
other indicators of hydrology present:			**Yes**		
Sample is located in a BVW :			**Yes**		

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU1 MM SRM2 **Date: 10/23/2017**

Tree Growth and Plant Survivorship

Herb.	Common name	scientific name	USFW	% cover	% Dom.	Dom. Plant	Dom Wetl. Species
NONE							

Shrub	Common Name	Scientific Name	USFW	total # of Indiv.	% Dom.	Dom plant	Dom Wetl. Species
	Silky dogwood	*Cornus amomum*	FacW	36	73%	**Y**	**Y**
	Willow sp*	*Salix sp*	Fac	10	20%	**Y**	**Y**
	Speckled alder	*Alnus incana*	FacW	3	6%	**N**	
	* unknown Salix species assigned a Facultative designation						

Sapling	Common name	scientific name	USFW	Hgt	DBH	Basal Area	% Dom	Dom species	Dom Wetl. Species
NONE									

Tree	Common name	scientific name	USFW	Hgt	DBH	Basal Area	% Dom	Dom species	Dom Wetl Species
	Speckled alder	*Alnus incana*	FacW	25'	6.2	30.2			
	Speckled alder	*Alnus incana*	FacW	25'	5.3	22.1			
	Speckled alder	*Alnus incana*	FacW	35'	8.4	55.4			
	Speckled alder	*Alnus incana*	FacW	30'	7.4	43			
				Sum of *Alnus* B.A.		**150.7**	**53%**	**Y**	**Y**
	River birch	*Betula nigra*	FacW	30'	7.3	41.9			
	River birch	*Betula nigra*	FacW	35'	8.4	55.4			
				Sum of *Betula* B.A.		**97.3**	**34%**	**Y**	**Y**
	Black willow	*Salix nigra*	Obl	25'	6.8	36.3	13%	N	
				Sum of *Salix* B.A.		**36.3**	**13%**	**N**	

Total number of Dominant wetland species: 4 ; Total number of Dominant upland species 0 :									
Indicators of Hydrology									
Hydric Soil Interpretation									
Soil Survey of Bristol County - South, 1981									
soil type mapped: UD									
hydric soil inclusions-yes									
field observations consistent with Soil Survey:									
No, Superfund site with wetland remediation monitoring									
soil description									
Horizon	**Depth**	**Matrix Color**		**Mottles Color**					
O	**1/4" - 0**								
A	**0 - 6"**	**7.5 YR 2.5/2**		**7.5 YR 4/6**					
B1	**6" - 10"**	**7.5 YR 3/2**		**7.5 YR 5/6**					
B2	**10" - 20"**	**10 YR 5/1**							
Is Soil Hydric? Yes									
other indicators of hydrology: yes									
site inundated:									
depth to free water in observation hole		**12"**							
depth to soil saturation in observation hole: 10"									
water marks									
drift lines		***along stream banks***							
sediment deposits									
drainage patterns in BVW									
oxidized rhizospheres									
water stained leaves:									
other:									
VEGETATION AND HYDROLOGY CONCLUSION									
# of wetland plants greater than non wetland indicator plants:			**Yes**						
hydric soil present :			**Yes**						
other indicators of hydrology present:			**Yes**						
Sample is located in a BVW :			**Yes**						

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU1 ME1 **Date: 11/3/2017**

Tree Growth and Plant Survivorship

Herb.	Common name	scientific name	USFW	% cover	% Dom.	Dom. Plant	Dom Wetl. Species
	Silky Dogwood	*Cornus amomum*	FacW	10%	50%	Y	Y
	Sedge	*Carex Sp*	unk.	5%	25%	Y	unk
	Sensitive Fern	*Onoclea sensiblis*	FacW	5%	25%	Y	Y
Shrub	**Common Name**	**scientific name**	**USFW**	**Total number of Individ.**	**% Dom**	**Dom Plant**	**Dom Wetland Species**
	Silky Dogwood	Cornus amomum	FacW	35	64.00%	Y	Y
	Sweet Pepperbush	Clethra alnifolia	Fac	14	25.00%	Y	Y
	Speckled Alder	*Alnus incana*	FacW	5	9.00%	N	
	Multiflora Rose	*Rosa multiflora*	FacU	1	2.00%	N	

Sapling	Common Name	scientific name	USFW	Hgt	DBH	Basal Area	% Dom	Dom plant	Dom Wetl. Species
	Bebb Willow	Salix bebbiana	FacW	**25'**	2.7	5.7			
	Bebb Willow	Salix bebbiana	FacW	**25'**	2.5	4.9			
	Bebb Willow	Salix bebbiana	FacW	**25'**	1.6	2			
	Bebb Willow	Salix bebbiana	FacW	**25'**	2.8	6.2			
	Bebb Willow	Salix bebbiana	FacW	**25'**	2.8	6.2			
	Bebb Willow	Salix bebbiana	FacW	**25'**	3.5	9.6			
	Bebb Willow	Salix bebbiana	FacW	**25'**	2.7	5.7			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.5	4.9			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.5	4.9			
	Bebb Willow	Salix bebbiana	FacW	**20'**	1.9	2.8			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.8	6.2			
	Bebb Willow	Salix bebbiana	FacW	**20'**	1.5	1.8			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.2	3.8			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.2	3.8			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.1	3.5			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.8	6.2			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.1	3.5			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.3	4.2			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.6	5.3			
	Bebb Willow	Salix bebbiana	FacW	**20'**	1.6	2			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.2	3.8			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.3	4.2			
	Bebb Willow	Salix bebbiana	FacW	**20'**	2.8	6.2			
	Bebb Willow	Salix bebbiana	FacW	**25'**	3	7.1			
	Bebb Willow	Salix bebbiana	FacW	**25'**	3.1	7.5			
				Sum of Salix B.A.		**122**	**97.00%**	**Y**	**Y**
	Speckled Alder	Alnus incana	FacW	**20'**	1.4	1.5			
	Speckled Alder	Alnus incana	FacW	**20'**	1.8	2.5			
				Sum of Alnus B.A.		**4**	**3.00%**	**N**	
Tree									
	Bebb Willow	Salix bebbiana	FacW	30'	7.6	45.4			
	Bebb Willow	*Salix bebbiana*	FacW	20'	5.2	21.2			
				Sum of Salix B.A.		**66.6**	**100.00%**	**Y**	**Y**

Total number of Dominant wetland species: 5 ; Total number of Dominant upland species: 0

Indicators of Hydrology

Hydric Soil Interpretation

Soil Survey of Bristol County - South, 1981

soil type mapped: UD

hydric soil inclusions-yes

field observations consistent with Soil Survey:

No, Superfund site with wetland remediation monitoring

soil description

Horizon	Depth	Matrix Color	Mottles Color
O	1/4"-0		
A	0-4"	10YR 2/1	
A2	4-12"	10YR 3/1	10YR 5/6

Is Soil Hydric? No - Matrix color in A2 not hydric although mottles are present

other indicators of hydrology

site inundated

depth to free water in observation hole: 3"

depth to soil saturation in observation hole: 1"

water marks

drift lines

sediment deposits

drainage patterns in BVW:

oxidized rhizospheres

water stained leaves

other

VEGETATION AND HYDROLOGY CONCLUSION

# of wetland plants greater than non wetland indicator plants	Yes
hydric soil present	No
other indicators of hydrology present	Yes
Sample is located in a BVW	Yes

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU1 MW1 **Date: 11/4/2017**

Tree Growth and Plant Survivorship

Herb.	Common name	scientific name	USFW	% cover	% Dom.	Dom. Plant	Dom Wetl. Species
	Common Reed	*Phragmites australis*	FacW	50%	77%	Y	Y (invasive)
	Sensitive Fern	*Onoclea sensibilis*	FacW	15%	23%	Y	Y
Shrub	**Common Name**	**scientific name**	**USFW**	**Total number of Individ.**	**% Dom**	**Dom Plant**	**Dom Wetl. Species**
	Speckled Alder	*Alnus incana*	FacW	4	20%	Y	Y
	Silky Dogwood	*Cornus amomum*	FacW	14	70%	Y	Y
	Elderberry	*Sambucus canadensis*	FacW	2	10%	N	

Sapling	Common Name	scientific name	USFW	Hgt	DBH	Basal Area	% Dom	Dom plant	Dom Wetl. Species
	Speckled Alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled Alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled Alder	*Alnus incana*	FacW	20'	1.3	1.3			
	Speckled Alder	*Alnus incana*	FacW	20'	1.5	1.8			
	Speckled Alder	*Alnus incana*	FacW	20'	1	0.8			
	Speckled Alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled Alder	*Alnus incana*	FacW	20'	0.9	0.6			
	Speckled Alder	*Alnus incana*	FacW	25'	2.4	4.5			
	Speckled Alder	*Alnus incana*	FacW	25'	2.1	3.5			
	Speckled Alder	*Alnus incana*	FacW	25'	1.9	2.8			
	Speckled Alder	*Alnus incana*	FacW	25'	1.5	1.8			
	Speckled Alder	*Alnus incana*	FacW	25'	2.1	3.5			
	Speckled Alder	*Alnus incana*	FacW	25'	2.5	4.9			
	Speckled Alder	*Alnus incana*	FacW	25'	2.9	6.6			
	Speckled Alder	*Alnus incana*	FacW	20'	1.5	1.8			
	Speckled Alder	*Alnus incana*	FacW	20'	1.3	1.3			
	Speckled Alder	*Alnus incana*	FacW	20'	1.7	2.3			
	Speckled Alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled Alder	*Alnus incana*	FacW	20'	1.3	1.3			
	Speckled Alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled Alder	*Alnus incana*	FacW	20'	1.3	1.3			
	Speckled Alder	*Alnus incana*	FacW	20'	1.4	1.5			
	Speckled Alder	*Alnus incana*	FacW	20'	1.8	2.5			
	Speckled Alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled Alder	*Alnus incana*	FacW	20'	1.7	2.3			
	Speckled Alder	*Alnus incana*	FacW	20'	1.8	2.5			
	Speckled Alder	*Alnus incana*	FacW	20'	1.8	2.5			
	Speckled Alder	*Alnus incana*	FacW	20'	1.7	2.3			
	Speckled Alder	*Alnus incana*	FacW	20'	1.2	1.1			
	Speckled Alder	*Alnus incana*	FacW	20'	2	3.1			
	Speckled Alder	*Alnus incana*	FacW	20'	1.5	1.8			
	Speckled Alder	*Alnus incana*	FacW	20'	1.8	2.5			
	Speckled Alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled Alder	*Alnus incana*	FacW	20'	1.8	2.5			
	Speckled Alder	*Alnus incana*	FacW	20'	2.2	3.8			
	Speckled Alder	*Alnus incana*	FacW	20'	1.9	2.8			
	Speckled Alder	*Alnus incana*	FacW	20'	1.5	1.8			
	Speckled Alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled Alder	*Alnus incana*	FacW	20'	1.8	2.5			
					Sum of *Alnus* B.A.:	**83.6**	**66%**	**Y**	**Y**
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.8	2.5			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.5	9.6			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.5	4.9			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.2	3.8			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.1	7.5			
					Sum of *Salix* B.A.:	**28.3**	**22%**	**Y**	**Y**
	Green Ash	*Fraxinus pennsylvanica*	FacW	25'	4.3	14.5			
					Sum of *Fraxinus* B.A.:	**14.5**	**11%**	**N**	**N**
Tree	None								

Total number of Dominant wetland species: 6* ; Total number of Dominant upland species: 0
*** One Invasive Wetland Species**
Indicators of Hydrology
Hydric Soil Interpretation
Soil Survey of Bristol County - South, 1981
soil type mapped: UD
hydric soil inclusions-yes
field observations consistent with Soil Survey:
No, Superfund site with wetland remediation monitoring

soil description

Horizon	depth	matrix color	mottles color
O	1/2" - 0		
A	0-3" (org: hemic)	10YR 2/1	
A2	3-12"	10 YR 2/2	7.5 YR 5/6

Is Soil Hydric? Yes

other indicators of hydrology
site inundated: yes
depth to free water in observation hole: surface
depth to soil saturation in observation hole: surface
water marks
drift lines
sediment deposits
drainage patterns in BVW:
oxidized rhizospheres: yes
water stained leaves: yes
other:

VEGETATION AND HYDROLOGY CONCLUSION
# of wetland plants greater than non wetland indicator plants: yes
hydric soil present: yes - saturated hemic A horizon encountered
other indicators of hydrology present: yes
Sample is located in a BVW : yes

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU1 MM2 **Date: 10/18/2017**

Tree Growth, Plant Survivorship, and Hummock Data Collection

65% Hummock in 30' Radius Plot:									
Herb.	**Common name**	**scientific name**	**USFW**	**% cover**	**% Dom.**	**Dom. Plant**	**Dom Wetl. Species**		
none									
Shrub	**Common Name**	**Scientific Name**	**USFW**	**total #**	**% Dom.**	**Dom plant**	**Dom Wetl. Species**		
				of Indiv.					
	American hazelnut	*Corylus americana*	FacU	20	59%	Y	N		
	Silky dogwood	*Cornus amomum*	FacW	6	18%	N			
	Winterberry	*Ilex verticillata*	FacW	4	12%	N			
	Green Ash	*Fraxinus pennsylvanica*	FacW	3	9%	N			
	Multiflora Rose	*Rosa multiflora*	FacU	1	3%	N			
Sapling	**Common name**	**scientific name**	USFW	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom plant**	**Dom Wetl. Species**
	Pussy Willow	*Salix discolor*	FacW	20'	4.9	18.9			
	Pussy Willow	*Salix discolor*	FacW	20'	3.9	11.9			
	Pussy Willow	*Salix discolor*	FacW	20'	3.1	7.5			
				Sum of *Salix* B.A.:		**38.3**	**68%**	**Y**	**Y**
	Box Elder	*Acer negundo*	Fac	20'	4.8	**18.1**			
				Sum of *Acer* B.A.:		**18.1**	**32%**	**Y**	**Y**
Tree	**Common name**	**scientific name**	**USFW**	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom species**	**Dom Wetl. Species**
	Red Maple	*Acer rubrum*	Fac	30'	6.5	33.2			
	Red Maple	*Acer rubrum*	Fac	35'	7.9	49			
	Red Maple	*Acer rubrum*	Fac	35'	7.1	39.6			
	Red Maple	*Acer rubrum*	Fac	35'	6.7	35.3			
				Sum of Acer B.A.:		**157.1**	100%	Y	Y
Total number of Dominant wetland species: 3 ; Total number of Dominant upland species 1:									
Indicators of Hydrology									
Hydric Soil Interpretation									
Soil Survey of Bristol County - South, 1981									
soil type mapped: UD									
hydric soil inclusions-yes									
field observations consistent with Soil Survey:									
No, Superfund site with wetland remediation monitoring									
soil description									
Horizon	**depth**	**matrix color**		**Mottles color**					
O	N/A								
A	0-4"	5YR 2.5/1		none					
A1	4"-16"	5YR 3/1		none					
Is Soil Hydric? No									
other indicators of hydrology									
site inundated:									
depth to free water in observation hole: 12"									
depth to soil saturation in observation hole: 6"									
water marks									
drift lines									
sediment deposits									
drainage patterns in BVW									
oxidized rhizospheres:									
water stained leaves:									
other:									
VEGETATION AND HYDROLOGY CONCLUSION									
# of wetland plants greater than non wetland indicator plants: Yes									
hydric soil present: no									
other indicators of hydrology present: Yes									
Sample is located in a BVW: Yes									

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU1 Pond 1 Date: 10/6/2017

Shrub and tree plots were mowed in the summer of 2017 and then treated with herbicide to rid them of invasive Multiflora Rose,

Tree Growth and Plant Survivorship

Herb.	Common name	scientific name	USFW	% cover	% Dom.	Dom. Plant	Dom Wetl. Species
	Herbaceous Plot is 90 % open water and 10% marsh						
	Blue Flag	*Iris veriscolor*	Obl	10%	100%	yes	yes
Shrub	None - mowed and herbicided multiflora rose						
Sapling	None						
Tree	None						
Total number of Dominant wetland species: 1 ; Total number of Dominant upland species: 0							
Indicators of Hydrology							
Hydric Soil Interpretation							
Soil Survey of Bristol County - South, 1981							
soil type mapped: UD							
hydric soil inclusions-yes							
field observations consistent with Soil Survey:							
No, Superfund site with wetland remediation monitoring							
soil description (located in shrub plot)							
Horizon	depth	matrix color	mottles color				
O N/A							
A	0-4"	5YR 2.5/1					
A1	4"-19"	10YR 2/2	10YR 4/4				
Is Soil Hydric? No							
other indicators of hydrology							
site inundated:							
depth to free water in observation hole: 14"							
depth to soil saturation in observation hole: 8"							
water marks		along pond edge					
drift lines							
sediment deposits							
drainage patterns in BVW:							
oxidized rhizospheres:							
water stained leaves:							
other:							
VEGETATION AND HYDROLOGY CONCLUSION							
# of wetland plants greater than non wetland indicator plants			Yes*				
hydric soil present			No				
other indicators of hydrology present			no				
Sample is located in a BVW			herbaceous layer is located in a BVW -				
* wetland plants are in herbaceous plot. No plants in shrub or tree plots							

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU1 Pond 2 **Date: 10/6/2017**

Tree Growth and Plant Survivorship

Herb.	**Common name**	**scientific name**	**USFW**	**% cover**	**% Dom**	**Dom Plant**	**Dom Wetl. Species**		
	Herbaceous Plot is 100% Open Water								
Shrub				**Total Number**	**% cover**	**Dom. Plant**	**Dom Wetl. Species**		
				of Individuals					
	Silky Dogwood	*Cornus amomum*	FacW	51	85%	yes	yes		
	Multiflora Rose	*Rosa multiflora*	FacU	3	5%	no			
	Speckled Alder	*Alnus rugosa*	FacW	2	3%	no			
	Red Maple	*Acer rubrum*	Fac	2	3%	no			
	Tatarian Honeysuckle	*Lonicera tatarica*	FacU	2	3%	no			
Sapling				**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom plant**	**Dom Wetl. Species**
	Speckled alder	*Alnus rugosa*	FacW	20'	1	0.8			
	Speckled alder	*Alnus rugosa*	FacW	20'	1.9	2.8			
	Speckled alder	*Alnus rugosa*	FacW	20'	2	3.1			
	Speckled alder	*Alnus rugosa*	FacW	20'	2.1	3.5			
	Speckled alder	*Alnus rugosa*	FacW	20'	1.9	2.8			
	Speckled alder	*Alnus rugosa*	FacW	20'	2.4	4.5			
	Speckled alder	*Alnus rugosa*	FacW	20'	1.7	2.3			
	Speckled alder	*Alnus rugosa*	FacW	20'	1.9	2.8			
	Speckled alder	*Alnus rugosa*	FacW	20'	2	3.1			
	Speckled alder	*Alnus rugosa*	FacW	20'	1.8	2.5			
	Speckled alder	*Alnus rugosa*	FacW	20'	1.3	1.3			
	Speckled alder	*Alnus rugosa*	FacW	25'	2.6	5.3			
	Speckled alder	*Alnus rugosa*	FacW	25'	2.7	5.7			
	Speckled alder	*Alnus rugosa*	FacW	25'	2.1	3.5			
	Speckled alder	*Alnus rugosa*	FacW	25'	2	3.1			
	Speckled alder	*Alnus rugosa*	FacW	25'	2.5	4.9			
	Speckled alder	*Alnus rugosa*	FacW	25'	2.1	3.5			
	Speckled alder	*Alnus rugosa*	FacW	25'	2.2	3.8			
	Speckled alder	*Alnus rugosa*	FacW	25'	2.8	6.2			
				Sum of *Alnus* B.A.:		**65.5**	**81%**	**yes**	**yes**
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.6	2			
	Bebb Willow	*Salix bebbiana*	FacW	25'	1.9	2.8			
	Bebb Willow	*Salix bebbiana*	FacW	25'	0.8	0.5			
	Bebb Willow	*Salix bebbiana*	FacW	25'	1.9	2.8			
	Bebb Willow	*Salix bebbiana*	FacW	25'	2.1	3.5			
	Bebb Willow	*Salix bebbiana*	FacW	25'	1.8	2.5			
	Bebb Willow	*Salix bebbiana*	FacW	25'	1.3	1.3			
				Sum of *Salix* B.A.:		**15.4**	**19%**	**No**	
Tree									
	Speckled Alder	*Alnus rugosa*	FacW	25'	9.6	72.4			
				Sum of *Alnus* B.A.		**72.4**	**100%**	**Yes**	

Total number of Dominant wetland species: 2 ; Total number of Dominant upland species: 0			
Indicators of Hydrology			
Hydric Soil Interpretation			
Soil Survey of Bristol County - South, 1981			
soil type mapped: UD			
hydric soil inclusions-yes			
field observations consistent with Soil Survey:			
No, Superfund site with wetland remediation monitoring			
soil description (located in shrub plot)			
Horizon depth	matrix color	mottles color	
O N/A			
A 0-4"	7.5YR 2.5/2		
B 4"-18"	10YR 6/1	10YR 5/8	
Is Soil Hydric? Yes			
other indicators of hydrology			
site inundated:			
depth to free water in observation hole: 16"			
depth to soil saturation in observation hole: 12"			
water marks	along pond edge		
drift lines			
sediment deposits			
drainage patterns in BVW:			
oxidized rhizospheres:			
water stained leaves:			
other:			
VEGETATION AND HYDROLOGY CONCLUSION			
# of wetland plants greater than non wetland indicator plants		Yes	
hydric soil present		Yes	
other indicators of hydrology present		No	
Sample is located in a BVW		Yes	

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU1 Pond 3 **Date: 10/4//2017**

Tree Growth and Plant Survivorship

Herb.	**Common name**	**scientific name**	**USFW**	**% cover**	**% Dom.**	**Dom. Plant**	**Dom Wetl. Species**
veg. < 3' tall							
	Blue flag	***Iris versicolor***	**Obl.**	15%	100%	Y	Y
	Common Name	**scientific name**	**USFW**	**Total number**	**% Dom**	**Dom Plant**	**Dom Wetl. Species**
Shrub				**of Individ.**			
	Silky Dogwood	*Cornus amomum*	FacW	40	53%	**Y**	**Y**
	Multiflora Rose	*Rosa multiflora*	FacU	25	33%	Y	**N**
	Speckled Alser	*Alnus incana*	FacW	10	13%	N	
Sapling	none						
Tree	none						
Total number of Dominant wetland species: 2 ; Total number of Dominant upland species: 1							
Indicators of Hydrology							
Hydric Soil Interpretation							
Soil Survey of Bristol County - South, 1981							
soil type mapped: UD							
hydric soil inclusions-yes							
field observations consistent with Soil Survey:							
No, Superfund site with wetland remediation monitoring							
soil description (located in shrub plot)							
Horizon	depth	matrix color	mottles color				
O N/A							
A	0-20"	10YR 3/1	10YR 3/6				
Is Soil Hydric? No							
other indicators of hydrology							
site inundated:							
depth to free water in observation hole: 20"							
depth to soil saturation in observation hole: 12"							
water stained leaves:							
drift lines: from high water line along pond edge							
sediment deposits							
drainage patterns in BVW:							
oxidized rhizospheres:							
water stained leaves:							
other:							
VEGETATION AND HYDROLOGY CONCLUSION							
# of wetland plants greater than non wetland indicator plants			Yes				
hydric soil present			No				
other indicators of hydrology present			No				
Sample is located in a BVW			No				

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU2 MM1 **Date: 10/18/2017**

Tree Growth, Plant Survivorship, and Hummock Data Collection

40% Hummock in 30' Radius Plot								
Herb.	**Common name**	**scientific name**	**USFW**	**% cover**	**% Dom.**	**Dom. Plant**	**Dom Wetl. Species**	
	herbaceous							
	Goldenrod	*Solidago canadensis*	FacU	15%	100%	Yes	No	

Shrub	**Common Name**	**Scientific Name**	**USFW**	**total #**	**% Dom.**	**Dom plant**	**Dom Wetl. Species**	
				of Indiv.				
	Red Osier Dogwood	*Cornus sericea*	FacW	18	69%	Yes	**Yes**	
	Speckled Alder	*Alnus incana*	FacW	4	15%	No		
	Arrowwood	*Viburnum recognitum*	Fac	3	12%	No		
	Tatarian Honeysuckle	*Lonicera tatarica*	FacU	1	4%	No		

Sapling	**Common name**	**scientific name**	USFW	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom plant**	**Dom Wetl. Species**
	Speckled Alder	*Alnus incana*	FacW	25'	2	3.1			
	Speckled Alder	*Alnus incana*	FacW	25'	2.9	6.6			
	Speckled Alder	*Alnus incana*	FacW	25'	3.8	11.3			
	Speckled Alder	*Alnus incana*	FacW	20'	1.2	1.1			
	Speckled Alder	*Alnus incana*	FacW	20'	0.9	0.6			
	Speckled Alder	*Alnus incana*	FacW	20'	0.9	0.6			
	Speckled Alder	*Alnus incana*	FacW	20'	0.7	0.4			
	Speckled Alder	*Alnus incana*	FacW	20'	0.6	0.3			
	Speckled Alder	*Alnus incana*	FacW	20'	0.9	0.6			
	Speckled Alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled Alder	*Alnus incana*	FacW	20'	0.9	0.6			
	Speckled Alder	*Alnus incana*	FacW	20'	1	0.8			
				Sum of *Alnus* BA		**27.00**	**39%**	**Yes**	**Yes**
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.8	2.5			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.6	5.3			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.1	7.5			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.3	8.6			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.6	10.2			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.8	6.2			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.9	2.8			
				Sum of *Salix* BA		**43.10**	**61%**	**Yes**	**Yes**

Tree	**Common name**	**scientific name**	**USFW**	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom species**	**Dom Wetl. Species**
	Speckled Alder	*Alnus incana*	FacW	**35'**	5.3	22.1			
	Speckled Alder	*Alnus incana*	FacW	35'	5	19.6			
	Speckled Alder	Alnus incana	FacW	35'	5.6	24.6			
				Sum of *Alnus* BA		**66.3**	**35%**	**Yes**	**Yes**
	Eastern Cottonwood	***Populus deltoides***	**Fac**	**40'**	**12.4**	**120.8**	**65%**	**Yes**	**yes**
				Sum of Populus B.A.		**120.8**	**65%**	**Yes**	**Yes**

Total number of Dominant wetland species: 5 ; Total number of Dominant upland species 1:									
Indicators of Hydrology									
Hydric Soil Interpretation									
Soil Survey of Bristol County - South, 1981									
soil type mapped: UD									
hydric soil inclusions-yes									
field observations consistent with Soil Survey:									
No, Superfund site with wetland remediation monitoring									
soil description									
Horizon	**depth**	**matrix color**		**Mottles color**					
O: N/A									
A	0-3"	7.5 YR 2.5/1							
A1	3" - 8"	7.5 YR 3/1		10YR 4/6					
B	8" - 12"	10 YR 7/1		10YR 5/8					
Is Soil Hydric?	yes								
other indicators of hydrology									
site inundated:									
depth to free water in observation hole:									
depth to soil saturation in observation hole: 6"									
water marks									
drift lines									
sediment deposits									
drainage patterns in BVW									
oxidized rhizospheres: YES - in B horizon									
water stained leaves:									
other:									
VEGETATION AND HYDROLOGY CONCLUSION									
# of wetland plants greater than non wetland indicator plants: Yes									
hydric soil present: Yes									
other indicators of hydrology present: Yes									
Sample is located in a BVW: Yes									

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU2 MM2 **Date: 9/28/2017**

Tree Growth, Plant Survivorship, and Hummock Data Collection

20% Hummock in 30' radius plot								
Herb.	**Common name**	**scientific name**	**USFW**	**% cover**	**% Dom.**	**Dom. Plant**	**Dom Wetl. Species**	
	Horsetail	*Equisetum arvense*	Fac	30%	60%	yes	yes	
	Tall Buttercup	*Ranunculus acris*	Fac	10%	20%	yes	yes	
	Canada Goldenrod	*Solidago candensis*	FacU	10%	20%	yes	no	
Shrub	**Common Name**	**Scientific Name**	**USFW**	**total # of Indiv.**	**% Dom.**	**Dom plant**	**Dom Wetl. Species**	
	Red Osier Dogwood	*Cornus sericea*	FacW	11	58.00%	Yes	Yes	
	Multiflora Rose	*Rosa multiflora*	FacU	3	16.00%	No		
	Speckled Alder	*Alnus incana*	FacW	2	11.00%	No		
	Swamp White Oak	*Quercus bicolor*	FacW	1	5.00%	No		
	Arrowwood	*Vinurnum recognitum*	Fac	1	5.00%	No		
	Autumn Olive	*Elaeagnus umbellata*	NC*	1	5.00%	No		
	* Not Classified							

Sapling	**Common name**	**scientific name**	USFW	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom plant**	**Dom Wetl. Species**
	Bebb Willow	*Salix bebbiana*	FacW	20'	2	3.14			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.3	1.3			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.7	2.3			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.1	1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	0.6	0.3			
	Bebb Willow	*Salix bebbiana*	FacW	20'	0.5	**0.2**			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2	3.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.6	10.2			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.5	4.9			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.9	6.6			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.9	6.6			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3	7.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.1	7.5			
	Bebb Willow	*Salix bebbiana*	FacW	20'	4.2	13.9			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.9	6.6			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.1	3.5			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.7	2.3			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.6	2			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2	3.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.1	3.5			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.7	5.7			
				Sum of Salix B.A.		**94.84**	**77%**	**Yes**	**Yes**
	Speckled Alder	*Alnus incana*	FacW	20'	1.4	1.5			
	Speckled Alder	*Alnus incana*	FacW	20'	1.3	1.3			
	Speckled Alder	*Alnus incana*	FacW	20'	0.9	0.6			
	Speckled Alder	*Alnus incana*	FacW	20'	3.3	8.6			
	Speckled Alder	*Alnus incana*	FacW	20'	3	7.1			
	Speckled Alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled Alder	*Alnus incana*	FacW	20'	1.2	1.1			
				Sum of *Alnus* B.A.		**21.2**	**17%**	**No**	
	Gray Birch	*Betula populifolia*	Fac	25'	3	7.1	6%	No	
				Sum of *Betula* B.A.		**7.1**	**6%**	**No**	

Tree	**Common name**	**scientific name**	**USFW**	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom sp.**	**Dom Wetland sp.**
	Green Ash	*Fraxinus pennsylvanica*	FacW	30'	5.7	25.5	33%	Yes	Yes
				Sum of *Fraxinus* B.A.		**25.2**	**33%**	**Yes**	**Yes**
	Cottonwood	*Populus deltoides*	Fac	35'	8.1	51.5	67%	Yes	Yes
				Sum of *Populus* B.A.		**51.5**	**67%**	**Yes**	**Yes**

Total number of Dominant wetland species: 6 ; Total number of Dominant upland species:1								
Indicators of Hydrology								
Hydric Soil Interpretation								
Soil Survey of Bristol County - South, 1981								
soil type mapped: UD								
hydric soil inclusions-yes								
field observations consistent with Soil Survey:								
No, Superfund site with wetland remediation monitoring								
soil description								
Horizon	**Depth**	**Matrix Color**		**Mottles Color**				
O N/A								
A	0 - 4"	7.5 YR 2.5/1						
B	4" - 18"	7.5 YR 5/1		7.5 YR 4/6				
Is Soil Hydric?	yes							
other indicators of hydrology								
site inundated:								
depth to free water in observation hole: 18"								
depth to soil saturation in observation hole: 10"								
water marks								
drift lines								
sediment deposits								
drainage patterns in BVW: YES swale								
oxidized rhizospheres: YES starting at 3" below the surface								
water stained leaves:								
other:								
VEGETATION AND HYDROLOGY CONCLUSION								
# of wetland plants greater than non wetland indicator plants			yes					
hydric soil present			yes					
other indicators of hydrology present			yes					
Sample is located in a BVW			yes					

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU2 MM3 Date: 10/18/17

Tree Growth, Plant Survivorship, and Hummock Data Collection

40% Hummocks in 30' radius plot									
Herb.	**Common name**	**scientific name**	**USFW**	**% cover**	**% Dom.**	**Dom. Plant**	**Dom Wetl. Species**		
	Goldenrod	*Solidago canadensis*	FacU	2%	100%	Yes	No		
Shrub	**Common Name**	**Scientific Name**	**USFW**	**total # of Indiv.**	**% Dom.**	**Dom plant**	**Dom Wetl. Species**		
	Red Osier dogwood	*Cornus sericea*	FacW	31	69%	Yes	Yes		
	Speckled Alder	*Alnus incana*	FacW	8	18%	No	No		
	Tatarian Honeysuckle	*Lonicera tatarica*	FacU	6	13%	No	No		
Sapling	**Common name**	**scientific name**	USFW	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom plant**	**Dom Wetl. Species**
	Speckled Alder	*Alnus incana*	FacW	20'	1.6	2			
	Speckled Alder	*Alnus incana*	FacW	20'	1.5	1.8			
	Speckled Alder	Alnus incana	FacW	25'	3	7.1			
	Speckled Alder	*Alnus incana*	FacW	25'	3.4	9.1			
	Speckled Alder	*Alnus incana*	FacW	15'	1	0.8			
	Speckled Alder	*Alnus incana*	FacW	25'	2.8	6.2			
	Speckled Alder	*Alnus incana*	FacW	25'	2.4	4.5			
	Speckled Alder	*Alnus incana*	FacW	20'	3.2	8			
	Speckled Alder	Alnus incana	FacW	20'	3.3	8.6			
	Speckled Alder	*Alnus incana*	FacW	15'	1.4	1.5			
					Sum of *Alnus* BA:	**49.6**	**32%**	**Yes**	**Yes**
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.5	9.6			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.8	11.3			
	Bebb Willow	*Salix bebbiana*	FacW	20'	4	12.6			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.6	5.3			
	Bebb Willow	*Salix bebbiana*	FacW	25'	2.2	3.8			
	Bebb Willow	*Salix bebbiana*	FacW	25'	2.4	4.5			
	Bebb Willow	*Salix bebbiana*	FacW	25'	3.1	7.5			
	Bebb Willow	*Salix bebbiana*	FacW	25'	2.3	4.2			
	Bebb Willow	*Salix bebbiana*	FacW	25'	4	12.6			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.3	4.2			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.9	6.6			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.5	1.8			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.8	2.5			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.8	6.2			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2	3.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.2	8			
					Sum of *Salix* BA:	**103.8**	**68%**	**Yes**	**Yes**
Tree	**Common name**	**scientific name**	**USFW**	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom species**	**Dom Wetl. Species**
	Red Maple	*Acer rubrum*	Fac	35'	7.3	41.9			
	Red Maple	*Acer rubrum*	Fac	35'	7.4	43			
					Sum of *Acer* BA:	**84.9**	**100%**	**Yes**	**Yes**

Total number of Dominant wetland species: 4 ; Total number of Dominant upland species: 1

Indicators of Hydrology

Hydric Soil Interpretation

Soil Survey of Bristol County - South, 1981

soil type mapped: UD

hydric soil inclusions-yes

field observations consistent with Soil Survey:

No, Superfund site with wetland remediation monitoring

soil description

Horizon	**depth**	**matrix color**	**Mottles color**
O	1/4" - 0	N/A	
A	0 - 1/2"	10 YR 2/1	
B	1/2" - 10"	10 YR 4/2	10 YR 4/6 strong mottling

Is Soil Hydric? no

other indicators of hydrology

site inundated

depth to free water in observation hole: 4"

depth to soil saturation in observation hole: 1"

water marks

drift lines

sediment deposits

drainage patterns in BVW

oxidized rhizospheres

water stained leaves

other

VEGETATION AND HYDROLOGY CONCLUSION

# of wetland plants greater than non wetland indicator plants: yes

hydric soil present: yes

other indicators of hydrology present: yes

Sample is located in a BVW: yes

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU2 MM4 **Date: 10/23/2017**

Tree Growth, Plant Survivorship, and Hummock Data Collection

40% Hummock in 30' radius plot								
Herb.	**Common name**	**scientific name**	**USFW**	**% cover**	**% Dom.**	**Dom. Plant**	**Dom Wetl. Species**	
	Common Reed	*Phragmites australis*	FacW	20%	44%	yes	**yes**	
	Ox Eye Sunflower	*Heliopsis helianthoides*	FacU	15%	33%	yes	**no**	
	Soft Rush	*Juncuc effusus*	Obl	10%	22%	yes	**yes**	

Shrub	**Common Name**	**Scientific Name**	**USFW**	**total #**	**% Dom.**	**Dom plant**	**Dom Wetl. Species**	
				of Indiv.				
	Silky Dogwood	*Cornus amomum*	FacW	4	**80%**	**Yes**	**Yes**	
	Swamp White Oak	*Quercus bicolor*	FacW	1	**20%**	**Yes**	**Yes**	

Sapling	**Common name**	**scientific name**	**USFW**	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom species**	**Dom Wetl.**
	Red Maple	Acer rubrum	Fac	20'	4.5	15.9			**Species**
	Red Maple	*Acer rubrum*	Fac	20'	2.4	4.5			
	Red Maple	*Acer rubrum*	Fac	20'	1.5	1.8			
				sum of Acer BA		**22.2**	**12%**	**No**	**No**
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.4	9.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.7	5.7			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.5	4.9			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.7	5.7			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3	7.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.3	4.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.3	4.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.3	4.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.3	4.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.6	5.3			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.6	5.3			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.3	4.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.5	1.8			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.4	4.5			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2	3.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.6	2			
	Bebb Willow	*Salix bebbiana*	FacW	20'	4.4	5.2			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.4	4.5			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.9	2.8			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.4	9.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	4.1	13.2			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3	7.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	3.8	11.3			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.3	4.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.3	4.1			
	Bebb Willow	*Salix bebbiana*	FacW	20'	1.5	1.8			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.8	6.2			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.1	3.5			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.6	5.3			
	Bebb Willow	*Salix bebbiana*	FacW	20'	2.7	5.7			
				Sum of *Salix* BA		**158.90**	**88%**	**Yes**	**Yes**

Tree	**Common name**	**scientific name**	**USFW**	**Hgt**	**DBH**	**Basal Area**	**% Dom**	**Dom species**	**Dom Wetl**
	Bebb Willow	*Salix bebbiana*	FacW	20'	5.4	22.9			**Species**
	Bebb Willow	*Salix bebbiana*	FacW	25'	5.9	27.3			
				Sum of *Salix* BA		**50.2**	**100%**	**Yes**	**Yes**

Total number of Dominant wetland species: 5 ; Total number of Dominant upland species 1 :

Indicators of Hydrology

Hydric Soil Interpretation

Soil Survey of Bristol County - South, 1981

soil type mapped: UD

hydric soil inclusions-yes

field observations consistent with Soil Survey:

No, Superfund site with wetland remediation monitoring

soil description

Horizon	**Depth**	**Matrix Color**	**Mottles color**
O	**none**		
A	**0 - 10"**	**7.5 YR 2.5/1**	
B	**10" - 20"**	**7.5YR 5/1**	**7.5 YR 5/6**

Is Soil Hydric? Yes

other indicators of hydrology:

site inundated: **in places**

depth to free water in observation hole **6"**

depth to soil saturation in observation hole: 4"

water marks

drift lines

sediment deposits

drainage patterns in BVW

oxidized rhizospheres

water stained leaves:

other:

VEGETATION AND HYDROLOGY CONCLUSION

# of wetland plants greater than non wetland indicator plants: yes

hydric soil present : yes

other indicators of hydrology present: yes

Sample is located in a BVW : yes

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU2 Adj Wetl 1 Date:10/23/2017

Tree Growth, Plant Survivorship, and Hummock Data Collection

Herb.	Common name	scientific name	USFW	% cover	% Dom.	Dom. Plant	Dom Wetl. Species
	Poison Ivy	*Toxicodendron radicans*	Fac	50%	59%	y	Y
	Canada Goldenrod	*Solidago canadensis*	FacU	25%	29%	y	N
	Sensitive Fern	*Onoclea sensibilis*	FacW	10%	12%	n	

Shrub	Common Name	scientific name	USFW	Total number of Individ.	% Dom	Dom Plant	Dom Wetl. Species
	Red Osier Dogwood	*Cornus sericea*	FacW	28	85%	y	Y
	Green Ash	*Fraxinus pennsylvanica*	FacW	3	9%	n	
	Tatarian honeysuckle	*Lonicera tataria*	FacU	2	6%	n	

Sapling	Common Name	scientific name	USFW	Hgt	DBH	Basal Area	% Dom	Dom plant	Dom Wetl. Species
	Speckled alder	*Alnus incana*	FacW	20'	1.6	2			
	Speckled alder	*Alnus incana*	FacW	20'	1.6	2			
	Speckled alder	*Alnus incana*	FacW	20'	2	3.1			
	Speckled alder	*Alnus incana*	FacW	20'	1.4	1.5			
	Speckled alder	*Alnus incana*	FacW	20'	1.8	2.5			
	Speckled alder	*Alnus incana*	FacW	20'	1.8	2.5			
	Speckled alder	*Alnus incana*	FacW	20'	1.3	1.3			
	Speckled alder	*Alnus incana*	FacW	20'	0.09	0.006			
	Speckled alder	*Alnus incana*	FacW	20'	1.7	2.3			
	Speckled alder	*Alnus incana*	FacW	20'	1.8	2.5			
	Speckled alder	*Alnus incana*	FacW	20'	1.5	1.8			
	Speckled alder	*Alnus incana*	FacW	20'	1.3	1.3			
	Speckled alder	*Alnus incana*	FacW	20'	1.3	1.3			
	Speckled alder	*Alnus incana*	FacW	20'	1.6	2			
	Speckled alder	*Alnus incana*	FacW	20'	1.5	1.8			
	Speckled alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled alder	*Alnus incana*	FacW	20'	1.3	1.3			
	Speckled alder	*Alnus incana*	FacW	20'	1.5	1.8			
	Speckled alder	*Alnus incana*	FacW	20'	1.5	1.8			
	Speckled alder	*Alnus incana*	FacW	20'	1.9	2.8			
	Speckled alder	*Alnus incana*	FacW	20'	2	3.1			
	Speckled alder	*Alnus incana*	FacW	20'	2.6	5.3			
	Speckled alder	*Alnus incana*	FacW	20'	1.3	1.3			
	Speckled alder	*Alnus incana*	FacW	20'	1.1	1			
	Speckled alder	*Alnus incana*	FacW	20'	1.6	2			
	Speckled alder	*Alnus incana*	FacW	20'	1.6	2			
	Speckled alder	*Alnus incana*	FacW	20'	1.4	1.5			
				Sum of *Alnus* B.A.		52.806	45%	y	Y
	Bebb Willow	*Salix bebbiana*	FacW	25'	3.7	10.8			
	Bebb Willow	*Salix bebbiana*	FacW	25'	4.9	18.9			
	Bebb Willow	*Salix bebbiana*	FacW	25'	1.7	2.3			
	Bebb Willow	*Salix bebbiana*	FacW	25'	4.2	13.9			
	Bebb Willow	*Salix bebbiana*	FacW	25'	4	12.6			
	Bebb Willow	*Salix bebbiana*	FacW	25'	3	7.1			
				Sum of *Salix* B.A.		65.6	55%	y	Y
Tree									
	Cottonwood	*Populus deltoides*	Fac	40'	14.5	165.1			
	Cottonwood	*Populus deltoides*	Fac	40'	13.8	149.6			
				Sum of *Populus* B.A.		314.7	67%	y	Y
	Speckled Alder	*Alnus incana*	FacW	35'	14	153.9			
				Sum of *Alnus* B.A.		153.9	**33%**	y	Y

Total number of Dominant wetland species:5 ; Total number of Dominant upland species: 1

Indicators of Hydrology
Hydric Soil Interpretation
Soil Survey of Bristol County - South, 1981
soil type mapped: UD
hydric soil inclusions-yes
field observations consistent with Soil Survey:
No, Superfund site with wetland remediation monitoring

soil description

Horizon	Depth	Matrix Color	Mottles Color
O	N/A		
A	0-5"	10YR 2/1	
B	5"-12"	10 YR 5/2	7.5 YR 5/8

Is Soil Hydric? No

other indicators of hydrology
site inundated:
depth to free water in observation hole: 8"
depth to soil saturation in observation hole: 5"
water marks
drift lines
sediment deposits
drainage patterns in BVW:
oxidized rhizospheres:
water stained leaves:
other:

VEGETATION AND HYDROLOGY CONCLUSION
# of wetland plants greater than non wetland indicator plants: yes
hydric soil present: yes
other indicators of hydrology present: yes
Sample is located in a BVW : yes

Sullivan's Ledge
Summer/Fall 2017
Plot ID: OU2 Adj Wetl 2 Date: 9/29/2017

Tree Growth and Plant Survivorship

Herb.	Common name	scientific name	USFW	% cover	% Dom.	Dom. Plant	Dom Wetl. Species
	Sensitive Fern	*Onoclea sensiblis*	FacW	30%	55%	Y	Y
	Poison Ivy	*Toxicodendron radicans*	Fac	15%	27%	Y	Y
	Red Osier Dogwood	*Cornus sericea*	FacW	10%	18%	N	

Shrub	Common Name	scientific name	USFW	Total number of Individ.	% Dom	Dom Plant	Dom Wetl. Species
	Arrowwood	*Viburnum recognitum*	Fac	11	40%	Y	Y
	Tartarian Honeysuckle	*Lonicera tatarica*	FacU	10	36%	Y	N
	Speckled Alder	*Alnus incana*	FacW	4	14%	N	
	Green Ash	*Fraxinus pennsylvanica*	FacW	2	7%	N	
	Multiflora Rose	*Rosa multiflora*	FacU	1	4%	N	

Sapling	Common Name	scientific name	USFW	Hgt	DBH	Basal Area	% Dom	Dom plant	Dom Wetl. Species
	Speckled Alder	*Alnus incana*	FacW	20'	0.5	0.2			
	Speckled Alder	*Alnus incana*	FacW	20'	1.7	2.3			
	Speckled Alder	*Alnus incana*	FacW	20'	1.8	2.5			
	Speckled Alder	*Alnus incana*	FacW	20'	2	3.1			
	Speckled Alder	*Alnus incana*	FacW	20'	2.1	3.5			
	Speckled Alder	*Alnus incana*	FacW	20'	1.7	2.3			
					Sum of *Alnus* B.A. :	**13.9**	**21%**	**Y**	**Y**
	Bebb Willow	*Salix bebiana*	FacW	20'	3.8	11.3			
	Bebb Willow	*Salix bebiana*	FacW	20'	3.6	10.2			
	Bebb Willow	*Salix bebiana*	FacW	20'	2.9	6.6			
	Bebb Willow	*Salix bebiana*	FacW	20'	4.9	18.9			
					Sum of *Salix* B.A. :	**47**	**71%**	**Y**	**Y**
	Eastern Larch	*Larix laricina*	FacW	25'	2.6	5.3			
					Sum of *Larix* B.A.	**5.3**	**8%**	**N**	
Tree									
	Speckled Alder	*Alnus incana*	FacW	25'	5.9	27.3			
	Speckled Alder	*Alnus incana*	FacW	25'	5	19.6			
	Speckled Alder	*Alnus incana*	FacW	25'	5.2	21.2			
	Speckled Alder	*Alnus incana*	FacW	25'	5.3	22.1			
	Speckled Alder	*Alnus incana*	FacW	25'	5.5	23.6			
	Speckled Alder	*Alnus incana*	FacW	35'	8.5	56.7			
	Speckled Alder	*Alnus incana*	FacW	35'	6.9	37.4			
	Speckled Alder	*Alnus incana*	FacW	35'	5.8	26.4			
	Speckled Alder	*Alnus incana*	FacW	35'	9	63.6			
	Speckled Alder	*Alnus incana*	FacW	35'	7.5	44.2			
	Speckled Alder	*Alnus incana*	FacW	35'	8	50.3			
	Speckled Alder	*Alnus incana*	FacW	35'	9.2	66.5			
	Speckled Alder	*Alnus incana*	FacW	35'	6.5	33.2			
	Speckled Alder	*Alnus incana*	FacW	35'	6.9	37.4			
	Speckled Alder	*Alnus incana*	FacW	35'	8.1	51.5			
	Speckled Alder	*Alnus incana*	FacW	35'	7.8	47.8			
	Speckled Alder	*Alnus incana*	FacW	35'	7.5	44.2			
					Sum of *Alnus* B.A.:	**673**	**94%**	**y**	**y**
	Green Ash	*Fraxinus pennylvanica*	FacW	30'	7.5	44.2			
					Sum of *Fraxinus* B.A. :	**44.2**	**6%**	**N**	

Total number of Dominant wetland species: 5 ; Total number of Dominant upland species: 1*
***** One Dominant Invasive Upland Species**
Indicators of Hydrology
Hydric Soil Interpretation
Soil Survey of Bristol County - South, 1981
soil type mapped: UD
hydric soil inclusions-yes
field observations consistent with Soil Survey:
No, Superfund site with wetland remediation monitoring

soil description

Horizon	depth	matrix color	mottles color
O	N/A		
A	0-10"	10YR 3/2	5YR 4/6*
A	10"-20"	10YR 5/2	10YR 5/8

* mottles appear 8" below surface
Is Soil Hydric? No

other indicators of hydrology
site inundated:
depth to free water in observation hole:
depth to soil saturation in observation hole: 10"
water marks
drift lines
sediment deposits
drainage patterns in BVW:
oxidized rhizospheres: yes
water stained leaves:
other:

VEGETATION AND HYDROLOGY CONCLUSION
# of wetland plants greater than non wetland indicator plants: yes
hydric soil present: yes
other indicators of hydrology present: yes
Sample is located in a BVW :

APPENDIX H – SITE INSPECTION DOCUMENTATION

Five-Year Review Site Inspection Checklist (Template)

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: Sullivan's Ledge OU1	**Date of inspection: 5/3/18**
Location and Region: New Bedford, MA / Region I	**EPA ID: MAD980731343**
Agency, office, or company leading the five-year review: EPA Region I (with assistance from AECOM)	**Weather/temperature: Partly Cloudy/70s**
Remedy Includes: (Check all that apply) x Landfill cover/containment x Access controls x Institutional controls x Groundwater pump and treatment ☐ Surface water collection and treatment ☐ Other_____ _____ ☐ Monitored natural attenuation x Groundwater containment ☐ Vertical barrier walls	
Attachments: x Inspection team roster attached ☐ Site map attached	
II. INTERVIEWS	
Interviews were performed by USEPA/AECOM and are included separately.	

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - x O&M manual — x Readily available — ☐ Up to date — ☐ N/A
   - x As-built drawings — x Readily available — ☐ Up to date — ☐ N/A
   - x Maintenance logs — x Readily available — ☐ Up to date — ☐ N/A

   Remarks_As-built drawings were distributed following construction completion; maintenance logs are provided with monthly reports from the City of New Bedford. The GWTP O&M Manual is available, but the City has indicated that they will be making updates to the manual in the next several months and in preparation for a possible shutdown of the GWTP (not yet determined). _____

2. **Site-Specific Health and Safety Plan** — x 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 — x Up to date — ☐ N/A

   Remarks__Maintained off-site_____

4. **Permits and Service Agreements**
   - ☐ Air discharge permit — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Effluent discharge — ☐ Readily available — ☐ Up to date — ☐ N/A
   - x Waste disposal, POTW — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Other permits_____ — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks__Permit for discharge to POTW not reviewed. _____

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

   Remarks_The blower stack for the landfill gas extraction system is monitored quarterly and documented in semi-annual monitoring reports from O'Brien & Gere. _____

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

   Remarks_____

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

   Remarks__Included in semi-annual monitoring reports from O'Brien & Gere and monthly reports from the City of New Bedford. Both are provided electronically to EPA. _____

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

   Remarks_____

9. **Discharge Compliance Records**
   - ☐ Air — ☐ Readily available — ☐ Up to date — ☐ N/A
   - x Water (effluent) — x Readily available — ☐ Up to date — ☐ N/A

   Remarks__Water effluent data is provided to EPA in monthly reports transmitted via email from City of New Bedford._____

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

    Remarks__Not reviewed_____

IV. O&M COSTS

O&M costs were obtained separately and are provided in the text of the Five-Year Review report.

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

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map x Gates secured ☐ N/A
Remarks__The fence surrounding the groundwater treatment plant and landfill cap on south of Hathaway Road was intact, with just minor areas where the barbed wire at the top was partially missing. This is judged to not compromise site security, particularly since there have been no reports of trespassing or vandalism. _____

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks_"No Trespassing" signage was present along the fence on the south side of Hathaway Road.
_____
_____

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes x No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes x No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) _____
Frequency __Annual reports prepared by City of New Bedford to document compliance_____
Responsible party/agency __City of New Bedford_____
Contact _____ _City Solicitor____ _____ _____
Name Title Date Phone no.

Reporting is up-to-date x Yes ☐ No ☐ N/A
Reports are verified by the lead agency x Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met x Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes x No ☐ N/A
Other problems or suggestions: ☐ Report attached
_____
_____
_____
_____

2. **Adequacy** x ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks_____
_____
_____

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map x No vandalism evident
Remarks__City staff also report that they have seen no evidence of vandalism or trespassing. _____
_____

2. **Land use changes on site** x N/A
Remarks_____
_____

3. **Land use changes off site** x N/A
Remarks__None in the past 5 years. _____
_____

VI. GENERAL SITE CONDITIONS

A. Roads x Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map x Roads adequate☐ N/A
Remarks_Minor ruts observed immediately adjacent to the access road in the southeastern portion of the landfill cap (see photo log) _____

B. Other Site Conditions

Remarks _____
_____
_____
_____
_____
_____

VII. LANDFILL COVERS x Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map x Settlement not evident
Areal extent_____ Depth_____
Remarks_____
_____

2. **Cracks** ☐ Location shown on site map x Cracking not evident
Lengths_____ Widths_____ Depths_____
Remarks_____
_____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
Areal extent_____ Depth_____
Remarks_A small area of low vegetation and possible erosion observed adjacent to access road in eastern portion of landfill cap (see photo log) _____

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
Areal extent_____ Depth_____
Remarks_Small animal holes (possibly from mice) observed in northeastern portion of cap adjacent to access road and inlet for vault #2 (see photo log) _____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress
☐ Trees/Shrubs (indicate size and locations on a diagram)
Remarks_Overall, well established and maintained. See note above under erosion; minor areas of low vegetation also observed adjacent to the landfill gas extraction system blower (see photo log) _____

6. **Alternative Cover (armored rock, concrete, etc.)** x N/A
Remarks_____
_____

7. **Bulges** ☐ Location shown on site map x Bulges not evident
Areal extent_____ Height_____
Remarks_____
_____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
x Wet areas ☐ Location shown on site map Areal extent_____
☐ Ponding ☐ Location shown on site map Areal extent_____
☐ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks__Wet area along northern portion of the eastern fence line appears to be outside the limits of the cap. _____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map x No evidence of slope instability
Areal extent_____
Remarks_____
_____

B. Benches ☐ Applicable x 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.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay
Remarks_____
_____

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay
Remarks_____
_____

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay
Remarks_____
_____

C. Letdown Channels ☐ Applicable x 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.)

1. **Settlement** ☐ Location shown on site map ☐ No evidence of settlement
Areal extent_____ Depth_____
Remarks_____
_____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation
Material type_____ Areal extent_____
Remarks_____
_____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion
Areal extent_____ Depth_____
Remarks_____
_____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____
_____

5. **Obstructions** Type_____ ☐ No obstructions
☐ Location shown on site map Areal extent_____
Size_____
Remarks_____
_____

6. **Excessive Vegetative Growth** Type_____
☐ No evidence of excessive growth
☐ Vegetation in channels does not obstruct flow
☐ Location shown on site map Areal extent_____
Remarks_____
_____

D. Cover Penetrations x Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning x Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration x Needs Maintenance
☐ N/A
Remarks__vents capped due to implementation of active gas collection system; some gas vent caps were missing the plugs that are removed to allow for monitoring; The pipe coupling for GV-11 had shifted and may be impacting the seal; The pipe coupling for GV-3, which connects the gas vent to the gas extraction system piping was cracked and resulting in an audible leak of ambient air into the system.
_____

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning x Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks__Flush-mount covers not opened during inspection. _____
_____

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning x Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_Certain groundwater monitoring wells were observed with well covers that were not locked, although the locks were present either on the cover or on the ground (MW-15, PZ-12, PZ-10, ECJ-4)
_____

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance x N/A
Remarks_____
_____

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

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

1. **Gas Treatment Facilities**
☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
x 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 and not inspected. See notes above regarding GV-3. _

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
☐ Good condition ☐ Needs Maintenance ☐ N/A
Remarks_Methane gas monitor at adjacent motel was not inspected. PMC representative indicated it is still operating and has never alarmed, but may be more than 10 years old. PMC also noted that the GWTP has a portable methane gas monitor that is calibrated quarterly. _____

F. Cover Drainage Layer x Applicable ☐ N/A

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

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

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

1. **Siltation** Areal extent_____ Depth_____ ☐ N/A
☐ Siltation not evident
Remarks_____
_____

2. **Erosion** Areal extent_____ Depth_____
☐ Erosion not evident
Remarks_____
_____

3. **Outlet Works** ☐ Functioning ☐ N/A
Remarks_____

4. **Dam** ☐ Functioning ☐ N/A
Remarks_____
_____

H. Retaining Walls ☐ Applicable x N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
Horizontal displacement_____ Vertical displacement_____
Rotational displacement_____
Remarks_____
_____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
Remarks_____
_____

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

1. **Siltation** ☐ Location shown on site map X Siltation not evident
Areal extent_____ Depth_____
Remarks_Some silt had accumulated in the unnamed stream near the headwall and the City indicated that they plan to remove it, which they have done periodically in the past; it may not be originating from the site, since stormwater from catch basins in Hathaway Road also discharge at that location. _____
_____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
☐ Vegetation does not impede flow
Areal extent_____ Type_____
Remarks_Drainage swales were in good condition with minor dead vegetation from the prior growing season in some areas. _____
_____

3. **Erosion** ☐ Location shown on site map x Erosion not evident
Areal extent_____ Depth_____
Remarks_____
_____

4. **Discharge Structure** x Functioning ☐ N/A
Remarks_____
_____

VIII. VERTICAL BARRIER WALLS x Applicable ☐ N/A

1. **Settlement** ☐ Location shown on site map x Settlement not evident
Areal extent_____ Depth_____
Remarks_____
_____

2. **Performance Monitoring** Type of monitoring_____
x Performance not monitored
Frequency_____☐ Evidence of breaching
Head differential_____
Remarks_____
_____

IX. GROUNDWATER/SURFACE WATER REMEDIES x Applicable ☐ N/A

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

1. **Pumps, Wellhead Plumbing, and Electrical**
☐ Good condition☐ All required wells properly operating x Needs Maintenance ☐ N/A
Remarks__Bedrock extraction well BEI-1 was not operating during inspection due to issues with the pump. The City is planning to replace the pump. _____
_____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition☐ Needs Maintenance
Remarks__The City did not report any issues during the inspection. _____
_____

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition☐ Requires upgrade ☐ Needs to be provided
Remarks___Not inspected_____
_____

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

1. **Collection Structures, Pumps, and Electrical**
☐ Good condition☐ Needs Maintenance
Remarks_____
_____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition☐ Needs Maintenance
Remarks_____
_____

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition☐ Requires upgrade ☐ Needs to be provided
Remarks_____
_____

C. Treatment System x Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
   x Metals removal ☐ Oil/water separation ☐ Bioremediation
   x Air stripping x Carbon adsorbers
   x Filters_____
   x Additive (*e.g.*, chelation agent, flocculent)_____
   ☐ Others_____
   ☐ Good condition ☐ Needs Maintenance
   x Sampling ports properly marked and functional
   x Sampling/maintenance log displayed and up to date (included in monthly reports from City)
   x Equipment properly identified
   ☐ Quantity of groundwater treated annually_____
   ☐ Quantity of surface water treated annually_____
   Remarks__The City reported that pump 252, which pumps water to the multi-media filters, is not working and a new pump is on order. Does not affect the current operations.
   _____

2. **Electrical Enclosures and Panels** (properly rated and functional)
   ☐ N/A ☐ Good condition ☐ Needs Maintenance
   Remarks___Not verified_____
   _____

3. **Tanks, Vaults, Storage Vessels**
   ☐ N/A x Good condition x Proper secondary containment ☐ Needs Maintenance
   Remarks___ _____
   _____

4. **Discharge Structure and Appurtenances**
   x N/A ☐ Good condition ☐ Needs Maintenance
   Remarks___Not accessible but operating_____
   _____

5. **Treatment Building(s)**
   ☐ N/A x Good condition (esp. roof and doorways) ☐ Needs repair
   x 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__See notes above regarding wells under Section VII.D.3 _____
   _____

D. Monitoring Data

1. Monitoring Data
   x Is routinely submitted on time x Is of acceptable quality

2. Monitoring data suggests:
   ☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

D. 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

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

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 to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

_____
_____See report text. _____
_____
_____

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.

_____
_____See report text. _____
_____

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.

_____
_____None identified as part of the site inspection. _____
_____
_____

Sullivan's Ledge Superfund Site
Wetlands Restoration Area (OU-1)
Site No.
5-Year Review Checklist

The following checklist was created to review maintenance and monitoring of the mitigation wetlands on the north side of Hathaway Road at Sullivan's Ledge Superfund Site in New Bedford, MA. A project site inspection was completed on May 3, 2018. The project goals stated in the Wetlands Restoration Plan (WRP) dated July 1997 were used as a basis for the OU-1 checklist.

I. HYDROLOGY			
Has the long-term goal for the wetland hydrology, namely the presence of groundwater and/or saturated soils within 12 inches of the wetland surface in each piezometer for at least three of the first five years and each fifth year thereafter, been met?	Yes **X**	No	Unknown
Comment: Two rounds of data have not been collected within a two-week period since the project's inception and it can't be confirmed that water levels have been within 12 inches of the wetland surface for two weeks. This attribute is intended to document that hydrology in the restored wetlands is sufficient to support wetland plants. Given the high percentage of wetland plants growing throughout the restored areas, and visible observations of saturated soils, sufficient hydrology has been qualitatively confirmed and observed during the 2018 site visit and previous site visits.			
II. PERMANENT SAMPLING PLOTS			
Did the OU-1 restoration and mitigation areas achieve and maintained a total 75% areal coverage of wetland plant species by the end of the second growing season?	Yes **X**	No	Unknown
Comment: Since this is a 5-year review, the discussion can be expanded to conditions beyond the second growing season. The CONB 2017 data and 2018 report indicate that the restored OU1 Middle Marsh area contained a wide variety of species, including emergent, shrub, and tree species. Similar to May 2013 observations, May 2018 inspection suggests that the OU1 West Mitigation area has a high abundance of phragmites, and remedial actions are recommended to remove this phragmites and re-seed the area.			
Has greater than 25% mean areal coverage of hummocks within the OU-1 Middle Marsh restoration area been maintained?	Yes **X**	No	Unknown
Comment: According to the City of New Bedford's 2018 Wetland Report, both OU-1 Middle Marsh plots contained greater than 25% hummock.			
III. HYDRIC SOILS			
Has an annual soil profile description for test pits within the 13 sampling plots been produced annually for the first three years, at the end of the fifth growing season, and every five years thereafter?	Yes **X**	No	Unknown
Comment: The City of New Bedford's 2018 Wetland Monitoring Report includes a soil profile			

description of test pits adjacent to the permanent sampling plots. All soil profiles included hydric soil indicators. In two plots, soil profiles could not be completed due to inundation, which is also an indication that hydric soil conditions are present.			
IV. MAINTENANCE			
Has the Contractor been performing periodic replanting in areas where the vegetation did not survive?	Yes **X**	No	Unknown
Comment: The Contractor has not installed additional plants since the last 5-year inspection/review, however, the CONB indicated that approximately 80 new woody shrubs will be installed in spring of 2018 in areas where multiflora rose was removed. .			
Has the Contractor been providing adequate control of invasive species in the OU-1 restoration and mitigation areas?	Yes **X**	No	Unknown
Comment: During the previous 5-year inspection it was reported that Galerucella beetles had been released to control purple loosestrife at the site. The population of this species, as well as cattail (*Typha* sp.) and common reed (*Phragmites australis*), have been reduced since the last 5-year review due to previously implemented control measures. In addition, the CONB has had multiflora rose at the site cut and treated with herbicide, and is in the process of replanting these areas. An abundance of phragmites was observed in the Mitigation Area West. It is recommended that measures be implemented to reduce the abundance and further control the further spread of these species, including removal and replanting with desirable native wetland species.			
Is erosion being controlled at:			
- Stream Channel?	Yes **X**	No	Unknown
- OU-1 Tributary 2?	Yes **X**	No	Unknown
- OU-1 Ponds?	Yes **X**	No	Unknown
- OU-1 Middle Marsh restoration area?	Yes **X**	No	Unknown
Comment: During the 2018 inspection, it was noted the rope fence was intact in most locations and that mowing limits were being properly observed. A few areas of rope fence require minor repair. Overall, the site appeared stable and no significant erosion was noted.			
V. ADDITIONAL COMMENTS			
Comment:			

Sullivan's Ledge Superfund Site
Wetlands Restoration Area (OU-2)
Site No.
5-Year Review Checklist

The following checklist was created to review maintenance and monitoring of the mitigation wetlands on the north side of Hathaway Road. A project site inspection was completed on May 3, 2018. The Performance Standards and Wetland Attribute Goals stated in the Final Operation and Maintenance (O&M) Plan Second Operable Unit were used as a basis for the OU-2 Wetland Restoration Area checklist.

I. Biological Indicators			
Survival			
Did 80% of the plantings of each tree and shrub species in the restored wetland survive after five years?	Yes **X**	No	Unknown
Have dead or moribund plants been replaced at the earliest possible time consistent with the growing season to achieve a minimum of the original plant density?	Yes **X**	No	Unknown
Comment: Although the northeast and southwest corners of Middle Marsh include areas of phragmites, most of Middle Marsh is densely vegetated with woody plant species in the canopy. The City of New Bedford is planning on treating the areas of phragmites in spring 2018.			
Tree Growth			
Did the tree height and dbh increase every five years at least 20% from original planting height?	Yes **X**	No	Unknown
Comment: Woody species present at the site during the 2018 site visit were notably larger and more robust than in previous years. Documentation that this criterion has been met is not complete, because height and dbh of all planted tree species was not well documented at the time of planting, or during the 2005 inspection. However, dbh data collected in 2011 and 2017 do document this data for current conditions, and illustrated that the size of the woody plantings has been increasing consistently. Overall, the data suggest that the intent of this goal is being met for most areas because a woody canopy layer has become well established, with the exception of the extreme northeastern and southwestern corners.			
Vegetative Diversity			
Was at least one woody and herbaceous non-invasive wetland species, in addition to the planted species, noted after five years and every five years thereafter?	Yes **X**	No	Unknown
Comment: As reported in all monitoring reports received since the 2003 monitoring, this standard has been met.			
Vegetative Cover			
Has 75% areal coverage of wetland plant species been achieved?	Yes **X**	No	Unknown
If 75% areal coverage of wetland plant species has <u>not</u> been achieved by the second growing season, has a plan of action been submitted?	Yes	No	N/A **X**
Comment: Wetland species appear to cover at least 75% of the restored wetland areas in all plots.			
Are greater than 50% of the dominant plants, exclusive of invasive species, wetland species?	Yes **X**	No	Unknown
Comment: All of the plots met the criteria of greater than 50% dominance by non-invasive wetland			

plants. Although still present at the site, invasive species are becoming less prevalent.			
II. Mystic Valley Amphipod (MVA)			
OU-2 wetland areas with suitable MVA habitat restored based on presence of MVA in restored OU-2 areas?	Yes **X**	No	Unknown
Plan for re-establishment required due to lack of presence of MVA within 3 years of initiation of restoration (in 2000)?	Yes	No	Not Applicable **X**
Comment: The 2003 Wetland Monitoring Report indicated that the Mystic Valley Amphipod was found in the restored OU2 areas during the sampling events in 2003.			
III. Wetland Substrate/Soils			
Physical Substrate Restoration			
Have areas of eroded soil been repaired?	Yes **X**	No	Unknown
Are hydric soils present based on soil profile descriptions?	Yes **X**	No	Unknown
Comment: The goal for restored wetland soils will be a trend for soils from all ten borings to meet the definition of hydric within ten years. However, based on soil data included in the 2006, 2012, and 2017 Wetland Monitoring Reports, the soils within the restored areas are showing positive indicators of ground water presence within 12 inches of the ground surface during the growing season.			
Has 25% mean areal coverage of hummocks in Middle Marsh been achieved?	Yes **X**	No	Unknown
Comment: Based on the 2017 data collected by the City of New Bedford, these plots do not contain greater than 25% hummocks. Plots #2 and #4 in Middle Marsh continue to include greater than 25% hummocks. On a mean basis, the plots show that on average Middle Marsh does include greater than 25% mean areal coverage of hummocks. In addition, although additional fill could be imported to create additional hummocks in this area, the benefit is not believed to outweigh the impact to adjacent well-established areas with high cover of canopy woody vegetation.			
IV. Wetland Hydrology			
Restored wetland sediments replicate water retention characteristics of the pre-remediation conditions?	Yes **X**	No	Unknown
Comment:			
Depth to groundwater less than 12 inches at piezometer locations?	Yes **X**	No	Unknown
Hydrology restored to pre-remediation conditions in Middle Marsh?	Yes **X**	No	Unknown
Comment: Two rounds of data have not been collected within a two-week period since the project's inception and it can't be confirmed that water levels have been within 12 inches of the wetland surface for two weeks. This attribute is intended to document that hydrology in the restored wetlands is sufficient to support wetland plants. Given the high percentage of wetland plants growing throughout the restored areas, and visible observations of saturated soils across the site, sufficient hydrology has been qualitatively confirmed and observed during the 2018 site visit and previous site visits.			
V. Post-Construction and Long-Term Monitoring			
Are post-construction and long-term monitoring events occurring annually and every five years, respectively? (O&M 1/99 4.2)	Yes **X**	No	Unknown
Are monitoring reports being prepared and submitted for review in accordance with the monitoring programs? (O&M 1/99 4.5)	Yes **X**	No	Unknown
Are corrective actions required for death or failure of plants to properly grow? (O&M 1/99 4.4)	Yes	No **X**	Unknown
Are corrective actions required for excessive plant damage caused by animals? (O&M 1/99 4.4)	Yes	No **X**	Unknown

Are corrective actions required for invasion of opportunistic plant species into restoration areas? (O&M 1/99 4.4)	Yes **X**	No	Unknown
Are corrective actions required for erosion of an amount of topsoil/backfill that modifies the topography of restoration areas to a degree that it would affect the success of restoration in those areas? (O&M 1/99 4.4)	Yes	No **X**	Unknown
Comment: There has been positive evidence that CONB purchased *Galerucella* beetles previously released during the prior five-year review are continuing to have a positive effect on controlling purple loosestrife. However, phragmites in Middle Marsh and the mitigation area west, and multiflora rose present along wetland borders in a few areas should be treated, cut, and removed in order to facilitate growth of desirable wetland species.			

Project # _____ Page _____ of _____
Client _____ Date _____
Site _____ By _____
Subject _____ App. _____

AECOM

Sullivan's Ledge Site Inspection for 5-Year Review
May 3, 2018

Name	Title/Company	Contact Info (phone/email
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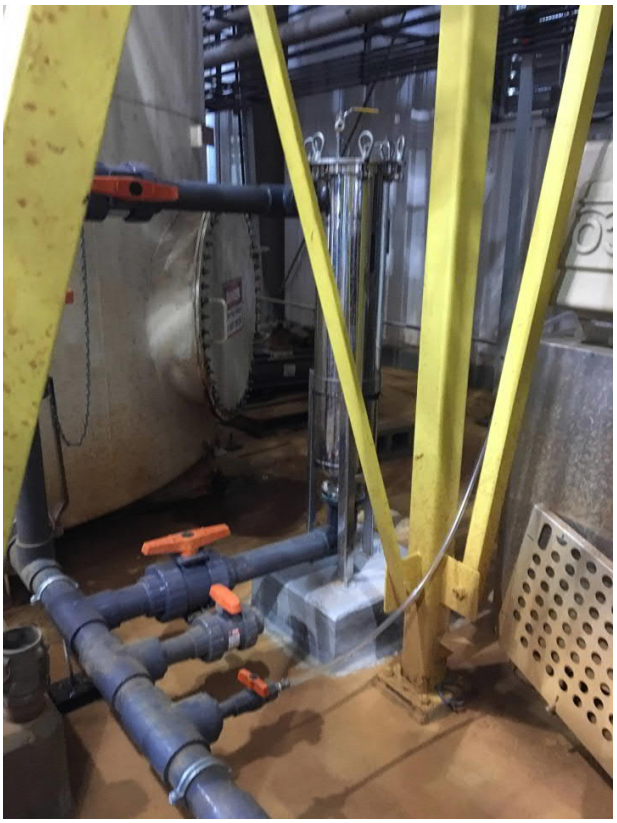
Cindy Castleberry-Lee	AECOM	cindy.castleberry@aecom.com

Spent granular activated carbon canisters from a former pilot test are rusting on the bottoms and should be removed from the GWTP for off-site disposal



Bag filter in center of photo was installed by the City in December 2017 to provide additional solids removal at the end of the treatment process.

Minor areas of missing vegetation adjacent to landfill gas extraction system blower should be reseeded.

View of landfill gas extraction system blower and discharge stack

Swing gates at GWTP entrance are in adequate condition.

Culvert that receives run-on from portions of the western property boundary appears in good condition.

Note barbed wire at top of fence section is damaged (possibly due to prior vegetation removal), but doesn't significantly affect site security. Similar conditions were noted along certain other portions of the site fencing.

Rip-rap lined southern cap boundary run-off collection swale is in good condition

Cap on gas vent GV-11 is missing plug. Also, pipe coupling (not shown) connecting the vent pipe to the cap appears to have shifted, potentially impacting the seal.

Monitoring well MW-15 is not locked.

Rip-rap lined eastern cap swale is in good condition

Minor rutting along edge of gravel access road in the southeastern area of the landfill cap should be filled and seeded.

Small area of low vegetation and possible minor erosion adjacent to gravel access road in eastern portion of landfill cap should be filled and seeded.

View of gas vent GV-3, which is directly connected to the gas extraction system header in the eastern portion of the landfill cap. Cracks in pipe coupling connecting the vent pipe to the extraction system piping resulting in an audible leak. The pipe coupling should be replaced.

View of eastern fence line looking south and gas monitoring well GM-19.

Inlet #3 in northeast corner of site receives run-on from off-site to the east. Note iron floc in wet area in center of photo.

Inlet structure at Vault #2 which receives run-off from the cap collection swales.

View of northern cap swale and access road.

Small animal holes in cap adjacent to access road and inlet structure at Vault #2.

Piezometer PZ-12 not locked, but lock is present on concrete pad.

Piezometer PZ-10 not locked, but lock is present on concrete pad.

View of headwall on north side of Hathaway Road.

Well ECJ-4, located in golf course, not locked.

Sediment Accumulation in Unnamed Stream Just Downstream of Hathaway Road

Unnamed Stream Downstream of Bridge to the North of Hathaway Road

Unnamed Stream Just Upstream of Middle Marsh

OU1 Unnamed Stream within OU2 Middle Marsh

Cut Multiflora Rose Covering Ground at OU1 Diversion Swale

Mitigation Area East

OU1 Pond Shore

Mitigation Area West Illustrating Dense Phragmites

Adjacent Wetland

OU1 Pond Shore

APPENDIX I – RISK CALCULATIONS

TABLE 1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SULLIVAN'S LEDGE SUPERFUND SITE OU1

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value	Screening Toxicity Value (N/C) (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
OU1 sediment															
	83-32-9	Acenaphthene		0.0274	mg/kg				0.0274	N/A	360 N	N/A	N/A	N	BSL
	208-96-8	Acenaphthylene		0.0142	mg/kg				0.0142	N/A	180 N	N/A	N/A	N	BSL
	120-12-7	Anthracene		0.22	mg/kg				0.22	N/A	1800 N	N/A	N/A	N	BSL
	56-55-3	Benzo(a)anthracene		1.9	mg/kg				1.9	N/A	1.1 C	N/A	N/A	Y	ASL
	50-32-8	Benzo(a)pyrene		1.4	mg/kg				1.4	N/A	0.1 C	N/A	N/A	Y	ASL
	205-99-2	Benzo(b)fluoranthene		3	mg/kg				3	N/A	1.1 C	N/A	N/A	Y	ASL
	191-24-2	Benzo(g,h,i)perylene		1	mg/kg				1	N/A	180 N	N/A	N/A	N	BSL
	207-08-9	Benzo(k)fluoranthene		1.4	mg/kg				1.4	N/A	11 C	N/A	N/A	N	BSL
	218-01-9	Chrysene		1.8	mg/kg				1.8	N/A	110 C	N/A	N/A	N	BSL
	53-70-3	Dibenz(a,h)anthracene		0.196	mg/kg				0.196	N/A	0.11 C	N/A	N/A	Y	ASL
	206-44-0	Fluoranthene		4.5	mg/kg				4.5	N/A	240 N	N/A	N/A	N	BSL
	86-73-7	Fluorene		0.034	mg/kg				0.034	N/A	240 N	N/A	N/A	N	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene		0.95	mg/kg				0.95	N/A	1.1 C	N/A	N/A	N	BSL
	91-20-3	Naphthalene		0.00647	mg/kg				0.00647	N/A	3.8 C	N/A	N/A	N	BSL
	85-01-8	Phenanthrene		1.3	mg/kg				1.3	N/A	180 N	N/A	N/A	N	BSL
	129-00-0	Pyrene		3.4	mg/kg				3.4	N/A	180 N	N/A	N/A	N	BSL
	12672-29-6	Aroclor-1248		0.085	mg/kg				0.085	N/A	0.23 C	N/A	N/A	N	BSL
	11097-69-1	Aroclor-1254		2.41	mg/kg				2.41	N/A	0.12 N	N/A	N/A	Y	ASL
	11096-82-5	Aroclor-1260		0.22	mg/kg				0.22	N/A	0.24 C	N/A	N/A	N	BSL
	7429-90-5	Aluminum		12000	mg/kg				12000	N/A	7700 N	N/A	N/A	Y	ASL
	7440-36-0	Antimony		1.5	mg/kg				1.5	N/A	3.1 N	N/A	N/A	N	BSL
	7440-38-2	Arsenic		7.6	mg/kg				7.6	N/A	0.68 C	N/A	N/A	Y	ASL
	7440-39-3	Barium		86	mg/kg				86	N/A	1500 N	N/A	N/A	N	BSL
	7440-41-7	Beryllium		1.3	mg/kg				1.3	N/A	16 N	N/A	N/A	N	BSL
	7440-43-9	Cadmium		0.27	mg/kg				0.27	N/A	7.1 N	N/A	N/A	N	BSL
	7440-70-2	Calcium		2200	mg/kg				2200	N/A	NS	N/A	N/A	N	NUT
	7440-47-3	Chromium		74	mg/kg				74	N/A	12000 N	N/A	N/A	N	BSL
	7440-48-4	Cobalt		8.7	mg/kg				8.7	N/A	2.3 N	N/A	N/A	Y	ASL
	7440-50-8	Copper		24	mg/kg				24	N/A	310 N	N/A	N/A	N	BSL
	7439-89-6	Iron		19000	mg/kg				19000	N/A	5500 N	N/A	N/A	Y	ASL
	7439-92-1	Lead		136	mg/kg				136	N/A	400 L	N/A	N/A	N	BSL
	7439-95-4	Magnesium		7200	mg/kg				7200	N/A	NS	N/A	N/A	N	NUT
	7439-96-5	Manganese		612	mg/kg				612	N/A	180 N	N/A	N/A	Y	ASL
	7439-97-6	Mercury		0.048	mg/kg				0.048	N/A	0.78 N	N/A	N/A	N	BSL
	7440-02-0	Nickel		32	mg/kg				32	N/A	150 N	N/A	N/A	N	BSL

TABLE 1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SULLIVAN'S LEDGE SUPERFUND SITE OU1

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value	Screening Toxicity Value (N/C) (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
	7440-09-7	Potassium		3200	mg/kg				3200	N/A	NS	N/A	N/A	N	NUT
	7782-49-2	Selenium		1.3	mg/kg				1.3	N/A	39 N	N/A	N/A	N	BSL
	7440-23-5	Sodium		350	mg/kg				350	N/A	NS	N/A	N/A	N	NUT
	7440-28-0	Thallium		2.5	mg/kg				2.5	N/A	0.078 N	N/A	N/A	Y	ASL
	7440-62-2	Vanadium		31	mg/kg				31	N/A	39 N	N/A	N/A	N	BSL
	7440-66-6	Zinc		120	mg/kg				120	N/A	2300 N	N/A	N/A	N	BSL

Notes:

Maximum detected concentrations for OU1 downstream samples collected in 2013, 2015, and 2017.

N/A = Not Applicable or Not Available

[2] The maximum detected concentration was used. Duplicate samples were not averaged prior to the identification of maxima.

[4] Screening toxicity values are the USEPA (November 2017) Regional Screening Levels (RSLs) for Residential Soil.

NS = None Specified

C = Carcinogen

N = Noncarcinogen (adjusted to a hazard quotient of 0.1)

L = Lead

The RSL values for noted analytes are as follows:

RSL for pyrene has been used for acenaphthylene, benzo(g,h,i)perylene, and phenanthrene.

RSL for chromium (III), Insoluble Salts used for chromium.

RSL for methyl mercury has been used for mercury.

[5] Codes used for rationale are as follows:

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: Essential Nutrient (NUT)

Below Screening Level (BSL)

TABLE 2

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

SULLIVAN'S LEDGE SUPERFUND SITE OU1

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
OU1 sediment									
	Benzo(a)anthracene	mg/kg			1.9E+00	1.9E+00	mg/kg	Maximum Detected	
	Benzo(a)pyrene	mg/kg			1.4E+00	1.4E+00	mg/kg	Maximum Detected	
	Benzo(b)fluoranthene	mg/kg			3.0E+00	3.0E+00	mg/kg	Maximum Detected	
	Dibenz(a,h)anthracene	mg/kg			2.0E-01	2.0E-01	mg/kg	Maximum Detected	
	Aroclor-1254	mg/kg			2.4E+00	2.4E+00	mg/kg	Maximum Detected	
	Aluminum	mg/kg			1.2E+04	1.2E+04	mg/kg	Maximum Detected	
	Arsenic	mg/kg			7.6E+00	7.6E+00	mg/kg	Maximum Detected	
	Cobalt	mg/kg			8.7E+00	8.7E+00	mg/kg	Maximum Detected	
	Iron	mg/kg			1.9E+04	1.9E+04	mg/kg	Maximum Detected	
	Manganese	mg/kg			6.1E+02	6.1E+02	mg/kg	Maximum Detected	
	Thallium	mg/kg			2.5E+00	2.5E+00	mg/kg	Maximum Detected	

TABLE 3

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SULLIVAN'S LEDGE SUPERFUND SITE OU1

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	OU1 sediment	CS	Chemical Concentration in Sediment	See Table 3s	mg/kg	See Table 3s	$\frac{CS \times IR \times EF \times ED \times CF \times RBA}{BW \times AT}$
				IR	Ingestion Rate	100	mg/day	USEPA, 1991	
				EF	Exposure Frequency	12	days/yr	Professional Judgement	
				ED	Exposure Duration	20	years	USEPA, 2014	
				CF	Conversion Factor	1.00E-06	kg/mg		
				RBA	Relative Bioavailability Factor	0.6 (Arsenic only) / 1	unitless	USEPA, 2012	
				BW	Body Weight	80	kg	USEPA, 2014	
				ATc	Averaging Time - cancer	25,550	days	USEPA, 1989	
				ATnc	Averaging Time - noncancer	7,300	days	USEPA, 1989	
Dermal	Recreational User	Adult	OU1 sediment	CS	Chemical Concentration in Sediment	See Table 3s	mg/kg	See Table 3s	$\frac{CS \times SA \times AF \times ABS \times EF \times ED \times CF}{BW \times AT}$
				SA	Surface Area	6,032	cm^2	USEPA, 2014	
				AF	Adherence Factor	0.3	mg/cm^2-day	USEPA, 2004	
				ABS	Dermal absorption fraction	see Attachment C	unitless	USEPA, 2004	
				EF	Exposure Frequency	12	days/yr	Professional Judgement	
				ED	Exposure Duration	20	years	USEPA, 2014	
				CF	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	80	kg	USEPA, 2014	
				ATc	Averaging Time - cancer	25,550	days	USEPA, 1989	
				ATnc	Averaging Time - noncancer	7,300	days	USEPA, 1989	

TABLE 3

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SULLIVAN'S LEDGE SUPERFUND SITE OU1

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Young Child (ages 1-6)	OU1 sediment	CS	Chemical Concentration in Sediment	See Table 3s	mg/kg	See Table 3s	$\frac{CS \times IR \times EF \times ED \times CF \times RBA}{BW \times AT}$
				IR	Ingestion Rate	200	mg/day	USEPA, 2014	
				EF	Exposure Frequency	12	days/yr	Professional Judgement	
				ED	Exposure Duration	6	years	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg		
				RBA	Relative Bioavailability Factor	0.6 (Arsenic only) / 1	unitless	USEPA, 2012	
				BW	Body Weight	15	kg	USEPA, 2014	
				ATc	Averaging Time - cancer	25,550	days	USEPA, 1989	
				ATnc	Averaging Time - noncancer	2,190	days	USEPA, 1989	
Dermal	Recreational User	Young Child (ages 1-6)	OU1 sediment	CS	Chemical Concentration in Sediment	See Table 3s	mg/kg	See Table 3s	$\frac{CS \times SA \times AF \times ABS \times EF \times ED \times CF}{BW \times AT}$
				SA	Surface Area	2,373	cm^2	USEPA, 2014	
				AF	Adherence Factor	0.2	mg/cm^2-day	USEPA, 2004	
				ABS	Dermal absorption fraction	see Attachment C	unitless	USEPA, 2004	
				EF	Exposure Frequency	12	days/yr	Professional Judgement	
				ED	Exposure Duration	6	years	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	15	kg	USEPA, 2014	
				ATc	Averaging Time - cancer	25,550	days	USEPA, 1989	
				ATnc	Averaging Time - noncancer	2,190	days	USEPA, 1989	

Recreational user exposure frequency assumes 12 exposures per year, which was used in the Phase II RI Risk Assessment.

TABLE 4

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

SULLIVAN'S LEDGE SUPERFUND SITE OU1

Chemical of Potential Concern (3)	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Benzo(a)anthracene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	Chronic	3E-04	mg/kg-day	(4)	3E-04	mg/kg-day	N/A	N/A	IRIS	7/2017
Benzo(b)fluoranthene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dibenz(a,h)anthracene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Aroclor-1254	Chronic	2E-05	mg/kg-day	(4)	2E-05	mg/kg-day	Immune System/Skin	300	IRIS	04/25/16
Aluminum	Chronic	1E+00	mg/kg-day	(4)	1E+00	mg/kg-day	Developmental	100	PPRTV	04/25/16
Arsenic	Chronic	3E-04	mg/kg-day	(4)	3E-04	mg/kg-day	Skin	3	IRIS	04/25/16
Cobalt	Chronic	3E-04	mg/kg-day	(4)	3E-04	mg/kg-day	Endocrine	3000	PPRTV	04/25/16
Iron	Chronic	7E-01	mg/kg-day	(4)	7E-01	mg/kg-day	Gastrointestinal	1.5	PPRTV	04/25/16
Manganese	Chronic	2.4E-02	mg/kg-day	0.04	9.6E-04	mg/kg-day	Nervous System	3	IRIS	04/25/16
Thallium	Chronic	1E-05	mg/kg-day	(4)	1E-05	mg/kg-day	Skin	3000	PPRTV	04/25/16

(1) Oral Absorption Efficiencies from Exhibit 4-1, RAGS Part E, USEPA 2004b.
Oral absorption efficiencies for aluminum, cobalt and iron obtained from ATSDR Toxicological Profiles.

(2) Calculated as: (oral RfD) x (oral to dermal adjustment factor).

(3) When the chronic RfD is based on a subchronic study, a subchronic RfD has typically been developed by the elimination of the uncertainty factor for subchronic to chronic adjustment. If no subchronic data are available, the chronic RfD has been adopted as the subchronic RfD.

(4) Oral absorption efficiency exceeds 50%. Therefore, no adjustment of the oral reference dose is necessary (USEPA, 2001).

RfD for thallium is based on thallium (soluble salts)

IRIS = Integrated Risk Information System

N/A = Not Applicable/Not Available

PPRTV = Provisional Peer Reviewed Toxicity Value

HEAST = Health Effects Assessment Summary Tables

TABLE 5

CANCER TOXICITY DATA -- ORAL/DERMAL

SULLIVAN'S LEDGE SUPERFUND SITE OU1

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units	(1)	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Benzo(a)anthracene	1.0E-01	(mg/kg-day) $^{-1}$	N/A	1.0E-01	(mg/kg-day) $^{-1}$	B2	IRIS	07/01/17
Benzo(a)pyrene	1.0E+00	(mg/kg-day) $^{-1}$	N/A	1.0E+00	(mg/kg-day) $^{-1}$	B2	IRIS	07/01/17
Benzo(b)fluoranthene	1.0E-01	(mg/kg-day) $^{-1}$	N/A	1.0E-01	(mg/kg-day) $^{-1}$	B2	IRIS	07/01/17
Dibenz(a,h)anthracene	1.0E+00	(mg/kg-day) $^{-1}$	N/A	1.0E+00	(mg/kg-day) $^{-1}$	B2	IRIS	07/01/17
Aroclor-1254	2E+00	(mg/kg-day) $^{-1}$	(1)	2.0E+00	(mg/kg-day) $^{-1}$	B2	IRIS	04/25/16
Aluminum	N/A	N/A	0.01	N/A	N/A	Inadequate	PPRTV	04/25/16
Arsenic	1.5E+00	(mg/kg-day) $^{-1}$	(1)	1.5E+00	(mg/kg-day) $^{-1}$	A	IRIS	04/25/16
Cobalt	N/A	N/A	(1)	N/A	N/A	Likely	PPRTV	04/25/16
Iron	N/A	N/A	(1)	N/A	N/A	Inadequate	PPRTV	04/25/16
Manganese	N/A	N/A	0.04	N/A	N/A	D	IRIS	04/25/16
Thallium	N/A	N/A	(1)	N/A	N/A	Inadequate	IRIS	04/25/16

IRIS = Integrated Risk Information System

PPRTV = Provisional Peer Reviewed Toxicity Value

Slope factor for benzo(a)pyrene, along with the appropriate relative potency factor (USEPA, 1993), used for the other carcinogenic PAHs.

(1) Oral absorption efficiency exceeds 50%. Therefore, no adjustment of the oral slope factor is necessary.

(2) Calculated as: (oral slope factor) / (oral to dermal adjustment factor)

N/A = Not Applicable/Not Available

EPA Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen (by the oral route)

TABLE 6

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SULLIVAN'S LEDGE SUPERFUND SITE OU1

Scenario Timeframe: Current/Future
Receptor Population: Recreational User
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration (1)		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration (1)		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	OU1 Sediment	Ingestion													
				Benzo(a)anthracene	2E+00	mg/kg	2.2E-08	mg/kg-day	1.0E-01	(mg/kg-day) $^{-1}$	4.5E-09	7.8E-08	mg/kg-day	N/A	N/A	N/A
				Benzo(a)pyrene	1E+00	mg/kg	1.6E-08	mg/kg-day	1.0E+00	(mg/kg-day) $^{-1}$	3.3E-08	5.8E-08	mg/kg-day	3.0E-04	mg/kg-day	1.9E-04
				Benzo(b)fluoranthene	3E+00	mg/kg	3.5E-08	mg/kg-day	1.0E-01	(mg/kg-day) $^{-1}$	7.0E-09	1.2E-07	mg/kg-day	N/A	N/A	N/A
				Dibenz(a,h)anthracene	2E-01	mg/kg	2.3E-09	mg/kg-day	1.0E+00	(mg/kg-day) $^{-1}$	4.6E-09	8.1E-09	mg/kg-day	N/A	N/A	N/A
				Aroclor-1254	2E+00	mg/kg	2.8E-08	mg/kg-day	2.0E+00	(mg/kg-day) $^{-1}$	5.7E-08	9.9E-08	mg/kg-day	2.0E-05	mg/kg-day	5.0E-03
				Aluminum	1E+04	mg/kg	1.4E-04	mg/kg-day	N/A	N/A	N/A	4.9E-04	mg/kg-day	1.0E+00	mg/kg-day	4.9E-04
				Arsenic	8E+00	mg/kg	5.4E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	8.0E-08	1.9E-07	mg/kg-day	3.0E-04	mg/kg-day	6.2E-04
				Cobalt	9E+00	mg/kg	1.0E-07	mg/kg-day	N/A	N/A	N/A	3.6E-07	mg/kg-day	3.0E-04	mg/kg-day	1.2E-03
				Iron	2E+04	mg/kg	2.2E-04	mg/kg-day	N/A	N/A	N/A	7.8E-04	mg/kg-day	7.0E-01	mg/kg-day	1.1E-03
				Manganese	6E+02	mg/kg	7.2E-06	mg/kg-day	N/A	N/A	N/A	2.5E-05	mg/kg-day	2.4E-02	mg/kg-day	1.0E-03
				Thallium	3E+00	mg/kg	2.9E-08	mg/kg-day	N/A	N/A	N/A	1.0E-07	mg/kg-day	1.0E-05	mg/kg-day	1.0E-02
			Exp. Route Total								2E-07					2E-02
			Dermal													
				Benzo(a)anthracene	2E+00	mg/kg	5.2E-08	mg/kg-day	1.0E-01	(mg/kg-day) $^{-1}$	1.0E-08	1.8E-07	mg/kg-day	N/A	N/A	N/A
				Benzo(a)pyrene	1E+00	mg/kg	3.9E-08	mg/kg-day	1.0E+00	(mg/kg-day) $^{-1}$	7.7E-08	1.4E-07	mg/kg-day	3.0E-04	mg/kg-day	4.5E-04
				Benzo(b)fluoranthene	3E+00	mg/kg	8.3E-08	mg/kg-day	1.0E-01	(mg/kg-day) $^{-1}$	1.7E-08	2.9E-07	mg/kg-day	N/A	N/A	N/A
				Dibenz(a,h)anthracene	2E-01	mg/kg	5.4E-09	mg/kg-day	1.0E+00	(mg/kg-day) $^{-1}$	1.1E-08	1.9E-08	mg/kg-day	N/A	N/A	N/A
				Aroclor-1254	2E+00	mg/kg	7.2E-08	mg/kg-day	2.0E+00	(mg/kg-day) $^{-1}$	1.4E-07	2.5E-07	mg/kg-day	2.0E-05	mg/kg-day	1.3E-02
				Aluminum	1E+04	mg/kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.0E+00	mg/kg-day	N/A
				Arsenic	8E+00	mg/kg	4.8E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	7.3E-08	1.7E-07	mg/kg-day	3.0E-04	mg/kg-day	5.7E-04
				Cobalt	9E+00	mg/kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.0E-04	mg/kg-day	N/A
				Iron	2E+04	mg/kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.0E-01	mg/kg-day	N/A
				Manganese	6E+02	mg/kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.6E-04	mg/kg-day	N/A
				Thallium	3E+00	mg/kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.0E-05	mg/kg-day	N/A
			Exp. Route Total								3E-07					1E-02
		Exposure Point Total									5E-07					3E-02
	Exposure Medium Total										N/A					N/A
Medium Total											N/A					N/A
											Total of Receptor Risks Across All Media					N/A
																Total of Receptor Hazards Across All Media

Notes

Shading indicates early-life cancer risk calculations for carcinogenic PAHs calculated by multiplying the result by the default age-dependent adjustment factor (ADAF) of 3 for 10/20 of the result (ages 7-16) and an ADAF of 1 for 10/20 of the result (ages 17-26).

(1) A relative bioavailability factor of 0.6 (60%) was applied to the soil arsenic ingestion intake calculation.

TABLE 7

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SULLIVAN'S LEDGE SUPERFUND SITE OU1

Scenario Timeframe: Current/Future
Receptor Population: Recreational User
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration (1)		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration (1)		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	OU1 Sediment	Ingestion													
				Benzo(a)anthracene	2E+00	mg/kg	7.1E-08	mg/kg-day	1.0E-01	(mg/kg-day) $^{-1}$	3.8E-08	8.3E-07	mg/kg-day	N/A	N/A	N/A
				Benzo(a)pyrene	1E+00	mg/kg	5.3E-08	mg/kg-day	1.0E+00	(mg/kg-day) $^{-1}$	2.8E-07	6.1E-07	mg/kg-day	3.0E-04	mg/kg-day	2.0E-03
				Benzo(b)fluoranthene	3E+00	mg/kg	1.1E-07	mg/kg-day	1.0E-01	(mg/kg-day) $^{-1}$	6.0E-08	1.3E-06	mg/kg-day	N/A	N/A	N/A
				Dibenz(a,h)anthracene	2E-01	mg/kg	7.4E-09	mg/kg-day	1.0E+00	(mg/kg-day) $^{-1}$	3.9E-08	8.6E-08	mg/kg-day	N/A	N/A	N/A
				Aroclor-1254	2E+00	mg/kg	9.1E-08	mg/kg-day	2.0E+00	(mg/kg-day) $^{-1}$	1.8E-07	1.1E-06	mg/kg-day	2.0E-05	mg/kg-day	5.3E-02
				Aluminum	1E+04	mg/kg	4.5E-04	mg/kg-day	N/A	N/A	N/A	5.3E-03	mg/kg-day	1.0E+00	mg/kg-day	5.3E-03
				Arsenic	8E+00	mg/kg	1.7E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	2.6E-07	2.0E-06	mg/kg-day	3.0E-04	mg/kg-day	6.7E-03
				Cobalt	9E+00	mg/kg	3.3E-07	mg/kg-day	N/A	N/A	N/A	3.8E-06	mg/kg-day	3.0E-04	mg/kg-day	1.3E-02
				Iron	2E+04	mg/kg	7.1E-04	mg/kg-day	N/A	N/A	N/A	8.3E-03	mg/kg-day	7.0E-01	mg/kg-day	1.2E-02
				Manganese	6E+02	mg/kg	2.3E-05	mg/kg-day	N/A	N/A	N/A	2.7E-04	mg/kg-day	2.4E-02	mg/kg-day	1.1E-02
				Thallium	3E+00	mg/kg	9.4E-08	mg/kg-day	N/A	N/A	N/A	1.1E-06	mg/kg-day	1.0E-05	mg/kg-day	1.1E-01
			Exp. Route Total								9E-07					2E-01
			Dermal													
				Benzo(a)anthracene	2E+00	mg/kg	2.2E-08	mg/kg-day	1.0E-01	(mg/kg-day) $^{-1}$	1.2E-08	2.6E-07	mg/kg-day	N/A	N/A	N/A
				Benzo(a)pyrene	1E+00	mg/kg	1.6E-08	mg/kg-day	1.0E+00	(mg/kg-day) $^{-1}$	8.7E-08	1.9E-07	mg/kg-day	3.0E-04	mg/kg-day	6.3E-04
				Benzo(b)fluoranthene	3E+00	mg/kg	3.5E-08	mg/kg-day	1.0E-01	(mg/kg-day) $^{-1}$	1.9E-08	4.1E-07	mg/kg-day	N/A	N/A	N/A
				Dibenz(a,h)anthracene	2E-01	mg/kg	2.3E-09	mg/kg-day	1.0E+00	(mg/kg-day) $^{-1}$	1.2E-08	2.7E-08	mg/kg-day	N/A	N/A	N/A
				Aroclor-1254	2E+00	mg/kg	3.0E-08	mg/kg-day	2.0E+00	(mg/kg-day) $^{-1}$	6.0E-08	3.5E-07	mg/kg-day	2.0E-05	mg/kg-day	1.8E-02
				Aluminum	1E+04	mg/kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.0E+00	mg/kg-day	N/A
				Arsenic	8E+00	mg/kg	2.0E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	3.0E-08	2.4E-07	mg/kg-day	3.0E-04	mg/kg-day	7.9E-04
				Cobalt	9E+00	mg/kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.0E-04	mg/kg-day	N/A
				Iron	2E+04	mg/kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.0E-01	mg/kg-day	N/A
				Manganese	6E+02	mg/kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.6E-04	mg/kg-day	N/A
				Thallium	3E+00	mg/kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.0E-05	mg/kg-day	N/A
			Exp. Route Total								2E-07					2E-02
		Exposure Point Total									1E-06					2E-01
	Exposure Medium Total										N/A					N/A
Medium Total											N/A					N/A
											Total of Receptor Risks Across All Media					Total of Receptor Hazards Across All Media
											N/A					N/A

Notes

Shading indicates early-life cancer risk calculations for carcinogenic PAHs calculated by multiplying the result by the default age-dependent adjustment factor (ADAF) of 10 for 2/6 of the result (ages 1-2) and an ADAF of 3 for 4/6 of the result (ages 3-6).

(1) A relative bioavailability factor of 0.6 (60%) was applied to the soil arsenic ingestion intake calculation.

TABLE 8

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SULLIVAN'S LEDGE SUPERFUND SITE OU1

Scenario Timeframe: Current/Future
Receptor Population: Recreational User
Receptor Age: Young Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk Young Child + Adult					Non-Carcinogenic Hazard Quotient Young Child				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	OU1 Sediment											
			Benzo(a)anthracene	4E-08	- -	2E-08	- -	6E-08	N/A	N/A	- -	N/A	N/A
			Benzo(a)pyrene	3E-07	- -	2E-07	- -	5E-07	N/A	2E-03	- -	6E-04	3E-03
			Benzo(b)fluoranthene	7E-08	- -	4E-08	- -	1E-07	N/A	N/A	- -	N/A	N/A
			Dibenz(a,h)anthracene	4E-08	- -	2E-08	- -	7E-08	N/A	N/A	- -	N/A	N/A
			Aroclor-1254	2E-07	- -	2E-07	- -	4E-07	Immune System/Skin	5E-02	- -	2E-02	7E-02
			Aluminum	N/A	- -	N/A	- -	N/A	Developmental	5E-03	- -	N/A	5E-03
			Arsenic	3E-07	- -	1E-07	- -	4E-07	Skin	7E-03	- -	8E-04	7E-03
			Cobalt	N/A	- -	N/A	- -	N/A	Endocrine	1E-02	- -	N/A	1E-02
			Iron	N/A	- -	N/A	- -	N/A	Gastrointestinal	1E-02	- -	N/A	1E-02
			Manganese	N/A	- -	N/A	- -	N/A	Nervous System	1E-02	- -	N/A	1E-02
			Thallium	N/A	- -	N/A	- -	N/A	Skin	1E-01	- -	N/A	1E-01
			Chemical Total	1E-06	- -	6E-07	- -	2E-06		2E-01	- -	2E-02	2E-01
			Radionuclide Total										
		Exposure Point Total						2E-06					2E-01
	Exposure Medium Total							2E-06					2E-01
Medium Total								2E-06					2E-01
Receptor Total								2E-06					2E-01

- - = Not Evaluated

N/A = Not Applicable

Total Risk Across All Media: 2E-06

Total Hazard Across All Media: 2E-01

Total Blood HI =	N/A
Total Cardiovascular HI =	N/A
Total Developmental HI =	5E-03
Total Endocrine HI =	1E-02
Total Gastrointestinal HI =	1E-02
Total Immune System HI =	7E-02
Total Kidney HI =	N/A
Total Liver HI =	N/A
Total Nervous System HI =	1E-02
Total Reproductive HI =	N/A
Total Respiratory HI =	N/A
Total Skin HI =	2E-01

APPENDIX J – VAPOR INTRUSION SCREENING

Table 1
Vapor Intrusion Evaluation of Groundwater Monitoring Data

Detected VOCs	Monitoring Results[3]					Maximum Detected Concentration	VISL [1]	Comments
	Sep-13	Sep-14	Sep-15	Sep-16	Sep-17			
MW-4A								
Benzene	0.28 J	0.23 J	0.25 J	0.5 U	0.35 J	0.35	6.93	
cis-1,2-Dichloroethene [2]	0.43 J	0.5 U	0.1 J	6.9	1.3	6.9	82.1	
Trichloroethene	0.5 U	0.5 U	0.5 U	1 U	0.84 J	0.84	2.18	
Vinyl chloride	1.36	1 U	1 U	5.3	1.2	5.3	2.45	VISL based on TCR of 1E-06; detected concentration below VISL based on TCR of 1E-05 (24.5 ug/L)
MW-5A								
Benzene	0.5 U	0.5 U	0.5 U	0.5 U	0.31	0.31	6.93	
Chlorobenzene	0.5 U	0.5 U	0.5 U	1 U	0.53	0.53	172	
Chloroform	0.45 J	0.38 J	0.25 J	1 U	1 U	0.45	3.55	
MW-13A								
Benzene	0.23 J	0.18 J	0.5 U	NA	NA	0.23	6.93	
Chlorobenzene	0.45 J	0.39 J	0.11 J	NA	NA	0.45	172	
cis-1,2-Dichloroethene [2]	0.34 J	0.15 J	0.21 J	NA	NA	0.34	82.1	
MW-12AR								
1,1-Dichloroethane	0.21 J	0.13 J	NA	1 UJ	0.26	0.26	33.4	
Benzene	27.5	15	NA	28	28.7	28.7	6.93	VISL based on TCR of 1E-06; detected concentrations below VISL based on TCR of 1E-05 (69.3 ug/L)
Chlorobenzene	38.7	22.7	NA	57	58.6	58.6	172	
Chloroethane	2.34	1.57	NA	3.5	3.6	3.6	9650	
cis-1,2-Dichloroethene [2]	0.42 J	0.18 J	NA	1 U	1 U	0.42	87.6	
Ethylbenzene	0.48 J	0.16 J	NA	1 U	0.35	0.48	15.2	
Toluene	1.07	0.45 J	NA	0.64 J	0.78	1.07	8070	
Xylene (total)	1.06 J	1.25	NA	1.2	1.7	1.25	162	

NOTES
All concentrations presented in ug/L.
1. Vapor Intrusion Screening Level (VISL) from EPA's online VISL calculator (https://epa-visl.ornl.gov/cgi-bin/visl_search) based on November 2017 updates.
   Groundwater target concentration for commercial exposure; target cancer risk (TCR) = 1E-06 and target hazard quotient (THQ) = 0.1; see the following pages for calculator output
2. 1,1-Dichloroethene used as a surrogate in the VISL calculator.
3. Data from OBG, 2018a, Appendix F, Table 1

VOC - Volatile Organic Compound
U - Not Detected; J - Estimated value
NA - Not analyzed

Default VISL Results
Commercial Equation Inputs

Output generated 19APR2018:08:22:59

Variable	Value
Exposure Scenario	Commercial
Temperature for Groundwater Vapor Concentration C	25
THQ (target hazard quotient) unitless	0.1
TR (target risk) unitless	0.000001
AT_w (averaging time - composite worker)	365
EF_w (exposure frequency - composite worker) day/yr	250
ED_w (exposure duration - composite worker) yr	25
ET_w (exposure time - composite worker) hr	8
LT (lifetime) yr	70
AF_{gw} (Attenuation Factor Groundwater) unitless	0.001
AF_{ss} (Attenuation Factor Sub-Slab) unitless	0.03

Commercial Vapor Intrusion Screening Levels (VISL)

Output generated 19APR2018:08:22:59

Chemical	CAS Number	Does the chemical meet the definition for volatility? (HLC>1E-5 or VP>1)	Does the chemical have inhalation toxicity data? (IUR and/or RfC)	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source? (C_{vp} > $C_{i,a}$,Target?)	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source? (C_{hc} > $C_{i,a}$,Target?)	Target Indoor Air Concentration (TCR=1E-06 or THQ=0.1) MIN($C_{ia,c}$,$C_{ia,nc}$) ($\mu g/m^3$)	Toxicity Basis	Target Sub-Slab and Exterior Soil Gas Concentration (TCR=1E-06 or THQ=0.1) C_{sg},Target ($\mu g/m^3$)	Target Groundwater Concentration (TCR=1E-06 or THQ=0.1) C_{gw},Target ($\mu g/L$)	Is Target Groundwater Concentration < MCL? (C_{gw} < MCL?)	Pure Phase Vapor Concentration C_{vp} (25 °C) ($\mu g/m^3$)	Maximum Groundwater Vapor Concentration C_{hc} ($\mu g/m^3$)	Temperature for Maximum Groundwater Vapor Concentration (°C)	Lower Explosive Limit LEL (% by volume)	LEL Ref	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	IUR Ref	Chronic RfC (mg/m^3)	Chronic RfC Ref	Mutagenic Indicator	Carcinogenic VISL TCR=1E-06 $C_{ia,c}$ ($\mu g/m^3$)	Noncarcinogenic VISL THQ=0.1 $C_{ia,nc}$ ($\mu g/m^3$)
Benzene	71-43-2	Yes	Yes	Yes	Yes	1.57	CA	52.4	6.93	No (5)	398000000	406000000	25	1.2	CRC89	7.8E-06	I	0.03	I		1.57	13.1
Chlorobenzene	108-90-7	Yes	Yes	Yes	Yes	21.9	NC	730	172	No (100)	72500000	63300000	25	1.3	CRC89	-		0.05	P		-	21.9
Chloroform	67-66-3	Yes	Yes	Yes	Yes	0.533	CA	17.8	3.55	Yes (80)	1260000000	1190000000	25	-		0.000023	I	0.0977	A		0.533	42.8
Dichloroethane, 1,1-	75-34-3	Yes	Yes	Yes	Yes	7.67	CA	256	33.4	--	1210000000	1160000000	25	5.4	CRC89	1.6E-06	C	-			7.67	-
Dichloroethylene, 1,1-	75-35-4	Yes	Yes	Yes	Yes	87.6	NC	2920	82.1	No (7)	3130000000	2580000000	25	6.5	CRC89	-		0.2	I		-	87.6
Ethyl Chloride	75-00-3	Yes	Yes	Yes	Yes	4380	NC	146000	9650	--	3500000000	3050000000	25	3.8	CRC89	-		10	I		-	4380
Ethylbenzene	100-41-4	Yes	Yes	Yes	Yes	4.91	CA	164	15.2	Yes (700)	54800000	54400000	25	0.8	CRC89	2.5E-06	C	1	I		4.91	438
Toluene	108-88-3	Yes	Yes	Yes	Yes	2190	NC	73000	8070	No (1000)	141000000	143000000	25	1.1	CRC89	-		5	I		-	2190
Trichloroethylene	79-01-6	Yes	Yes	Yes	Yes	0.876	NC	29.2	2.18	Yes (5)	488000000	515000000	25	8	CRC89	4.1E-06	I	0.002	I	Mut	2.99	0.876
Vinyl Chloride	75-01-4	Yes	Yes	Yes	Yes	2.79	CA	92.9	2.45	No (2)	10000000000	10000000000	25	3.6	CRC89	4.4E-06	I	0.1	I	Mut	2.79	43.8
Xylenes	1330-20-7	Yes	Yes	Yes	Yes	43.8	NC	1460	162	Yes (10000)	45600000	28700000	25	-		-		0.1	I		-	43.8

Chemical Properties

Output generated 19APR2018:08:22:59

Chemical	CAS Number	Does the chemical meet the definition for volatility? (HLC>1E-5 or VP>1)	Does the chemical have inhalation toxicity data? (IUR and/or RfC)	MW (g/mol)	MW Ref	Vapor Pressure VP (mm Hg)	VP Ref	Pure Component Water Solubility S (mg/L)	S Ref	MCL (ug/L)	Henry's Law Constant @25°C (atm-m^3/mole)	Henry's Law Constant (unitless)	H`& HLC Ref	Henry's Law Constant Used in Calcs (unitless)	Air Diffusivity D_{ia} (cm^2/s)	D_{ia} Ref	Water Diffusivity D_{iw} (cm^2/s)	D_{iw} Ref	Normal Boiling Point T_{boil} (K)	BP Ref	Critical Temperature T_{crit} (K)	T_{crit} Ref	Enthalpy of vaporization at the normal boiling point $\Delta H_{v,b}$ (cal/mol)	$\Delta H_{v,b}$ Ref	Organic Carbon Partition Coefficient K_{oc} (cm3/g)	K_{oc} Ref	Lower Explosive Limit LEL (% by volume)	LEL Ref
Benzene	71-43-2	Yes	Yes	78.115	PHYSPROP	94.8	PHYSPROP	1790	PHYSPROP	5	0.00555	0.227	PHYSPROP	0.227	0.0895	WATER9 (U.S. EPA, 2001)	0.0000103	WATER9 (U.S. EPA, 2001)	353.2	PHYSPROP	562	CRC89	7340	CRC89	145.8	EPI	1.2	CRC89
Chlorobenzene	108-90-7	Yes	Yes	112.56	PHYSPROP	12	PHYSPROP	498	PHYSPROP	100	0.00311	0.127	PHYSPROP	0.127	0.0721	WATER9 (U.S. EPA, 2001)	9.48E-06	WATER9 (U.S. EPA, 2001)	404.9	PHYSPROP	632	CRC89	8410	CRC89	233.9	EPI	1.3	CRC89
Chloroform	67-66-3	Yes	Yes	119.38	PHYSPROP	197	PHYSPROP	7950	PHYSPROP	80	0.00367	0.15	PHYSPROP	0.15	0.0769	WATER9 (U.S. EPA, 2001)	0.0000109	WATER9 (U.S. EPA, 2001)	334.3	PHYSPROP	536	CRC89	6990	Weast	31.82	EPI	-	
Dichloroethane, 1,1-	75-34-3	Yes	Yes	98.96	PHYSPROP	227	PHYSPROP	5040	PHYSPROP	-	0.00562	0.23	PHYSPROP	0.23	0.0836	WATER9 (U.S. EPA, 2001)	0.0000106	WATER9 (U.S. EPA, 2001)	330.6	PHYSPROP	523	CRC89	6900	CRC89	31.82	EPI	5.4	CRC89
Dichloroethylene, 1,1-	75-35-4	Yes	Yes	96.944	PHYSPROP	600	PHYSPROP	2420	PHYSPROP	7	0.0261	1.07	PHYSPROP	1.07	0.0863	WATER9 (U.S. EPA, 2001)	0.000011	WATER9 (U.S. EPA, 2001)	304.9	PHYSPROP	482	YAWS	6250	CRC89	31.82	EPI	6.5	CRC89
Ethyl Chloride	75-00-3	Yes	Yes	64.515	PHYSPROP	1010	PHYSPROP	6710	PHYSPROP	-	0.0111	0.454	PHYSPROP	0.454	0.104	WATER9 (U.S. EPA, 2001)	0.0000116	WATER9 (U.S. EPA, 2001)	285.5	PHYSPROP	460	CRC89	5890	CRC89	21.73	EPI	3.8	CRC89
Ethylbenzene	100-41-4	Yes	Yes	106.17	PHYSPROP	9.6	PHYSPROP	169	PHYSPROP	700	0.00788	0.322	PHYSPROP	0.322	0.0685	WATER9 (U.S. EPA, 2001)	8.46E-06	WATER9 (U.S. EPA, 2001)	409.3	PHYSPROP	617	CRC89	8500	CRC89	446.1	EPI	0.8	CRC89
Toluene	108-88-3	Yes	Yes	92.142	PHYSPROP	28.4	PHYSPROP	526	PHYSPROP	1000	0.00664	0.271	PHYSPROP	0.271	0.0778	WATER9 (U.S. EPA, 2001)	0.0000092	WATER9 (U.S. EPA, 2001)	383.8	PHYSPROP	592	CRC89	7930	Weast	233.9	EPI	1.1	CRC89
Trichloroethylene	79-01-6	Yes	Yes	131.39	PHYSPROP	69	PHYSPROP	1280	PHYSPROP	5	0.00985	0.403	PHYSPROP	0.403	0.0687	WATER9 (U.S. EPA, 2001)	0.0000102	WATER9 (U.S. EPA, 2001)	360.4	PHYSPROP	571	YAWS	7510	Weast	60.7	EPI	8	CRC89
Vinyl Chloride	75-01-4	Yes	Yes	62.499	PHYSPROP	2980	EPI	8800	PHYSPROP	2	0.0278	1.14	PHYSPROP	1.14	0.107	WATER9 (U.S. EPA, 2001)	0.000012	WATER9 (U.S. EPA, 2001)	259.9	PHYSPROP	425	CRC89	4970	CRC89	21.73	EPI	3.6	CRC89
Xylenes	1330-20-7	Yes	Yes	106.17	PHYSPROP	7.99	PHYSPROP	106	PHYSPROP	10000	0.00663	0.271	PHYSPROP	0.271	0.0685	WATER9 (U.S. EPA, 2001)	8.46E-06	WATER9 (U.S. EPA, 2001)	411.7	PHYSPROP	620	YAWS	8520	Weast	382.9	EPI	-	

APPENDIX K – ARARS TABLES

TABLE 1. REVIEW OF ARARS FOR OPERABLE UNIT 1
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Safe Drinking Water Act Regulations, 40 CFR Part 141, Subpart B	ROD: waived	Establishes MCLs for public drinking water supplies. These relevant and appropriate regulations will be waived because of technical impracticability.	Not provided in ROD	These regulations were waived in the ROD.
TSCA PCB Disposal Requirements, 40 CFR 761.60	ROD: applicable, some requirements will be waived	Disposal of soils and sediments with PCBs over 50 ppm, must be by incinerator or equivalent alternative method, or chemical waste landfill. Remedy will result in chemical waste landfill containing existing wastes which have been previously landfilled on site and solidified soils and sediments. Some requirements of chemical waste landfill which are not necessary to protect against risk of injury to health or environment will be waived under the waiver provisions of the TSCA regulations.	Not provided in ROD	The requirements of 40 CFR 761.75(b)(4-9) were met during remedy construction. Other requirements of chemical waste landfills were waived in the ROD. These requirements were also complied with for off-site disposal of sludge from the GWTP. When the sludge was determined to contain greater than 50 ppm PCBs, the sludge was disposed of at an EPA-approved chemical waste landfill.
RCRA Land Disposal Regulations, 40 CFR 268 Subpart C	ROD: not applicable	These regulations are not applicable because solidified soils are not expected to contain characteristic or listed hazardous waste.	Not provided in ROD	These regulations are not applicable because pre-design studies (TCLP metals analyses) showed that soil and sediment, representative of material that was excavated, did not exhibit the toxicity characteristics and therefore did not constitute a hazardous waste.

TABLE 1. REVIEW OF ARARS FOR OPERABLE UNIT 1
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
RCRA Minimum Technology Regulations, 40 CFR 264.300	ROD: not applicable	These regulations establish standards for new or replacement landfills, or lateral expansions of landfills, including double liner and leachate collection. Not applicable because remedy does not involve creation of new or replacement landfill, or lateral expansion of landfill. Double liners are not relevant and appropriate because it is technically infeasible to construct a double liner separating wastes in quarry pits from the groundwater. Remedy will comply with leachate collection requirements, except inappropriate length of operation requirements.	Not provided in ROD	It should be noted that numerous amendments have been made to these regulations since June 28, 1989. The remedy remains protective because the groundwater treatment plant continues to collect and treat groundwater and leachate collected.

TABLE 1. REVIEW OF ARARS FOR OPERABLE UNIT 1
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Surface Water Discharge Regulations, 40 CFR 122, promulgated pursuant to Clean Water Act	ROD: applicable	Applicable to discharge of groundwater treatment system effluent. If effluent is discharged to surface waters, regulations will be attained through compliance with state water quality standards, and monitoring of discharge.	Not provided in ROD	These regulations are not applicable to the groundwater treatment system effluent, since it is discharged to the POTW. The discharge contemplated in the ROD is no longer necessary. Therefore the remedy remains protective.
Pretreatment Regulations for Indirect Discharges to POTWs, 40 CFR Part 403	ROD: applicable	These regulations control the discharge of pollutants into POTWs, including specific and general prohibitions. If groundwater from passive collection system is discharged to sewer after New Bedford secondary treatment plant becomes operational, these regulations will be applicable, and the remedy will comply through pretreatment.	Not provided in ROD	Numerous amendments have been made to these regulations since June 28, 1989. Changes to the regulations do not impact the protectiveness of the remedy because the GWTP is complying with the local sewer use ordinance which complies with the regulations.
Discharge of Dredged and Fill Materials Regulations, 40 CFR 230, promulgated under Section 404 of Clean Water Act	ROD: applicable	This regulation applies to the use of fill material in stream and wetlands. Remedy will comply because there is no practicable alternative having a less adverse impact on aquatic organisms, and steps will be taken to minimize adverse impacts, such as sedimentation basins, baffles and stream and wetlands restoration.	Not provided in ROD	There are no impacts to the protectiveness of the remedy. These requirements were applicable during remedy construction but are no longer part of any action contemplated during operation and maintenance of the site.
National Ambient Air Quality Standards (NAAQS), 40 CFR 50.6, promulgated pursuant to Clean Air Act	ROD: applicable	These applicable regulations set primary and secondary 24-hour concentrations for emissions of particulate matter. Fugitive dust from excavation, treatment, solidification and disposal will be maintained below these standards, by dust suppressants if necessary.	Not provided in ROD	These requirements remain applicable if further land disturbing activities are conducted. No major activities of this kind are currently anticipated.

TABLE 1. REVIEW OF ARARS FOR OPERABLE UNIT 1
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
OSHA Worker Safety Regulations, 29 CFR Part 1910	ROD: applicable	These applicable regulations contain safety and health standards that will be met during all remedial activities, including construction of the cap and installation of groundwater wells.	Not provided in ROD	OSHA worker protection standards are no longer considered ARAR for CERCLA response actions, but are To Be Considered. The Settling Parties and their Contractors are required to comply with OSHA worker protection standards during operation and maintenance of facilities on-site that are still contaminated with hazardous substances; for instance the groundwater treatment facility.
Department of Transportation Regulations for Transport of Hazardous Materials, 49 CFR Parts 107, 171.1 - 172.558	ROD: applicable	Requirements for transporting hazardous materials off-site will be met.	Not provided in ROD	Transport of treatment residuals and chemicals to/from the site is performed in compliance with DOT rules.
Massachusetts Drinking Water Regulations (310 CMR 22.00)	ROD: waived	Establishes maximum contaminant levels for public drinking water supplies. Attainment of this relevant and appropriate regulation will be waived because of technical impracticability.	Not provided in ROD	These regulations were waived in the ROD.
Massachusetts Groundwater Quality Standards (314 CMR 6.00)	ROD: waived	Establishes minimum groundwater criteria. Attainment of this relevant and appropriate regulation will be waived because of technical impracticability.	Not provided in ROD	These regulations were waived in the ROD and no longer exist.
Massachusetts Hazardous Waste Closure and Post Closure Regulations, 310 CMR 30.580 and 30.590	ROD: relevant and appropriate	The closure and post closure regulations are relevant and appropriate. The cap will be constructed and maintained and monitoring will be performed in compliance with these requirements.	Not provided in ROD	The closure and post closure regulations are applicable and maintenance and monitoring are being performed in accordance with the Site Operations and Maintenance Manual. A Site Closure Plan was developed in compliance with 310 CMR 30.580.

TABLE 1. REVIEW OF ARARS FOR OPERABLE UNIT 1
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Massachusetts Hazardous Waste Location Regulations, 310 CMR 30.700	ROD: relevant and appropriate	The cap will be constructed outside the 100-year floodplain in accordance with these relevant and appropriate regulations.	Not provided in ROD	These location requirements were met during construction. The culverts beneath Hathaway Road were augmented to carry the potential flood from the 100-yr storm away from the cap.
Massachusetts Hazardous Waste Groundwater Protection Regulations, 310 CMR 30.660	ROD: relevant and appropriate	The groundwater monitoring requirements are relevant and appropriate. Semi-annual monitoring for specified indicators of hazardous constituents are required to verify the effectiveness of closure. The remedy will comply with the substantive requirements, except that monitoring will be quarterly for the first three years and the frequency will be reevaluated thereafter.	Not provided in ROD	Groundwater monitoring is being conducted on a routine basis in accordance with the Post-Construction Environmental Monitoring Plan. Monitoring was conducted quarterly through 2008 and is now conducted semi-annually.
Massachusetts Hazardous Waste Landfill Regulations, 310 CMR 30.620	ROD: relevant and appropriate	Landfill requirements include double liners, leachate collection systems, and technical requirements for cap. Double liner requirements are not appropriate to this site, since groundwater below landfill will remain contaminated. Other requirements are relevant and appropriate and will be attained, except that leachate collection may be terminated prior to 30 years after closure, if target levels for the passive system have been achieved.	Not provided in ROD	The requirement for post-closure care is relevant and appropriate and is on-going in accordance with the Site Operation and Maintenance Manual.
Massachusetts Supplemental Requirements for Hazardous Waste Management Facilities, 314 CMR 8.00	ROD: applicable	RCRA facilities subject to surface water discharge requirements must also comply with DEQE regulations regarding location, technical standards for landfills, closure and post-closure, and management standards.	Not provided in ROD	These requirements are not applicable because the groundwater treatment plant discharges to the New Bedford POTW, not to surface water.

TABLE 1. REVIEW OF ARARS FOR OPERABLE UNIT 1
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Massachusetts Surface Water Quality Standards, 314 CMR 4.00	ROD: applicable	Surface waters must be free from pollutants which are present in toxic amounts, which exceed recommended limits for most sensitive use, or which exceed safe exposure levels. These applicable standards will be attained during remedial design and operation of the treatment system.	Not provided in ROD	As constructed, the groundwater treatment plant discharges to the New Bedford POTW, not to surface water. As a result, surface waters are not impacted by a discharge at the Site.
Massachusetts Wetlands Protection Regulations, 310 CMR 10.00	ROD: applicable	This applicable regulation sets performance standards for dredging banks, vegetated wetlands, and lands under water. The remedy and mitigative measures will attain these standards.	Not provided in ROD	The soil and sediment excavation and stream lining were conducted so that adverse effects were minimized. Erosion control measures were used throughout remedy construction. A Wetlands Restoration Plan was prepared which outlined measures to attain these standards. Post-construction wetland monitoring was conducted annually following completion of excavation and initial wetlands restoration and through 2006. Long-term wetland monitoring was conducted in 2011 and 2017 and will be conducted every five years to ensure the long-term effectiveness of the wetland restoration program. Annual wetland monitoring reports have been submitted during the post-construction period and for the first two long-term monitoring events. The reports summarize maintenance and monitoring performed within wetland restoration areas of OU1 and OU2.
Massachusetts Ambient Air Quality Standards, 310 CMR 6.00	ROD: applicable	This applicable regulation sets primary and secondary standards for emissions of particulate matter. These standards will be met during implementation.	Not provided in ROD	These requirements were met during remedy construction activities.

TABLE 1. REVIEW OF ARARS FOR OPERABLE UNIT 1
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Massachusetts Right to Know Regulations, 454 CMR 21.000	ROD: applicable	Informational requirements of these regulations will be attained during implementation.	Not provided in ROD	Worker safety rules are no longer considered ARAR for CERCLA reponse actions but are To Be Considered.
Executive Orders 11990 and 11988	ROD: To be considered	These executive orders regarding protection of floodplains and wetlands were considered in the evaluation and development of remedial alternatives. The soil and sediment excavation and stream lining will be conducted in such a manner to avoid or minimize adverse impacts.	Not provided in ROD	The requirements to avoid or minimize adverse impacts to wetlands were met during remedy construction. A Wetlands Restoration Plan was prepared which outlined measures to attain these standards. Post-construction wetland monitoring was conducted annually following completion of excavation and initial wetlands restoration and through 2006. Long-term wetland monitoring was conducted in 2011 and 2017 and will be conducted every five years to ensure the long-term effectiveness of the wetland restoration program. Annual wetland monitoring reports were submitted during the post-construction period and for the first two long-term monitoring events. The reports summarize maintenance and monitoring performed within wetland restoration areas of OU1 and OU2.
Interim Sediment Quality Criteria	ROD: To be considered	Interim sediment quality criteria were considered in establishing target levels for cleanup of sediments.	Not provided in ROD	Although the Interim Sediment Quality Criterion for PCBs was never finalized, the technical basis for sediment quality criteria for non-ionic organic contaminants such as PCBs remains a scientifically defensible approach to setting sediment quality criteria for PCBs. These criteria were considered in the development of cleanup standards for the site.

TABLE 1. REVIEW OF ARARS FOR OPERABLE UNIT 1
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Masachusetts Solid Waste Management Regulations, 310 CMR 19.117	ROD: not provided in ROD	Not provided in ROD	Not provided in ROD	Considered applicable due to the detection of landfill gas at perimeter monitoring wells at concentrations greater than 25% LEL. The provisions of this regulation mandate the control of landfill gases to concentrations less than 25% LEL to prevent public health and safety concerns. Although this regulation was not included in the ROD, it provides a mechanism to measure the performance of landfill gas generation at the site. Other ARARs listed do not provide such a mechanism. A process is in place to comply with the regulation. An active landfill gas collection system has been implemented by the OU1 Settling Parties. Quarterly landfill gas monitoring is conducted in order to evaluate the effectiveness of the system in controlling landfill gas migration.
Masachusetts Solid Waste Management Regulations, 310 CMR 19.118(4)	ROD: not provided in ROD	Not provided in ROD	Not provided in ROD	Considered applicable; requires the installation of gas monitoring wells to monitor the possible migration of explosive gases.

TABLE 1. REVIEW OF ARARS FOR OPERABLE UNIT 1
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Masachusetts Solid Waste Management Regulations, 310 CMR 19.132(4)	ROD: not provided in ROD	Not provided in ROD	Not provided in ROD	Considered applicable due to the detection of landfill gas at perimeter monitoring wells at concentrations greater than 25% LEL. The provisions of this regulation require the DEP be notified when concentrations of landfill gas are measured above 25% LEL at the property boundary. Although this was not included in the ROD, other ARARs listed do not provide a requirement to notify the DEP under such conditions, which is considered an appropriate means to maintain public health and safety.
Masachusetts Solid Waste Management Regulations, 310 CMR 19.150	ROD: not provided in ROD	Not provided in ROD	Not provided in ROD	Considered applicable due to the detection of landfill gas at property boundaries at concentrations greater than 25% LEL. Although this was not included in the ROD, it provides a method to address the landfill gas concentrations above 25% LEL, and is referenced in 310 CMR 19.132(4). Other ARARs do not provide a means to address the landfill gas concentrations.

TABLE 1. REVIEW OF ARARS FOR OPERABLE UNIT 1
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Massachusetts Air Pollution Control Regulations, 310 CMR 7.00	ROD: applicable	Applicable to emissions of particulates during implementation of remedy.	Not provided in ROD	The emissions of particulates during remedy construction were addressed. 310 CMR 7.00 is applicable to the discharge of emissions from the active landfill gas collection system which has been implemented and is currently operating. The need for off-gas controls was evaluated as part of the design for the gas extraction and discharge system and was determined to not be needed based on anticipated VOC discharges. Quarterly monitoring of the stack effluent and ambient air at locations near and downwind of the discharge point is being conducted.

TABLE 2. REVIEW OF LOCATION-SPECIFIC ARARS, CRITERIA, ADVISORIES, AND GUIDANCE FOR OPERABLE UNIT 2 (MIDDLE MARSH)
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

Medium/Authority (from ROD)	ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Federal Regulatory Requirements	Clean Water Act (CWA) Guidelines for Disposal of Dredged or Fill Material (33 U.S.C. 1344) (40 CFR Part 230)	ROD: Applicable	No discharge of dredged or fill material shall be permitted if there is a practicable alternative to the discharge which would have a less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. Appropriate and practicable steps must be taken which will minimize the potential adverse impacts of the discharge of the dredged material on the aquatic ecosystem.	Any activities that involve the discharge of dredge or fill materials in wetlands shall be conducted in a manner utilizing the alternative which would have the least adverse impact on the aquatic ecosystem and the environment, pursuant to 40 CFR 230.10(a).	This requirement was met during remedy construction. The discharge of fill materials in wetlands was conducted to have the least adverse impact on the aquatic ecosystem and the environment. Fill materials were obtained from off-site. Soils used as fill were tested to demonstrate that they met wetland soil requirements and had less than 1 mg/kg total PCBs.
	Statement of Procedures on Floodplain Management and Wetlands Protection (40 CFR 6, App. A)	ROD: Applicable	Federal agencies shall avoid, wherever possible, the long and short term impacts associated with the destruction of wetlands and the occupancy and modifications of floodplains and wetlands development wherever there is a practicable alternative in accordance with Executive Orders 11990 and 11988. The agency shall promote the preservation and restoration of floodplains so that their natural and beneficial values can be realized. Any plans for actions in wetlands or floodplains must be submitted for public review.	All practicable means will be used to minimize harm to wetlands and floodplains. Wetlands and floodplains disturbed by excavation will be restored to their original conditions.	Note that this provision of the CFR no longer exists and the current provision is a FEMA regulation codified at 44 CFR 9. The provision cited in the ROD was applicable during remedial construction, which was conducted so that impacts to wetlands were minimized. Erosion control measures were used throughout construction. A wetlands restoration plan was prepared which outlined measures to attain these standards. Post-construction wetland monitoring was conducted annually following completion of excavation and initial wetlands restoration and through 2006. Long-term wetland monitoring was conducted in 2011 and 2017 and will be conducted every five years to ensure the long-term effectiveness of the wetland restoration program. Annual wetland monitoring reports were submitted during the post-construction period and for the first two long-term monitoring events. The reports summarize maintenance and monitoring performed within wetland restoration areas of OU1 and OU2.

TABLE 2. REVIEW OF LOCATION-SPECIFIC ARARS, CRITERIA, ADVISORIES, AND GUIDANCE FOR OPERABLE UNIT 2 (MIDDLE MARSH)
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

Medium/Authority (from ROD)	ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
	Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.)	ROD: Applicable	Under 662, any modification of a body of water requires consultation with the U.S. Fish and Wildlife Services, to develop measures to prevent, mitigate, or compensate for losses to fish and wildlife. This requirement is addressed under CWA Section 404 requirements.	During the identification, screening, and evaluation of alternatives, the effects on wetlands are evaluated. If an alternative modifies a body of water, EPA must consult the U.S. Fish and Wildlife Service. Whenever possible, the remedial alternative describes measures to prevent, mitigate, or compensate for losses to fish and wildlife.	This requirement was met during remedy construction. U.S. Fish and Wildlife Service was consulted.
	RCRA Location Standards (40 CFR 264.18)	ROD: Relevant and Appropriate	This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain.	A RCRA facility that is located on a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility or no adverse effects on human health and the environment would result if washout occurred.	No facility has been constructed within OU2. If a facility is proposed, it must be approved in accordance with this regulation.
	Hazardous Waste Facility Siting Regulations (990 CMR 1.00)	ROD: Relevant and Appropriate	These regulations outline the criteria for the construction, operation, and maintenance of a new facility or increase in an existing facility for the storage, treatment, or disposal of hazardous waste.	No portion of the facility may be located within a wetland or bordering a vegetated wetland, or within a 100-year floodplain, unless approved by the state.	These regulations are not applicable since no facility has been constructed within OU2.

TABLE 2. REVIEW OF LOCATION-SPECIFIC ARARS, CRITERIA, ADVISORIES, AND GUIDANCE FOR OPERABLE UNIT 2 (MIDDLE MARSH)
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

Medium/Authority (from ROD)	ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
State Regulatory Requirements	Massachusetts Wetlands Protection Act (M.G.L. 131, §40); Massachusetts Wetlands Protection Regulations (310 CMR §10.00)	ROD: Applicable	These regulations are promulgated under Wetlands Protection Laws, which regulate dredging, filling, altering, polluting of inland wetlands. Work within 100 feet of a wetland is regulated under this requirement. The requirement also defines wetlands based on vegetation type and requires that effects on wetlands be mitigated. Each remedial alternative will be evaluated for its ability to attain regulatory performance standards, including mitigation of impacted wetlands.	If alternatives involve removing, filling, dredging, or altering a DEP-defined wetland, or conducting work within 100 feet of a wetland, it must be demonstrated that the modifications are not significant to the wetland or that the proposed work will contribute to the protection of the wetland. Whenever possible, remedial actions will be conducted so that impacts to wetlands will be minimized or mitigated.	Remedial construction was conducted so that impacts to wetlands were minimized. Erosion control measures were used throughout construction. A wetlands restoration plan was prepared which outlined measures to attain these standards. Post-construction wetland monitoring was conducted annually following completion of excavation and initial wetlands restoration and through 2006. Long-term wetland monitoring was conducted in 2011 and 2017 and will be conducted every five years to ensure the long-term effectiveness of the wetland restoration program. Annual wetland monitoring reports were submitted during the post-construction period and for the first two long-term monitoring events. The reports summarize maintenance and monitoring performed within wetland restoration areas of OU1 and OU2.
	Massachusetts Endangered Species Act (M.G.L. ch. 131, §40); Massachusetts Endangered Species Act Regulations, Part III (321 CMR §§10.30 - 10.43)	ROD: Applicable	These regulations established Massachusetts' list of threatened and endangered species and species of special concern. The habitat of any species listed under this requirement is protected by the regulations promulgated under the MA Wetlands Protection Act.	If alternatives involve impacts to the habitat of any listed species, appropriate actions must be taken during remediation to mitigate or minimize impacts to the species and its critical habitat. Habitats of any listed species will be identified prior to remediation.	This requirement was met during remedial design and construction. The Mystic Valley amphipod was identified as a species of special concern at the site, and measures were taken to minimize impacts to the species and its critical habitat.
State Nonregulatory Requirements to be Considered	Massachusetts Wetlands Protection Policy 90-2; Standards and Procedures for Determining Adverse Impacts to Rare Species	ROD: To be Considered	This policy clarifies the rules regarding rare species habitat contained at 310 CMR 10.59.	Habitats of rare species, as determined by the Massachusetts Natural Heritage Program, will be considered in the mitigation plans.	This requirement was met during remedial design and construction. The Mystic Valley amphipod was identified as a species of special concern at the site, and was considered in the site mitigation plans.

TABLE 3. REVIEW OF ACTION-SPECIFIC ARARS FOR THE SELECTED AND CONTINGENCY REMEDIES, OPERABLE UNIT 2 (MIDDLE MARSH)
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
National Pollution Discharge Elimination System (NPDES) (40 CFR 122 and 125)	ROD: Applicable	Regulates the discharge of water into public surface waters.	Discharged water will be monitored for the required pollutants and standards will be met.	No water was discharged to surface waters during construction. Instead, construction water was treated and discharged to the New Bedford POTW in accordance with pretreatment program requirements.
Toxic Pollutant Effluent Standards (40 CFR 129)	ROD: Applicable	Regulates the discharge of the following pollutants: aldrin/dieldrin, DDT, endrin, toxaphene, benzidine, and PCBs.	All discharge waters will be monitored for the regulated pollutants and will meet standards.	No water was discharged to surface waters during construction. Instead, construction water was treated and discharged to the New Bedford POTW in accordance with pretreatment program requirements.
Massachusetts Surface Water Quality Standards 314 CMR 4.00	ROD: Applicable	These standards designate the most sensitive uses for which the various waters of the Commonwealth shall be enhanced, maintained and protected. Minimum water quality criteria required to sustain the designated uses are established. Federal AWQC are to be considered in determining effluent discharge limits. Where recommended limits are not available, site-specific limits shall be developed. Any on-site water treatment and discharge is subject to these requirements.	Water from the dewatering process will be discharged directly to the unnamed stream. If this water does not meet state standards, it will be treated prior to discharge. Effluent limitations for water discharges will be established so that such discharges shall not result in a violation of state water quality standards.	These regulations are not applicable since no water was discharged to surface waters during construction. Instead, construction water was treated and discharged to the New Bedford POTW in accordance with pretreatment program requirements.

TABLE 3. REVIEW OF ACTION-SPECIFIC ARARS FOR THE SELECTED AND CONTINGENCY REMEDIES, OPERABLE UNIT 2 (MIDDLE MARSH)
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Clean Water Act 404 (40 CFR 230)	ROD: Applicable	No discharge of dredged or fill material shall be permitted if there is a practicable alternative to the discharge which would have a less adverse impact to the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. Appropriate and practicable steps must be taken which will minimize the potential adverse impacts of the discharge material on the aquatic ecosystem.	**Selected Remedy:** Any activities that involve the discharge of dredge or fill materials in wetlands shall be conducted in a manner utilizing the alternative which would have the least adverse impact on the aquatic ecosystem and the environment, pursuant to 40 CFR 230.10(a), and any excavated areas to be filled shall be filled with clean materials from off-site, in accordance with 40 CFR 230. **Contingency Remedy:** Any activities that involve the discharge of dredge or fill materials in wetlands shall be conducted in a manner utilizing the alternative which would have the least adverse impact on the aquatic ecosystem and the environment, pursuant to 40 CFR 230.10(a), and any excavated areas to be filled shall be filled with adequately treated and appropriately reconditioned materials.	This requirement was met during remedy construction. The discharge of fill materials in wetlands was conducted to have the least adverse impact on the aquatic ecosystem and the environment. Fill materials were obtained from off-site. Soils used as fill were tested to demonstrate that they met wetland soil requirements and had less than 1 mg/kg total PCBs.

TABLE 3. REVIEW OF ACTION-SPECIFIC ARARS FOR THE SELECTED AND CONTINGENCY REMEDIES, OPERABLE UNIT 2 (MIDDLE MARSH)
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Procedures on Floodplain Management and Wetlands Protection (40 CFR 6, App A)	ROD: Applicable	Federal agencies shall avoid, wherever possible, the long and short term impacts associated with the destruction of wetlands and the occupancy and modifications of floodplains and wetlands development wherever there is a practicable alternative in accordance with Executive Orders 11990 and 11988. The agency shall promote the preservation and restoration of floodplains so that their natural and beneficial values can be realized. Any plans for actions in wetlands or floodplains must be submitted for public review.	This alternative will take into consideration this statement. All practicable means will be used to minimize harm to wetlands and floodplains. Wetlands and floodplains disturbed by excavation will be restored to their original conditions. Temporary fill placed in the golf course and wetland for access roads and staging area will not have a significant impact on the extent of flooding. Culverts will be placed under the access roads to allow for undiverted passage of flood waters.	Note that this provision of the CFR no longer exists and the current provision is a FEMA regulation codified at 44 CFR 9. The provision cited in the ROD was applicable during remedial construction, which was conducted so that impacts to wetlands were minimized. Erosion control measures were used throughout construction. A wetlands restoration plan was prepared which outlined measures to attain these standards. Post-construction wetland monitoring was conducted annually following completion of excavation and initial wetlands restoration and through 2006. Long-term wetland monitoring was conducted in 2011 and 2017 and will be conducted every five years to ensure the long-term effectiveness of the wetland restoration program. Annual wetland monitoring reports were submitted during the post-construction period and for the first two long-term monitoring events. The reports summarize maintenance and monitoring performed within wetland restoration areas of OU1 and OU2.

TABLE 3. REVIEW OF ACTION-SPECIFIC ARARS FOR THE SELECTED AND CONTINGENCY REMEDIES, OPERABLE UNIT 2 (MIDDLE MARSH)
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Massachusetts Wetlands Protection Act (M.G.L. 131, §40) (310 CMR 10.00)	ROD: Applicable	The dredging, filling, altering, or polluting of inland wetlands and work within 100 feet of a wetland is regulated. Each remedial alternative will be evaluated for its ability to attain regulatory performance standards, including mitigation of impacted wetlands.	Wetlands disturbed by excavation will be restored to original conditions. All practicable means will be used to minimize wetland disturbance. Remedial activities will be selected based on the ability to minimize adverse effects on such habitats.	Remedial construction was conducted so that impacts to wetlands were minimized. Erosion control measures were used throughout construction. A wetlands restoration plan was prepared which outlined measures to attain these standards. Post-construction wetland monitoring was conducted annually following completion of excavation and initial wetlands restoration and through 2006. Long-term wetland monitoring was conducted in 2011 and 2017 and will be conducted every five years to ensure the long-term effectiveness of the wetland restoration program. Annual wetland monitoring reports were submitted during the post-construction period and for the first two long-term monitoring events. The reports summarize maintenance and monitoring performed within wetland restoration areas of OU1 and OU2.

TABLE 3. REVIEW OF ACTION-SPECIFIC ARARS FOR THE SELECTED AND CONTINGENCY REMEDIES, OPERABLE UNIT 2 (MIDDLE MARSH)
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Massachusetts Endangered Wildlife and Wild Plants Regulations (321 CMR 8.00)	ROD: Applicable	These regulations established Massachusetts' list of threatened and endangered species and species of special concern. The habitat of any species listed under this requirement is protected by the regulations promulgated under the Massachusetts Wetlands Protection Act.	If the alternative involves impact to the habitat of any listed species, appropriate actions must be taken during remediation to mitigate or minimize impacts to the species and its critical habitat. Habitats of any listed species will be identified prior to remediation.	This requirement was met during remedial design and construction. The Mystic Valley amphipod was identified as a species of special concern at the site, and actions were taken to mitigate or minimize impacts to the species and critical habitat.
Massachusetts Certification for Dredging, Dredged Material Disposal, and Filling in Waters (314 CMR 9.00)	ROD: Applicable	The substantive portions of these regulations establish criteria and standards for the dredging, handling and disposal of fill material and dredged material.	Excavation, filling, and disposal operations will meet substantive criteria and standards in these regulations. The remedial alternative will be designed to ensure the maintenance or attainment of the MA Water Quality Standards in the affected waters and to minimize the impact on the environment.	This requirement was met during remedy construction. The discharge of fill materials in wetlands was conducted to have the least adverse impact on the aquatic ecosystem and the environment. Fill materials were obtained from off-site. Soils used as fill were tested to demonstrate that they met wetland soil requirements and had less than 1 mg/kg total PCBs.
Fish and Wildlife Coordination Act (16 U.S.C. 166 et seq.)	ROD: Applicable	Any modification of a body of water requires prior consultation with the U.S. FWS to develop measures to prevent, mitigate, or compensate for losses to fish and wildlife.	Prior to excavation, EPA will consult with U.S. FWS. This alternative includes measures to prevent, mitigate, or compensate for losses to fish and wildlife.	This requirement was met during remedy construction. U.S. Fish and Wildlife Service was consulted.

TABLE 3. REVIEW OF ACTION-SPECIFIC ARARS FOR THE SELECTED AND CONTINGENCY REMEDIES, OPERABLE UNIT 2 (MIDDLE MARSH)
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
TSCA, Subpart D, Storage and Disposal (40 CFR 761.60, 761.65, 761.79)	ROD: Applicable if PCB concentrations are >50 ppm; Relevant and appropriate if PCB concentrations are <50 ppm	All dredged materials that contain PCBs at concentrations of 50 ppm or greater shall be disposed of in an incinerator or in a chemical waste landfill or, upon application, using a disposal method to be approved by the EPA Region in which the PCBs are located. On-site storage facilities for PCBs shall meet, at a minimum, the following criteria: • Adequate roof and walls to prevent rain • Adequate floor with continuous curbing • No openings that would permit liquids to flow from curbed area • Not located at a site that is below the 100-year flood water elevation	**Selected Remedy:** Disposal of soils/sediments under the cap at the Disposal Area will comply with chemical waste landfill requirements except requirements waived in the ROD for the First Operable Unit. These regulations will be considered by U.S. EPA Region I in the selection of this alternative and in the design of storage facilities. Solid debris,excluding trees and bushes, shall be decontaminated prior to off-site transport or off-site disposal in accordance with 40 CFR 761.79; storage facilities shall be designed consistent with 40 CFR 761.65(b)(a)(i), (ii), and (iii). **Contingency Remedy:** These regulations will be considered by U.S. EPA Region I in the selection of this alternative and in the design of storage facilities. Solid debris, excluding trees and bushes, shall be decontaminated prior to off-site transport or off-site disposal in accordance with 40 CFR 761.79; storage facilities shall be designed consistent with 40 CFR 761.65(b)(a)(i), (ii), and (iii). PCB-concentrated waste oils from the solvent extraction process will be disposed of in accordance with these regulations.	This requirement was met during remedy construction. None of the soils handled during OU2 remedial actions exceeded the 50 ppm level for PCBs. No off-site treatment or disposal of solid debris was required during construction. The contingency remedy identified in the ROD was not utilized.

TABLE 3. REVIEW OF ACTION-SPECIFIC ARARS FOR THE SELECTED AND CONTINGENCY REMEDIES, OPERABLE UNIT 2 (MIDDLE MARSH)
SULLIVAN'S LEDGE SUPERFUND SITE, NEW BEDFORD, MASSACHUSETTS

ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Massachusetts Supplemental Requirements for Hazardous Waste Management Facilities (314 CMR 8.00)	ROD: Relevant and Appropriate	Water treatment units which are exempted from M.G.L.c.21C and which treat, store, or dispose of hazardous wastes generated at the same site are regulated to ensure that such activities are conducted in a manner which protects public health and safety and the environment.	If treatment of sediment/soil dewatering water is necessary, all process will comply with Massachusetts requirements regarding location, technical standards, closure and post-closure, and management standards.	Temporary treatment of sediment dewatering water during remedial actions complied with Massachusetts regulations.
Massachusetts Hazardous Waste Regulations 310 CMR 30.000)	ROD: Applicable if sediments/soils are defined as hazardous waste under Mass. Law; relevant and appropriate if sediments/soils are similar to hazardous wastes; For contingency remedy, applicable to PCB-concentrated waste oil	Regulate the generation, storage, collection, transport, treatment, disposal, use, reuse, and recycling of hazardous waste in Massachusetts. The regulations provide procedural standards for the following: generators (310 CMR 30.300), general management standards for all facilities (301 CMR 30.510), contingency plan, emergency procedures, preparedness, and prevention (314 CMR 30.520), manifest system (310 CMR 30.530), closure and post-closure (310 CMR 30.580), landfill requirements (310 CMR 30.620), protection (310 CMR 30.660), use and management of containers (310 CMR 30.680), and facility location standards and land disposal restrictions (310 CMR 30.700).	**Selected and Contingency Remedies:** Based on known information, EPA expects that the sediment/soil are not hazardous waste under Massachusetts law. However, if the sediment/soil is designated hazardous waste under Massachusetts law, all processes involving the contaminated sediment/soil will be conducted in accordance with state hazardous waste regulations. **Contingency Remedy:** All processes involving the PCB-concentrated waste oil will be conducted in accordance with these regulations.	Post-closure requirements are being addressed by OU1. The contingency remedy identified in the ROD was not ultilized.
RCRA, Land Disposal Regulations (40 CFR 268, Subpart C)	ROD: Applicable if the sediments/soil are characteristic of hazardous waste under federal law	Prohibits the disposal of RCRA hazardous waste in the land unless treatment standards are met or treatability variance is obtained.	Based on known information, EPA expects that the sediment/soil are not hazardous waste. However, if the sediment/soil is hazardous waste due to the presence of metals, it will be solidified to render it non-hazardous or, alternatively, to meet the treatability variance requirements in the land disposal requirements.	These regulations are not applicable because pre-design studies (TCLP metals analyses) conducted for OU1 showed that soil and sediment, representative of material that was excavated, did not exhibit the toxicity characteristics and therefore did not constitute a hazardous waste.

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ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
National Ambient Air Quality Standards (NAAQS), 40 CFR 50.6, promulgated pursuant to Clean Air Act	ROD: Applicable	The maximum primary and secondary 24-hr. concentration for particulate emissions from site excavation activities must be maintained below 150 ug/m^3, 24-hour average for particulates having a mean diameter of 10 micrometers or less. The annual standard is 50 ug/m^3, annual arithmetic mean.	The ambient air will be continuously monitored to ensure compliance with federal regulations.	Particulate monitoring was conducted and dust suppressants were used when necessary to control fugitive dust. These requirements are only applicable if further land disturbing activities are conducted.
Massachusetts Ambient Air Quality Standards (310 CMR 6.00) and Massachusetts Air Pollution Control Regulations (310 CMR 7.00)	ROD: Applicable	**Selected Remedy:** The applicable portions of these regulations prohibit burning or emissions of dust which causes or contributes to a condition of air pollution. **Contingency Remedy:** All construction and treatment activities will utilize Best Available Control Technology in order to prevent contaminant transfer between other media and air. Massachusetts AALs and TELs are used in determining compliance with these regulations. Burning or emissions of dust which causes or contributes to a condition of air pollution are prohibited.	**Selected Remedy:** Control measures will be implemented to ensure compliance with state regulations. **Contingency Remedy:** The ambient air will be continuously monitored and control measures shall be implemented to ensure compliance with state regulations.	These requirements were met during remedy construction activities. The contingency remedy identified in the ROD was not utilized.
Federal Noise Control Act (40 CFR 204, 205, 211)	ROD: Relevant and Appropriate	Regulates construction and transportation equipment noise, process equipment and noise levels, and noise levels at the property boundaries of the project.	Site noise levels will be in accordance with federal requirements.	These requirements were met during remedy construction.
Toxic Substance Control Act (TSCA), Subpart G, PCB Spill Clean-up Policy (40 CFR 761.120-135)	ROD: To be considered	Sets cleanup levels for PCB spills of 50 ppm or greater at 10 ppm for non-restricted access areas, and 25 ppm for restricted access areas.	Cleanup levels established in Chapter Six of the Feasibility Study are consistent with this policy.	The requirements were met during remedy construction. Soils and sediment sampling is being conducted as part of post-construction environmental monitoring to verify continued compliance with the cleanup levels.

TABLE 3. REVIEW OF ACTION-SPECIFIC ARARS FOR THE SELECTED AND CONTINGENCY REMEDIES, OPERABLE UNIT 2 (MIDDLE MARSH)
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ARAR (from ROD)	Status (from ROD)	Requirement Synopsis (from ROD)	Action to be Taken to Attain ARAR (from ROD)	Five-Year Review
Interim Sediment Quality Criteria	ROD: To be considered	These criteria were developed by U.S. EPA for certain hydrophobic organic compounds, including PCBs, to protect benthic organisms. The criteria for PCBs is 19.5 ug PCB/g carbon.	The cleanup levels developed in Chapter 6 of the Feasibility Study are consistent with interim criteria.	The Interim Sediment Quality Criterion for PCBs was never finalized. The technical basis for sediment quality criteria for non-ionic organic contaminants such as PCBs remains a scientifically defensible approach to setting sediment quality criteria for PCBs in sediment.
Massachusetts Allowable Ambient Air Limits - Annual (AALs) and Massachusetts Threshold Effects Exposure Levels (TELs)	ROD: To be considered	These guidances are to be considered in evaluating whether a condition of air pollution exists. The TEL for PCB is 0.003 ug/m^3 and the AAL is 0.005 ug/m^3.	Massachusetts air limits and exposure levels will be considered in the evaluation of emissions monitoring results.	These requirements were considered during construction. An air monitoring program was implemented to monitor and ensure compliance with these emission limits.
Guidance on Remedial Actions for Superfund Sites with PCB Contamination	ROD: To be considered	Describes various scenarios and considerations pertinent to determining the appropriate level of PCBs that can be left in each contaminated media to achieve protection of human health and the environment.	This guidance will be considered in determining the appropriate level of PCBs that will be left in the sediment/soil. Management of PCB-contaminated residuals will be designed in accordance with the guidance.	This guidance was considered during remedial design.
EPA Interim Policy for Planning and Implementing CERCLA Response Actions. Proposed Rule, 50 CFR 45933 (November 5, 1985)	ROD: To be considered	Discusses the need to consider treatment, recycling, and reuse before offsite land disposal is used. Prohibits use of a RCRA facility for offsite management of Superfund hazardous substances if it has significant RCRA violations.	**Selected Remedy:** This policy will be considered in the treatment of the PCB-contaminated sediment/soil. **Contingency Remedy:** This policy will be considered in the treatment of the PCB-contaminated waste oil stream.	Off-site disposal of PCB-contaminated sediment/soil was not conducted. The contingency remedy identified in the ROD was not utilized.