



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION I  
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September 29, 2020

Mr. David Barney  
BRAC Environmental Coordinator  
Naval Facilities Engineering Command  
BRAC Program Management Office East  
PO Box 169  
South Weymouth, MA 02190

**Re: Fifth Five-Year Review Report for the Naval Air Station Brunswick NPL Site, Maine**

Dear Mr. Barney:

This office is in receipt of the U.S. Navy's Fifth Five-Year Review Report for the Naval Air Station Brunswick NPL Site, dated September 2020. Upon review of this report, EPA concurs with the findings that all CERCLA remedies selected for the Site have been implemented and are currently protective of human health and the environment.

Important follow-up actions identified in the Five-Year Review that are necessary to maintain long-term protectiveness at the Site will be initiated by the Navy in the very near future. These actions will include the completion of a CERCLA remedial investigation of historical Navy releases of per- and polyfluoroalkyl substances, also known as PFAS, to the NAS Brunswick environment. EPA looks forward to continuing our collaborative efforts with the Navy and Maine Department of Environmental Protection to expeditiously complete work associated with the Five-Year Review recommendations so that all NAS Brunswick remedies continue to remain protective and eventually meet their cleanup objectives.

For purposes of future planning, the sixth Five-Year Review for NAS Brunswick should be completed no later than September 29, 2025.

Sincerely,

BRYAN OLSON  
  
Digitally signed by BRYAN  
OLSON  
Date: 2020.09.29 16:24:23  
-04'00'

Bryan Olson, Director  
Superfund & Emergency Management Division

cc: Iver MacLeod, MEDEP  
Chris Swain, MEDEP  
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Mike Daly, EPA



Naval Facilities Engineering Command Mid-Atlantic  
Norfolk, Virginia

**Final  
Fifth Five-Year Review Report**

Former Naval Air Station Brunswick  
Brunswick, Maine

September 2020

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FINAL  
FIFTH FIVE-YEAR REVIEW REPORT  
  
FORMER NAVAL AIR STATION BRUNSWICK  
BRUNSWICK, MAINE

COMPREHENSIVE LONG-TERM  
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Department of the Navy  
Naval Facilities Engineering Command Mid-Atlantic  
9742 Maryland Avenue  
Norfolk, Virginia 23511

CONTRACT NUMBER N6247016D9008  
CONTRACT TASK ORDER N4008518F5894

SEPTEMBER 2020

APPROVED BY:



DAVID BARNEY  
U.S. NAVY  
BASE ENVIRONMENTAL COORDINATOR  
BRAC PMO EAST

DATE

September 29, 2020

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## **Acronyms and Abbreviations**

ADAF	Age dependent adjustment factor
AFFF	Aqueous film-forming foam
ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criterion
BRAC	Base Realignment and Closure
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	CERCLA Information System
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Chemical of concern
COPC	Contaminant of potential concern
CTO	Contract Task Order
CVOC	Chlorinated volatile organic compound
DCA	Dichloroethane
DCE	Dichloroethene
DPT	Direct-push technology
DRMO	Defense Reutilization and Marketing Office
DRO	Diesel-range organics
EA	EA Science and Technology
ECC	Environmental Chemical Corporation
EOD	Explosive Ordnance Disposal

EPA	United States Environmental Protection Agency
EPH	Extractable petroleum hydrocarbons
ESC	Engineering Service Center
ESD	Explanation of Significant Differences
EU	exposure unit
FFA	Federal Facility Agreement
FS	Feasibility Study
GAC	Granular activated carbon
GWETS	Groundwater extraction and treatment system
HA	Hazard Assessment
HI	Hazard index
HRA	Historical Radiological Assessment
IAS	Initial Assessment Study
ID	Implementation Document
ILCR	Incremental lifetime cancer risk
IR	Installation Restoration
LHA	Lifetime Health Advisory
LTM	Long-term monitoring
LTMP	Long-Term Monitoring Plan
LUC	Land use control
LUCIP	Land Use Control Implementation Plan
MC	Munitions constituents
MCL	Maximum Contaminant Level
MEC	Munitions and explosives of concern
MEDEP	Maine Department of Environmental Protection

MEG	Maximum Exposure Guideline
MPPEH	Material potentially presenting an explosive hazard
MRRA	Mid-Coast Regional Development Authority
msl	Mean sea level
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	No Further Action
NPL	National Priorities List
O&M	Operation and maintenance
OSHA	Occupational Safety and Health Administration
OSSR	Orion Street Skeet Range
OU	Operable Unit
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PEL	Permissible Exposure Limits
PFAS	Per- and polyfluoroalkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PID	Photoionization detector
POTW	Publicly owned treatment works
QAPP	Quality Assurance Project Plan
RAB	Restoration Advisory Board

RAG	Remedial Action Guideline
RAO	Remedial Action Objective
RBESV	Risk-based ecological screening level
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFP	Relative potency factor
RI	Remedial Investigation
ROD	Record of Decision
RSL	Regional Screening Level
SOP	Standard Operating Procedure
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semivolatile organic compound
TAL	Target Analyte List
TCA	Trichloroethane
TCE	Trichloroethene
TCL	Target Compound List
TLV	Threshold Limit Value
µg/L	Microgram per liter
UPL	Upper protection limits
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
UXO	Unexploded ordnance
VISL	Vapor Intrusion Screening level
VOC	Volatile organic compound
yd <sup>3</sup>	Cubic yard

## Five-Year Review Summary Form

SITE IDENTIFICATION				
<b>Site Name:</b> Brunswick Naval Air Station				
<b>EPA ID:</b> ME8170022018				
<b>Region:</b> 1	<b>State:</b> ME	<b>City/County:</b> Cumberland County		
SITE STATUS				
<b>NPL Status:</b> Final				
<b>Multiple OUs?</b> Yes	<b>Has the site achieved construction completion?</b> No			
REVIEW STATUS				
<b>Lead agency:</b> Other Federal Agency <b>If "Other Federal Agency" was selected above, enter Agency name:</b> Dept. of the Navy				
<b>Author name (Federal or State Project Manager):</b> Prepared by Tetra Tech under contract to BRAC PMO East				
<b>Author affiliation:</b> BRAC PMO East				
<b>Review period:</b> 16 January 2015 – 15 January 2020				
<b>Date of site inspection:</b> September 20 and 21, 2019				
<b>Type of review:</b> Statutory				
<b>Review number:</b> 5				
<b>Triggering action date:</b> 09/30/2015 (signature date of Fourth Five-Year Review Report)				
<b>Due date (five years after triggering action date):</b> 9/20/2025				
Issues/Recommendations				
<b>OU(s) without Issues/Recommendations Identified in the Five-Year Review:</b>				
OU1, Sites 1 and 3; OU7, Site 2 and Site 7; OU6, Site 9; OU9, Site 12; OU10, Quarry Area				
<b>Issues and Recommendations Identified in the Five-Year Review:</b>				
<b>OU(s):</b> 2	<b>Issue Category:</b> Other			
	<b>Issue:</b> Potential for human exposure to PFOS/PFOA was not anticipated in the OU2 ROD.			
	<b>Recommendation:</b> A PFAS RI should be completed for NAS Brunswick including the Eastern Plume to determine if additional action is required to address CERCLA risk.			
<b>Affect Current Protectiveness</b> No	<b>Affect Future Protectiveness</b> Yes	<b>Implementing Party</b> Navy	<b>Oversight Party</b> EPA/State	<b>Milestone Date</b> December 2022

<b>Protectiveness Statement(s)</b>		
<b>Operable Unit:</b>	<b>Protectiveness Determination:</b>	<b>Addendum Due Date:</b>
OU1, Sites 1 and 3	Protective	NA
<b>Protectiveness Statement:</b> No deficiencies were identified during this five-year review of the Sites 1 and 3 remedy, and no issues related to current or future site operations, conditions, or activities prevent the remedy from being protective now or in the future. The remedy implemented at Sites 1 and 3 is protective of human health and the environment. Exposure to groundwater, which could result in unacceptable risks if groundwater was used for potable purposes, is prevented via LUCs. Operation of the groundwater extraction system was successful in mitigating environmental impacts by reducing the amount of contaminated groundwater migrating to Mere Brook via direct discharge and leachate seeps. Construction of the cap and slurry wall, extension of the cap, short-term operation of the groundwater extraction system, groundwater monitoring and LUCs provide protection until completion of the remedy is achieved to provide full protectiveness. The remedial actions that are completed (cap and slurry wall construction, groundwater extraction, and implementation of LUCs) and ongoing (LTM) are operating as designed. Long-term protectiveness will be verified through continued monitoring in accordance with the Base-Wide QAPP and through LUC inspections in accordance with the LUC RD to ensure continued maintenance of the LUCs including cap integrity. Based on the activities that are completed and ongoing, the intent and goals of the Sites 1 and 3 ROD have been or will be met.		
OU7, Site 2	Protective	NA
<b>Protectiveness Statement:</b> No deficiencies were identified during this five-year review of the Site 2 remedy, and no issues related to current or future site operations, conditions, or activities prevent the remedy from being protective now or in the future. Exposure to landfill materials and soil and groundwater impacted by these materials is prevented through the expanded soil cover and through maintenance of LUCs implemented across the expanded site boundary. The results of future LTM will be used to continue to evaluate the effectiveness of the remedy and to assess potential contaminant migration. The remedial actions have been implemented as designed and include measures to prevent exposure, and the remedial actions that have been completed (soil cover and fence installation and extension and implementation of LUCs) and that are ongoing (LTM) are operating as designed. Long-term protectiveness will be verified through continued monitoring in accordance with the Base-Wide QAPP and through LUC inspections in accordance with the LUC RD to ensure continued maintenance of the LUCs including soil cover integrity. Based on the activities that are completed and ongoing, the intent and goals of the Site 2 ROD are being or will be met.		
OU7, Site 7	Protective	NA
<b>Protectiveness Statement:</b> No deficiencies were identified during this five-year review of the Site 7 remedy, and no issues related to current or future site operations, conditions, or activities prevent the remedy from being protective now or in the future. Exposure to soil and groundwater, which could result in unacceptable risks, is prevented through maintenance of LUCs at the site. The recent soil removal is expected to facilitate the restoration of contaminated Site 7 groundwater. Groundwater LUCs will be maintained until contaminant concentrations decrease to less than ROD cleanup goals. Groundwater monitoring will continue to be conducted at Site 7 to assess progress in meeting cleanup goals. The groundwater remedial actions have been implemented as designed and include measures that prevent exposure, and the remedial actions that are completed (implementation of LUCs) and ongoing (LTM) are operating as designed. Long-term protectiveness of the remedy will be verified by continued monitoring in accordance with the Base-Wide QAPP and LUC		

inspections in accordance with the LUC RD. Based on the activities that are completed and ongoing, the intent and goals of the Site 7 ROD have been or will be met.

<b>Operable Unit:</b>	<b>Protectiveness Determination:</b>	<b>Addendum Due Date:</b>
OU6, Site 9	Protective	NA

**Protectiveness Statement:**

No deficiencies were identified during this five-year review of the Site 9 remedy, and no issues related to current or future site operations, conditions, or activities prevent the remedy from being protective now or in the future. Exposure to soil and groundwater, which could result in unacceptable risks, is prevented through maintenance of LUCs implemented across the expanded ash-impacted area. Groundwater monitoring provides a degree of protection of human health and the environment, and implementation of LUCs provides a significant degree of protection until completion of the remedy is achieved to provide full protectiveness. The results of future groundwater monitoring will be used to continue to evaluate the effectiveness of the remedy. The remedial actions have been implemented as designed and include measures that prevent exposure, and the remedial actions that are completed (implementation of LUCs) and ongoing (LTM) are operating as designed. Long-term protectiveness of the remedy will be verified by continued monitoring in accordance with the LTMP and through LUC inspections in accordance with the LUC RD. Based on the activities that are completed and ongoing, the intent and goals of the Site 9 ROD have been or will be met.

<b>Operable Unit:</b>	<b>Protectiveness Determination:</b>	<b>Addendum Due Date:</b>
OU9, Site 12	Protective	NA

**Protectiveness Statement:**

No deficiencies were identified during this five-year review of the Site 12 remedy, and no issues related to current or future site operations, conditions, or activities prevent the remedy from being protective now or in the future. LUCs limit use of the property and prohibit intrusive activities that could result in exposure to munitions items potentially remaining in the subsurface at the site. The remedial actions (LUCs) have been implemented and are operating as designed and include measures that prevent exposure. Long-term protectiveness of the remedy will be verified by LUC inspections in accordance with the LUC RD to ensure continued maintenance of the LUCs. Based on the activities that are completed and ongoing, the intent and goals of the Site 12 ROD have been met.

<b>Operable Unit:</b>	<b>Protectiveness Determination:</b>	<b>Addendum Due Date:</b>
OU10, Quarry Area	Protective	NA

**Protectiveness Statement:**

No deficiencies were identified during this five-year review of the Quarry Area remedy, and no issues related to current or future site operations, conditions, or activities prevent the remedy from being protective now or in the future. Installation and maintenance of the soil cover and LUCs (informally implemented until finalization of the draft LUC RD) limit use of the property and prohibit intrusive activities that could result in exposure to potential munitions items and PAH-contaminated soil remaining in the subsurface at the site. The soil cover remedial action that has been completed and is operating as designed. Although Quarry Area LUCs have not been formally implemented at this site (via finalization of a LUC RD), the objectives of the LUCs are currently being met. The Navy continues to control the site and prohibits any use of the area. The Navy's on-site representative performs periodic inspections to confirm that LUC objectives continue to be met. In addition to restrictions on use of the Waste Disposal/Fill Area portion of the site, caution/UXO hazard warning signs were posted at site access points, and a kiosk containing a UXO information sheet was installed at the site to inform the public of potential hazards and to warn against intrusive activities that could result in exposure to potential explosive hazards. Long-term protectiveness of the remedy will be verified by continued LUC inspections in accordance with the LUC RD, included in the revised Base-Wide LUCIP, to ensure continued maintenance of the LUCs implemented upon finalization of the LUC RD. Based on the activities that are completed and ongoing, the intent and goals of the Quarry Area ROD have been met.

<b>Operable Unit:</b> OU2, Eastern Plume	<b>Protectiveness Determination:</b> Short-Term Protective	<b>Addendum Due Date (if applicable):</b> NA
<b>Protectiveness Statement:</b> Remedial measures implemented at the Eastern Plume are protective of human health and the environment in the short term. Although groundwater concentrations of site COCs and PFOS/PFOA are greater than ROD cleanup goals and EPA LHAs, respectively, within Sites 1, 2, 3 and Eastern Plume GMZ, LUCs are in place to prevent groundwater use. However, the nature and extent of PFAS contamination at the Eastern Plume and other areas of the former NAS Brunswick is not fully understood. Therefore, completion of a base-wide PFAS RI for NAS Brunswick is needed to determine if additional action is required under CERCLA and whether the remedy is protective in the long-term.		
<b>Sitewide Protectiveness Statement (if applicable)</b>		
<i>For sites that have achieved construction completion, enter a sitewide protectiveness determination and statement.</i>		
<b>Protectiveness Determination:</b> Short-Term Protective	<b>Addendum Due Date (if applicable):</b> December 2022	
<b>Protectiveness Statement:</b> <i>The potential for exposure to PFAS was not anticipated in the OU2 ROD. Investigations are recommended for the Eastern Plume as part of a larger base-wide RI for the former NAS Brunswick to ensure protectiveness in the long term. The remedies at all other former NAS Brunswick OUs/sites are protective of human health and the environment.</i>		

## **1.0 Introduction**

The purpose of five-year reviews is to determine whether implemented remedies are protective of human health and the environment. The methods, findings, and conclusions of the reviews are documented in Five-Year Review Reports. In addition, Five-Year Review Reports identify issues found during the review, if any, and identify recommendations to address them.

The United States Environmental Protection Agency (EPA) is responsible for implementing statutory five-year reviews pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121, 40 United States Code (U.S.C.) §9621, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300. CERCLA §121 states:

“If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than every five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the president shall take or require such action. The President shall report to Congress a list of facilities at which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.”

The Agency interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

“If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.”

For federal facility sites under the jurisdiction, custody, or control of the Department of Defense, Executive Order 12580 relieves the EPA of this responsibility and delegates the responsibility to the Department of Defense. The Navy is the lead agency responsible for five-year reviews at former Naval Air Station (NAS) Brunswick, working with EPA and Maine Department of Environmental Protection (MEDEP) through the Federal Facility Agreement (FFA) dated October 1990.

This Five-Year Review has been prepared under Contract Task Order (CTO) N4008518F5894 as part of Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N6247016D9008 for the Base Realignment and Closure (BRAC) Program Management Office East. BRAC Program Management Office East conducted this five-year review of the pending, completed, and ongoing remedial actions implemented at Sites 1, 2, 3, 7, 9, 12, the Quarry Area, and Eastern Plume at former NAS Brunswick, located in Cumberland County, Brunswick, Maine. A general site location map of NAS Brunswick is presented as Figure 1-1, and the locations of Installation Restoration (IR) Program sites are shown on Figure 1-2. Because hazardous substances, pollutants, or contaminants remain at Sites 1, 2, 3, 7, 9, 12, the Quarry Area, and Eastern Plume at NAS Brunswick in excess of levels that allow for unlimited use and unrestricted exposure, five-year reviews are required.

The initial trigger date for the statutory five-year reviews at NAS Brunswick was the start of remedial action construction for the Sites 1 and 3 landfill cover and slurry wall on 6 December 1994. The first five-year review for NAS Brunswick was completed in March 2000 (EA, 2000), second review was completed in September 2005 (ECC/EA, 2005), third review was completed in September 2010 (Tetra Tech, 2010c) and fourth five-year review was completed in September 2015 (Tetra Tech, 2015c). This is the fifth five-year review for NAS Brunswick and was prepared based on remedial actions conducted as of 15 January 2020.

This five-year review included the following sites with Records of Decision (RODs) finalized after the listing of the facility on the National Priorities List (NPL) in July 1987:

- Site 1 – Orion Street Landfill - North
- Site 2 – Orion Street Landfill - South
- Site 3 – Hazardous Waste Burial Area
- Site 7 – Old Acid/Caustic Pit
- Site 9 – Neptune Drive Disposal Area
- Site 12 – Explosive Ordnance Disposal (EOD) Area
- Quarry Area
- Eastern Plume

The Operable Unit (OU) designations for these sites in the Superfund Enterprise Management System (SEMS), which replaced the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS), are as follows:

- Sites 1 and 3 – OU1
- Site 2 – OU7
- Site 7 – OU7
- Site 9 – OU6
- Site 12 – OU9
- Quarry Area – OU10
- Eastern Plume – OU2

This report consists of 10 sections and three appendices, as follows:

- Section 1.0 discusses the purpose of the report and provides a summary of the history and site chronology of NAS Brunswick.
- Sections 2.0 through 8.0 are the five-year reviews for Sites 1 and 3 (OU1), Site 2 (OU7), Site 7 (OU7), Site 9 (OU6), Site 12 (OU9), Quarry Area (OU10). and Eastern Plume (OU2), respectively, at NAS Brunswick. Each section includes a site chronology, background, summary of remedial actions performed, five-year review findings, assessment, deficiency list, recommendations, and protectiveness statement.
- Section 9.0 provides a general summary, conclusions, and protectiveness statement for the NAS Brunswick facility. This section also identifies when the next five-year review is required and the other tasks that should be performed as part of that five-year review.
- Section 10.0 provides a listing of the references, base wide and by site, used in preparation of this report.
- Appendix A contains photographs of each of the sites.
- Appendix B will include copies of the public notices of the start of the Fifth Five-Year Review published in local newspapers.
- Appendix C will include completed interview forms and the list of potential interviewees to whom interview questionnaires were sent.

### **Administrative Components and Community Involvement**

This five-year review consisted of a review of relevant documents, interviews, and a site inspection. A public notice announcing the initiation of the five-year review process was published in the *Brunswick Times Record* on June 2, 2020.

The completed Fifth Five-Year Review Report will be available at the Information Repository located at the Curtis Memorial Library, 23 Pleasant Street, Brunswick, Maine, and on the BRAC Project Management Office website at

[https://www.bracpmo.navy.mil/brac\\_bases/northeast/nas\\_brunswick.html](https://www.bracpmo.navy.mil/brac_bases/northeast/nas_brunswick.html)

A second public notice will be published announcing the completion of the five-year review and its availability at the Information Repository.

The next five-year-review for NAS Brunswick is required to be completed by 30 September 2025.

## **1.1 Site Chronology**

The following is a list of important NAS Brunswick historical events and relevant dates:

- In December 1982, EPA's contractor, NUS Corporation, completed a Preliminary Assessment of the base that included Sites 1, 2, and 3 (1983a).
- In June 1983, an Initial Assessment Study (IAS) was completed by the Navy that detailed historical hazardous material usage and waste disposal practices at Sites 1 through 10 (Roy F. Weston, Inc., 1983).
- In August 1984, EPA's contractor, NUS Corporation completed a Site Inspection of Sites 1, 2, and 3 (1983b).
- In June 1985, the Navy completed a Pollution Abatement Confirmation Study (E.C. Jordan, 1985). This study recommended further investigation as identified in earlier assessments and inspections.
- In July 1987, NAS Brunswick was placed on EPA's NPL.
- In 1987, the Remedial Investigation (RI)/Feasibility Study (FS) process began for seven sites recommended for further investigation in previous investigations, including Sites 1, 2, 3, 7, 9, and Eastern Plume.
- In August 1990, the Draft Final RI Report was submitted (E.C. Jordan, 1990).
- In October 1990, the Navy entered into an FFA with EPA and MEDEP regarding the cleanup of environmental contamination at NAS Brunswick (U.S. Navy, 1990).

- In August 1991, the Draft Final Supplemental Investigation Report was completed, which identified Remedial Action Objectives (RAOs) and alternatives for Sites 1, 2, 3, 7, 9, and Eastern Plume.
- In October 1991, the Focused FS for Sites 1 and 3 was completed (E.C. Jordan, 1991c).
- In March 1992, the Draft Final FS was completed for Sites 2, 5, 6, 7, 9, 12, 14, and Sites 4, 11, and 13/Eastern Plume (E.C. Jordan, 1992).
- In June 1992, a ROD was signed for Sites 1 and 3 (U.S. Navy, 1992a). Also in June 1992, an interim ROD for an Interim Remedial Action at the Eastern Plume Operable Unit was signed (U.S. Navy, 1992b).
- On 6 December 1994, remedial action construction began with the installation of a cover over and slurry wall around Sites 1 and 3. Because this was the beginning of remedial action construction at NAS Brunswick after listing on the NPL, the date became the original trigger date for five-year reviews for the facility.
- In February 1998, the Final ROD for the Eastern Plume (U.S. Navy, 1998a) was signed. This ROD also documented NFA decisions for Sites 4, 11, and 13.
- In September 1998, a ROD was signed for Site 2 (U.S. Navy, 1998b).
- In September 1999, a ROD was signed for Site 9 (U.S. Navy, 1999).
- In March 2000, the First Five-Year Review Report was finalized for NAS Brunswick (EA, 2000).
- On 31 December 2000, the Navy updated and finalized the NAS Brunswick Operating Instruction 5090.1B, Restriction on Excavation Activities, to include groundwater use restrictions at IR Program sites.
- In September 2002, a ROD was signed for Site 7 (U.S. Navy, 2002).
- In September 2002, EPA issued a Preliminary Close-Out Report for the NAS Brunswick NPL sites (EPA, 2002).
- In 2005, the BRAC Commission selected NAS Brunswick for closure.
- In January 2006, the Final Base-Wide Quality Assurance Project Plan (QAPP) (ECC/EA, 2006) was issued, detailing long-term monitoring (LTM) Standard Operating Procedures (SOPs) and data quality objectives.

- On 6 June 2007, EPA issued a letter assessing stipulated penalties against the Navy as a result of IR Program wells not being sampled in accordance with approved LTM Plans (LTMPs).
- The NAS Brunswick Operating Instruction was updated again on 5 March 2008 as 5090.1C.
- An Explanation of Significant Differences (ESD) was issued in September 2010 documenting a change in the groundwater treatment system at the Eastern Plume from air stripping with subsequent vapor-phase and liquid-phase granular activated carbon (GAC) treatment to an advanced chemical oxidation treatment process using hydrogen peroxide and ozone (HiPOx). The ESD also documented the addition of vinyl chloride and 1,4-dioxane as chemicals of concern (COCs) for the Eastern Plume and interim cleanup goals for these two chemicals.
- The base's flying mission ended in January 2010, and NAS Brunswick was disestablished on May 31, 2011.
- An NFA ROD for Site 17 soil was signed in September 2011 (U.S. Navy, 2011). Groundwater monitoring is ongoing at Site 17, and any future actions determined to be required for groundwater at the site will be documented in a ROD for groundwater.
- The Long-Term Monitoring Optimization Report for Eastern Plume was updated as Revision 1 in June 2013 (Tetra Tech, 2013c), and the 2013 Revision of the Long-Term Monitoring Plan for the Eastern Plume was finalized in October 2013 (Tetra Tech, 2013d).
- The Long-Term Monitoring Optimization Report for Sites 1, 3, 2, 7, and 9 was finalized in February 2015 (Tetra Tech, 2015a).
- An ESD for Site 7, finalized in September 2014, documented the planned excavation of cadmium-contaminated soil to address continuing elevated concentrations of cadmium in groundwater at the site. The ESD also documented the plan to place excavated soil from Site 7 beneath the landfill cap extension at Sites 1 and 3.
- A multi-site Land Use Control (LUC) ESD was finalized in April 2015 documenting changes to the LUC components of the remedies for Sites 1 and 3, 2, 4, 7, 9, 12, and the Eastern Plume associated with the change in site conditions brought about by the disestablishment of the base on May 2011.

- The ROD for Site 12, EOD Area, was signed in September 2015.
- The Base-Wide LUC Implementation Plan (LUCIP), including site-specific LUC Remedial Designs (RDs) for Sites 1 and 3, 2, 4, 7, 9, 12, and the Eastern Plume was finalized in September 2016 (Tetra Tech, 2016).
- An NFA ROD for the Orion Street Skeet Range (OSSR), was signed in September 2016. The Navy conducted removal actions in 2016 to reduce site risk posed by PAHs and lead in soil and to facilitate property transfer.
- The ROD for the Quarry Area was signed in September 2017, and remedial actions required by the ROD (residual munitions clearance and soil cover installation) were completed in 2018.
- Any future construction activities at former NAS Brunswick will require the property owner to submit a Brunswick Landing Construction Permission Request Form to the Navy for approval before the Town of Brunswick will approve a construction permit. The Brunswick Landing Construction Permission Request process is in place and functioning as intended to prevent/minimize uncontrolled human exposure during construction activities that could potentially result in unacceptable risks posed by site contaminants. The NAS Brunswick Base-Wide LUCIP is in the process of being revised and will include the Construction Permission Request process as one of the implementing actions.

## **1.2 Background**

The former NAS Brunswick is located in Brunswick, Cumberland County, Maine, south of the Androscoggin River and south of Route 1 between Routes 24 and 123 (Figure 1-1). The base supported the Navy's antisubmarine warfare operations in the Atlantic Ocean with several squadrons of P-3 maritime patrol aircraft. NAS Brunswick was selected in 2005 by the BRAC Commission for closure and was deactivated on May 31, 2011. The base population and facility operations decreased significantly with the end of the base's flying mission in January 2010. More than 80 percent of the former base has been transferred out of Navy ownership since base closure, and redevelopment activities are ongoing, including opening of a civilian airport (Brunswick Executive Airport) and business and industrial park (Brunswick Landing).

The former base occupied approximately 3,094 acres, and the operational area covered approximately 138 acres east of the two parallel runways extending north to south in the northern portion of the facility. The operational area included numerous office buildings, barracks, recreational facilities, hangars, repair shops, and other facilities that formerly

supported NAS Brunswick aircraft, although building demolition associated with base closure and redevelopment is ongoing. Forested areas, grasslands, shrubland, marsh, and open water comprise approximately 83 percent of the base, with the remaining 17 percent consisting of paved areas (primary flight ramps and runways) of the operations area. The southern edge of the base borders coves and estuaries of the Gulf of Maine.

Undisturbed topography at NAS Brunswick is characterized by low undulating hills with deeply incised brooks. Ground surface elevations range from mean sea level (msl) in lowland drainage areas and the Harpswell Cove estuary to more than 110 feet above msl west and southwest of the southern end of the runways. Topography in the developed areas of the base has been modified by construction, with ground surface elevations generally ranging from 50 to 75 feet above msl.

Property uses surrounding the former NAS Brunswick are primarily suburban and rural residential, with some commercial and light industrial uses along Routes 1, 24, and 123. An elementary school and a college are located within a 1-mile radius of the western base boundary.

Since its closure in 2011 and subsequent redevelopment, former NAS Brunswick now includes commercial and industrial businesses, a business technology accelerator/incubator, various organizations, several colleges and universities, natural and recreational areas, neighborhoods, a military reserve center, a general aviation airport, and renewable energy facilities. Former NAS Brunswick is now known as Brunswick Landing.

A total of 21 sites at NAS Brunswick have been or are being investigated under the Navy's IR Program and in accordance with the requirements of CERCLA and the Superfund Amendments and Reauthorization Act.

The following 11 IR Program sites require NFA:

- Site 4 (OU5) – Acid/Caustic Pit
- Site 5 (OU4) – Orion Street Asbestos Disposal Site
- Site 6 (OU4) – Sandy Road Rubble and Asbestos Disposal Site
- Site 8 (OU3) – Perimeter Road Disposal Area
- Site 11 (OU5) – Fire Training Area
- Site 13 (OU5) – Defense Reutilization and Marketing Office (DRMO) Area
- Site 14 – Old Dump No. 3
- Site 15 – Merriconeag Extension Debris Site
- Site 16 – Swampy Road Debris Site
- Soil at Site 17 (OU8) – Former Building 95 (groundwater is still being monitored)

- Site 18 – West Runway Study Area
- OSSR (OU11)
- Fitch Avenue Skeet Range (OU11)

Investigations are ongoing for Site 17 groundwater, a ROD is expected to be signed for Picnic Pond (OU12) in late 2020, and the remaining sites, 1, 2, 3, 7, 9, 12, Quarry Area, and Eastern Plume, are included in this Fifth Five-Year Review Report.

The Navy's assessment of per- and polyfluoroalkyl substances (PFAS) is ongoing at former NAS Brunswick on a site-wide basis. The Navy published a comprehensive report in August 2019 (Resolution Consultants, 2019) presenting all PFAS data collected as part of numerous on- and off-base investigations. These investigations were initiated in response to the Navy's documented historical storage, handling, use, and releases of PFAS-containing aqueous film-forming foam (AFFF) when NAS Brunswick was an active installation.

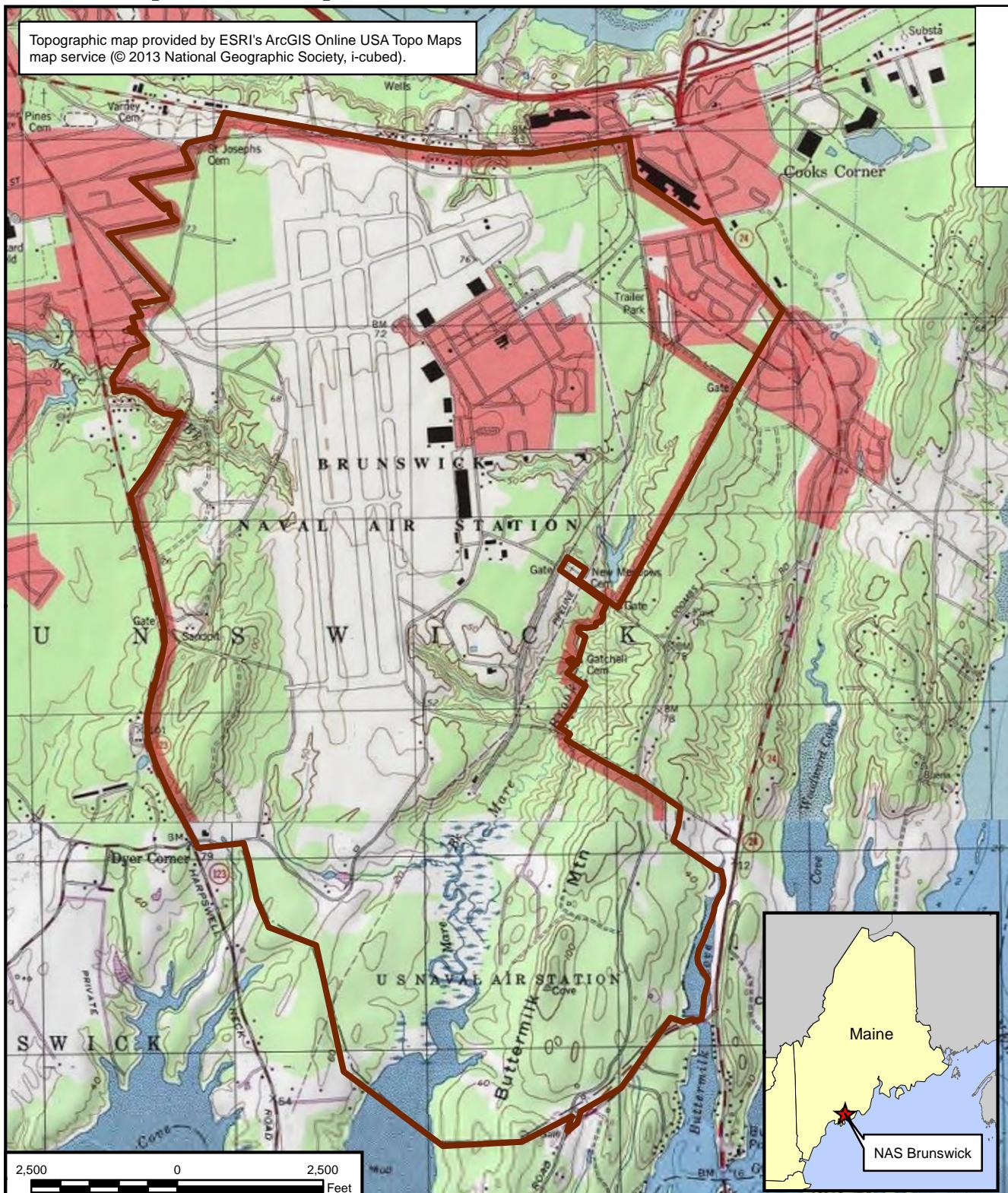
Concentrations detected in groundwater at several locations across the former base exceeded EPA's Lifetime Health Advisory (LHA) of 0.07 micrograms per liter ( $\mu\text{g}/\text{L}$ ) for perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), individually or combined (EPA, 2016a and 2016b). In addition, the Navy also completed groundwater sampling of both private and public drinking water supplies on and outside of Brunswick Landing. This included the sampling of numerous residential wells outside the former NAS Brunswick boundary, a public drinking water source operated by the Town of Brunswick, and a well providing potable water to the golf course located on Brunswick Landing. Results from all sampled drinking water sources were less than EPA LHAs. The State of Maine has not currently promulgated drinking water or groundwater standards for PFAS, including PFOS and PFOA. However, the State's Department of Health and Human Services has issued a fact sheet adopting EPA's health advisory of 0.07  $\mu\text{g}/\text{L}$  for PFOA and PFOS, individually and combined, in drinking water. According to Maine's Remedial Action Guidelines for Sites Contaminated with Hazardous Substances Rules, MEDEP recommends that EPA health advisory levels be applied at sites where groundwater is currently being used, or may be used in the future, for human consumption.

The Navy will proceed with planning and implementing an RI for PFAS in accordance with CERCLA, the NCP, and the Brunswick Naval Air Station FFA to determine the nature and extent of contamination associated with historical PFAS releases to the environment. Potential exposure to PFAS-contaminated groundwater is controlled by the Navy through restrictions placed in documents transferring NAS Brunswick property outside the Navy as well as LUCs established as part of CERCLA remedies implemented at the former base.

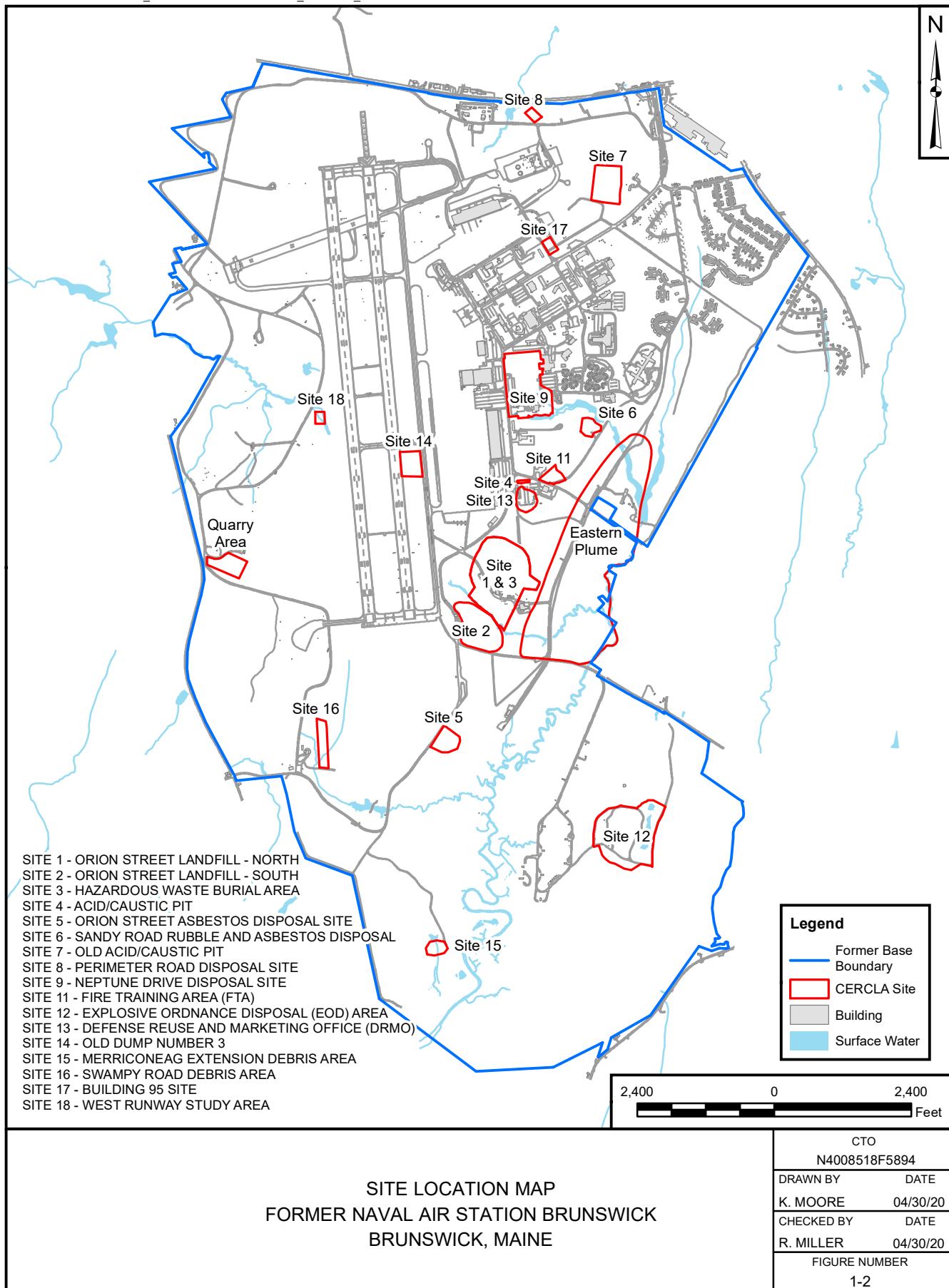
## **1.3 ARAR and Site-Specific Action Levels Changes**

The Applicable or Relevant and Appropriate Requirements (ARARs) identified in each of the RODs were reviewed, as were new federal and state regulations that have been promulgated since the previous five-year review. Changes since the last five-year review are discussed in Section 2.0 through 6.0 on a site-specific basis.

Topographic map provided by ESRI's ArcGIS Online USA Topo Maps map service (© 2013 National Geographic Society, i-cubed).



DRAWN BY J. ENGLISH	DATE 10/08/09	 <b>TETRA TECH</b>	CONTRACT NUMBER 2330	CTO NUMBER WE49
CHECKED BY R. MILLER	DATE 04/23/15	<b>FACILITY LOCATION MAP</b> <b>FORMER NAVAL STATION,</b> <b>BRUNSWICK, MAINE</b>	APPROVED BY ____	DATE ____
REVISED BY ____	DATE ____		APPROVED BY ____	DATE ____
SCALE AS NOTED	____		FIGURE NO. 1-1	REV 0



## **2.0 OU1, Site 1, Orion Street Landfill – North, and Site 3, Hazardous Waste Burial Area**

### **2.1 Introduction**

Site 1, Orion Street Landfill - North and Site 3, Hazardous Waste Burial Area, are two closed landfills located within a restricted area in the central portion of the former NAS Brunswick (Figures 1-1 and 2-1). Records indicate that the Site 1 landfill was used from 1955 to 1975 for disposal of materials including garbage, food waste, refuse, waste oil, solvents, pesticides, petroleum products, paint wastes, aircraft and automobile parts, and various chemicals. Site 3 is located across from Site 1, next to the access road into the Weapons Compound. Records indicate that Site 3 operated from 1960 to 1973 as a disposal area for solvents, paints, and isopropyl alcohol. Although Site 3 was originally believed to be a separate disposal area, field sampling activities did not show a clear delineation between the two sites. Therefore, based on the proximity of the two sites, common historical land use, and hydrogeological characteristics, and because the impacts of past disposal practices at Sites 1 and 3 could not be distinguished, Sites 1 and 3 were combined in the ROD (U.S. Navy, 1992) and are addressed together in this section.

### **2.2 Site Chronology**

A list of important Sites 1 and 3 historical events and relevant dates in the site chronology is shown below. The identified events are illustrative, not comprehensive. Further information about activities and actions at the site can be found in the Administrative Record available as part of the Information Repository at the Curtis Memorial Library, 23 Pleasant Street, Brunswick, Maine, 04011-2261.

<b>Event</b>	<b>Date</b>
Base-Wide Preliminary Assessment	December 1982
Base-Wide IAS	June 1983
Base-Wide Site Inspection	August 1984
Pollution Abatement Confirmation Study	June 1985
Draft Final RI Report	August 1990
Draft Final Supplemental RI Report	August 1991
FS	October 1991
Sites 1 and 3 ROD signed	June 1992

Event	Date
Remedial Design Summary Report	May 1993
Sites 1 and 3 LTMP	August 1994
ESD for removal and transport of contaminated materials from Sites 5, 6, and 8 to Sites 1 and 3 for use as subgrade fill for the cover	September 1994
Extraction wells EW-06 and EW-07 activated	November 1994
Beginning of Sites 1 and 3 remedial action construction (base-wide trigger date for five-year reviews)	6 December 1994
Remedial Action Report for Sites 1 and 3 finalized	1995
Extraction wells EW-06 and EW-07 deactivated	November 1997
Corrective measure to repair erosion of the landfill cap observed during 1998 inspection	June 1999
First Five-Year Review Report signed (EA, 2000b)	March 2000
ESD documenting the institutional control boundary of the Eastern Plume, including Sites 1 and 3 (U.S., Navy, 2000b)	December 2000
Operating Instruction NASBINST 5090.1B issued (U.S. Navy, 2000a)	31 December 2000
Navy is notified of being in non-compliance with the gauging schedule	October 2003
Second Five-Year Review Signed (ECC/EA, 2005)	4 October 2005
Installation of 1300-series monitoring well pairs downgradient of the slurry wall gap	October 2005
Revised Screening Values for Surface Water, Seep Water and Sediment document finalized	January 2006
Final Operation and Maintenance Plan for the landfills	January 2008
Final Long-Term Monitoring Plan for Sites 1 and 3	February 2008
Navy is assessed stipulated penalties for non-compliance with the FFA	June 2008
Operating Instruction NASBINST 5090.1C issued	5 March 2008
EPA issues Fish Study Report for Mere Brook	November 2008
Final Technical Memorandum Evaluation of Eastern Plume Extraction Well Network and Sites 1 and 3 Remedy (groundwater modeling study)	August 2009
Technical Memorandum, Data Gap Investigations for Sites 1 and 3, Site 2, and Site 7	June 2013
LTM Optimization Report for Sites 1, 3, 2, 7, and 9	February 2015
LUC ESD for Sites 1 and 3, 2, 4, 7, 9, and the Eastern Plume	April 2015
Base-Wide QAPP for the LTM Program, 2015 Revision	August 2015
Base-Wide LUCIP, including the combined LUC RD for Sites 1 and 3, Site 2, and Eastern Plume	September 2016
Draft 2020 Update to Base-Wide LUCIP/LUC RDs	2020
LTM	March 1995 to present

## 2.3 Background

### 2.3.1 Physical Characteristics

Sites 1 and 3 were located in a restricted area in the central portion of the former NAS Brunswick, east of the southern end of the main runways. Site 1 covers approximately 60 acres, although the area of documented refuse disposal is only approximately 8.5 acres. Site 3 consists of approximately 1.5 acres and is contiguous to Site 1. The 8.5-acre disposal area at Site 1 is an open, slightly rolling, grass-covered field bordered to the north, west, and east by woodlands and to the south by the former Weapons Compound and steep embankments bordering Mere Brook. Site 3 is located adjacent to Site 1 to the southwest and consists of a small knoll covered with grass and a pine grove. Lowland areas along Mere Brook are heavily wooded, and slopes along portions of the brook are typically very steep in areas adjacent to Sites 1 and 3. A brief discussion of geology and hydrogeology applicable to Sites 1 and 3 is included in Section 6.3.1.

### 2.3.2 Land and Resource Use

The Sites 1 and 3 area is presently owned by the Navy and currently inactive, and no structures are located within the landfill boundaries. The majority of potable water that was and continues to be used at the former base is supplied by the Brunswick/Topsham Water District municipal water supply. Two water supply wells, the Dyer's Gate bedrock well and golf course well, were located within the boundaries of the former base. The Dyer's Gate well, located approximately 240 to 300 feet from the center of the Site 2 landfill, was abandoned in 2013 in accordance with state requirements (H&S Environmental, Inc., 2013). This well supplied non-potable water for the few workers at the nearby guardhouse (ATSDR, 2005). Because of the limited number of people it supplied, it was not regulated by the Maine Drinking Water Program; however, it was sampled as part of the Site 2 LTM program until September 2009, and no landfill-related contaminants of concern were detected. As discussed in Section 1.2, the golf course well was sampled as part of the Navy's assessment of potential PFAS in drinking water sources on and around the former base. PFOS and PFOA concentrations in the golf course well were less than EPA's LHAs for these two contaminants.

The golf course well (PWS ID94492101) is located at the golf course clubhouse (former Building 78) within the boundaries of the golf course in the southwestern portion of the base and approximately 0.5 mile southwest and not hydraulically downgradient of Sites 1 and 3. This well previously supplied water to a former farmhouse in the area acquired

by the Navy in the late 1940s or early 1950s and was used by the Navy to supply water to visitors to the golf course (ATSDR, 2005). The area including this well was transferred to the Mid-Coast Regional Redevelopment Authority (MRRA) in 2012. Continued use of the well for the same purpose as when it was under Navy control is permitted, but in accordance with the deed associated with the property transfer, increased water withdrawal for other uses, including expansion of the golf course, golf course clubhouse, and/or restaurant areas, must be approved by the Navy and applicable regulatory authorities. As described in Section 1.9, this well was sampled by the Navy during recent PFAS investigation, and PFOA and PFOS concentrations were less than EPA LHAs.

In the overburden, groundwater from the landfills is interpreted to flow to the southeast and discharge to Mere Brook and flows out along the banks as leachate seeps. Figure 2-2 is a shallow groundwater contour map based on data from the October 2019 monitoring event at Sites 1 and 3. Mere Brook flows into the Atlantic Ocean at Harpswell Cove, which is designated as a potential aquaculture area by the State of Maine and which supports various commercially important fish and shellfish species (U.S. Navy, 1994).

### **2.3.3 History of Contamination**

Historical records indicate that the Site 1 landfill was used from 1955 to 1975 for materials including garbage, food waste, refuse, waste oil, solvents, pesticides, petroleum products, paint wastes, aircraft and automobile parts, and various chemicals. Site 3 operated from 1960 to 1973 as a disposal area for wastes including solvents, paints, and isopropyl alcohol.

### **2.3.4 Initial Response and Basis for Taking Action**

The base-wide IAS completed in 1983 by Roy F. Weston recommended further investigation of Site 1 based on disposal of hazardous wastes including solvents and because migration pathways to surface water and groundwater were identified. For Site 3, further investigation was recommended based on the presence of hazardous waste and because migration pathways to surface water and groundwater were identified. Further investigation of Sites 1 and 3 was also recommended after completion of the Site Inspection and Pollution Abatement Confirmation Study (NUS Corporation, 1983b; E.C. Jordan, 1985). During the RI, chlorinated solvent; benzene, toluene, ethylbenzene, and xylenes (BTEX); and metals contamination in groundwater was detected at Sites 1 and 3, and metals detected in Mere Brook adjacent to the site were attributed to discharge of contaminated groundwater from the sites.

During the 1990s, environmental contamination was observed in several media at Sites 1 and 3, including soil, groundwater, leachate, leachate sediment, surface water, and sediment. Contaminants detected at Sites 1 and 3 included polynuclear aromatic hydrocarbons (PAHs) and pesticides in soil; volatile organic compounds (VOCs) and metals in groundwater; metals, VOCs, and semivolatile organic compounds (SVOCs) in leachate; and metals in surface water. The source area for this contamination is considered to be the landfills, although no single well-defined source of contamination has been identified (U.S. Navy, 1992). The estimated volume of landfilled waste at the two sites is 300,000 cubic yards (yd<sup>3</sup>), as determined based on test pits completed at the site during pre-ROD investigation activities.

Exposure pathways evaluated in the human health risk assessment conducted for Sites 1 and 3 as part of the RI included direct contact with and incidental ingestion of soil, sediment, surface water, leachate, and groundwater. Under the land use conditions evaluated during the RI, no exposure routes were considered to present a risk to human health. However, under a future hypothetical residential exposure scenario, estimated risks/hazards were unacceptable for direct contact with PAHs in surface soil, surface water, sediment, leachate, and leachate sediments and for exposure to groundwater from Sites 1 and 3. In addition, exposure to mercury in soil and sediment associated with leachate seeps was identified as having potentially adverse impacts on terrestrial organisms (e.g., earthworms, small birds, and rodents). All other estimated ecological risks are at acceptable levels (E.C., Jordan, 1991a).

The environmental risk assessment concluded that iron and zinc in surface water in the portion of Mere Brook adjacent to Sites 1 and 3 may cause some adverse impacts to aquatic organisms. Iron and zinc were also detected at concentrations greater than their Ambient Water Quality Criteria (AWQCs) (established for the protection of aquatic life) upstream of Sites 1 and 3, suggesting that other sources (e.g., the runways) in addition to the Sites 1 and 3 leachate seeps are affecting the brook. Concentrations of iron and zinc downstream of Sites 1 and 3 and at monitoring locations in Harpswell Cove are less than their respective AWQCs. All other contaminants in Mere Brook were detected at concentrations less than levels considered to present ecological risk (U.S. Navy, 1992).

Based on unacceptable human health risks and potential ecological impacts, the cleanup goals listed below were established in the Sites 1 and 3 ROD (U.S. Navy, 1992).

Parameter	Maximum Concentration	Target Cleanup Level
<b>Human Health – Groundwater (µg/L)</b>		
Arsenic	107	50 <sup>(1)</sup>
Vinyl Chloride	180	2
Methylene Chloride	460	5
cis-1,2-DCE	140	70
trans-1,2-DCE	140	100
Chromium (total)	11	100
Lead	60	15 <sup>(2)</sup>
Nickel	78	100 <sup>(3)</sup>
<b>Ecological – Leachate Soil/Sediment (mg/kg)</b>		
Mercury	3.3	1 <sup>(4)</sup>

Except as noted, cleanup goals are federal Maximum Contaminant Levels (MCLs).

1 MCL at the time of the ROD; current MCL is 10 µg/L, effective 26 January 2006.

2 Federal Action Level.

3 MCL Goal.

4 Risk-based value.

## 2.4 Remedial Actions

### 2.4.1 Remedy Selection

The 1992 ROD established the following RAOs for Sites 1 and 3:

- Reduce the generation and migration of contaminated groundwater.
- Reduce the potential risk associated with ingestion of contaminated groundwater.
- Minimize future negative impacts to Mere Brook and the sediment in leachate seeps resulting from discharge of contaminated groundwater and leachate.
- Reduce the concentrations of metals (iron and zinc) discharging to Mere Brook.

The selected remedy, designed to achieve these goals by containing the buried waste and minimizing migration of contaminants from the landfills by reducing water flow through the waste, includes the following components, as listed in the 1992 ROD:

- Installation of a slurry wall to divert uncontaminated groundwater flow around the sites, preventing groundwater contact with landfill waste material.

- Construction of a low-permeability cap to reduce rainfall infiltration and thereby reduce leachate production.
- Construction and operation of a groundwater extraction system to remove contaminated groundwater beneath the cap and within the slurry wall, thereby lowering the water table to levels below the waste and removing the most contaminated groundwater, preventing its discharge to Mere Brook.
- Groundwater treatment to address dissolved metals and VOCs.
- Discharge of treated water.
- Institutional controls and land use restrictions including installation of warning signs and prohibition of use of the landfills and use of groundwater from the sites.
- Environmental monitoring to assess the effectiveness of the cap and slurry wall in diverting groundwater around the sites and preventing further contamination of groundwater and also to assess the dispersion and degradation of contamination that already emanated from the landfills.

The June 1992 Sites 1 and 3 ROD also specified that should the Weapons Compound be closed, the Navy would evaluate the need for extending the cap to include that portion of the Weapons Compound that was also historically part of the landfill area.

The selected remedy was determined to be protective of human health and the environment, to attain ARARs, and to be cost effective. The remedy complies with action- and location-specific ARARs, and eventual compliance with chemical-specific ARARs will be verified by monitoring.

The selected remedy was expected to eliminate leachate seeps and prevent further contamination of sediment in the vicinity of the seeps. Although the remedial action does not directly reduce mercury concentrations in these sediments, other natural processes (e.g., scour or sedimentation) will reduce concentrations over time, and monitoring is being conducted to access the effectiveness of these processes in minimizing further impact to the Mere Brook ecosystem (U.S. Navy, 1992).

## 2.4.2 Remedy Implementation

### Groundwater Extraction and Treatment

In May 1993, the Remedial Design Summary Report was finalized for Sites 1 and 3, and remedial construction began in fall 1994. In 1994, the Navy finalized an ESD for the site

that allowed for contaminated materials at Sites 5, 6, and 8 to be removed, transported to Sites 1 and 3, and used as subgrade fill for the cover at the site. The 1994 ESD was necessary because the 1992 ROD did not include use of material from Sites 5, 6, and 8 as a component of the remedy.

A soil bentonite slurry wall, placed to divert clean groundwater flow around the landfill, was keyed into an underlying marine clay unit and has a permeability of  $10^{-6}$  to  $10^{-7}$  centimeters per second. In addition, the low-permeability cap was extended over the slurry wall to prevent infiltration within the slurry wall limits. A small portion (estimated at the time to be less than 0.3 acre) of Site 1 is located within the former Weapons Area Compound and was not included in the initial cover system due to strict access restrictions placed on the Weapons Area Compound at that time when NAS Brunswick was an active installation (U.S. Navy, 1992). After completion of a data gap investigation in 2010 and 2011, the cover was extended over this area in 2017.

Two extraction wells to dewater the area within the slurry wall (EW-6 and EW-7) began operation in June 1995 and were deactivated in November 1997, with the approval of MEDEP and EPA, based on the following: (1) decreasing yields; (2) stabilized water levels within the confines of the slurry wall; and (3) water levels 0.9 foot below the lowest reported depth of waste material, except at MW-234R, thus achieving the design intent of the low-permeability cap, slurry wall, and landfill extraction wells.

The ROD stated that one pore volume of groundwater within the slurry wall (estimated at 16 million gallons) was to be removed by the extraction wells, based on calculations completed by E.C. Jordan as part of the FS for Sites 1 and 3 (1991b). Approximately 3.6 million gallons were removed by extraction wells EW-6 and EW-7 from January 1996 to November 1997 when the wells were deactivated after water elevations stabilized below the majority of the waste. It is likely the difference between the estimated volume of groundwater to be removed (16 million gallons) and the actual volume (3.6 million gallons) removed is attributed to specific retention of the pore water and capillary action, because the combined effect of the slurry wall and groundwater depression caused by pumping would have reversed the groundwater gradient at the slurry wall gap, preventing groundwater from exiting through this gap.

### **LUCs**

Land use restrictions at Sites 1 and 3 were initially implemented via NAS Brunswick Instruction 5090.1B (replaced in 2008 by version 5090.1C), and the LUC component of the remedy for Sites 1 and 3 was modified as documented in the 2015 multi-site ESD to clarify the LUC objectives in light of base closure. Based on the proximity of Sites 1 and 3, Site 2, and the Eastern Plume, their LUC boundaries were combined, with

groundwater restrictions across the entire combined area, referred to as the groundwater management zone (GMZ) and soil restrictions as required in a smaller overlapping soil management zone (SMZ) (see Figure 2-3). The LUC performance objectives for Sites 1 and 3, as documented in the 2015 multi-site LUC ESD, are as follows:

- Prevent uncontrolled human exposure to and/or use of contaminated groundwater within the groundwater management zone.
- Prevent unacceptable human exposure to volatile vapors potentially migrating from contaminated groundwater to the indoor air of future habitable structures within the groundwater management zone.
- Prevent changes in hydrology within the groundwater management zone that have the potential to negatively impact the nature and extent of delineated groundwater contamination.
- Manage future construction activities within the soil and groundwater management zones to prevent uncontrolled human exposure and/or transport/migration of contaminated soil and groundwater.
- Prevent uncontrolled human exposure to and/or use of surface and subsurface soils within the soil management zone.
- Protect the integrity and operation of the landfill cap and remediation and monitoring systems within the soil and groundwater management zones.

The LUCs required to achieve these performance objectives for the soil and groundwater management zones, as provided in the LUC RD for Sites 1, 2, 3, and Eastern Plume (Tetra Tech, 2016) are listed below.

### **Soil Management Zone**

- Prohibit residential use within the soil management zone unless prior written approval is obtained from the Navy, EPA, and MEDEP. Prohibited residential uses shall include, but are not limited to, any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent or nursing care facilities.
- Prohibit soil excavation/disturbance or any construction activities not associated with monitoring, maintenance, or other necessary remedial actions within the soil management zone to protect the landfill cap, slurry wall, and supporting stormwater management ditches and retaining basin.

- Protect the integrity of all current and future remedial systems/components in the soil management zone, including maintaining the cap and warning signs. Based on this restriction, any use or activity that would interfere with the implementation or effectiveness of the remedy is prohibited.

### **Groundwater Management Zone**

- Prohibit all uses of groundwater underlying the groundwater management zone unless prior written approval is obtained from the Navy, EPA, and MEDEP.
- Protect the integrity of all current and future remedial systems/components within the groundwater management zone. Based on this restriction, any use or activity that would interfere with the implementation or effectiveness of the remedy is prohibited.
- Prohibit construction of habitable structures in the groundwater management zone without evaluation and potential mitigation of vapor intrusion and unless prior written approval is obtained from the Navy, EPA, and MEDEP.

These LUCs were implemented upon finalization of the LUC RD, which is included as an appendix to the Base-Wide LUCIP, and the LUCs will be monitored, maintained, enforced, and reported on in accordance with provisions in the LUC RD. The LUC RD also documents the requirements for continuation of the LUCs if all or part of the Sites 1 and 3 property is transferred out of Navy ownership. Any future construction activities will also require the property owner to submit a Brunswick Landing Construction Permission Request Form to the Navy for approval before the Town of Brunswick will approve a construction permit. The Brunswick Landing Construction Permission Request process is in place and functioning as intended to prevent/minimize uncontrolled human exposure during construction activities that could potentially result in unacceptable risks posed by site contaminants. The Base-Wide LUCIP is in the process of being revised and will include the Construction Permission Request process as one of the LUC implementing actions.

### **LTM**

The objective of the monitoring component of the remedy is to obtain the data necessary to assess the long-term effectiveness of remedial actions in meeting the Sites 1 and 3 RAOs. Environmental monitoring was initiated in March 1995, and as of fall 2019, 50 LTM events have been completed at Sites 1 and 3. An LTM Optimization Report for Sites 1 and 3, Site 2, Site 7, and Site 9 was finalized in February 2015 (Tetra Tech, 2015a) presenting optimization recommendations for LTM at these sites, and monitoring is currently being conducted in accordance with the August 2015 Base-Wide

QAPP for the LTM Program based on the approved recommendations in the final LTM Optimization Report.

### **Cap Extension**

As stated above, a small portion of Site 1 located within the former Weapons Area Compound (southern edge of the landfill) was not included in the cover system when it was installed due to strict access restrictions placed on the Weapons Area Compound when NAS Brunswick was an active installation. After closure of the base and in accordance with the Sites 1 and 3 ROD, the Navy conducted an investigation in 2010 and 2011 to determine the nature and extent of uncapped landfill waste in the former Weapons Compound area of the site and to determine whether any additional capping and/or slurry wall construction was required at Sites 1 and 3. Based on the results of the investigation, it was determined that an extension of the existing landfill cap should be constructed over uncapped waste in an approximately 1.12-acre area but that extension of the slurry wall was not warranted (Tetra Tech, 2013b). Construction activities associated with the Sites 1 and 3 cap extension were completed in 2017, and subsequent fence reinstallation and extension and access road work was completed in 2018. Contaminated soils excavated from several other sites (Site 7, Site 9, Fitch Avenue Skeet Range, and OSSR) were consolidated within the 1.12-acre area prior to construction of the Sites 1 and 3 cap extension.

#### **2.4.3 System Operation/Operation and Maintenance**

The groundwater extraction system operated from 1994 to 1997 and was deactivated when the goal of lowering the water table to below the level of the waste was achieved.

The Navy is conducting LTM and maintenance in accordance with the Base-Wide QAPP for the LTM Program (Tetra Tech, 2015b). Landfill inspections are conducted annually in conjunction with LTM events. The Operation and Maintenance (O&M) Manual (ECC, 2008a) includes the following O&M activities, which are completed, as necessary, as part of LTM activities:

- Visual inspection of the cover with regard to vegetation, stability, animal burrows, and need for corrective action. In addition, the grass on the cover is mowed twice a year.
- Surveying of landfill cap settlement markers to determine any changes in cap conditions.
- Inspection of the drainage swales for blockages, erosion or instability, and any

need for corrective action.

- Inspection of the stormwater detention basin at Sites 1 and 3 and any need for corrective action.
- Inspection of the conditions of groundwater monitoring wells and gas probes.
- Inspection of the conditions of equipment such as fencing, culverts, and catch basins, and any need for corrective action.
- Inspection of the slope south of the landfill along Mere Brook for the presence of erosion or sloughing.
- Identification of settlement of the parking lot or access roads.
- Bi-annual environmental monitoring of groundwater, surface water, sediment, sediment seeps, and leachate seeps.
- Inspection for drinking water wells and any ground disturbance within the LUC boundary.
- Inspection of required signage around the landfill and near the seep sample locations.
- Inspection of the LUC boundary.

## **2.5 Progress Since the Last Five-Year Review**

No non-compliance issues were identified during the fourth five-year review of the remedial action for Sites 1 and 3. The review found that the selected remedy at Sites 1 and 3 was protective of human health and the environment and was functioning as designed. In addition, the Navy did not identify any issues or recommendations for the Sites 1 and 3 remedy that required follow-up action to ensure remedy protectiveness. Activities completed at Sites 1 and 3 since the last five-year review are summarized below. LTM activities are discussed in Section 2.6.1.

As stated above, an extension of the landfill cap was completed in 2017 to cover a small area of uncapped waste in the former Weapons Compound area. The cap extension was designed to cover the area of uncapped waste (determined to be approximately 1.12 acres based on pre-design fieldwork) and to allow the consolidation of approximately 4,000 cubic yards of soil from other sites at the base under the expanded cap. Prior to construction of the cap extension, a chain-link fence was installed to

encompass the expanded capped area. Cap extension field activities included excavation of the landfill cap material to expose the existing liner, placement of soil (and debris from Sites 1 and 3 foundation and road demolition) for disposal, installation and testing of the multi-layer cap, installation of a gas vent and drainage piping system, and site restoration. Soil and debris consolidation under the landfill cap extension totaled approximately 4,259 cubic yards and included:

- 115 cubic yards of debris from Sites 1 and 3 foundation and road demolition
- 1,900 cubic yards of soil from FASR
- 1,332 cubic yards of cadmium-impacted soil from Site 7
- 684 cubic yards of soil from Hangar 4 excavation
- 136 cubic yards of PAH-impacted soil from Site 9
- 92 cubic yards of lead-impacted soil from 2017 OSSR removal action

Based on the results of the Historical Radiological Assessment (HRA), which was finalized in March 2014 and presented the results of the Navy's efforts to identify potentially radiologically impacted sites based on past activities at the facility involving radiological materials, a radiological surface survey at Sites 1 and 3 was conducted in 2015 and 2016. Small areas with slightly elevated radionuclide concentrations were discovered at several landfill outfalls and were excavated and removed for permitted off-site disposal. The radiologically impacted materials identified and removed from portions of the landfill perimeter drainage system were determined to be naturally rad-elevated aggregates and soils imported to the site and used to construct the original Sites 1 and 3 cover system. The radiologically impacted materials were not associated with historic disposal of radionuclide contamination as part of Navy landfilling operations. More than 130 samples were collected to evaluate possible migration, but the results did not indicate any migration of the contamination off site. The Navy is developing a monitoring program work plan to periodically assesses these outfall areas to ensure that detections of radiation remain less than State of Maine requirements.

## 2.6 Five-Year Review Process

### 2.6.1 Document and Analytical Data Review

Documents reviewed as part of this five-year review are referenced throughout the text and are included by site in the reference section (Section 10). Information in this subsection summarizing the results of LTM are based on Sites 1 and 3 LTM reports.

Between March 1995 and fall 2019, a total of 50 LTM events have been completed at Sites 1 and 3, including sampling and analysis of groundwater, surface water, sediment, leachate seep water, and leachate sediment. LTM data are compared to federal MCLs, State of Maine MEGs, and derived risk-based ecological screening values (RBESVs) established in 2006 (EA, 2006). These RBESVs were developed for media at NAS Brunswick other than soil and groundwater and for which no prior benchmark values had been established. Because the streams adjacent to NAS Brunswick are freshwater systems, the benchmarks were developed for the protection of freshwater environments and aquatic organisms.

### **LTM Program**

In accordance with the Base-Wide QAPP, the current LTM program for Sites 1 and 3 includes annual sampling of five monitoring wells (MW-218, MW-1&3-1301A, MW-1&3-1302A, MW-1&3-1303A, and MW-1&3-1304), three co-located leachate seep and leachate sediment locations (SEEP/LT-3, SEEP-LT-4, and SEEP/LT-9), two surface water locations (SW-7 and SW-15), and two sediment locations (SED-15 and SED-18). In addition, 24 wells and two stream gauges are gauged annually. Annual groundwater samples are analyzed for VOCs and metals and leachate sediment, surface water, and two of the three leachate seep samples are analyzed for metals only. Sediment samples are analyzed for metals and pesticides, and the third seep sample is analyzed for VOCs, metals, and pesticides.

Every 5 years, six additional wells (total of 11) and two additional co-located leachate seep and sediment locations (total of five) are sampled to confirm contaminant concentration distributions. The five-year sampling event for Sites 1 and 3 was conducted in fall 2019. The additional groundwater samples are analyzed for VOCs and metals. The additional leachate seep and sediment samples are analyzed for metals, and one of the seep samples is also analyzed for VOCs.

The Base-Wide QAPP also included sampling of three wells at Sites 1 and 3 (MW-1&3-1301B, 1302B, and 1303B), with analysis for VOCs and metal, for two consecutive events (2018 and 2019) to evaluate conditions after contaminated soil disposal (from Sites 7 and 9, OSSR and Fitch Avenue Skeet Range) and cap extension activities.

The conclusions for the Sites 1 and 3 LTM program, based historical and current monitoring results, are as follows:

- Groundwater elevations within the slurry wall remain below the trigger elevations, indicating that groundwater is not in contact with the landfill contents.

- Shallow groundwater is minimally impacted by contamination, although cadmium concentrations in well MW-1302B have increased to levels greater than the MCL over the last few years.
- In deep groundwater within the landfill, vinyl chloride was detected in excess of screening levels as defined in the QAPP (Tetra Tech, 2015b). Based on concentrations in deep downgradient wells, vinyl chloride is migrating downgradient of the landfill (at very low concentrations) but is not migrating off site (i.e., outside of the site boundary).
- Other VOCs and pesticides are not migrating from the landfill (i.e., the capped landfill footprint) at levels of concern, as indicated by groundwater, sediment, and leachate seep sampling data.
- In deep groundwater, 2019 arsenic concentrations exceeded screening levels and background values in two wells (MW-218 and MW-1&3-1303A). Historical data indicate decreasing arsenic concentrations over time.
- Groundwater samples from shallow wells MW-1&3-1301B, MW-1&3-1303B, MW-202A, MW-203, MW-204, and MW-240 and deep well MW-219 have not exceeded MCLs since 2013.
- Upstream and downstream surface water and sediment sampling data are generally similar, indicating no significant impacts from Sites 1 and 3.
- In leachate seep samples, no VOCs or pesticides have been detected in excess of RBESVs for at least the past 5 years (EA, 2006). Concentrations of several metals exceed RBESVs. Barium, iron, and manganese concentrations exceeded RBESVs in all 2019 leachate seep samples.
- In leachate sediment samples, several metals were detected in excess of RBESVs. Barium and cobalt concentrations exceeded RBESVs in all 2019 leachate sediment samples.

## 2.6.2 Site Inspections

Site inspections are conducted during each long-term monitoring sampling event in the fall of each year. The most recent LTM event was completed in October 2019. In addition, the annual LUC inspection was conducted at Sites 1 and 3 on September 20, 2019. Photographs taken during this inspection are included in Appendix A. The results of the inspections conducted during monitoring events are documented in the monitoring event reports generated for each LTM event. Minor maintenance issues

were noted during the landfill inspection in October 2019, as discussed in the associated LTM report (Tetra Tech, 2020). None of these issues affect the protectiveness of the remedy, and no remedy protectiveness issues were noted during the 2019 LUC inspection. Based on the results of these inspections, the Sites 1 and 3 remedy is functioning as intended and remains protective.

### **2.6.3 Interviews**

The Navy holds regular Restoration Advisory Board (RAB) meetings for former NAS Brunswick to discuss the process of the cleanup program, ongoing investigations, Navy property transfer actions, and/or site status. Interview questionnaires were emailed to 11 potential interviewees, and four completed questionnaires were returned. The list of interviewees and returned questionnaires are included in Appendix C. No concerns related to remedy protectiveness at any of the sites were included in the responses, although general incidences of vandalism at Brunswick Landing were mentioned. The findings of this fifth five-year review will be presented at a future RAB meeting after finalization of this report in September 2020.

## **2.7 Technical Assessment**

### **2.7.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?**

The review of documents, risk assumptions, and results of the site inspection indicate that the Sites 1 and 3 remedy is functioning as intended by the 1992 ROD, 1994 ESD, and 2015 multi-site LUC ESD. The cap and slurry wall were installed as designed and continue to meet performance objectives, and the groundwater extraction wells successfully dewatered the landfill materials, as verified by monitoring well gauging. The cap and slurry wall continue to be effective in reducing the generation and migration of contaminated groundwater and leachate. Implementation of LUCs to prevent groundwater use and exposure to landfill waste/contaminated soil provides protection of human health and the environment while concentrations of contaminants remain in excess of cleanup levels. Construction of the cap extension ensures that the landfill cap extends over all areas of waste, facilitating effective implementation of LUCs in the area that previously had base-related access restrictions.

The remedial actions are being implemented as designed and include measures that prevent exposure. The remedial actions that have been completed (slurry wall and cap installation and extension; groundwater extraction, treatment, and discharge; and LUCs)

and actions that are ongoing (LTM) operated/are operating as designed, and the data indicate progress toward meeting the RAOs. Based on the completed and ongoing activities, the intent and goals of the Sites 1 and 3 ROD have been or will be met.

## **2.7.2 Question B: Are the Assumptions, Toxicity Data, Cleanup Values, and RAOs Used at the Time of the Remedy Selection Still Valid?**

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. The change in site conditions associated with the closing of the base was addressed via the LUC ESD, as described above. In addition, the LUC RD for Sites 1 and 3 (included as an appendix to the Base-Wide LUCIP) includes provisions that LUCs be incorporated into any future leases or property transfer documents and that EPA and MEDEP be notified of any transfer actions. According to the Brunswick Naval Air Station Reuse Master Plan (Matrix Design Group, 2007), planned future use of the Sites 1 and 3 area is non-residential (business and technology industries). The Base-Wide LUCIP is also in the process of being revised and will include the Brunswick Landing Construction Permission Request process as one of the LUC implementing actions.

### **2.7.2.1 ARAR and Site-Specific Action Level Changes**

New standards should be considered during the five-year review process as part of the protectiveness determination. Under the NCP, if a new requirement is promulgated after the ROD is signed, and the requirement is determined to be an ARAR, the new requirement must be attained only if necessary to ensure that the remedy is protective of human health and the environment. The ARAR evaluation did not identify any changes that would call into question the protectiveness of the remedy.

Groundwater cleanup goals for Sites 1 and 3, as documented in the ROD, were based on federal MCLs (except lead, which was based on the federal Action Level). The only change to the MCLs for groundwater constituents with cleanup goals was the reduction in the arsenic MCL from 50 µg/L to 10 µg/L, which became effective in January 2006 (during the second five-year review period). Although human exposure to Sites 1 and 3 groundwater is restricted within the Sites 1, 2, 3, and Eastern Plume GMZ, and arsenic concentrations do not exceed the current MCL beyond the GMZ, Sites 1 and 3 groundwater will need to attain the 10 µg/L level for the groundwater RAOs to be satisfied. For this reason, it is recommended that an ESD be issued to revise the arsenic groundwater cleanup goal to 10 µg/L. The only potential impact to the remedy implementation is that additional time may be required for groundwater to meet the revised cleanup goal.

## **2.7.2.2 *Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods***

There have been no changes in physical conditions, exposure pathways, or land use that would affect the protectiveness of the Site 1 and 3 remedy.

In 2014, EPA finalized a Directive to determine groundwater exposure point concentrations (EPCs) (<https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236917>). This Directive provides recommendations to develop groundwater EPCs. The recommendations to calculate the 95-percent upper confidence limit (UCL) of the arithmetic mean concentration for each contaminant from wells within the core/center of the plume, using the statistical software ProUCL, could result in lower groundwater EPCs than the maximum concentrations routinely used for EPCs as past practice in risk assessment, leading to changes in groundwater risk screening and evaluation. In general, this approach could result in slightly lower risk or higher screening levels. (EPA. 2014).

In 2014, EPA finalized a Directive to update standard default exposure factors and frequently asked questions associated with these updates. [https://www.epa.gov/sites/production/files/2015-11/documents/oswer\\_directive\\_9200.1-120\\_exposurefactors\\_corrected2.pdf](https://www.epa.gov/sites/production/files/2015-11/documents/oswer_directive_9200.1-120_exposurefactors_corrected2.pdf). Many of these exposure factors differ from those used in the risk assessment supporting the ROD. These changes in general would result in a slight decrease of the risk estimates for most chemicals (EPA. 2014). Although calculated risks from potential exposure pathways at former NAS Brunswick sites may differ from those previously estimated, slightly higher for some contaminants and slightly lower for others, the revised methodologies themselves are not expected to affect the overall protectiveness of the remedy. In addition, these risk assessment methodology changes are not expected to affect the protectiveness of the remedy because the Sites 1 and 3 groundwater cleanup goals are based on promulgated standards (MCLs) rather than calculated risk-derived concentrations. A review of site information identifies that these updates do not call into question the protectiveness of the remedy.

In February 2018, EPA launched an online Vapor Intrusion Screening Level (VISL) calculator (<https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator>) that can be used to obtain risk-based screening level concentrations for groundwater, sub-slab soil gas, and indoor air. The VISL calculator uses the same database as the Regional Screening Levels (RSLs) for toxicity values and physiochemical parameters and is automatically updated during the semi-annual RSL updates. As discussed in the Fourth Five-Year Review Report, vapor intrusion was not addressed as a potential pathway during previous Sites 1 and 3 investigations, although VOCs were detected in several media, including groundwater. Because site conditions

have not changed since the human health risk assessment (i.e., sites are still inactive with no structures present), evaluation of this potential pathway continues to be unnecessary. Additionally, vapor intrusion considerations were incorporated into the clarified LUC objectives for Sites 1 and 3, as documented in the 2015 LUC ESD, and associated LUCs to address potential vapor intrusion issues in potential future habitable structures built on site are included in the LUC RD.

The exposure assumptions used are considered to be conservative and reasonable in evaluating risk and developing risk-based cleanup levels. Furthermore, changes in risk assessment methods do not affect the protectiveness of the Sites 1 and 3 remedy because exposure to landfill materials and impacted groundwater is prevented by construction and maintenance of the landfill cover system and implementation of LUCs. No changes to these assumptions or the cleanup levels developed from them is warranted. There have been no changes to the standardized risk assessment methodology, other than those noted above, that could affect the protectiveness of the remedy.

### **2.7.3 Question C: Has any other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?**

No additional human health or ecological risks have been identified, and no weather-related events have affected the protectiveness of the remedy. No other information has been identified that calls into question the protectiveness of the remedy.

### **2.7.4 Technical Assessment Summary**

Based on the data reviewed and the site inspection, the remedy is functioning as intended by the 1992 ROD as modified by the 1994 and 2015 ESDs. There have been no changes in the physical conditions at the sites, toxicity factors for the COCs, or to the standardized risk assessment methodology that would affect the protectiveness of the remedy. Issues related to the change in land use associated with closure of the base have been addressed via the LUC ESD and LUC RD. There is no other information that calls into question the protectiveness of the remedy.

## **2.8 Issues**

No deficiencies were identified during this five-year review of the Sites 1 and 3 remedy, and no issues related to site operations, conditions, or activities prevent the remedy from being protective at this time or in the future.

## 2.9 Recommendations and Follow-Up Actions

Because no issues affecting the protectiveness of the remedy were identified, there are no recommendations for Sites 1 and 3, and no follow-up actions are required.

Human exposure to Sites 1 and 3 groundwater is restricted within the Sites 1, 2, 3, and Eastern Plume GMZ and arsenic concentrations do not exceed the current MCL beyond the GMZ. However, Sites 1 and 3 groundwater will need to attain the 10 µg/L level for the groundwater RAOs to be satisfied. For this reason, it is recommended that an ESD be issued to revise the arsenic groundwater cleanup goal to 10 µg/L. This recommendation does not affect the protectiveness determination for the site but is associated with ensuring continued protectiveness.

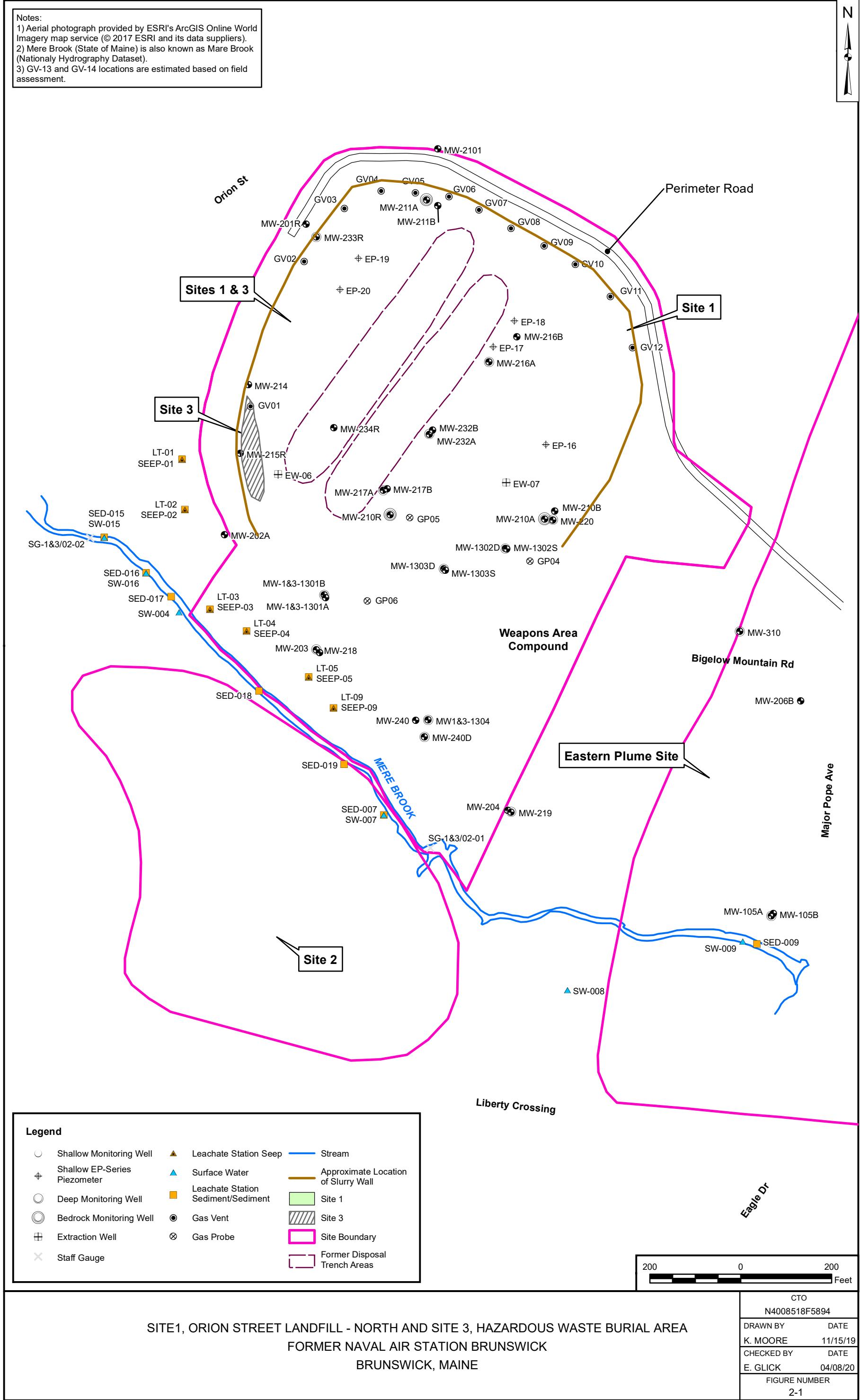
## 2.10 Protectiveness Statement

Protectiveness Statement(s)		
Operable Unit:	Protectiveness Determination:	Planned Completion Date:
OU1, Sites 1 and 3	Protective	
<p><b>Protectiveness Statement:</b> The remedy implemented at Sites 1 and 3 is protective of human health and the environment. Exposure to groundwater, which could result in unacceptable risks if groundwater was used for potable purposes, is prevented through maintenance of LUCs at the site. Short-term operation of the groundwater extraction system was successful in dewatering landfill wastes below the water table, thus mitigating this impacted groundwater from migrating to Mere Brook via direct discharge and leachate seeps. Construction of the cap and slurry wall, extension of the cap, short-term operation of the groundwater extraction system, and groundwater monitoring provide a degree of protection of human health and the environment, and LUCs provides a significant degree of protection until completion of the remedy is achieved to provide full protectiveness. The results of future LTM will be used to continue to evaluate the effectiveness of the remedy and to assess potential contaminant migration. The remedial actions have been implemented as designed and include measures that prevent exposure, and the remedial actions that are completed (cap and slurry wall construction, completed short-term groundwater extraction, and LUCs) and ongoing (LTM) are operating as designed. Long-term protectiveness of the remedy will continue to be verified by continued monitoring in accordance with the Base-Wide QAPP and through LUC inspections conducted in accordance with the LUC RD to ensure continued maintenance of LUCs. Based on the activities that are completed and ongoing, the intent and goals of the Sites 1 and 3 ROD have been or will be met.</p>		

Notes:

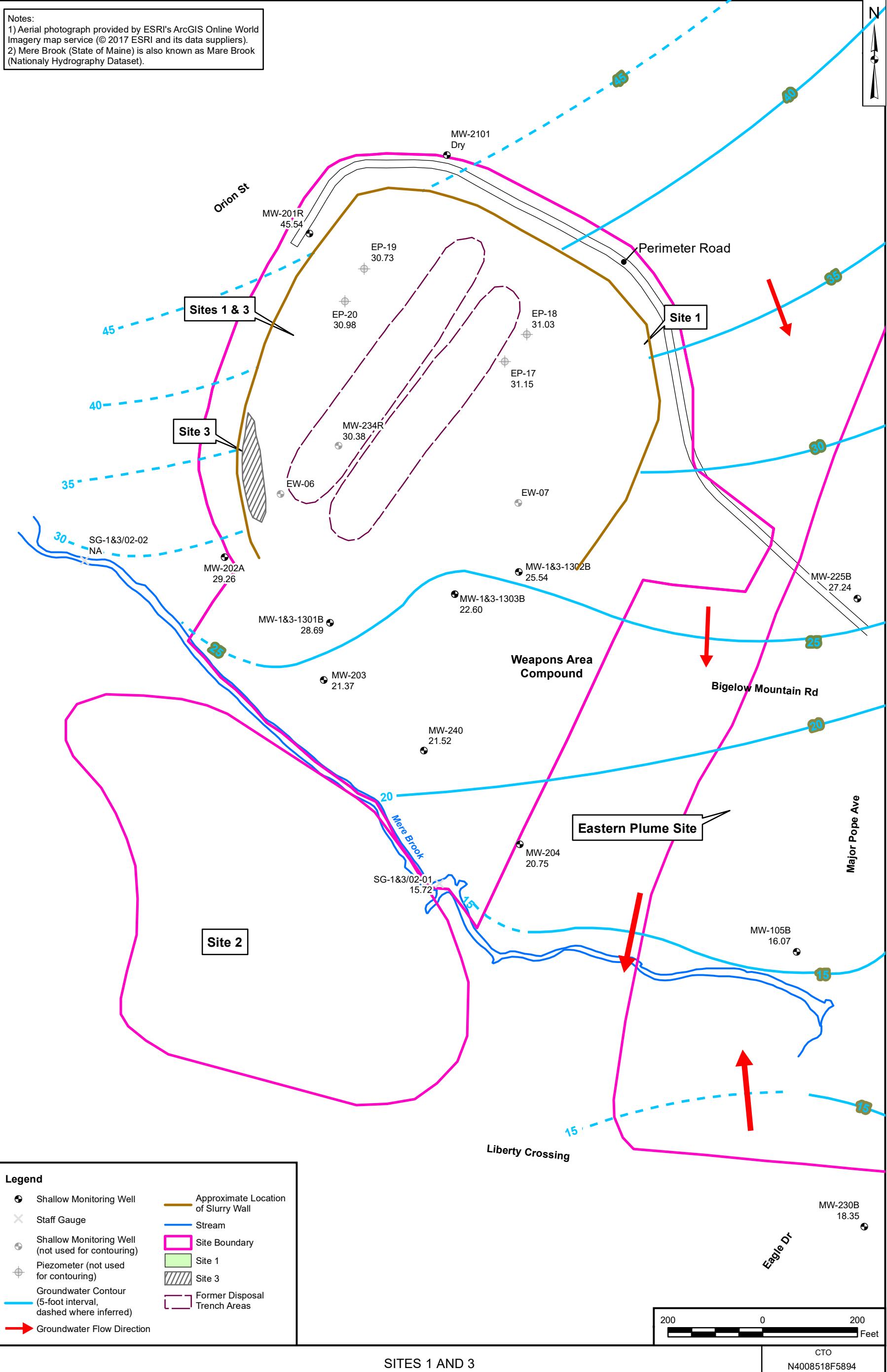
- 1) Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2017 ESRI and its data suppliers).
- 2) Mere Brook (State of Maine) is also known as Mare Brook (National Hydrography Dataset).
- 3) GV-13 and GV-14 locations are estimated based on field assessment.

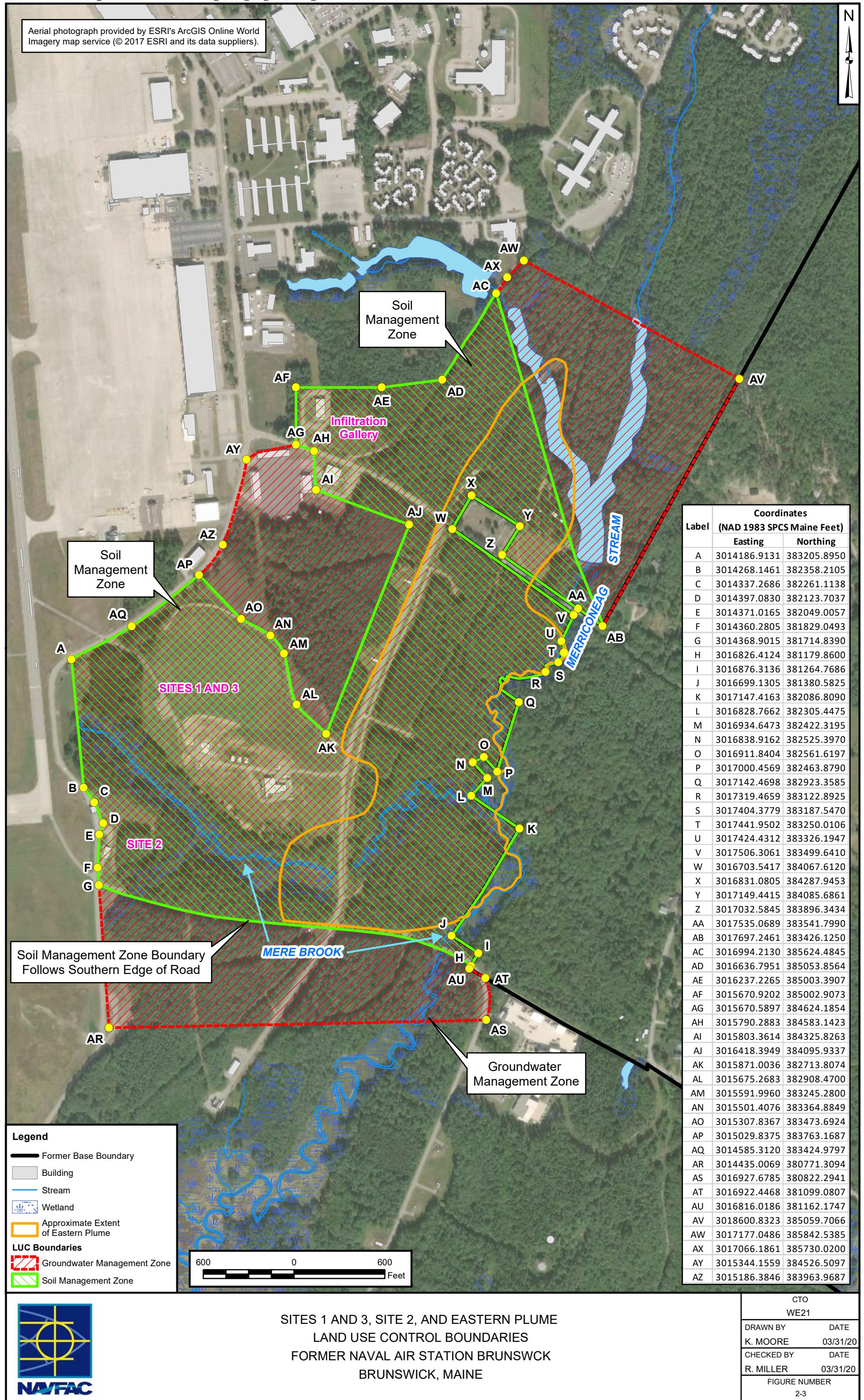
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Notes:  
 1) Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2017 ESRI and its data suppliers).  
 2) Mere Brook (State of Maine) is also known as Mare Brook (Nationally Hydrography Dataset).

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## 3.0 OU7, Site 2, Orion Street Landfill – South

### 3.1 Introduction

Site 2, Orion Street Landfill – South, is a former borrow pit and inactive landfill located within a formerly restricted area in the central portion of NAS Brunswick adjacent to Mere Brook and south of Sites 1 and 3 near the southern end of the main runways (see Figure 2-2). The site was used as the primary base landfill from 1945 until 1955, although it may have been in actual operation for less than 10 years because NAS Brunswick was closed from 1946 to 1951. The base was occupied by non-military tenants from 1946 to 1951, and it is unknown if the landfill was used during that period of time. An incinerator once located at Site 2 was reportedly used to burn solid waste; therefore, a substantial component of the disposed material was assumed to be ash. Miscellaneous refuse once exposed along the eastern side of the landfill, including drums, small containers, office furniture, and domestic wastes, were removed from the site in 1999. Other waste reportedly disposed of in the landfill included solvents, paint, oil, toluene, methyl ethyl ketone, and medical supplies. Based on investigations conducted in 2008 and 2011/2012, additional areas adjacent to Site 2 to the north and northwest also contain landfilled materials such as broken concrete, glass, asphalt, and scrap metal, and a smaller portion of the northern area was also found to contain incinerator ash. The quantities of wastes, including hazardous materials, disposed of at Site 2 and the area north of Site 2 are unknown.

### 3.2 Site Chronology

A list of important Site 2 historical events and relevant dates in the site chronology is shown below. The identified events are illustrative, not comprehensive. Further information about activities and actions at the site can be found in the Administrative Record available as part of the Information Repository at the Curtis Memorial Library, 23 Pleasant Street, Brunswick, Maine, 04011-2261.

Event	Date
Base-Wide Preliminary Assessment	December 1982
Base-Wide IAS	June 1983
Base-Wide Site Inspection	August 1984
Pollution Abatement Confirmation Study	June 1985
Draft Final RI Report	August 1990

Event	Date
FS for Sites 2, 4, 7, 9, 11, and 13	March 1992
United States Fish and Wildlife Service (USFWS) fish sampling in Mere Brook near Site 2	Summer 1995
Site 2 ROD signed	September 1998
Removal of exposed debris and stabilization of landfill face	August 1999
Site 2 LTMP	February 2000
First Five-Year Review Report signed	March 2000
Operating Instruction NASBINST 5090.1B issued	31 December 2000
Second Five-Year Review Signed	4 October 2005
Revised Screening Values for Surface Water, Seep Water and Sediment document finalized	January 2006
Operating Instruction NASBINST 5090.1C issued	5 March 2008
EPA issues Fish Study Report for Mere Brook	November 2008
Site Investigation activities to evaluate an adjacent area north of Site 2 that included an incinerator and possible additional landfill area	September to December 2008
Site Investigation Report, Revision 1	March 2011
LTM Optimization Report for Sites 1, 3, 2, 7, and 9	February 2015
Technical Memorandum, Data Gap Investigations for Sites 1 and 3, Site 2, and Site 7	June 2013
LUC ESD for Sites 1 and 3, 2, 4, 7, 9, and the Eastern Plume	April 2015
Base-Wide QAPP for the LTM Program, 2015 Revision	August 2015
Base-Wide LUCIP, including the combined LUC RD for Sites 1 and 3, Site 2, and Eastern Plume	September 2016
Soil cover and fence extension	2015 and 2016
Draft 2020 Update to Base-Wide LUCIP/LUC RDs	2020
LTM	April 2000 to present

### 3.3 Background

#### 3.3.1 Physical Characteristics

Site 2 occupies approximately 2 acres on Orion Street in a previously restricted area in the central portion of NAS Brunswick, near the southern end of the main runways. When the landfill closed in 1955, the site was covered with soil that supported a dense stand of conifers, and the face of the landfill was vegetated with tall meadow grass. Shallow groundwater from Site 2 and the Area North of Site 2 discharges to Mere Brook and to seeps along a steep embankment on the western side of Mere Brook.

Fill and ash/suspected ash layers at Site 2 and in the Area North of Site 2 are underlain by the Upper Sand, Transition Unit, and Presumpscot clay geologic units that make up

a significant portion of the unconsolidated deposits found at the former NAS Brunswick. The Upper Sand consists of fine to medium sand with varying amounts of silt and ranges in thickness from approximately 6 to 27 feet, and the Transition Unit includes fine sand and silt with interbedded clay and ranges in thickness from 5 to 19 feet. The depth to the Presumpscot clay is relatively shallow in the area, and this unit, which consists of clay with lenses of fine sand and/or silt, slopes steeply to the east. The top of the clay unit defines the bottom of the unconfined aquifer at the site, and groundwater flow above this unit in the area of Site 2/Area North of Site 2 is to the east and northeast discharging to Mere Brook. Figure 3-2 is a shallow groundwater contour map based on data from the October 2019 monitoring event at Site 2.

### **3.3.2 Land and Resource Use**

Site 2 is currently owned by the Navy and is currently inactive, and no structures are located within the site boundaries. The majority of potable water that was used and continues to be used at the former base is supplied by the Brunswick/Topsham Water District municipal water supply. Two water supply wells, the Dyer's Gate bedrock well and golf course well, were located within the boundaries of the former base. The Dyer's Gate well, located approximately 240 to 300 feet from the center of the Site 2 landfill, was abandoned in 2013 in accordance with state requirements (H&S Environmental, Inc., 2013). This well supplied non-potable water for the few workers at the nearby guardhouse (ATSDR, 2005). Because of the limited number of people it supplied, it was not regulated by the Maine Drinking Water Program; however, it was sampled as part of the Site 2 LTM program until September 2009, and no concentrations of concern were detected.

The golf course well (PWS ID94492101) is located at the golf course clubhouse (former Building 78) within the boundaries of the golf course in the southwestern portion of the base and approximately 0.5 mile southwest and not hydraulically downgradient of Site 2. This well previously supplied water to a former farmhouse in the area acquired by the Navy in the late 1940s or early 1950s and was used by the Navy to supply water to visitors to the golf course (ATSDR, 2005). The area including this well was transferred to the MRRA in 2012. Continued use of the well for the same purpose as when it was under Navy control is permitted, but in accordance with the deed associated with the property transfer, increased water withdrawal for other uses, including expansion of the golf course, golf course clubhouse, and/or restaurant areas, must be approved by the Navy and applicable regulatory authorities.

Mere Brook, north-northeast of Site 2, receives drainage from the runways to the northwest and runoff and leachate from the Sites 1, 2, and 3 landfills. Mere Brook flows

into the Atlantic Ocean at Harpswell Cove, which is designated as a potential aquaculture area by the State of Maine and which supports various commercially important fish and shellfish species (U.S. Navy, 1994).

### **3.3.3 History of Contamination**

Historical records indicate that the Site 2 landfill was used from 1945 to 1955 for materials including solvents, paint, oil, toluene, methyl ethyl ketone, and medical supplies. Items such as drums, small containers, office furniture, and domestic wastes were removed from the eastern side of the landfill in 1999. An incinerator at the site was reportedly used to burn solid waste, possibly from 1959 to 1965, based on information from aerial photographs. Quantities of hazardous materials disposed of at Site 2 are unknown.

### **3.3.4 Initial Response and Basis for Taking Action**

The 1983 base-wide IAS recommended further investigation of Site 2 based on disposal of hazardous wastes and because migration pathways to surface water and groundwater were identified. Further investigation of Site 2 was also recommended after completion of the Site Inspection and Pollution Abatement Confirmation Study (NUS Corporation, 1983b; E.C. Jordan, 1985).

Environmental contamination attributable to Site 2, mainly metals and low levels of pesticides and PAHs, has been detected in leachate and sediment associated with seeps and in stream surface water and sediment (E.C. Jordan, 1990). These contaminants are consistent with historical land use and disposal of incinerated wastes at this site. The greatest levels of contamination observed at Site 2 were detected in leachate seeps. Various metals were detected in leachate and sediment samples, including iron and mercury at concentrations most elevated relative to background values available at the time of the RI. Low levels of DDT were detected in leachate and adjacent surface soil samples.

Although elevated levels of contaminants were detected, concentrations in soil, groundwater, surface water, sediment, and leachate were determined not to pose human health risks in exceedance of either the EPA target carcinogenic risk range of  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$  or the MEDEP cumulative cancer risk guidance level of  $1 \times 10^{-5}$  for the hypothetical future residential use scenario evaluated in the risk assessment. Non-carcinogenic hazards were also significantly less than the target Hazard Index (HI) of 1.0 for all potential exposures evaluated (E.C. Jordan, 1990).

Significant ecological risks were not identified in the ecological risk assessment conducted as part of the RI (E.C. Jordan, 1990) or in the base-wide baseline risk assessment completed in 1992 (E.C. Jordan, 1992). In 1995, USFWS conducted a study to determine concentrations of metals and pesticides in fish samples collected from Mere Brook near Site 2 (1997). No adverse effects were identified resulting from metals contamination related to Site 2. Elevated concentrations of some pesticide-related compounds were detected, but the source of these compounds was not determined as a part of this study.

## **3.4 Remedial Actions**

### **3.4.1 Remedy Selection**

The Navy determined that Minimal Action was appropriate for Site 2 because concentrations of organics and inorganics in soil, groundwater, surface water, sediment, and leachate were determined not to pose unacceptable human health or ecological risks. Based on the lack of unacceptable risks, no RAOs were identified for Site 2 in the ROD.

Components of the selected alternative for Site 2 include the following:

- Institutional controls including maintenance of the existing fence, installation of warning signs, and land use restrictions.
- Removal of surface debris visible on the depression immediately south and east of the landfill.
- Installation of a groundwater monitoring well to provide additional downgradient data.
- Environmental monitoring, including collection and analysis of samples of groundwater, seeps, surface water, and sediment.
- Five-year site reviews.
- Modifications to the selected remedy, if necessary.

The selected remedy was determined to be protective of human health and the environment, to attain ARARs, and to be cost effective.

As stated in the Third Five-Year Review Report, the “Minimal Action” remedy chosen for Site 2 in the 1998 ROD is analogous to a presumptive landfill remedy, for which inherent risks associated with landfill material are assumed to be present, and the intent of the remedy is to prevent exposure to and minimize migration from the landfill area to adjacent areas. Although no unacceptable risks were identified, it is assumed that exposure to waste materials would be associated with unacceptable risk, and it is based on that presumed risk that protection of human health and the environment is assessed for Site 2 in this five-year review.

### **3.4.2 Remedy Implementation**

#### **LUCs**

Land use restrictions at Site 2 were initially implemented via the NAS Brunswick Instruction 5090.1B (replaced in 2008 by version 5090.1C), and the LUC component of the remedy for Site 2 was modified as documented in the 2015 multi-site ESD to clarify the LUC objectives in light of base closure. Based on the proximity of Sites 1 and 3, Site 2, and the Eastern Plume, their LUC boundaries were combined, with groundwater restrictions across the entire combined area, referred to as the GMZ, and soil restrictions as required in a separate SMZ (see Figure 2-3). The LUC performance objectives for Site 2, as documented in the multi-site LUC ESD and 2016 Base-Wide LUCIP, are as follows:

- Prevent uncontrolled human exposure to and/or use of contaminated groundwater within the groundwater management zone.
- Prevent unacceptable human exposure to volatile vapors potentially migrating from contaminated groundwater to the indoor air of future habitable structures within the groundwater management zone.
- Prevent changes in hydrology within the groundwater management zone that have the potential to negatively impact the nature and extent of delineated groundwater contamination.
- Manage future construction activities within the soil and groundwater management zones to prevent uncontrolled human exposure and/or transport/migration of contaminated soil and groundwater.
- Prevent uncontrolled human exposure to and/or use of surface and subsurface soils within the soil management zone.

- Protect the integrity and operation of the soil cover and remediation and monitoring systems within soil and groundwater management zones.

The LUCs required to achieve these performance objectives for the soil and groundwater management zones, as provided in the LUC RD for Sites 1, 2, 3, and Eastern Plume are as follows:

### **Soil Management Zone**

- Prohibit residential use of the soil management zone unless prior written approval is obtained from the Navy, EPA, and MEDEP. Prohibited residential uses shall include, but are not limited to, any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent or nursing care facilities.
- Prohibit soil excavation/disturbance or any construction activities not associated with monitoring, maintenance, or other necessary remedial actions within the soil management zone to protect the landfill cover.
- Protect the integrity of all current and future remedial systems/components in the soil management zone, including maintaining the soil cover, warning signs, and fencing. Based on this restriction, any use or activity that would interfere with the implementation or effectiveness of the remedy is prohibited.

### **Groundwater Management Zone**

- Prohibit all uses of groundwater underlying the groundwater management zone unless prior written approval is obtained from the Navy, EPA, and MEDEP.
- Protect the integrity of all current and future remedial systems/components within the groundwater management zone. Based on this restriction, any use or activity that would interfere with the implementation or effectiveness of the remedy is prohibited.
- Prohibit construction of habitable structures in the groundwater management zone without evaluation and potential mitigation of vapor intrusion and unless prior written approval is obtained from the Navy, EPA, and MEDEP.

These LUCs were implemented upon finalization of the LUC RD, which is included as an appendix to the Base-Wide LUCIP, and the LUCs will be monitored, maintained, enforced, and reported on in accordance with provisions in the LUC RD. The LUC RD also documents the requirements for continuation of the LUCs if all or part of the Site 2 property is transferred out of Navy ownership. Any future construction activities will also

require the property owner to submit a Brunswick Landing Construction Permission Request Form to the Navy for approval before the Town of Brunswick will approve a construction permit. The Brunswick Landing Construction Permission Request process is in place and functioning as intended to prevent/minimize uncontrolled human exposure during construction activities that could potentially result in unacceptable risks posed by site contaminants. The Base-Wide LUCIP is in the process of being revised and will include the Construction Permission Request process as one of the LUC implementing actions.

In August 1999, the Navy removed and disposed of miscellaneous surface debris located south and east of the Site 2 landfill and placed a soil cover on the previously uncovered portions of the former landfill. The miscellaneous surface debris (crushed empty drums, chairs, and miscellaneous metal debris) was removed and placed in roll-off containers for off-base disposal. The soil cover, consisting of 12 inches of common fill and 3 inches of topsoil, is designed to prevent direct contact with the material remaining in the landfill but is not an impermeable cover system. Signs installed as part of the remedy and existing fencing were used to limit access to the Site 2 area.

Groundwater monitoring well MW-NASB-24I was installed at the site on 22 June 2000 as required by the ROD.

Based on the identification during post-ROD investigations of debris in areas north and west of the original area considered Site 2, an expansion of the existing soil cover and fence was conducted in 2015 and 2016 to encompass the additional areas with debris. In addition, LUCs have been implemented over the expanded area within which debris has been identified. Expansion of the soil cover, fence, and LUCs to encompass the expanded area now prevent exposure to waste in all areas within the expanded site boundary, thus extending the existing remedy to all required areas of the site.

### **LTM**

Environmental monitoring was initiated in April 2000, and as of fall 2019, 35 LTM events have been completed at Site 2. An LTM Optimization Report for Sites 1 and 3, Site 2, Site 7, and Site 9 was finalized in February 2015 (Tetra Tech, 2015a) presenting optimization recommendations for LTM at these sites, and monitoring is currently being conducted in accordance with the August 2015 Base-Wide QAPP for the LTM Program based on the approved recommendations in the final LTM Optimization Report.

### **3.4.3 System Operation/Operation and Maintenance**

The Navy is conducting LTM and maintenance in accordance with the Base-Wide QAPP for the LTM Program (Tetra Tech, 2015b). The monitoring program currently consists of annual sampling of six groundwater monitoring wells (MW-104, MW-2-304, MW-2-305, MW-2-309, MW-2-310, and MW-2-311), one surface water location (SW-07), one sediment location (SED-18), and one leachate seep and co-located leachate sediment location (LT-201). All samples are analyzed for metals, and the sediment sample is also analyzed for pesticides. In addition, 16 wells and two stream gauges are gauged annually. Every 5 years, three additional wells (total of 11) are sampled and analyzed for metals to confirm contaminant concentration distributions. The five-year sampling event for Site 2 was conducted in fall 2018.

The following O&M activities are also completed during each LTM event:

- Visual inspection of the cover with regard to erosion and differential settlement
- Inspection for animal burrows in the cover
- Inspection for stressed vegetation
- Inspection for seeps and shallow seep sampling piezometers
- Inspection of the condition of groundwater monitoring wells
- Verification of no change of land use or new construction in the area
- Inspection of the condition of equipment such as wells and signage

The visual inspections are completed during each monitoring event, and the results are documented in each monitoring event report. The most recent LTM event was conducted in October 2019.

## **3.5 Progress Since the Last Five-Year Review**

No non-compliance issues were identified during the fourth five-year review of the remedial action for Site 2; no RAOs were identified in the ROD due to the lack of identified unacceptable risks. The review found that the selected remedy at Site 2 was protective of human health and the environment and was functioning as designed. Soil cover extension activities completed at Site 2 since the last five-year review are summarized in Section 3.4.2, and LTM activities are discussed in Section 3.6.1.

## **3.6 Five-Year Review Process**

### **3.6.1 Document and Analytical Data Review**

Documents reviewed as part of this five-year review are referenced throughout the text and are included by site in the reference section (Section 10). Information in this subsection summarizing the results of LTM are based on semi-annual Site 2 LTM reports.

Monitoring was initiated in April 2000 at Site 2, and as of fall 2019, 35 LTM events have been completed at Site 2. LTM data are compared to federal MCLs, State of Maine MEGs, and derived RBESVs established in 2006 (EA, 2006) (see Section 2.6.1).

Data from the Site 2 LTM program indicate that metals concentrations in groundwater, seep leachate and sediment, and surface water and sediment from Mere Brook remain stable. Based on both historical and 2019 monitoring results, the conclusions for the Site 2 LTM program are as follows:

- Arsenic concentrations exceeded the MCL in upgradient well MW-02-310 and downgradient wells MW-243 and MW-02-309 but were similar to the background level established for NAS Brunswick (Tetra Tech, 2012).
- Groundwater concentrations at MW-103, MW-104, MW-2-304, MW-2-311 have not exceeded MCLs or construction worker RAGs for at least 3 consecutive years.
- The most recent chromium MCL exceedance at the site was in September 2004. Thus, chromium concentrations are no longer a concern in groundwater at Site 2.
- Surface water collected from downstream location SW-07 (shared sampling location with Sites 1 & 3) had metals concentrations similar to the upstream SW-15 sampling location for Sites 1 & 3. Consistent with recent MEs in 2015 to 2018, barium and manganese concentrations exceeded criteria at SW-07; however, concentrations were less than background surface water upper protection limits (UPLs) for Mere Brook (as established in the 2012 Background Study Report), indicating that they may represent background concentrations.
- Concentrations of barium exceeded criteria in sediment at SED-18. Metals concentrations are consistent with historical MEs. Barium results were less than the background sediment UPL for Mere Brook.

- Leachate sediment collected at LT-201 contained antimony, barium, beryllium, lead, mercury, and selenium at concentrations exceeding associated RBESVs.
- Leachate seep water collected at SEEP-201 contained concentrations of barium, beryllium, copper, iron, manganese, and silver exceeding associated RBESVs. With the exception of the 2018 monitoring event increase in metals concentrations, particularly cadmium, metals concentrations have been relatively consistent over the past 5 years.

### **3.6.2 Site Inspections**

Site inspections are conducted during each long-term monitoring sampling event in the fall of each year. The most recent LTM event was completed in October 2019. In addition, the annual LUC inspection was conducted at Site 2 on September 20, 2019. Photographs taken during this inspection are included in Appendix A. The results of the inspections conducted during monitoring events are documented in the monitoring event reports generated for each LTM event. Minor maintenance issues were noted during the landfill inspection in October 2019, as discussed in the associated LTM report (Tetra Tech, 2020). None of these issues affect the protectiveness of the remedy, and no remedy protectiveness issues were noted during the 2019 LUC inspection. Based on the results of these inspections, the Site 2 remedy is functioning as intended and remains protective.

### **3.6.3 Interviews**

The Navy holds regular Restoration Advisory Board (RAB) meetings for former NAS Brunswick to discuss the process of the cleanup program, ongoing investigations, Navy property transfer actions, and/or site status. Interview questionnaires were emailed to 11 potential interviewees, and four completed questionnaires were returned. The list of interviewees and returned questionnaires are included in Appendix C. No concerns related to remedy protectiveness at any of the sites were included in the responses, although general incidences of vandalism at Brunswick Landing were mentioned. The findings of this fifth five-year review will be presented at a future RAB meeting after finalization of this report in September 2020.

## 3.7 Technical Assessment

### 3.7.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?

The review of documents, risk assumptions, and results of the site inspection indicate that the Site 2 remedy is functioning as intended in the 1998 ROD and 2014 multi-site LUC ESD. Implementation of LUCs to prevent exposure to landfill contents and associated soil and groundwater provides protection of human health and the environment while concentrations of contaminants remain in excess of cleanup levels. Expansion of the soil cover, installation of signage identifying Site 2 as a closed landfill, and extending fencing over the entire landfill area prevent human exposure to subsurface landfill materials and ensures continued protectiveness. The results of the ongoing LTM program are used to provide information on potential contaminant migration.

The remedial actions are being implemented as designed and include measures that prevent exposure. The remedial actions that have been completed (soil cover installation and extension and LUCs) and actions that are ongoing (LTM) are operating as designed. Based on the completed and ongoing activities, the intent and goals of the Site 2 ROD have been met.

### 3.7.2 Question B: Are the Assumptions, Toxicity Data, Cleanup Values, and RAOs Used at the Time of the Remedy Selection Still Valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. Based on the delineation of waste at the site during the Site Investigation and data gap investigation, the expanded site area, encompassed by an expanded fence and expanded soil cover, was included within the expanded LUC boundary. The change in site conditions associated with the closing of the base was addressed via the LUC ESD, as described above. In addition, the LUC RD for Site 2 (included as an appendix to the Base-Wide LUCIP) includes provisions that LUCs be incorporated into any future leases or property transfer documents and that EPA and MEDEP be notified of any transfer actions. According to the Brunswick Naval Air Station Reuse Master Plan (Matrix Design Group, 2007), planned future use of Site 2 is commercial/industrial (business and technology industries) and open space (natural area). The Base-Wide LUCIP is also in the process of being revised and will include the Brunswick Landing Construction Permission Request process as one of the LUC implementing actions.

### **3.7.2.1 ARAR and Site-Specific Action Level Changes**

No environmental media cleanup goals were established in the Site 2 ROD because no unacceptable site risks were identified in the risk assessment completed for the site. Therefore, there are no impacts to remedy protectiveness from any changes in ARARs.

### **3.7.2.2 Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods**

There have been no changes in physical conditions, exposure pathways, or land use that would affect the protectiveness of the Site 2 remedy.

In 2014, EPA finalized a Directive to determine groundwater exposure point concentrations (EPCs) (<https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236917>). This Directive provides recommendations to develop groundwater EPCs. The recommendations to calculate the 95-percent upper confidence limit (UCL) of the arithmetic mean concentration for each contaminant from wells within the core/center of the plume, using the statistical software ProUCL, could result in lower groundwater EPCs than the maximum concentrations routinely used for EPCs as past practice in risk assessment, leading to changes in groundwater risk screening and evaluation. In general, this approach could result in slightly lower risk or higher screening levels. (EPA. 2014).

Also in 2014, EPA finalized a Directive to update standard default exposure factors and frequently asked questions associated with these updates. [https://www.epa.gov/sites/production/files/2015-11/documents/oswer\\_directive\\_9200.1-120\\_exposurefactors\\_corrected2.pdf](https://www.epa.gov/sites/production/files/2015-11/documents/oswer_directive_9200.1-120_exposurefactors_corrected2.pdf). Many of these exposure factors differ from those used in the risk assessment supporting the ROD. These changes in general would result in a slight decrease of the risk estimates for most chemicals (EPA. 2014).

Although calculated risks from potential exposure pathways at former NAS Brunswick sites may differ from those previously estimated, slightly higher for some contaminants and slightly lower for others, the revised methodologies themselves are not expected to affect the protectiveness of the remedy. A review of site information identifies that these updates do not call into question the protectiveness of the remedy.

VOCs have not been detected at Site 2 at concentrations of concern; therefore, vapor intrusion is not a pathway of concern at the site. The vapor intrusion-related LUCs included in the LUC RD for the combined Sites 1 and 3, Site 2, and Eastern Plume groundwater management zone are required based on VOC concentrations in Sites 1 and 3 and Eastern Plume groundwater only.

The exposure assumptions used are considered to be conservative and reasonable in evaluating risk. No changes to these assumptions developed from them is warranted. There have been no changes to the standardized risk assessment methodology, other than those noted above, that could affect the protectiveness of the remedy. Finally, these changes in risk assessment methods do not affect the protectiveness of the Site 2 remedy because exposure to landfill materials is prevented by maintenance of the soil cover and implementation of LUCs.

### **3.7.3      Question C: Has any other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?**

No additional human health or ecological risks have been identified, and no weather-related events have affected the protectiveness of the remedy. No other information has been identified that calls into question the protectiveness of the remedy.

### **3.7.4      Technical Assessment Summary**

Based on the data reviewed and the site inspection, the remedy is functioning as intended by the 1998 ROD, as modified by the 2014 multi-site LUC ESD. There have been no changes in the physical conditions at the site, toxicity factors, or to the standardized risk assessment methodology that would affect the protectiveness of the remedy. Issues related to the change in land use associated with closure of the base were addressed via the LUC ESD and RD. There is no other information that calls into question the protectiveness of the remedy.

## **3.8      Issues**

No deficiencies were identified during this five-year review of the Site 2 remedy, and no issues related to site operations, conditions, or activities prevent the remedy from being protective at this time or in the future.

## **3.9      Recommendations and Follow-Up Actions**

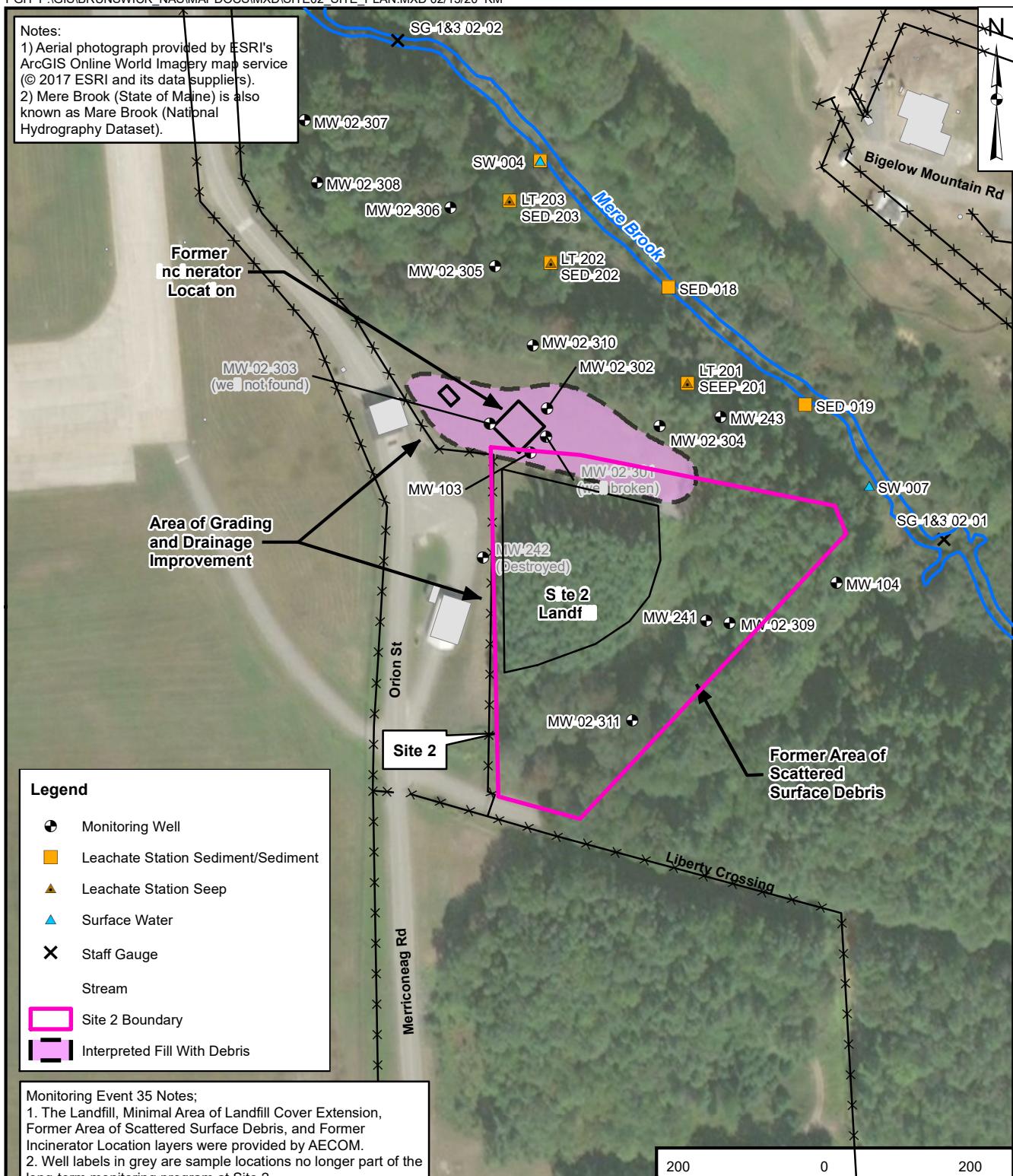
Because no issues affecting the protectiveness of the remedy were identified, there are no recommendations for Site 2, and no follow-up actions are required.

### **3.10 Protectiveness Statement**

<b>Protectiveness Statement(s)</b>		
<i>Operable Unit:</i>	<i>Protectiveness Determination:</i>	<i>Planned Completion Date:</i>
OU7, Site 2	Protective	

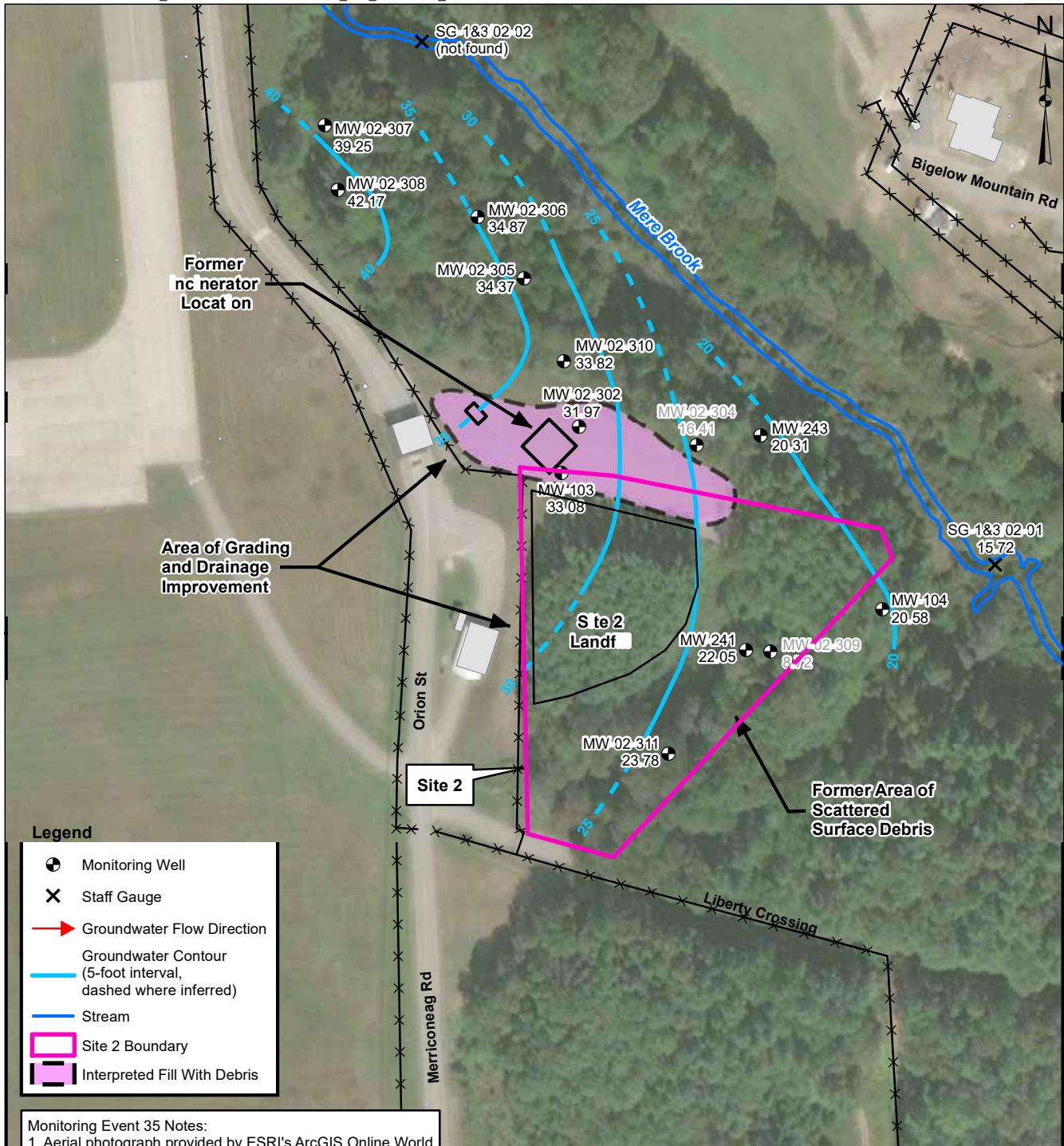
The remedy implemented at Site 2 is protective of human health and the environment. Exposure to landfill materials and soil and groundwater impacted by these materials is prevented through the expanded soil cover and through maintenance of LUCs implemented across the expanded site boundary. The results of future LTM will be used to continue to evaluate the effectiveness of the remedy and to assess potential contaminant migration. The remedial actions have been implemented as designed and include measures to prevent exposure, and the remedial actions that have been completed (soil cover and fence installation and extension and LUCs) and that are ongoing (LTM) are operating as designed. Long-term protectiveness will be verified through continued monitoring in accordance with the Base-Wide QAPP and through LUC inspections in accordance with the LUC RD to ensure continued maintenance of the LUCs. Based on the activities that are completed and ongoing, the intent and goals of the Site 2 ROD are being or will be met.

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SITE 2, ORION STREET LANDFILL - SOUTH  
FORMER NAVAL AIR STATION BRUNSWICK  
BRUNSWICK, MAINE

CTO	N4008518F5894
DRAWN BY	DATE
S. PAXTON	11/18/19
CHECKED BY	DATE
E. GLICK	02/13/20
FIGURE NUMBER	
	3-1



**SITE 2**  
**SHALLOW GROUNDWATER CONTOUR MAP**  
**OCTOBER 2019**  
**FORMER NAVAL AIR STATION**  
**BRUNSWICK, MAINE**

CTO	N4008518F5894
DRAWN BY	DATE
K. MOORE	12/11/19
CHECKED BY	DATE
E. GLICK	03/03/20
FIGURE NUMBER	
	3-2

## **4.0 OU7, Site 7, Old Acid/Caustic Pit**

### **4.1 Site Description**

Site 7, Old Acid Caustic Pit, is located in the northern portion of the base, west of the main gate (Fitch Avenue) and northeast of the former Old Navy Fuel Farm (see Figure 2-3). From 1952 to 1969, an unknown quantity of liquid wastes including transformer oils, battery acids, solvents, and miscellaneous liquids were poured into the Site 7 acid/caustic pit for disposal. No records of the exact location of the pit have been found. In addition to the acid/caustic pit, the area was used as an equipment laydown area and DRMO facility.

### **4.2 Site Chronology**

A list of important Site 7 historical events and relevant dates in the site chronology is shown below. The identified events are illustrative, not comprehensive. Further information about activities and actions at the site can be found in the Administrative Record available as part of the Information Repository at the Curtis Memorial Library, 23 Pleasant Street, Brunswick, Maine, 04011-2261.

<b>Event</b>	<b>Date</b>
Base-Wide IAS	June 1983
Base-Wide Site Inspection	June 1985
Draft Final RI Report	August 1990
Draft Final Supplemental RI Report	August 1991
FS for Sites 2, 4, 7, 9, 11, and 13	March 1992
First Five-Year Review Report signed	March 2000
Operating Instruction NASBINST 5090.1B issued	31 December 2000
Site 7 ROD signed	September 2002
Final LTMP for Site 7	January 2005
Second Five-Year Review signed	4 October 2005
LTMP updated to include three wells installed in June 2007	August 2007
Operating Instruction NASBINST 5090.1C issued	5 March 2008
Supplemental RI Report	June 2010
LTM Optimization Report for Sites 1, 3, 2, 7, and 9	February 2015
Technical Memorandum, Data Gap Investigations for Sites 1 and 3, Site 2, and Site 7	June 2013
ESD for removal of cadmium-contaminated soil	September 2014

Event	Date
LTM Optimization Report for Sites 1, 3, 2, 7, and 9	February 2015
Sampling and Analysis Plan (SAP), Field Sampling Plan, and Uniform Federal Policy-Quality Assurance Project Plan (QAPP), for IR Site 7 Old Acid/Caustic Pit	March 2015
LUC ESD for Sites 1 and 3, 2, 4, 7, 9, and the Eastern Plume	April 2015
Base-Wide QAPP for the LTM Program, 2015 Revision	August 2015
Base-Wide LUCIP, including the LUC RD for Site 7	September 2016
Final Work Plan for Soil Remediation at IR Site 7 Old Acid/Caustic Pit	June 2017
Completion Report, Soil Remediation at IR Site 7 Old Acid/Caustic Pit	October 2019
Draft 2020 Update to Base-Wide LUCIP/LUC RDs	2020
LTM	Spring 2005 to present

## 4.3 Background

### 4.3.1 Physical Characteristics

Site 7 is a generally flat open clearing approximately 1.4 acres in size surrounded by woods to the west, north, and east. A drainage ditch is located east of and parallel to the access road. No streams are associated with the site; a wetland area extends from the southwest into the northern portion of the site. The Site 7 area is underlain by fine to medium sand at depths ranging up to 20 feet. The Transition Unit, common elsewhere at NAS Brunswick, was not identified at Site 7; the Presumpscot clay unit underlies the sand. Depth to bedrock at the site is estimated to range from 11.7 to 20.6 feet below ground surface. The hydrogeology at Site 7 is characterized by shallow overburden groundwater with the water table varying in depth from 4 and 7 feet below ground surface.

### 4.3.2 Land and Resource Use

Site 7 was the former location of the acid/caustic pit used from 1952 to 1969 for liquid waste disposal. The site was also the former location of the DRMO and was used as an equipment laydown and storage area. The site area is currently owned by the Navy and is inactive, and no structures are present within the site boundaries. Potable water in the Site 7 area of the former base is supplied by the Brunswick/Topsham Water District municipal water supply.

### **4.3.3 History of Contamination**

From 1952 to 1969, an unlined pit at Site 7 was used to dispose of transformer oils, battery acids, caustics, solvents, and other miscellaneous liquids. In addition to the acid/caustic pit, the area was used as an equipment laydown and storage area and DRMO facility. The handling and storage of associated materials reportedly resulted in isolated spills and leaks of fuels and oils. The precise location of the pit does not appear to have been documented, but the location was estimated based on previous site investigation activities including soil gas surveys, geophysical surveys, soil borings, and test pitting.

### **4.3.4 Initial Response and Basis for Taking Action**

The 1983 base-wide IAS recommended further investigation of Site 7 based on the suspected presence of transformer oil possibly containing polychlorinated biphenyls (PCBs), the suspected presence of solvents, and the possibility of migration to groundwater. The results of subsequent sampling eliminated PCBs as potential contaminants at Site 7. The Pollution Abatement Confirmation Study (E.C. Jordan, 1985) did not recommend further investigation of Site 7 because no groundwater contamination was detected and because the slightly elevated lead concentrations in soil "do not represent a potential threat to public health or the environment." During the RI, cadmium and manganese were detected in groundwater at concentrations greater than MCLs and/or MEGs, and PAHs and DDT were detected in soil samples (E.C. Jordan, 1990 and 1991).

The human health and ecological risk assessments during the 1991 RI concluded that there were no unacceptable risks based on site conditions at that time (industrial land use and no use of groundwater). Additional risk estimates in 1992 evaluating a hypothetical future residential scenario concluded that risks for soil were within EPA's target risk range but greater than MEDEP's target risk. Ingestion of groundwater was not evaluated because groundwater was not used and was not expected to be used in the future. Additional risk screening calculations were performed using new soil data from the 2009 Supplemental RI at Site 7. Estimated risks associated with residential and industrial exposure to surface and subsurface soil were less than EPA's target risk range of  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$ ; however, risks for residential exposure to surface and subsurface soil were greater than MEDEP's target risk of  $1 \times 10^{-5}$ , due mainly to carcinogenic PAHs. No unacceptable non-carcinogenic hazards were estimated.

In 2000 and 2001, supplemental investigations were performed in an attempt to identify and remove a potential soil source of continuing elevated cadmium concentrations in

groundwater. During excavations, no definite soil source was identified, although soil was removed in an attempt to decrease groundwater cadmium concentrations. In April 2002, the Navy's Remedial Action Contractor removed soil that had been stockpiled at the site during the 2000 and 2001 investigations and associated excavations. As part of this removal action, 400 yd<sup>3</sup> of soil were excavated, 140 yd<sup>3</sup> of contaminated soil were disposed of off site, and 260 yd<sup>3</sup> of excavated soil determined not to require off-site disposal were spread on the ground surface at Site 7 (in an approximately 6-inch layer) and may be covering soil identified during the RI as contaminated with DDT and PAHs (Foster Wheeler, 2002).

## **4.4 Remedial Actions**

### **4.4.1 Remedy Selection**

The 2002 ROD established the following RAOs for Site 7:

- Reduce contaminant concentrations in Site 7 groundwater to consistently less than federal MCLs and state MEGs.
- Prevent human and ecological exposure (i.e., ingestion, dermal contact) to Site 7 groundwater and soil.
- Prevent any migration of the Site 7 groundwater plume off site.

The ROD identified the following COCs for soil at Site 7 but did not identify soil cleanup goals:

- Total carcinogenic PAHs
- Total non-carcinogenic PAHs
- 4,4-DDE
- 4,4-DDD
- 4,4-DDT
- Aroclor-1254
- Arsenic
- Cadmium
- Lead
- Manganese
- Mercury

The groundwater COCs were identified as cadmium and manganese, and the cleanup goals were identified as 5 µg/L (the MCL at the time of the ROD and currently) and 200 µg/L (the Maine MEG at the time of the ROD), respectively. The 2018 cadmium groundwater RAGs for residential and construction worker exposure pathways are 9.2 and 940 µg/L, respectively (MEDEP, 2018). There is no primary MCL for manganese; the secondary MCL is 50 µg/L (EPA, 2014). The 2018 manganese groundwater RAGs for residential and construction worker exposure pathways are 430 and 37,000 µg/L, respectively.

The selected remedy for Site 7, institutional controls with groundwater monitoring, includes the following major components to address soil and groundwater contamination:

- Institutional controls to prevent human contact with and use of soil and groundwater at the site.
- Conduct LTM of groundwater to verify that contamination remains localized and to monitor contaminant trends until concentrations are consistently less than MCLs/MEGs.
- Five-year reviews.

As stated in the ROD, natural attenuation processes are expected to address the low-level threats associated with cadmium and manganese in groundwater at the site. LUCs were used to address potential risks associated with exposure to soil and to groundwater until natural attenuation processes reduce concentrations to less than the cleanup goals (MCL/MEGs). The selected remedy was determined to be protective of human health and the environment, to attain ARARs, and to be cost effective. The remedy complies with action-specific ARARs, and eventual compliance with chemical-specific ARARs will be verified by monitoring. No location-specific ARARs were identified for Site 7.

#### **4.4.2 Remedy Implementation**

##### **LTM**

The objective of the monitoring component of the remedy is to obtain the data necessary to assess the long-term effectiveness of remedial actions in meeting the Site 7 RAOs. Environmental monitoring was initiated in spring 2005, and as of May 2019, 25 monitoring events have been completed at Site 7. An LTM Optimization Report for Sites 1 and 3, Site 2, Site 7, and Site 9 was finalized in February 2015 (Tetra Tech,

2015a) presenting optimization recommendations for LTM at these sites, and monitoring is currently being conducted in accordance with the August 2015 Base-Wide QAPP for the LTM Program based on the approved recommendations in the final LTM Optimization Report.

As stated in the ROD, the goals of the LTM program are as follows:

- Assess trends in the concentrations of cadmium and manganese in groundwater to assess the effectiveness of natural attenuation in restoring site groundwater to Site 7 ROD cleanup goals.
- Assess whether Site 7 groundwater contamination is migrating and negatively impacting downgradient groundwater quality.
- Assess variations in local groundwater flow patterns.
- Monitor and maintain the structural integrity of long-term groundwater monitoring wells.

### **LUCs**

Land use restrictions at Site 7 were initially implemented via the NAS Brunswick Instruction 5090.1B (replaced in 2008 by version 5090.1C), and the LUC component of the remedy for Site 7 was modified as documented in the 2015 multi-site ESD to clarify the LUC objectives in light of base closure. The LUC performance objectives for Site 7, as documented in the ESD, are as follows:

- Prevent uncontrolled human exposure to and/or use of contaminated groundwater
- Manage future construction activities to prevent uncontrolled human exposure and/or transport/migration of contaminated soil and groundwater.
- Prevent uncontrolled human exposure to and/or use of surface and subsurface soils within the soil management zone.
- Protect active and future remediation and monitoring systems.

The LUCs required to achieve these performance objectives, as provided in the LUC RD for Site 7, are as follows:

- Prohibit residential use of the site unless prior written approval is obtained from the Navy, EPA, and MEDEP.

- Prohibit soil excavation/disturbance or any construction activities unless prior written approval is obtained from the Navy, EPA, and MEDEP.
- Prohibit all uses of groundwater underlying the site unless prior written approval is obtained from the Navy, EPA, and MEDEP.
- Protect the integrity of all current and future remedial systems.

These LUCs were implemented upon finalization of the LUC RD, which is included as an appendix to the Base-Wide LUCIP, and the LUCs will be monitored, maintained, enforced, and reported on in accordance with provisions in the LUC RD (see Figure 4-2). The LUC RD also documents the requirements for continuation of the LUCs if all or part of the Site 7 property is transferred out of Navy ownership. Any future construction activities will also require the property owner to submit a Brunswick Landing Construction Permission Request Form to the Navy for approval before the Town of Brunswick will approve a construction permit. The Base-Wide LUCIP is also in the process of being revised and will include the Brunswick Landing Construction Permission Request process as one of the LUC implementing actions.

#### **4.4.3 System Operation/Operation and Maintenance**

The Navy is conducting LTM in accordance with the Base-Wide QAPP for the LTM Program (Tetra Tech, 2015b). The integrity and condition of site monitoring wells are inspected during each monitoring event, and the results are documented in the report generated for each monitoring event.

### **4.5 Progress Since the Last Five-Year Review**

No non-compliance issues were identified during the fourth five-year review of the remedial action for Site 7. The review found that the selected remedy at Site 7 was protective of human health and the environment and was functioning as designed. Activities completed at Site 7 since the last five-year review are summarized below. LTM activities are discussed in Section 4.6.1.

As documented in the 2014 Site 7 ESD, cadmium-contaminated soil posing a continued leaching threat to site groundwater was excavated from two areas of the site and disposed of beneath the expanded cap at Sites 1 and 3. Removing this residual source is expected to eventually facilitate the natural attenuation of contamination and achievement of Site 7 groundwater cleanup goals. Soil excavation activities at Site 7 began in 2015, in accordance with SAP (Tetra Tech EC, 2015), but were temporarily

halted when three aerial practice bombs were encountered. The discovery of these discarded items is assumed to be associated with former DRMO operations on Site 7, which included the collection and sale of scrap metal materials generated at NAS Brunswick when it was an active installation. Excavated soil was replaced, the site was surrounded with a chain-link fence, and EOD personnel responded and identified, inspected, and removed the inert practice bombs. Cadmium-contaminated soil removal activities continued in 2017 after preparation of planning documents incorporating munitions safety issues. Also, because Site 7 was considered a location of potential radiological impact due to DRMO storage of equipment and aircraft components containing radio-luminescent dials and gauges, radiological surveying and scanning were conducted concurrent with soil excavation activities. Site 7 excavation included approximately 1,332 cubic yards (1,998 tons) of cadmium-contaminated soil (to meet the pickup level of 2.5 mg/kg), 14,680 pounds of scrap metal, 144.75 pounds of material documented as safe (MDAS), nine radiological devices, and 7.5 cubic yards (11.25 tons) of soil disposed of as low-level radioactive waste under the expanded cap at Sites 1 and 3 (Tetra Tech EC, 2019).

## 4.6 Five-Year Review Process

### 4.6.1 Document and Analytical Data Review

Documents reviewed as part of this five-year review are referenced throughout the text and are included in the reference section (Section 10). Information in this subsection summarizing the results of LTM are based on Site 7 LTM reports.

The LTM program for Site 7 includes annual spring sampling of nine wells, with analysis for cadmium and manganese. Three additional wells are sampled every 5 years (most recently in May 2019). Groundwater samples from Site 7 are analyzed for cadmium and manganese (Tetra Tech, 2015a). Since April 2005, there have been 25 monitoring events at Site 7.

Several wells, particularly those closer to areas with historical cadmium exceedances in soil, had significant increases in cadmium and/or manganese concentrations during 2019 sampling. Although soil removal actions were conducted in 2001 and 2017, test pit soil sample results from 2017 indicated that soil with elevated cadmium levels may remain at the site (Tetra Tech EC 2019a). Cadmium and manganese concentrations greater than criteria were detected in groundwater from wells located within (MW-NASB-099 and MW-NASB-722) or directly downgradient (MW-NASB-228, MW-NASB-770 and MW-NASB-771) of the suspected former acid/caustic pit and excavation areas,

but concentrations at wells further downgradient were significantly less than criteria. Other than the increasing concentrations during May 2019 and at well MW-NASB-228, where cadmium concentrations have been increasing over time, historical cadmium and manganese groundwater concentration trends are stable or generally decreasing.

Downgradient migration of cadmium and/or manganese in groundwater may be occurring in the direction of sentinel wells MW-07-02, MW-07-03, and MW-07-04; however, cadmium and manganese concentrations at these locations were significantly less than criteria in 2019. Concentrations of cadmium and manganese in groundwater at Site 7 will continue to be evaluated during future LTM events to assess trends and potential downgradient migration at concentrations exceeding criteria.

#### **4.6.2 Site Inspections**

Site inspections are conducted during each long-term monitoring sampling event in the spring of each year. The most recent LTM event was completed in May 2019. In addition, the annual LUC inspection was conducted at Site 7 on September 20, 2019. Photographs taken during this inspection are included in Appendix A. The results of the inspections conducted during monitoring events are documented in the monitoring event reports generated for each LTM event. No issues impacting remedy protectiveness were noted during the 2019 LUC inspection, and based on the results of the inspection, the Site 7 remedy is functioning as intended and remains protective.

#### **4.6.3 Interviews**

The Navy holds regular Restoration Advisory Board (RAB) meetings for former NAS Brunswick to discuss the process of the cleanup program and ongoing investigations, Navy property transfer actions, and/or site status. Interview questionnaires were emailed to 11 potential interviewees, and four completed questionnaires were returned. The list of interviewees and returned questionnaires are included in Appendix C. No concerns related to remedy protectiveness at any of the sites were included in the responses, although general incidences of vandalism at Brunswick Landing were mentioned. The findings of this fifth five-year review will be presented at a future RAB meeting after finalization of this report in September 2020.

## 4.7 Technical Assessment

### 4.7.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?

The review of documents, risk assumptions, and results of the site inspection indicate that the Site 7 remedy is functioning as intended by the 2002 ROD, as modified by the 2014 soil removal ESD and 2015 multi-site ESD. LTM is being conducted to assess the progress of natural attenuation in reducing concentrations of cadmium and manganese in groundwater and confirming that contaminated groundwater is not migrating off site. The soil removal completed in 2017 is expected to accelerate the natural attenuation of cadmium-contaminated groundwater by removing soil with elevated concentrations of cadmium. Implementation of LUCs to prevent groundwater use provides protection of human health and the environment until groundwater cleanup goals are met, and LUCs to prevent residential land use and soil disturbance preclude exposure to soil that may be associated with unacceptable risks.

The remedial actions are being implemented as designed and include measures that prevent exposure. The remedial actions currently in operation (LUCs and LTM) are operating as designed, and the data indicate progress toward meeting the RAOs. Based on the completed and ongoing activities, the intent and goals of the Site 7 ROD have been or will be met.

### 4.7.2 Question B: Are the Assumptions, Toxicity Data, Cleanup Values, and RAOs Used at the Time of the Remedy Selection Still Valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. The change in site conditions associated with the closing of the base was addressed via the multi-site LUC ESD, as described above. In addition, the LUC RD for Site 7 (included as an appendix to the Base-Wide LUCIP) includes provisions that LUCs be incorporated into any future leases or property transfer documents and that EPA and MEDEP be notified of any transfer actions. According to the Brunswick Naval Air Station Reuse Master Plan (Matrix Design Group, 2007), planned future use of Site 7 is commercial/industrial (professional office).

#### 4.7.2.1 ARARs and Site-Specific Action Level Changes

The ARAR evaluation identified changes associated with the Site 7 remedy.

Groundwater cleanup goals for Site 7, as documented in the 2002 ROD, were based on the federal MCL and Maine MEG for cadmium (5 µg/L) and the MEG for manganese (200 µg/L). The current (2018) residential RAGs for cadmium and manganese are 9.2 and 500 µg/L, respectively. The Site 7 ROD cleanup goal concentrations for these two contaminants are lower than the RAGs; therefore, they continue to remain protective. The current EPA tap water RSL for manganese is 430 µg/L at noncancer HI of 1. The current (2018) residential RAG for manganese is 500 µg/L. As a result, the Site 7 manganese groundwater cleanup goal continues to be protective.

#### **4.7.2.2 *Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods***

There have been no changes in physical conditions, exposure pathways, or land use that would affect the protectiveness of the Site 7 remedy.

On January 19, 2017, EPA issued revised (less carcinogenic) cancer toxicity values and new non-cancer toxicity values for benzo(a)pyrene. Benzo(a)pyrene did not have non-cancer toxicity values prior to January 19, 2017. Benzo(a)pyrene is now considered to be carcinogenic by a mutagenic mode of action; therefore, cancer risks are now evaluated for different human developmental stages using age dependent potency adjustment factors (ADAFs) for different age groups. The cancer potency of other carcinogenic PAHs is adjusted by the use of relative potency factors (RPFs), which are expressed relative to the potency of benzo(a)pyrene. The non-cancer effects of benzo(a)pyrene were not evaluated in the past due to the absence of non-cancer values. PAHs were only detected at levels of concern in soil at Site 7, and these changes would not have altered the selection of the remedy or the protectiveness of the remedy as implemented (LUCs currently prohibit exposure to soil at Site 7).

In 2014, EPA finalized a Directive to determine groundwater exposure point concentrations (EPCs) (<https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236917>). This Directive provides recommendations to develop groundwater EPCs. The recommendations to calculate the 95-percent upper confidence limit (UCL) of the arithmetic mean concentration for each contaminant from wells within the core/center of the plume, using the statistical software ProUCL, could result in lower groundwater EPCs than the maximum concentrations routinely used for EPCs as past practice in risk assessment, leading to changes in groundwater risk screening and evaluation. In general, this approach could result in slightly lower risk or higher screening levels. (EPA. 2014).

Also in 2014, EPA finalized a Directive to update standard default exposure factors and frequently asked questions associated with these updates.

[https://www.epa.gov/sites/production/files/2015-11/documents/oswer\\_directive\\_9200.1-120\\_exposurefactors\\_corrected2.pdf](https://www.epa.gov/sites/production/files/2015-11/documents/oswer_directive_9200.1-120_exposurefactors_corrected2.pdf). Many of these exposure factors differ from those used in the risk assessment supporting the ROD. These changes in general would result in a slight decrease of the risk estimates for most chemicals (EPA. 2014).

Although calculated risks from potential exposure pathways at former NAS Brunswick sites may differ from those previously estimated, slightly higher for some contaminants and slightly lower for others, the revised methodologies themselves are not expected to affect the protectiveness of the remedy. A review of site information identifies that these updates do not call into question the protectiveness of the remedy. Finally, these changes in risk assessment methods do not affect the protectiveness of the Site 7 remedy because exposure to soil and groundwater is prevented by the establishment and implementation of LUCs for both of these media.

The exposure assumptions used are considered to be conservative and reasonable in evaluating risk and developing risk-based cleanup levels. No changes to these assumptions or the cleanup levels developed from them is warranted. There have been no changes to the standardized risk assessment methodology, other than those noted above, that could affect the protectiveness of the remedy.

VOCs have not been detected at Site 7 at concentrations of concern; therefore, vapor intrusion is not a pathway of concern at the site.

#### **4.7.3 Question C: Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?**

No additional human health or ecological risks have been identified, and no weather-related events have affected the protectiveness of the remedy. No other information has been identified that calls into question the protectiveness of the remedy.

#### **4.7.4 Technical Assessment Summary**

Based on the data reviewed and the site inspection, the remedy is functioning as intended by the 2002 ROD as modified by the 2014 LUC ESD. There have been no changes in the physical conditions at the sites, toxicity factors for the COCs, or to the standardized risk assessment methodology that would affect the protectiveness of the remedy. Issues related to the change in land use associated with closure of the base have been addressed via the LUC ESD and RD. There is no other information that calls into question the protectiveness of the remedy.

## 4.8 Issues

No deficiencies were identified during this five-year review of the Site 7 remedy, and no issues related to site operations, conditions, or activities prevent the remedy from being protective at this time or in the future.

## 4.9 Recommendations and Follow-Up Actions

Because no issues affecting the protectiveness of the remedy were identified, there are no recommendations for Site 7, and no follow-up actions are required.

Additional munitions and radiological surveying are recommended to assess any potential residual impacts or contamination from historical operation of the DRMO. The Navy has already begun the planning process for these investigations. This recommendation does not affect the protectiveness determination for the site but is associated with ensuring continued protectiveness.

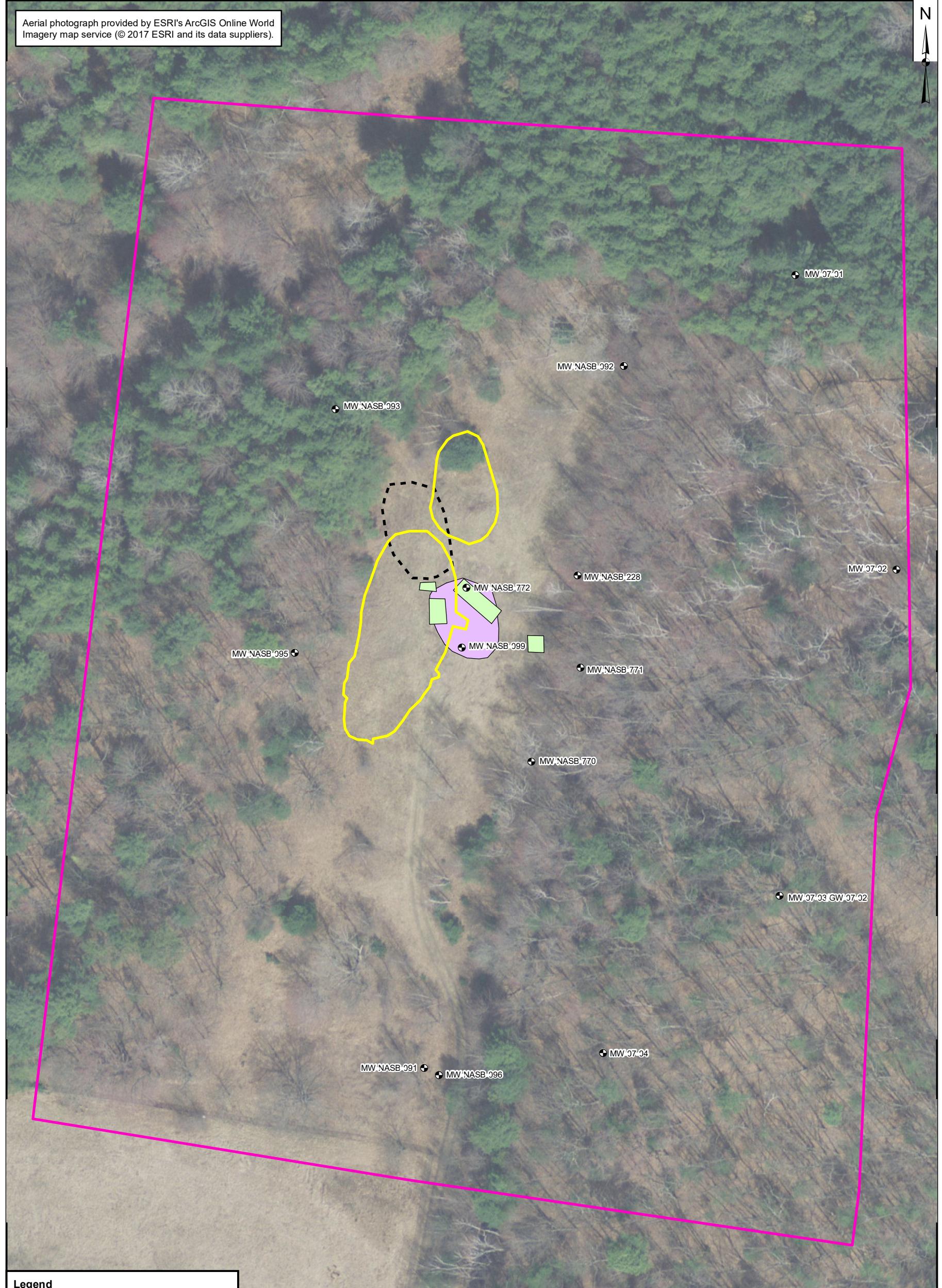
## 4.10 Protectiveness Statement

<b>Protectiveness Statement(s)</b>		
<i>Operable Unit:</i>	<i>Protectiveness Determination:</i>	<i>Planned Completion Date:</i>
OU7, Site 7	Protective	
<i>Protectiveness Statement:</i> The remedy implemented at Site 7 is protective of human health and the environment. Exposure to soil and groundwater, which could result in unacceptable risks, is prevented through maintenance of LUCs at the site. The recent soil removal is expected to facilitate the restoration of contaminated Site 7 groundwater. Groundwater LUCs will be maintained until contaminant concentrations decrease to less than ROD cleanup goals. Groundwater monitoring will continue to be conducted at Site 7 to assess progress in meeting cleanup goals. Long-term protectiveness of the remedy will be verified by continued monitoring in accordance with the Site 7 LTM requirements, Base-Wide QAPP, and LUC inspections in accordance with the LUC RD. Based on the activities that are completed and ongoing, the intent and goals of the Site 7 ROD have been or will continue to be met.		

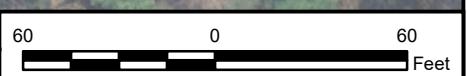
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Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2017 ESRI and its data suppliers).

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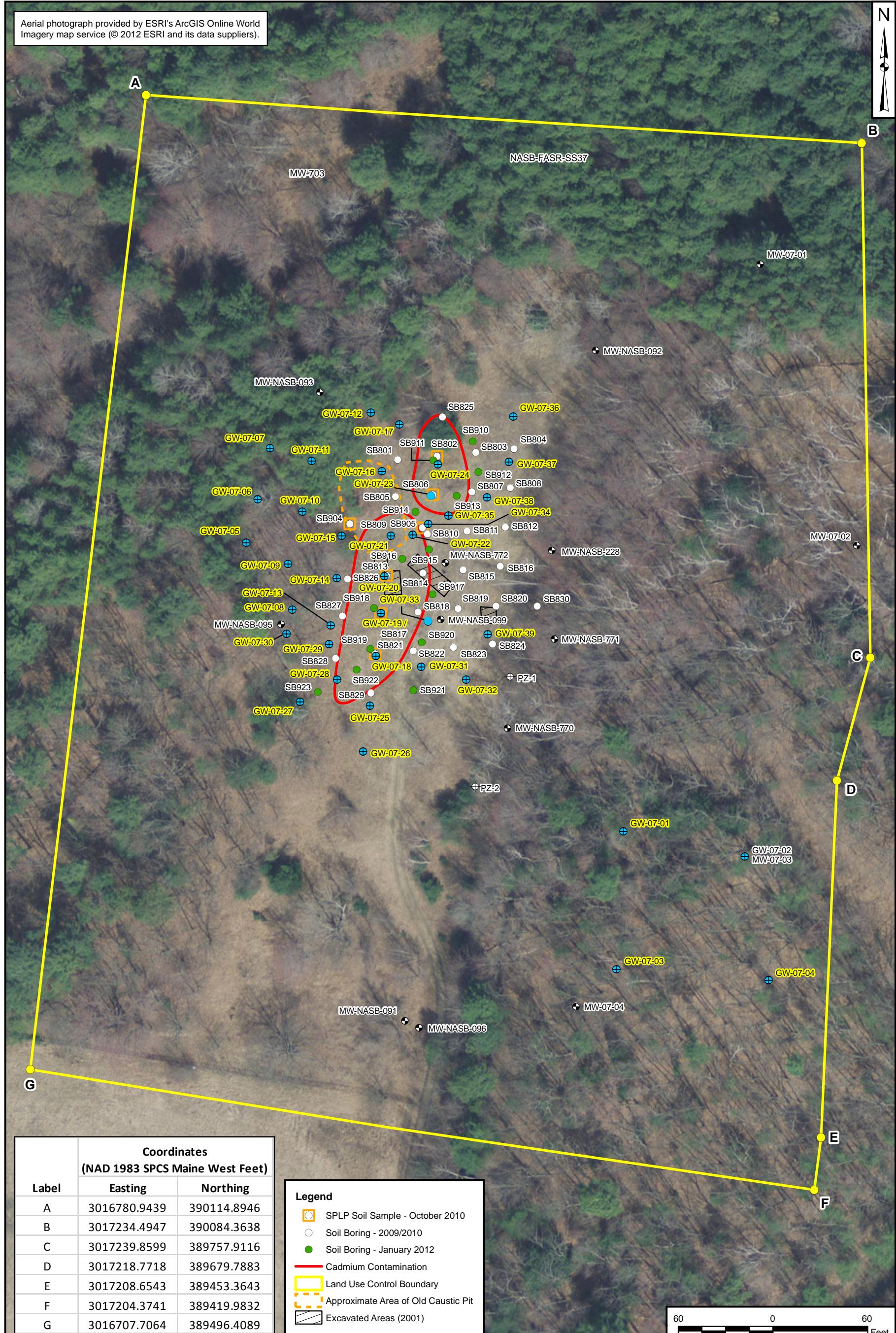
**Legend**

- Monitoring Well
- Land Use Control Boundary
- Approximate Area of Old Caustic Pit
- 2017 Excavation Area
- 2001 Excavation Area
- Area of Cadmium Soil Exceedances (2001)



**SITE 7, OLD ACID/CAUSTIC PIT**  
**FORMER NAVAL AIR STATION BRUNSWICK**  
**BRUNSWICK, MAINE**

CTO	N4008518F5894
DRAWN BY	DATE
K. MOORE	04/30/20
CHECKED BY	DATE
R. MILLER	05/01/20
FIGURE NUMBER	4-1



DRAWN BY J. ENGLISH	DATE 02/04/16	 <b>TETRA TECH</b> <b>SITE 7 - OLD ACID/CAUSTIC PIT</b> <b>LAND USE CONTROL BOUNDARIES</b> <b>FORMER NAVAL AIR STATION</b> <b>BRUNSWICK, MAINE</b>		CONTRACT NUMBER 2330	CTO NUMBER WE49
CHECKED BY R. MILLER	DATE 02/09/16			APPROVED BY ____	DATE ____
REVISED BY ____	DATE ____			APPROVED BY ____	DATE ____
SCALE AS NOTED				FIGURE NO. 4-2	REV 0

## 5.0 OU6, Site 9, Neptune Drive Disposal Site

### 5.1 Introduction

Site 9, Neptune Drive Disposal Site, occupies approximately 20 acres in the central portion of the former base. Records indicate that Site 9 includes a former incinerator and associated ash landfill/dump area north of Avenue C/Neptune Drive and a solvent burning or dumping area south of Avenue C/Neptune Drive southeast of Building 201. The incinerator was reportedly used from April 1943 until fall 1946 but may have been used as late as 1953 when barracks buildings (now demolished) were constructed at the site. Solid wastes were incinerated, and the ash was disposed of in the dump (now referred to as the ash landfill/dump area). Other wastes reportedly disposed of in this area included solvents that were burned on the ground, paint sludges, and possibly wastes from the metal shop (U.S. Navy, 1999). Prior to 1953, the inactive ash landfill was closed, and a soil cover was installed over it. In 1953, Buildings 218 and 219, former military barracks (now demolished), were constructed over the former landfill area.

### 5.2 Site Chronology

A list of important Site 9 historical events and relevant dates in the site chronology is shown below. The identified events are illustrative, not comprehensive. Further information about activities and actions at the site can be found in the Administrative Record available as part of the Information Repository at the Curtis Memorial Library, 23 Pleasant Street, Brunswick, Maine, 04011-2261.

Event	Date
Base-Wide IAS	June 1983
Base-Wide Site Inspection	August 1984
Pollution Abatement Confirmation Study	June 1985
Draft Final RI Report	August 1990
Draft Final Supplemental RI Report	August 1991
FS for Sites 2, 4, 7, 9, 11, and 13	1992
Interim ROD documenting selection of natural attenuation and LTM as interim remedy and requiring Navy to conduct additional source investigation	September 1994
LTMP submitted	January 1995
Additional source investigations failed to identify source of vinyl	1995 to 1996

Event	Date
chloride in groundwater	
LTMP update finalized	August 1999
Final Site 9 ROD signed	September 1999
First Five-Year Review Report signed	March 2000
Operating Instruction NASBINST 5090.1B issued	31 December 2000
Additional soil and groundwater investigations	2003 to 2004
Draft LUCIP submitted	7 July 2004
Second Five-Year Review signed	4 October 2005
Excavation of ash-containing soil	April 2006 to October 2008
Draft Remedial Action Closure Report submitted detailing 2006 to 2008 excavation activities	June 2009
Time-Critical Removal Action Memorandum issued for removal of ash material and impacted soil at Site 9	20 June 2007
Operating Instruction NASBINST 5090.1C issued	5 March 2008
Two additional direct-push technology (DPT) investigations to determine the extent of ash north and south of Neptune Drive and to further investigate Building 201	May to June 2008
Pore water sampling at Upper Impoundment Pond to evaluate previous diesel-range organics (DRO) exceedances	May 2009
Final Site 9 LTMP issued	July 2009
Data Gap Investigation	November 2010
LTM Optimization Report for Sites 1, 3, 2, 7, and 9	February 2015
LUC ESD for Sites 1 and 3, 2, 4, 7, 9, and the Eastern Plume	April 2015
Draft LUCIP, including LUC RDs for Sites 1 and 3, 2, 4, 7, 9, and the Eastern Plume	August 2015
Draft Base-Wide QAPP for the LTM Program, 2015 Revision	August 2015
Base-Wide LUCIP, including the LUC RD for Site 9	September 2016
PAH Hot Spot Delineation Sampling	June and July 2015
PAH Hot Spot Soil Removal	June to September 2015
Draft 2020 Update to Base-Wide LUCIP/LUC RDs	2020
Post-Removal Action Risk Assessment Report	March 2020
Operating Properly and Successfully (OPS) Demonstration Report	March 2020
LTM	March 1995 to present

## **5.3 Background**

### **5.3.1 Physical Characteristics**

Site 9 is located within the central developed area of NAS Brunswick and is bounded to the north by Burbank Avenue, to the east by Building 211 and a paved parking area, to the south by impoundment ponds, and to the west by aircraft hangars and the flightline area. The Site 9 area is generally flat, with two steep-sided stream channels in the southern portion of the site that discharge into Picnic Pond, located 2,000 feet downstream of Site 9. In 1997, surface water impoundment ponds were constructed within these channels to capture runoff from the central portion of the base, including runways, parking lots, and roads. Construction of the impoundment ponds flooded the former southern unnamed stream (forming Upper Impoundment Pond) and partially flooded the northern unnamed stream (forming Lower Impoundment Pond).

The Site 9 area is underlain by fine to medium sand at depths ranging up to 40 feet and thicknesses decreasing from east to south. The sand is underlain by the Transition Unit composed of fine sand and silt with clay, and a clay unit underlies the Transition Unit and extends to an undetermined depth. Depth to bedrock at the site has not been determined. Groundwater is believed to discharge to the unnamed stream and surface water impoundment ponds.

### **5.3.2 Land and Resource Use**

Site 9 was the former location of an incinerator and ash landfill/dump and a reported hazardous waste disposal area. Structures remaining on site include Building 201, Galley/Neptune Hall, a dining facility, and Building 29, Auto Hobby Shop. A former picnic/recreational area was located east of Building 201. Military barracks formerly located on site (Buildings 212 to 220) have all been demolished. The unnamed streams in the southern portion of the site that contain the impoundment ponds flow into Mere Brook, which flows into the Harpswell Cove estuary at the southern perimeter of the base. Harpswell Cove is an area of commercial fishing. Potable water in the Site 9 area of the former base is supplied by the Brunswick/Topsham Water District municipal water supply.

### **5.3.3 History of Contamination**

During the mid-1940s, an incinerator was reportedly used at Site 9, and incinerator ash was disposed of in trenches on the ash landfill/dump area underlying former Buildings

218 and 219. It is believed that the incinerator was in operation from April 1943 until fall 1946 but may have been used as late as 1953 when the barracks were built. Prior to barracks construction in 1953, the inactive ash landfill was closed, and a soil cover was installed over it. In 1953, former Buildings 217, 218, 219, and 220 were constructed over the former landfill area. Other wastes disposed of in the ash landfill/dump area included solvents that were burned on the ground, paint sludges, and wastes from a nearby metal shop.

In addition to the incinerator and associated dump area, historical documents and aerial photographs show what was once a possible solvent burning or dumping area east and southeast of Building 201. In addition, a septic system associated with Building 201 was suspected to be a potential source of contamination found at Site 9. Building 201 was used as the Chief's Club until 1993 when it was converted into the galley (cafeteria). However, subsequent investigations failed to identify a source of contamination in this area.

Based on the results of 2003 DPT investigations, the volume of ash in the ash landfill/dump area was estimated as approximately 16,000 yd<sup>3</sup>, and a removal action completed in 2008 included removal of 42,355 tons of impacted soil from this area (ECC, 2009a). However, subsequent investigations identified ash over a larger area north and northwest of the former incinerator and south of Avenue C/Neptune Drive.

### **5.3.4 Initial Response and Basis for Taking Action**

The 1983 base-wide IAS recommended further investigation of Site 9 based on the suspected presence of hazardous wastes and the presence of migration pathways to surface water. Further investigation of Site 9 was also recommended after completion of the Site Inspection and Pollution Abatement Confirmation Study (NUS Corporation, 1983; E.C. Jordan, 1985).

Sampling and analysis during the RI identified contaminants in excess of screening levels including VOCs and inorganics in groundwater; PAHs, pesticides, fuel-related constituents, and inorganics in soil; PAHs and inorganics in surface water, PAHs, pesticides, and inorganics in stream sediment; and pesticides and inorganics in leachate. The following summarizes the results of the human health risk assessments conducted as part of the 1991 RI and 1994 Technical Memorandum (ABB-ES, 1994):

- Hypothetical future ingestion of groundwater: carcinogenic risk exceeded EPA's target risk range of 1 X 10-4 to 1 X 10-6 and MEDEP's target risk of 1 X 10-5 due to vinyl chloride, and non-carcinogenic hazards were greater than the target HI of 1.0 using maximum and average concentrations due to manganese.

- Dermal contact with or accidental ingestion of stream sediments: carcinogenic risk due to PAHs was within EPA's risk range but greater than MEDEP's target risk using average concentrations and was greater than both the EPA risk range and MEDEP target risk using maximum concentrations. However, more recent investigations have indicated that risks due to stream sediment (in an unnamed stream and adjacent impoundment ponds) are primarily attributed to non-Site 9 sources (U.S. Navy, 1999).
- Exposure to surface soil: carcinogenic risks due to PAHs were slightly greater than MEDEP's target risk but were within EPA's target risk range.
- Risk estimates for surface water and leachate were less than EPA's target risk range.
- Risk from ash landfill/dump contents was not evaluated in the risk assessments because the contents were considered inaccessible (covered by the former barracks at the time of the risk assessments and interim and final RODs).

Ecological risks to aquatic organisms from contaminants in surface water were not predicted to be severe. Additionally, much of the impact is attributed to base-wide contamination (stormwater runoff to the impoundment ponds) and not Site 9 activities. Risks to terrestrial organisms from exposure to soil, leachate seep, surface water, and stream sediment were presumed to be minimal or insignificant. Groundwater contamination is not accessible to ecological receptors and was therefore determined to pose no threat. The baseline risk assessment indicated a potential for serious impact on benthic macroinvertebrates; however, an additional risk assessment conducted by USFWS determined that chemical constituents in sediment were not toxic to the two test organisms evaluated (1997).

An Interim ROD for Site 9 was signed in July 1994 documenting selection of natural attenuation, LTM, and institutional controls as the interim remedy to address unacceptable risks associated with hypothetical future groundwater use at Site 9 during the time when additional investigative activities to identify source areas were conducted (U.S. Navy, 1994b).

The RAOs for the interim ROD were as follows:

- Reduce VOC contamination in groundwater to concentrations considered protective of human health.

- Evaluate groundwater quality and measure contaminant concentrations in groundwater, surface water, sediment, and leachate through long-term environmental monitoring.
- Conduct additional source investigations of possible source areas of contamination both north and south of Neptune Drive.

The interim remedy relied on natural attenuation to reduce concentrations of VOCs in groundwater, institutional controls to prevent use of groundwater from the site, and LTM to evaluate the progress of natural attenuation and to verify that migration off site and to surface water, sediment, and leachate were not occurring. The LTM program was initiated in March 1995 and is ongoing in accordance with the final ROD, as discussed below.

## 5.4 Remedial Actions

### 5.4.1 Remedy Selection

The 1999 final ROD established the following RAOs for Site 9 (based on the assumptions that barracks covered and thereby prevented access to the landfill and that the base would remain active):

- Reduce contaminant concentrations in Site 9 groundwater to less than federal MCL and state MEG target cleanup levels.
- Prevent human exposure and ecological exposure (i.e., ingestion, dermal contact) to Site 9 groundwater.
- Prevent human exposure and ecological exposure (i.e., ingestion, dermal contact) to the contents of the inactive ash landfill/dump area at Site 9.
- Prevent any migration of the Site 9 groundwater plume off site or of contaminants from the inactive ash landfill/dump area to groundwater and/or surface water.

The cleanup goals established in the 1999 final ROD are as follows:

- 1,2-Dichloroethene – 70 µg/L (federal MCL for cis-1,2-dichloroethane).
- 1,2-Dichloroethane – 5 µg/L (federal MCL).
- Vinyl chloride – 0.15 µg/L (Maine MEG at the time of the ROD; the current residential RAG is 0.19 µg/L).

The selected remedy to achieve these goals includes the following components:

- Continuation of natural attenuation, which relies on natural flushing and dispersion processes and in-situ biological systems to dilute and degrade contaminants to concentrations sustained at or less than the cleanup goals.
- Continuation of the LTM program that began after the interim ROD to verify that landfill contents are not impacting groundwater, to monitor the progress of natural attenuation, and to monitor for contaminant plume migration (off site or to other media).
- Continuation of LTM of surface water, leachate seeps, and stream sediments for indications of contaminant migration.
- Institutional controls to prevent use of and contact with impacted groundwater and prevent the disturbance of or contact with the contents of the ash landfill/dump area at Site 9.
- Five-year reviews.

The selected remedy was determined to be protective of human health and the environment, to attain ARARs, and to be cost effective. The remedy complies with action-specific ARARs, and eventual attainment of chemical-specific ARARs will be verified by monitoring. No location-specific ARARs were identified for Site 9.

#### **5.4.2 Remedy Implementation**

##### **LTM**

LTM was initiated in accordance with the interim ROD in March 1995 and continued in accordance with the 1999 final ROD, and as of fall 2019, 50 monitoring events have been completed at Site 9. An LTM Optimization Report for Sites 1 and 3, Site 2, Site 7, and Site 9 was finalized in February 2015 (Tetra Tech, 2015a) presenting optimization recommendations for LTM at these sites, and monitoring is currently being conducted in accordance with the August 2015 Base-Wide QAPP for the LTM Program based on the approved recommendations in the final LTM Optimization Report.

The objectives of the monitoring component of the remedy are as follows:

- Assess trends in the concentrations of contaminants in groundwater, leachate, surface water, and sediment to determine the effectiveness of natural attenuation.

- Assess whether groundwater downgradient of the ash landfill/dump area is impacted by inorganics from the site.
- Assess whether contamination is migrating off site.
- Assess variations in groundwater flow patterns.
- Monitor the structural integrity of the groundwater monitoring wells.

### **LUCs**

LUCs at Site 9 were initially implemented via the NAS Brunswick Instruction 5090.1B (replaced in 2008 by version 5090.1C), and the LUC component of the remedy for Site 9 was modified as documented in the 2015 multi-site ESD to clarify the LUC objectives in light of base closure. The LUC performance objectives for Site 9, as documented in the ESD, are as follows:

- Prevent uncontrolled human exposure to and/or use of contaminated groundwater within the groundwater management zone.
- Manage future construction activities to prevent uncontrolled human exposure and/or transport/migration of contaminated soil and groundwater.
- Protect active and future remediation and monitoring systems.

The LUCs required to achieve these performance objectives, as provided in the LUC RD for Site 9 are as follows:

- Prohibit residential use of the site unless prior written approval is obtained from the Navy, EPA, and MEDEP.
- Prohibit soil excavation/disturbance or any construction activities unless prior written approval is obtained from the Navy, EPA, and MEDEP.
- Prohibit all uses of groundwater underlying the site unless prior written approval is obtained from the Navy, EPA, and MEDEP.
- Protect the integrity of all current and future remedial systems.

These LUCs were implemented upon finalization of the LUC RD, which is included as an appendix to the Base-Wide LUCIP, and the LUCs will be monitored, maintained, enforced, and reported on in accordance with provisions in the LUC RD. Figure 5-2 shows the LUC boundaries for Site 9. The LUC RD also documents the requirements for continuation of the LUCs if all or part of the Site 9 property is transferred out of Navy

ownership. Any future construction activities will also require the property owner to submit a Brunswick Landing Construction Permission Request Form to the Navy for approval before the Town of Brunswick will approve a construction permit. The Base-Wide LUCIP is also in the process of being revised and will include the Brunswick Landing Construction Permission Request process as one of the LUC implementing actions.

#### **5.4.3 System Operation/Operation and Maintenance**

The Navy is conducting LTM and maintenance in accordance with the Base-Wide QAPP for the LTM Program (Tetra Tech, 2015e). The integrity and condition of site monitoring wells are inspected during each monitoring event, and the results are documented in the report generated for each monitoring event.

### **5.5 Progress Since the Last Five-Year Review**

No non-compliance issues were identified during the fourth five-year review of the remedial action for Site 9. The review found that the selected remedy at Site 9 remained protective of human health and the environment and was functioning as designed. Activities completed at Site 9 since the last five-year review are summarized below. LTM activities are discussed in Section 5.6.1.

#### **Data Gap Investigation and Risk Re-Evaluation**

Additional soil investigations were completed after 2008 to delineate the remaining portions of the ash landfill/dump area (ECC, 2009a) and to collect additional samples to facilitate the assessment of residual human health risk at the site after post-ROD soil removals and demolition of the barracks formerly overlying the ash landfill/dump area and considering the 2005 closure announcement for the base (the final Site 9 remedy was selected in the 1999 ROD based on the assumption that the former barracks covered and prevented access to the ash landfill/dump area of the site and that the base would remain active) (Tetra Tech, 2015h).

Additional sampling was conducted at Site 9 to define the visible extent of ash and to address data gaps to provide adequate data to further assess potential human and ecological risk (Tetra Tech, 2010a and 2010b). Sampling for the data gap investigation was conducted in November 2010, and a draft report was submitted detailing the sampling activities and results and summarizing the results of human health and ecological risk assessments based on previous and 2010 data. After submission of the draft data gap investigation report in 2015, the Navy, in consultation with EPA and

MEDEP, determined that a limited surface soil removal should be conducted to further reduce risks to recreational receptors to acceptable levels (risks to recreational receptors were acceptable in all other areas of the site). As described in the Proposed Site 9 Surface Hot Spot Delineation Approach (Tetra Tech, 2015b), additional soil sampling was conducted in a grid pattern around the two previous sample locations in the Site 9 North Area (S9-SB03 and S9-SB07) with maximum concentrations of carcinogenic PAHs (evaluated collectively as benzo(a)pyrene equivalents) to determine the areas of soil that would need to be removed to reduce the overall average benzo(a)pyrene equivalent concentration to a level that would be protective of recreational receptors. This hot spot delineation sampling was conducted in June and July 2015 (Tetra Tech, 2015c), and the associated follow-up removal action soil excavation activities were completed from June to September 2017 (Tetra Tech EC, 2018).

Following completion of data gap investigation sampling and 2017 excavation activities, human health and ecological risks were re-evaluated using post-excavation soil results and recent LTM groundwater data, and the results of the risk re-evaluation are presented in the Post-Removal Action Risk Assessment Report (Tetra Tech, 2019). The updated risk assessment was conducted to provide estimates of risk for groundwater, including vapor intrusion risks, and for surface (0 to 1 foot bgs) and subsurface (1 to 10 foot bgs) soil after recent soil removals, barracks demolition, and base closure. Ash encountered at the site was in thin, discontinuous, subsurface layers and in small amounts mixed with subsurface soil. Analytical results for samples from ash layers and soil mixed with ash were included in the 2019 risk re-evaluation.

Human health risks were evaluated separately for areas of the site north (former barracks location) and south of Neptune Drive (referred to as the North and South Area Exposure Units [EUs]) based on planned future uses of these areas. Anticipated future uses are mixed use (e.g., commercial/industrial and/or residential/recreational) for the North Area, and industrial/commercial for the South Area, based on Town of Brunswick Reuse Subdistricts information. To be conservative, both the North Area and South Area were evaluated for all possible future exposures (i.e., all receptors defined for the HHRA) to ensure that all potential future land uses were evaluated.

For the North Area, site-specific hazard indices (His) for surface and subsurface soil for all receptors were less than or equal to 1 on a target-organ or system basis under the Reasonable Maximum Exposure (RME) scenario; therefore, adverse non-carcinogenic effects are not anticipated for exposures to soil for any of the receptors evaluated. HIs for child and adult residents exposed to groundwater exceeded 1 due primarily to manganese and thallium; however, manganese and thallium were eliminated as COCs based on the results of the uncertainty analysis. Incremental lifetime cancer risks

(ILCRs) for surface and subsurface soil for all receptors were less than or within EPA's target risk range of  $1\times 10^{-4}$  to  $1\times 10^{-6}$ . Medium-specific ILCRs for child and lifelong residents exposed to groundwater exceeded EPA's target risk range, and total ILCRs for child and lifelong residents exceeded EPA's target risk range. Vinyl chloride was the primary risk driver for exposures to groundwater in the North Area of the site. Potential human health risks associated with the subsurface vapor intrusion pathway into indoor building air were within EPA's target risk range.

For the South Area, site-specific HIs for surface and subsurface soil for all receptors were less than or equal to 1 on a target-organ or system basis under the RME scenario; therefore, adverse non-carcinogenic effects are not anticipated for exposures with soil for any of the receptors evaluated. HIs for child and adult residents exposed to groundwater exceeded 1, and arsenic was the primary risk driver. Manganese was also identified as a primary risk driver but was eliminated as a COC based on the uncertainty analysis. ILCRs for soil for all receptors were less than or within EPA's target risk range of  $1\times 10^{-4}$  to  $1\times 10^{-6}$ . Medium-specific ILCRs for child, adult, and lifelong residents exposed to groundwater and total cancer risk estimates for these receptors exceeded EPA's target risk range. TCE, vinyl chloride, and arsenic were the primary risk drivers for exposures to groundwater. Potential human health risks associated with the subsurface vapor intrusion pathway into indoor building air were within EPA's target risk range.

The chemicals retained as COCs upon completion of the HHRA include vinyl chloride in North Area groundwater and TCE, vinyl chloride, and arsenic in South Area groundwater. Unacceptable risks are associated with direct contact exposures to groundwater, primarily through incidental ingestion; vapor intrusion risks are acceptable. No chemicals were retained as ecological chemicals of potential concern for plants, invertebrates, or wildlife as a result of the ERA. Therefore, it was concluded that no further evaluation of ecological risk is warranted. Although risks associated with exposure to soil at the site were acceptable for all human health and receptors based on the results of the revised risk assessment, the selected remedy requires preventing exposure to the contents of the ash landfill/dump area.

Based on the results of the post-removal action risk re-evaluation, an OPS Demonstration Report was prepared to document completed and ongoing remedial actions for soil and groundwater at the site (Tetra Tech, 2020). A successful OPS demonstration to EPA is required deeded transfer of property within CERCLA sites undergoing long-term remedial actions prior to the attainment of all environmental cleanup objectives. EPA approval of the OPS Determination Report is one facet of the deed transfer process for federally owned property. As documented in the EPA-approved OPS Demonstration Report, the current remedy is protective of human health

because exposure to the contents of the ash landfill/dump area and groundwater use are prevented by LUCs. LUCs will continue until groundwater COC concentrations decrease to less than cleanup levels, as determined by the continued LTM program. Potential future migration of groundwater to off-site areas or to nearby surface water or sediment is also monitored via the LTM program.

## 5.6 Five-Year Review Process

### 5.6.1 Document and Analytical Data Review

Documents reviewed as part of this five-year review are referenced throughout the text and are included by site in the reference section (Section 10). Site 9 monitoring began in March 1995, and as of fall 2019, a total of 50 LTM events have been completed. Site 9 LTM currently includes sampling of groundwater, surface water, and sediment and water level measurements at wells and stream gauges in accordance with the Base-Wide QAPP (Tetra Tech, 2015e). The five-year review sampling event at Site 9 was conducted in October 2019 and includes collection of samples from 12 wells and one surface water one and sediment sample from the same location. All groundwater samples were analyzed for Target Compound List (TCL) VOCs, and samples from three wells were also analyzed for TAL metals. The surface water sample was analyzed for TCL VOCs and TAL metals, and the sediment sample was analyzed for TAL metals. Water level measurements were collected from 19 wells and two stream gauges. The Base-Wide QAPP stated that groundwater results are to be compared to EPA MCLs and MEDEP MEGs for drinking water, but MEGs have been replaced by RAGs for residential and construction worker exposure scenarios (MEDEP, 2018).

The conclusions for the Site 9 LTM program, based historical and current monitoring results, are as follows:

- VOC concentrations, except TCE at MW-09-001 and VC at MW-09-003 and MW-09-005A, were either less than detection limits or less than MCLs and RAGs during the October 2019 event.
- Vinyl chloride concentrations in groundwater from well MW-09-003 have decreased since 2009 and have been relatively stable/decreasing at a slower rate since April 2014. Vinyl chloride concentrations in groundwater from well MW-09-005A have been steadily decreasing since 2016.
- At MW-09-076A, located downgradient of the ash landfill/dump area, cis-1,2-DCE and TCE have been detected at concentrations less than screening levels since the

well was installed. MW-09-076, located adjacent to MW-09-076A, historically and during the 2019 sampling event, did not have detectable levels of chlorinated VOCs, except for a single vinyl chloride detection in September 2016 of 0.32 µg/L, which is slightly greater than the Site 9 ROD groundwater cleanup goal and current RAGs of 0.15 and 0.19 µg/L, respectively.

- cis-1,2-DCE and TCE have been detected at MW-09-074, located downgradient of the ash landfill/dump area, throughout the LTM program; however, concentrations have been less than screening levels since May 2001.
- MW-09-002A, MW-09-002B, MW-09-003, MW-09-004, MW-09-005A, MW-09-005B, and MW-09-076A were installed in December 2008 to assess groundwater contaminant migration. With the exception of VC at MW-09-003 and MW-09-005A, VOC detections in these wells have been less than screening levels, as discussed above.
- Inorganic chemicals are present at the site as a result previous ash disposal. In October 2019, arsenic in well MW-09-005B and manganese in wells MW-09-005A and MW-09-204 were detected at concentrations exceeding residential RAGs. Arsenic concentrations in well MW-09-005B have decreased since 2016. Manganese concentrations in wells MW-09-005A and MW-09-204 have fluctuated over time.
- Barium concentrations in both surface water and sediment from co-located samples SED/SW-010 exceeded RBESVs (EA, 2006) during the 2019 monitoring event. Barium concentrations in SW-010 have remained consistent overtime, while barium concentrations in SED-010 has decreased since 2015. Additionally, iron and manganese concentrations in the surface water sample, SW-010, exceeded RBESVs in 2019, and have remained consistent over time, with some fluctuation.

## 5.6.2 Site Inspections

Site inspections are conducted during each long-term monitoring sampling event in the spring of each year. The most recent LTM event was completed in May 2019. In addition, the annual LUC inspection was conducted at Site 9 on September 20, 2019. Photographs taken during this inspection are included in Appendix A. The results of the inspections conducted during monitoring events are documented in the monitoring event reports generated for each LTM event. No issues impacting remedy protectiveness were noted during the 2019 LUC inspection, and based on the results of the inspection, the Site 9 remedy is functioning as intended and remains protective.

### **5.6.3 Interviews**

The Navy holds regular Restoration Advisory Board (RAB) meetings for former NAS Brunswick to discuss the process of the cleanup program and ongoing investigations, Navy property transfer actions and/or site status. Interview questionnaires were emailed to 11 potential interviewees, and four completed questionnaires were returned. The list of interviewees and returned questionnaires are included in Appendix C. No concerns related to remedy protectiveness at any of the sites were included in the responses, although general incidences of vandalism at Brunswick Landing were mentioned. The findings of this fifth five-year review will be presented at a future RAB meeting after finalization of this report in September 2020.

## **5.7 Technical Assessment**

### **5.7.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?**

The review of documents, risk assumptions, and results of the site inspection indicate that the Site 9 remedy is functioning as intended by the 1999 ROD. LTM is being conducted to assess the progress of natural attenuation in reducing concentrations of VOCs in groundwater and verifying that contaminated groundwater is not migrating off site and that residual soil contamination is not migrating to groundwater or surface water at levels of concern.

Implementation of LUCs to prevent groundwater use provides protection of human health and the environment until groundwater cleanup goals are met, and LUCs to prevent soil disturbance preclude exposure to soil that may be associated with unacceptable risks.

The remedial actions are being implemented as designed and include measures that prevent exposure. The remedial actions currently in operation (LUCs and LTM) are operating as designed, and the data indicate progress toward meeting the RAOs. Based on the completed and ongoing activities, the intent and goals of the Site 9 ROD have been or will be met.

## **5.7.2 Question B: Are the Assumptions, Toxicity Data, Cleanup Values, and RAOs Used at the Time of the Remedy Selection Still Valid?**

Changes in physical conditions at the site from the time of the ROD include the following:

- Excavation and off-site disposal of a significant quantity of ash-impacted soil.
- Demolition of barracks at Site 9, four of which were constructed over the former landfill.
- Identification of ash-impacted soil outside of the former LUC boundary, as established in the NAS Brunswick Operating Instruction 5090.1C.

Removal of ash-impacted soil reduced risks associated with potential exposure to soil at Site 9 and reduced the potential for contaminants in soil to migrate to groundwater or surface water. The 2005 demolition of barracks allowed the Navy to complete the removal of approximately 49,000 tons ash/contaminant-impacted Site 9 soil, thereby reducing potential future risks posed by this contamination. Identification of ash outside of the previous LUC boundary does not impact the protectiveness of the remedy because LUCs have now been implemented over all areas within which residual ash has been observed per the 2015 NAS Brunswick multi-site LUC ESD and Base-Wide LUCIP.

The change in site conditions associated with the closing of the base was addressed via the 2015 multi-site LUC ESD, as described above. In addition, the LUC RD for Site 9 (included as an appendix to the Base-Wide LUCIP) includes provisions that LUCs be incorporated into any future leases or property transfer documents and that EPA and MEDEP be notified of any transfer actions. The LUC boundary in the LUC RD encompasses all of the areas identified as associated with the ash landfill based on the most recent data. According to the Brunswick Naval Air Station Reuse Master Plan (Matrix Design Group, 2007), planned future uses of Site 9 include commercial/industrial (business and technology industries) in the south and mixed use (which could include commercial/industrial and/or residential/recreational uses) in the north.

There have been no other changes in the physical conditions of the site that would affect the protectiveness of the remedy.

### **5.7.2.1 ARARs and Site-Specific Action Level Changes**

The ARAR evaluation did not identify any changes that would call into question the current protectiveness of the remedy and is further discussed below.

Groundwater cleanup goals for Site 9, as documented in the ROD, were based on federal MCLs for 1,2-DCA and 1,2-DCE and the Maine MEG for vinyl chloride. The current residential RAG for vinyl chloride is 0.19 µg/L (MEDEP, 2018). This change is not expected to have a negative impact on the remedy or to have altered the remedy selected at the time of the ROD because the Site 9 groundwater cleanup goal is 0.15 µg/L and therefore continues to be protective. The MCLs for 1,2-DCA and 1,2-DCE have not changed.

#### **5.7.2.2 *Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods***

On January 19, 2017, EPA issued revised (less carcinogenic) cancer toxicity values and new non-cancer toxicity values for benzo(a)pyrene. Benzo(a)pyrene did not have non-cancer toxicity values prior to January 19, 2017. Benzo(a)pyrene is now considered to be carcinogenic by a mutagenic mode of action; therefore, cancer risks are now evaluated for different human developmental stages using ADAFs for different age groups. The cancer potency of other carcinogenic PAHs is adjusted by the use of RPFs, which are expressed relative to the potency of benzo(a)pyrene. The non-cancer effects of benzo(a)pyrene were not evaluated in the past due to the absence of non-cancer values. PAHs were only detected at levels of concern in soil at Site 9, and these changes would not have altered the selection of the remedy or the protectiveness of the remedy as implemented (LUCs currently prohibit exposure to potential PAH-contaminated subsurface soil in the ash landfill/dump area of Site 7).

In 2014, EPA finalized a Directive to determine groundwater exposure point concentrations (EPCs) (<https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236917>). This Directive provides recommendations to develop groundwater EPCs. The recommendations to calculate the 95-percent upper confidence limit (UCL) of the arithmetic mean concentration for each contaminant from wells within the core/center of the plume, using the statistical software ProUCL, could result in lower groundwater EPCs than the maximum concentrations routinely used for EPCs as past practice in risk assessment, leading to changes in groundwater risk screening and evaluation. In general, this approach could result in slightly lower risk or higher screening levels. (EPA. 2014).

Also in 2014, EPA finalized a Directive to update standard default exposure factors and frequently asked questions associated with these updates.  
[https://www.epa.gov/sites/production/files/2015-11/documents/oswer\\_directive\\_9200.1-120\\_exposurefactors\\_corrected2.pdf](https://www.epa.gov/sites/production/files/2015-11/documents/oswer_directive_9200.1-120_exposurefactors_corrected2.pdf). Many of these exposure factors differ from those

used in the risk assessment supporting the ROD. These changes in general would result in a slight decrease of the risk estimates for most chemicals (EPA. 2014).

Although calculated risks from potential exposure pathways at former NAS Brunswick sites may differ from those previously estimated, slightly higher for some contaminants and slightly lower for others, the revised methodologies themselves are not expected to affect the protectiveness of the remedy. A review of site information identifies that these updates do not call into question the protectiveness of the remedy.

The exposure assumptions used are considered to be conservative and reasonable in evaluating risk and developing risk-based cleanup levels. No changes to these assumptions or the cleanup levels developed from them is warranted. There have been no changes to the standardized risk assessment methodology, other than those noted above, that could affect the protectiveness of the remedy. Finally, as presented in Section 5.5, Site 9 human health and ecological risks were re-evaluated using post-soil removal and LTM groundwater data sets. Current risk assessment methodologies were used and concluded that risk posed by site soils are within EPA's acceptable thresholds for cancer and non-cancer risks. Elevated risk associated with hypothetical future residential consumption of site groundwater is consistent with the conclusions previously determined in the RI.

Vapor intrusion was evaluated as part of the recent updated risk assessment conducted for Site 9 (Tetra Tech, 2020) using current methodology and screening values. Potential human health risks associated with the subsurface vapor intrusion pathway into indoor building air were within EPA's target risk range for both the North and South Areas of the site.

### **5.7.3      Question C: Has any other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?**

No additional human health or ecological risks have been identified, and no weather-related events have affected the current protectiveness of the remedy. No other information has been identified that calls into question the protectiveness of the remedy.

### **5.7.4      Technical Assessment Summary**

Based on the data reviewed and the site inspection, the remedy is functioning as intended by the 1999 ROD. There have been no changes in toxicity factors for the COCs or to the standardized risk assessment methodology that would affect the protectiveness of the remedy. Issues related to the change in land use associated with

closure of the base have been addressed via the LUC ESD and RD. Changes in physical conditions at the site (see Section 5.7.2) were taken into account in the revised risk assessment. There is no other information that calls into question the protectiveness of the remedy.

## 5.8 Issues

No deficiencies were identified during this five-year review of the Site 9 remedy, and no issues related to site operations, conditions, or activities prevent the remedy from being protective at this time or in the future.

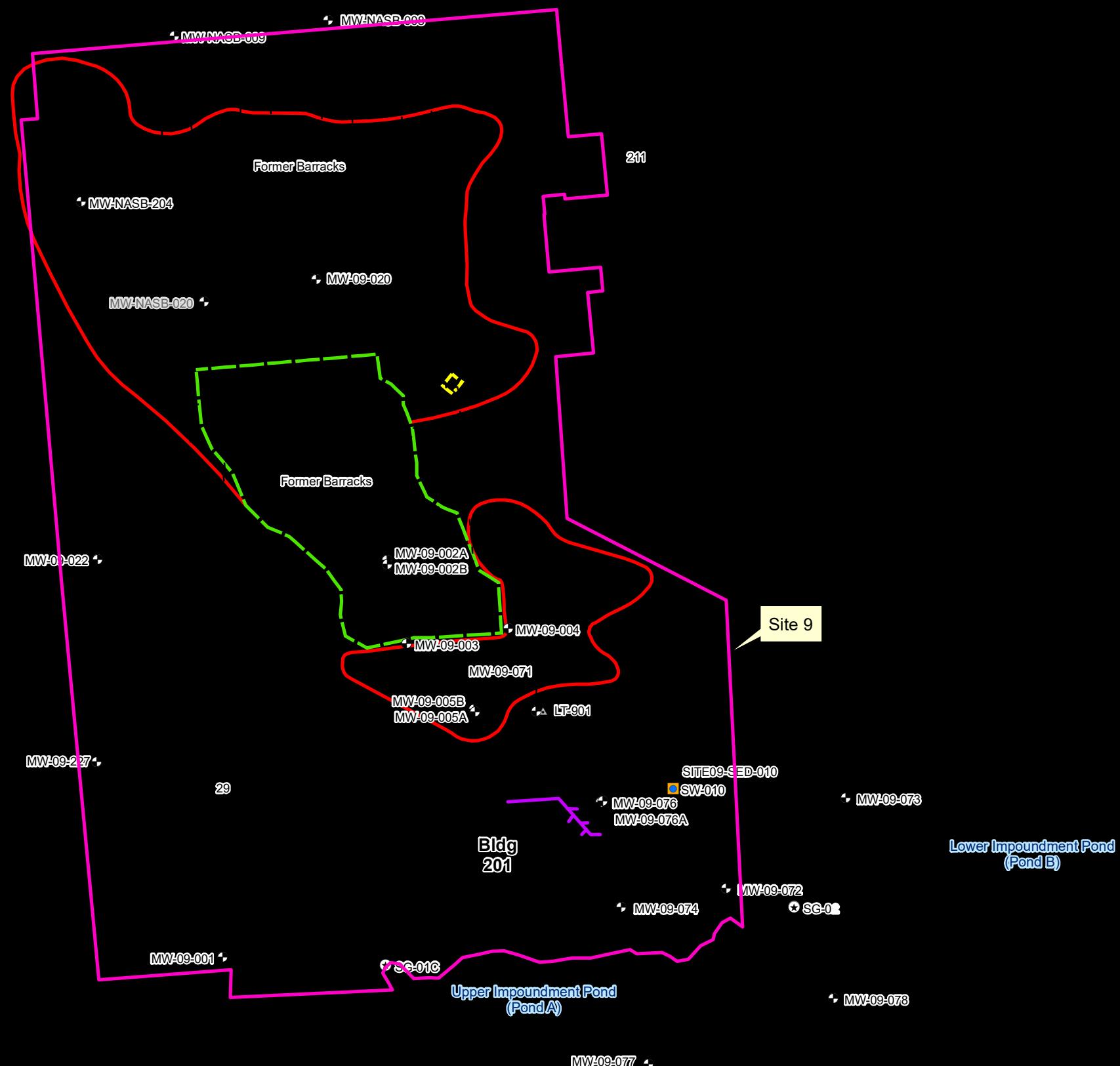
## 5.9 Recommendations and Follow-Up Actions

Because no issues affecting the protectiveness of the remedy were identified, there are no recommendations for Site 9, and no follow-up actions are required.

## 5.10 Protectiveness Statement

<b>Protectiveness Statement(s)</b>		
<i>Operable Unit:</i>	<i>Protectiveness Determination:</i>	<i>Planned Completion Date:</i>
OU6, Site 9	Protective	
<i>Protectiveness Statement:</i> The remedy implemented at Site 9 is protective of human health and the environment. Exposure to soil and groundwater, which could result in unacceptable risks, is prevented through maintenance of LUCs implemented across the expanded ash-impacted area. Groundwater monitoring and implementation of LUCs provide protection until completion of the remedy is achieved. The results of future groundwater monitoring will be used to continue to evaluate the effectiveness of the remedy. The remedial actions have been implemented as designed and include measures that prevent exposure, and the remedial actions that are completed (LUCs) and ongoing (LTM) are operating as designed. Long-term protectiveness of the remedy will be verified by continued monitoring in accordance with the Base-Wide QAPP and through LUC inspections in accordance with the LUC RD to ensure continued maintenance of the LUCs implemented upon finalization of the LUC RD. Based on the activities that are completed and ongoing, the intent and goals of the Site 9 ROD have been or will be met.		

Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2017 ESRI and its data suppliers).



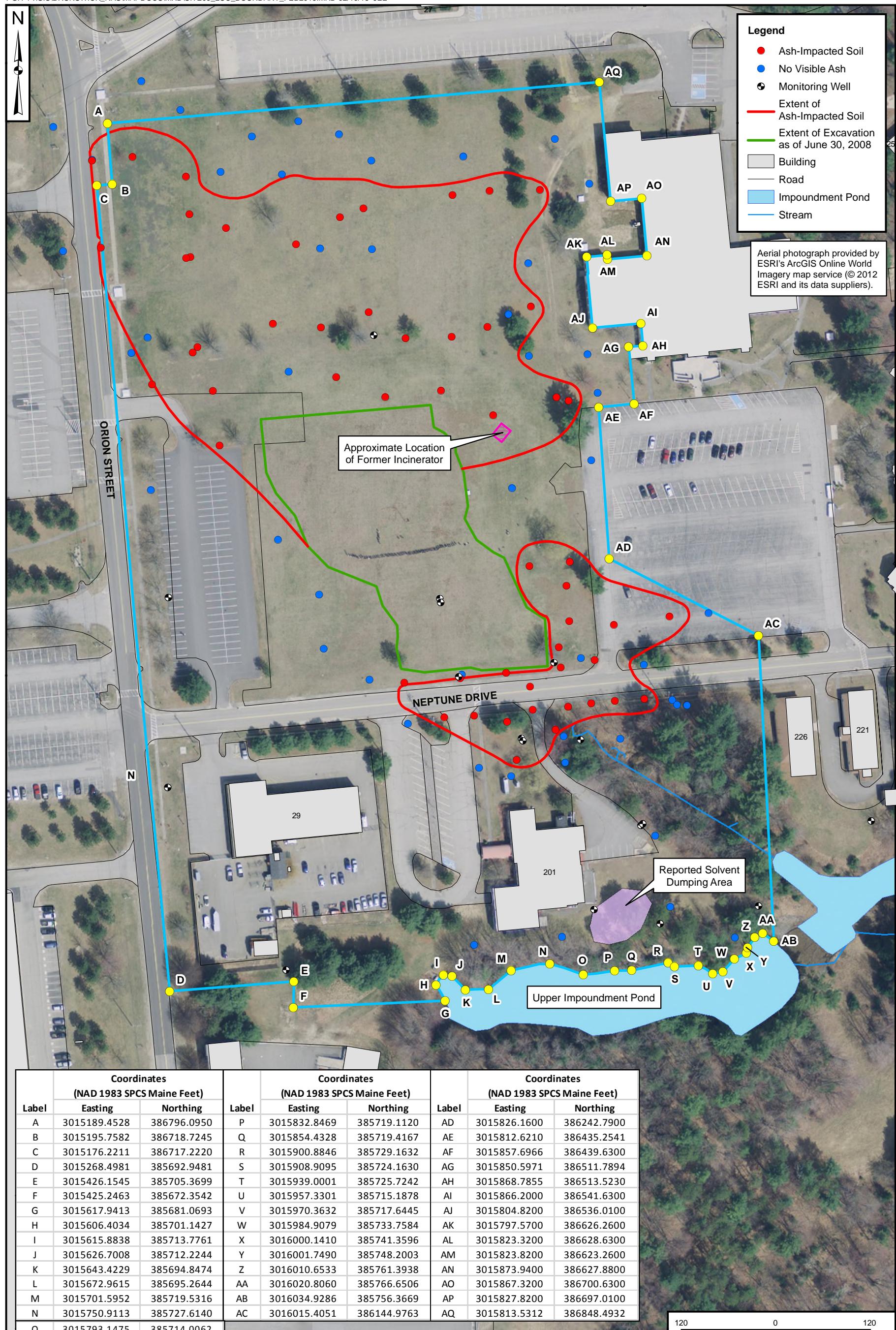
#### Legend

● LTM Monitoring Well	— Extent of Ash-Impacted Soil Based On Visible Observations of Ash
★ Staff Gauge	— Abandoned Septic System
▲ Leachate Seep Station	— Reported Solvent Disposal Area
● LTM Surface Water Location	— Approximate Location of Old Incinerator
■ Sediment Sample Location	— Site 9 LUC Boundary
— Approximate Excavation Limit (June 2008)	

150 0 150 Feet

SITE 9, NEPTUNE DRIVE DISPOSAL SITE  
FORMER NAVAL AIR STATION  
BRUNSWICK, MAINE

CTO N4008518F5894	DATE
DRAWN BY K. MOORE	09/09/20
CHECKED BY R. MILLER	09/09/20
FIGURE NUMBER 5-1	

DRAWN BY DATE  
J. ENGLISH 02/04/16**TETRA TECH**CONTRACT NUMBER  
2330  
CTO NUMBER  
WE49CHECKED BY DATE  
R. MILLER 02/10/16APPROVED BY DATE  
— —

REVISED BY DATE

APPROVED BY DATE  
— —SITE 9 - NEPTUNE DRIVE DISPOSAL SITE  
LAND USE CONTROL BOUNDARIES  
FORMER NAVAL STATION  
BRUNSWICK, MAINEFIGURE NO.  
5-2SCALE  
AS NOTEDREV  
0

## **6.0 OU9, Site 12, EOD Area**

### **6.1 Site Description**

Site 12, EOD Area, was reportedly used from 1981 through 2004 for the disposal of small quantities of ordnance, pyrotechnics, privately manufactured explosive devices, and war souvenirs, although aerial photography indicates that the site may have been in use for explosives disposal prior to 1981. EOD operations at NAS Brunswick, including Site 12, were officially terminated on June 1, 2004. The site was also used for landfilling of non-munitions construction debris and reportedly may have included a former sand and gravel borrow pit. The ROD for Site 12 was signed in September 2015; therefore, this is the first five-year review of the remedy for this site.

Site 12 Explosive Ordnance Disposal (EOD) Area was originally defined as an approximately 112.7-acre site located in the southeastern portion of former Naval Air Station (NAS) Brunswick in a remote, open, upland area on Buttermilk Mountain. The site boundary was initially based on the 1,250-foot Inhabited Building Distance (IBD) established as the range limit; however, the actual area where munitions and explosives of concern (MEC) were expected to be present (i.e., the area within the perimeter road) was much smaller based on the conceptual site model (CSM) developed for the Preliminary Assessment (PA) and PA Addendum (Malcolm Pirnie, 2006 and 2007).

### **6.2 Site Chronology**

A list of important Site 12 historical events and relevant dates in the site chronology is shown below. The identified events are illustrative, not comprehensive. Further information about activities and actions at the site can be found in the Administrative Record available as part of the Information Repository at the Curtis Memorial Library, 23 Pleasant Street, Brunswick, Maine, 04011-2261.

<b>Event</b>	<b>Date</b>
Base-Wide IAS	June 1983
Base-Wide Site Inspection	June 1985
Draft Final Supplemental RI Report	August 1991
Draft Final Supplemental FS	1991
Draft Final FS	1992
Munitions Program Preliminary Assessment	2007
Munitions Program Site Inspection	2009

Event	Date
Action Memorandum for Time-Critical Removal Action (TCRA) and TRCA Report	2012
Bedrock Fracture Trace Analysis	2012
Technical Memorandum, Groundwater Report	2013
Hydrographic, Side-Scan Sonar, Time-Domain Electromagnetic Induction, and Probing Survey of Site 12 Pond	2013
Technical Report, Site 12 Pond Sediment Report	2014
MC RI	2015
Action Memorandum and MEC RI	2014 and 2015
Action Memorandum and Berm Area Remedial Action	2014 and 2015
FS	2015
ROD	September 2015
LUCIP, including LUC RD for Site 12	September 2016
Draft 2020 Update to Base-Wide LUCIP/LUC RDs	2020

## 6.3 Background

### 6.3.1 Physical Characteristics

Site 12 is currently defined as approximately 23 acres in size, and a large portion of the site was covered with tall grasses until vegetation removal associated with Navy investigation and munitions clearance activities were completed. A pond complex consisting of two small ponds separated by a marshy area is located on the eastern edge of the site and is surrounded by mature trees. Wetlands are present near the pond and in the northcentral portion of the site. A 5- to 6-foot-tall, semi-circular, earthen berm approximately 24 feet wide and 255 feet long, within which historical detonations were conducted, was investigated and removed in 2014. Additionally, several suspected berms were identified based on review of historical aerial photographs, and the area encompassing these berms was investigated and addressed via a removal action in 2014.

Surficial materials at Site 12 include approximately 3 to 6 inches of topsoil and 6 inches to 2.5 feet of reworked surface soil with fill. The underlying clay with varying amounts of silt (interpreted as the Presumpscot Clay) ranges from approximately 3 to 9 feet thick. Bedrock crops out east of the overall berm area along Perimeter Road. The schist bedrock, identified as the Cape Elizabeth Formation, at Site 12 occurs below the Presumpscot Clay at depths ranging from approximately 4 to 10 feet bgs. Shallow bedrock to approximately 20 feet bgs was broken or had significant water loss during coring, and similar head elevations in site monitoring wells support the interpretation of

the interconnectedness of fractures in shallow bedrock. Groundwater flow appears to be seasonally influenced in the Site 12 area, with flow during the drier summer period to the northwest across the Site 12, from the pond toward the wetlands, and flow during the wetter winter period to the northwest and east from the center of the site (see Figure 6-2). Based on hydraulic head elevations above the bedrock-overburden interface, groundwater at Site 12 is generally confined in the bedrock within the overall berm area. During boring advancement at Site 12, reworked soil/fill material (0 to 3 feet bgs) was observed as being moist to wet, and the top 2.5 feet of the clay was dry, suggesting low permeability and potentially low hydraulic connectivity between the reworked soil/fill overburden and bedrock.

### **6.3.2 Land and Resource Use**

Site 12 was the former location of an EOD area and was also used for disposal of non-munitions construction debris and reportedly may have included a former sand and gravel borrow pit. The site area is currently inactive, and no structures are present within the site boundaries.

### **6.3.3 History of Contamination**

A 1978 aerial photograph shows a circular berm-like feature present on site, indicating that activities (that may or may not have been EOD related) were taking place at Site 12 prior to 1978. Otherwise, existing documentation indicates that Site 12 was used from 1981 through June 2004 for the disposal of small quantities of ordnance, pyrotechnics, privately manufactured explosive devices, and war souvenirs. The site was officially designated a Class "D" disposal site with a maximum limit of 25 pounds net explosive weight (NEW) on September 18, 1990. It was briefly designated as a training area with a maximum limit of 5 pounds NEW and bare charges only in June 2000. In October 2002, the site was restored to a Class "D" operation with a limit of 25 pounds NEW and retained that status until June 1, 2004, when EOD activities at NAS Brunswick were officially terminated. It was reported by E.C. Jordan Company (1991a) that between 1984 and 1989, EOD activity had consisted of six "burns" for training and destruction of ordnance/explosives. The site was also used for disposal of non-munitions construction debris. E.C. Jordan Company (1991b and 1992) also reported that the EOD pit area included what appeared to be a former sand/gravel borrow pit.

A 5- to 6-foot high, semi-circular, earthen berm approximately 24 feet wide and 255 feet long, was previously located at the site. The berm was razed during the Berm Area Remedial Action (Bering Sea Eccotech/Parsons, 2015). A dumpster within the berm area, historically used for flashing small quantities of explosives and/or propellants such

as grenade fuzes, was removed from the site in the 1990s. Military personnel occupied one control bunker located approximately 200 feet southwest of the former earthen berm mound during detonation of explosive charges. This control bunker was also razed during the Berm Area Remedial Action. In addition to the berm that was removed in 2014, several suspected historical berms were identified at Site 12 based on review of aerial photography.

A pond located on the eastern edge of the site was partially filled in with stumps and dirt related to the establishment of the EOD area in the early 1980s. No historical documentation of MEC disposal in the pond were found; however, it was suspected to have potentially occurred. MEC clearance of the pond was conducted in 2014 (USA Environmental, 2015).

The presumed source materials at Site 12 are munitions items assumed to remain at the site as a result of past EOD activities. The potential threat to human health and the environment from MC was evaluated in the MC RI, and no unacceptable risks to human health or the environment were identified. There is the potential for MEC/material potentially presenting an explosive hazard (MPPEH) to be present at the site in the subsurface in areas that have not been cleared to depth. The munitions removal efforts to date at Site 12 have cleared the entire site ground surface, the subsurface up to 2 feet bgs within the former berm area (with partial clearance below 2 feet bgs), and the pond and surrounding area. Although subsurface munitions items were primarily of concern only within the former berm area, it is possible that munitions items may remain in the subsurface below 2 feet bgs in the berm area, although exposure would be unlikely because an orange geotextile liner was placed at 2 feet bgs to demarcate the depth of munitions clearance. Additionally, although unlikely, MEC/MEPPEH items may remain in the kickout area of the site that was not completely cleared to depth. MEC/MPPEH and other munitions-related items presumed to be present at this site are not expected to migrate significantly from the subsurface to the ground surface (as result of erosion, frost heave, and other natural changes to the ground surface at the site). Upward migration of MEC/MPPEH to the ground surface is very unlikely and not a significant concern because the top 2 feet of the MEC area of primary concern (former berm area) have been remediated, and the liner placed at the bottom of the excavated area is expected to significantly inhibit upward migration of any munitions-related items that may remain at depths deeper than 2 feet in this area.

### **6.3.4 Initial Response and Basis for Taking Action**

In June 1983, an IAS was completed that detailed historical hazardous material usage and waste disposal practices at NAS Brunswick. The IAS identified the EOD Area as a

range or impact zone. No further information was provided.

A Draft Final Supplemental RI was completed in 1991, and an FS was completed in 1992 by E.C. Jordon. The FS found a No Action alternative appropriate for Site 12 because the baseline risk assessment did not indicate a risk to either human health or the environment; therefore, an initial response was not required. However, due to continued use of Site 12 after completion of the 1991 RI/FS, additional investigation activities were requested by MEDEP to confirm the findings of the 1991 RI/FS and to determine whether continued use of the EOD area had created any additional environmental impacts. The MC RI was conducted from 2012 to 2014 to further investigate the nature and extent of MC contamination associated with the historical activities at Site 12. The results of the MC RI indicated that human health and ecological risks associated with chemical concentrations in site media were within acceptable risk levels, and no remedial actions are required to address MC at the site. As part of the 2015 FS, qualitative MEC Hazard Assessments (HAs) were performed to assess current and future explosive hazards to current and future human receptors at Site 12. Based on site history and MEC/MPPEH items at the site observed during previous clearance activities, it is presumed that MEC/MPPEH are present in uncleared subsurface areas of the site, and based on the associated potential explosive hazard, remedial action was determined to be required at the site.

## **6.4 Remedial Actions**

### **6.4.1 Remedy Selection**

As established in the 2015 ROD, the RAO for Site 12 is to prevent the direct contact explosive hazard associated with potential exposure to MEC/MPPEH items that may still be present at the site, while still allowing site access. This RAO is based on the planned future non-intrusive passive recreational use of the site as a Natural Area. Because there are no MC COCs (i.e., no MC in site media are associated with unacceptable risk), no medium-specific cleanup goals were established in the ROD.

The selected remedy for Site 12 includes implementation of LUCs to limit use of the property and to prevent intrusive activities that could result in exposure to munitions items potentially remaining in the subsurface at the site. The selected remedy was determined to be protective of human health and the environment, to attain ARARs, and to be cost effective. The remedy complies with the identified chemical-specific ARARs; no location- or action-specific ARARs were identified for Site 12.

## **6.4.2 Remedy Implementation**

The LUC performance objectives for Site 12 are as follows:

- To prohibit use of the site for anything other than non-intrusive passive recreational activities. Only those recreational uses that would not significantly alter the environment will be permitted (e.g., hiking, jogging, bird watching, and hunting). Residential, industrial/commercial, intrusive recreational, and agricultural uses of the site will be prohibited.
- To prohibit any kind of intrusive activities, below the ground surface, within the LUC boundary without prior written approval from the Navy, EPA, and MEDEP.
- To maintain the integrity of any future monitoring or remediation system(s).

The LUCs required to achieve these performance objectives, as provided in the LUC RD for Site 12, are as follows:

- Prevent use of the site for anything other than non-intrusive passive recreational activities.
- Prohibit any kind of intrusive activities, below the ground surface, within the LUC boundary without prior written approval from the Navy, EPA, and MEDEP.
- Protect any future monitoring or remediation and monitoring systems/ components.
- Incorporation of these restrictions into any real estate property documents (i.e., deeds or leases) associated with future sale or lease of the site.
- Posting and maintenance of caution/UXO hazard warning signs.
- Annual LUC inspections to ensure that there are no violations of the above-listed prohibitions and to ensure that no previously buried MEC/MPPEH items are present on the ground surface within the LUC boundary.
- If a violation of the restrictions occurs, a description of the violation and the corrective actions to be taken to restore protectiveness will be reported to EPA and MEDEP.
- Implementation of a public educational program to warn the visiting public of the potential presence of ordnance, the importance of not disturbing (yet reporting) suspect items observed within the LUC boundary, and the importance of not conducting intrusive activities at the site.

These LUCs were implemented upon finalization of the LUC RD, which is included as an appendix to the Base-Wide LUCIP, and the LUCs will be monitored, maintained, enforced, and reported on in accordance with provisions in the LUC RD. Figure 6-2 presents the LUC boundaries for Site 12. The LUC RD also documents the requirements for continuation of the LUCs if all or part of the Site 12 property is transferred out of Navy ownership. Any future construction activities will also require the property owner to submit a Brunswick Landing Construction Permission Request Form to the Navy for approval before the Town of Brunswick will approve a construction permit. The Base-Wide LUCIP is also in the process of being revised and will include the Brunswick Landing Construction Permission Request process as one of the LUC implementing actions.

#### **6.4.3 System Operation/Operation and Maintenance**

The Navy conducts annual LUC inspections at Site 12 to confirm the continued implementation and effectiveness of the LUCs.

### **6.5 Progress Since the Last Five-Year Review**

As stated above, Site 12 was not included in previous five-year reviews because the ROD was not signed until September 2015 (after the date for inclusion in the Fourth Five-Year Review Report).

### **6.6 Five-Year Review Process**

#### **6.6.1 Document and Analytical Data Review**

Documents reviewed as part of this five-year review are referenced throughout the text and are included in the reference section (Section 10). Because no site risks associated with munitions constituents were identified in excess of EPA's threshold criteria for cancer and non-cancer risk, no medium-specific LTM is necessary or required.

#### **6.6.2 Site Inspections**

An annual LUC inspection was conducted at Site 12 on September 20, 2019. Photographs taken during this inspection are included in Appendix A. No issues impacting remedy protectiveness were noted during the 2019 LUC inspection, and

based on the results of the inspection, the Site 12 remedy is functioning as intended and remains protective.

### **6.6.3 Interviews**

The Navy holds regular Restoration Advisory Board (RAB) meetings for former NAS Brunswick to discuss the process of the cleanup program and ongoing investigations, Navy property transfer actions, and/or site status. Interview questionnaires were emailed to 11 potential interviewees, and four completed questionnaires were returned. The list of interviewees and returned questionnaires are included in Appendix C. No concerns related to remedy protectiveness at any of the sites were included in the responses, although general incidences of vandalism at Brunswick Landing were mentioned. The findings of this fifth five-year review will be presented at a future RAB meeting after finalization of this report in September 2020.

## **6.7 Technical Assessment**

### **6.7.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?**

All available information indicates that the Site 12 remedy is functioning as intended by the 2015 ROD. LUCs have been implemented, via the LUC RD, and the LUC objectives are currently being met. The remedial actions are being implemented as designed and include measures that prevent exposure to munitions items potentially remaining in the subsurface at the site. The required remedial actions (implementation of LUCs) are operating as designed, and the RAO is being met. Based on the completed and ongoing activities, the intent and goals of the Site 12 ROD have been met.

### **6.7.2 Question B: Are the Assumptions, Toxicity Data, Cleanup Values, and RAOs Used at the Time of the Remedy Selection Still Valid?**

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. The LUC RD for Site 12 (included as an appendix to the Base-Wide LUCIP) includes provisions that LUCs be incorporated into any future leases or property transfer documents. Site 12 and surrounding property to the north and south of the site were divided into four parcels for transfer and are no longer under Navy control. Two parcels in the northern part of the transfer area were conveyed by deed to

MRRA in February 2018 under an Economic Development Conveyance. Current use of these parcels is as open space.

In December 2017, the Navy assigned the two parcels in the southern part of the area to the Department of the Interior and National Park Service. In July 16, 2018, NPS granted Constructive Possession of the parcels to the Town, which includes all obligations and liabilities of ownership, including responsibility for care and handling, and all risk of loss and damage to the premises. Deeds for transfer of the parcels to the town are pending. The town is currently using these parcels for passive recreational purposes including hiking, biking, and cross-country skiing.

The Brunswick Naval Air Station Reuse Master Plan (Matrix Design Group, 2007), identified planned future use of Site 12 as a Natural Area restricted to passive/non-intrusive recreational activities. Current and planned future reuses are consistent with these restrictions, and for property within the Site 12 LUC boundary, all requirements of the LUD RD were incorporated into the transfer deeds.

#### **6.7.2.1 ARARs and Site-Specific Action Level Changes**

The Naval Sea Systems Command (NAVSEA) policy, *Ammunition and Explosives Safety Ashore, (NAVSEA OP 5, Volume 1, 7th Revision, Change 12, Chapter 14-2.1 and 14-2.1a)* was identified as an ARAR for the Site 12 remedy. This policy requires the Navy to: (1) implement a munitions response action at an identified site prior to its transfer from Department of Defense control and (2) implement LUCs to prevent/limit exposure to any explosive hazards potentially remaining at the site. The ARAR evaluation did not identify any new ARARs or changes to this ARAR that would call into question the protectiveness of the remedy.

#### **6.7.2.2 Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods**

There have been no changes in physical conditions, exposure pathways, or land use that would affect the protectiveness of the Site 12 remedy.

The exposure assumptions used are considered to be conservative and reasonable in evaluating risk and developing risk-based cleanup levels. No changes to these assumptions or the cleanup levels developed from them is warranted. There have been no changes to the standardized risk assessment methodology since the 2015 ROD that could affect the protectiveness of the remedy.

VOCs were not detected at Site 12 at concentrations of concern; therefore, vapor intrusion is not a pathway of concern at the site.

### **6.7.3      Question C: Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?**

No additional human health or ecological risks or munitions hazards have been identified, and no weather-related events have affected the protectiveness of the remedy. No other information has been identified that calls into question the protectiveness of the remedy.

### **6.7.4      Technical Assessment Summary**

Based on the data reviewed and the site inspection, the remedy is functioning as intended by the 2015 ROD. There have been no changes in the physical conditions at the sites or to the standardized MC risk assessment or MEC Hazard Assessment methodologies that would affect the protectiveness of the remedy. There is no other information that calls into question the protectiveness of the remedy. The property that makes up Site 12 was transferred by deed from the Navy to the Department of the Interior/National Park Service (for eventual transfer to the Town of Brunswick) and MRRA. Included in the transfer documents were the LUCs required by the Site 12 ROD, as outlined in Section 6.4.2. No violations of LUCs have occurred since the conveyance of Site 12, and the remedy continues to be protective.

## **6.8      Issues**

No deficiencies were identified during this five-year review of the Site 12 remedy, and no issues related to site operations, conditions, or activities prevent the remedy from being protective at this time or in the future.

## **6.9      Recommendations and Follow-Up Actions**

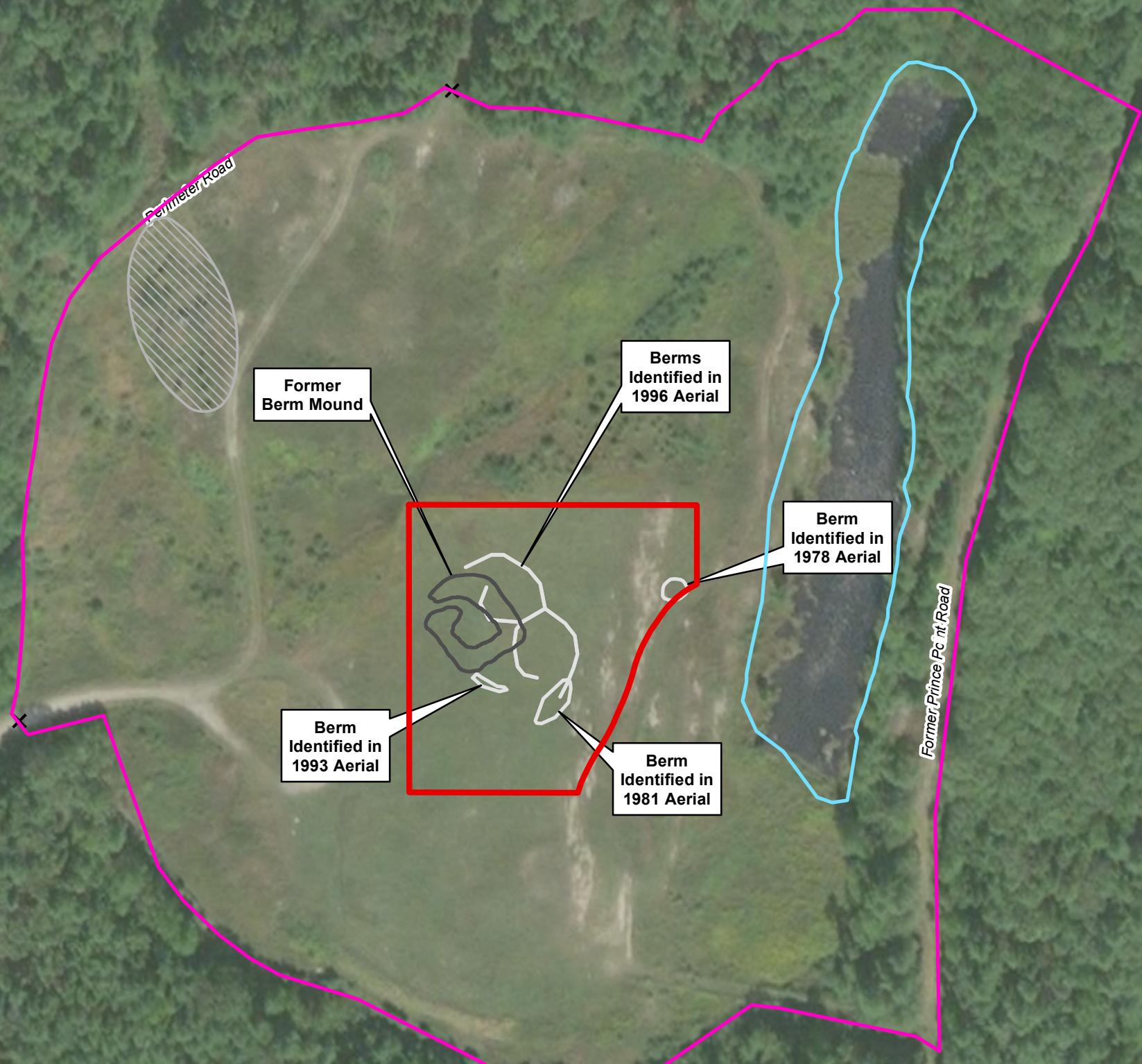
Because no issues affecting the protectiveness of the remedy were identified, there are no recommendations for Site 12, and no follow-up actions are required.

## **6.10 Protective Statement**

<b>Protectiveness Statement(s)</b>		
<i>Operable Unit:</i>	<i>Protectiveness Determination:</i>	<i>Planned Completion Date:</i>
OU9, Site 12	Protective	
<p><i>Protectiveness Statement:</i> The remedy implemented at Site 12 is protective of human health and the environment. LUCs limit use of the property and prohibit intrusive activities that could result in exposure to munitions items potentially remaining in the subsurface at the site. The remedial actions (LUCs) have been implemented and are operating as designed and include measures that prevent exposure. Long-term protectiveness of the remedy will be verified by LUC inspections in accordance with the LUC RD to ensure continued maintenance of the LUCs implemented upon finalization of the LUC RD. Based on the activities that are completed and ongoing, the intent and goals of the Site 12 ROD have been met.</p>		

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#### Legend

✗ Gate in Fence

— Historical Suspect Berm Locations (approximate)

◻ Former Berm Mound (approximate)

■ Berm Area

□ Pond

▨ Steep Rocky Slope

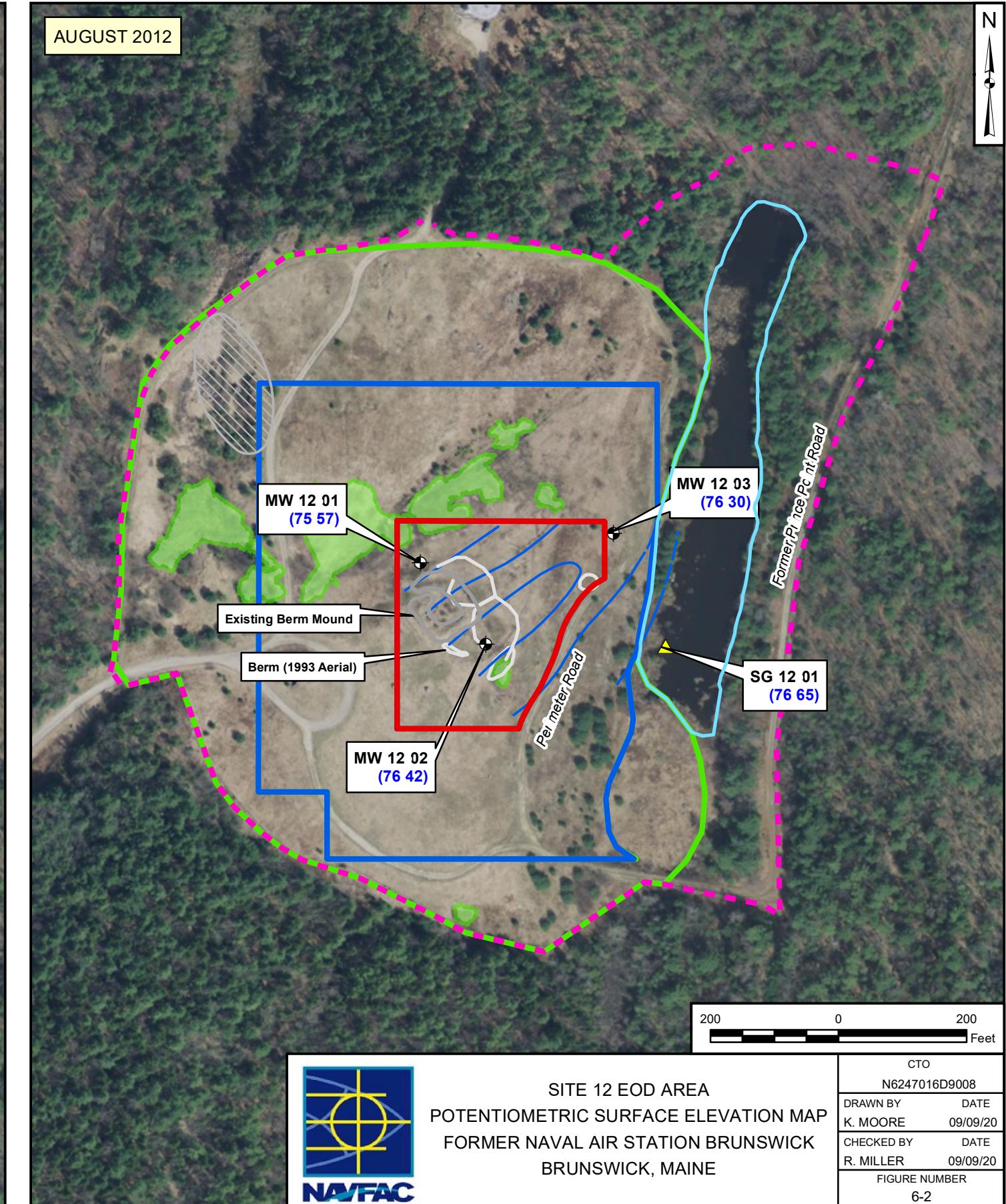
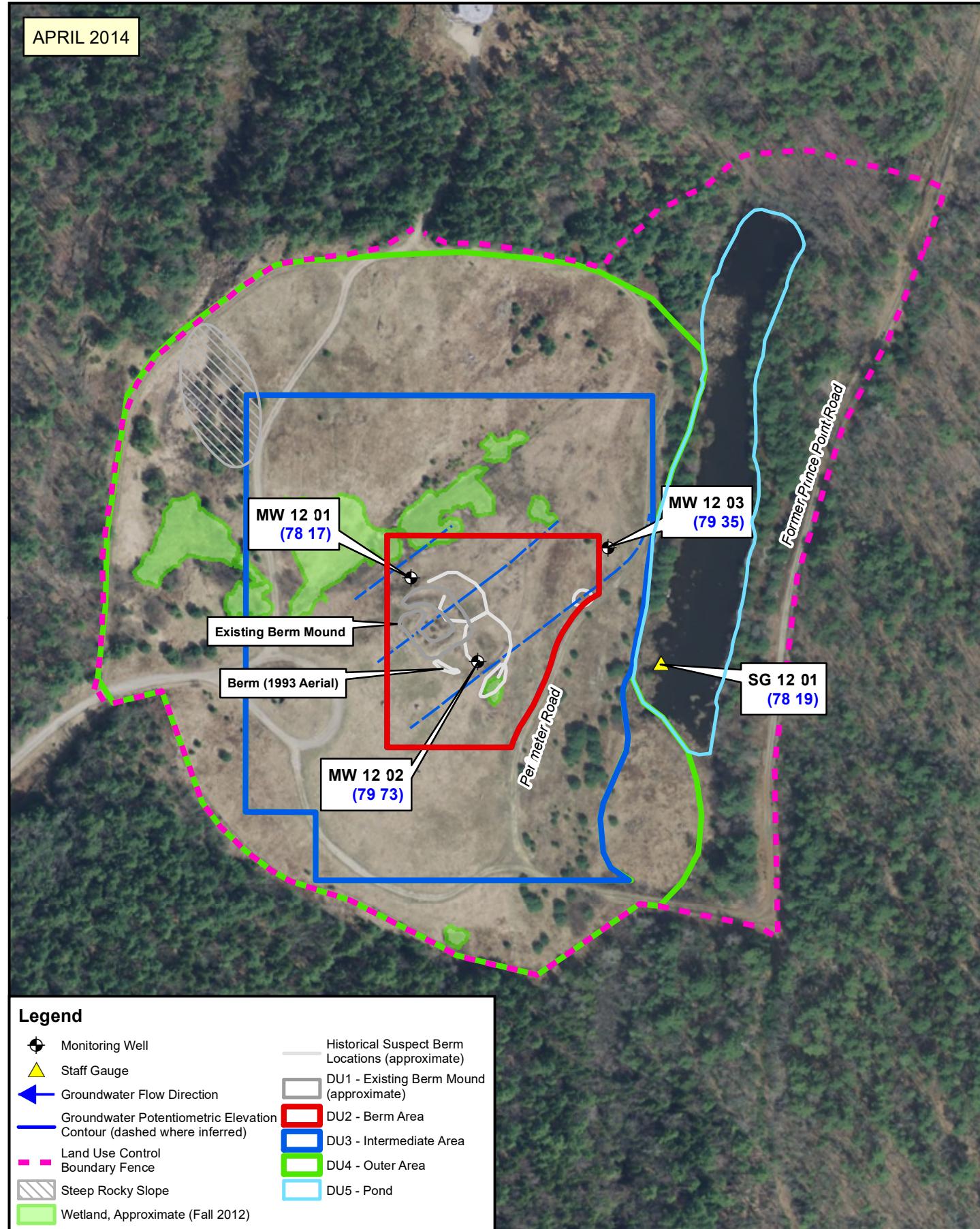
NAD 1983 - North American Datum of 1983  
SPCS - State Plane Coordinate System

150 0 150  
Feet

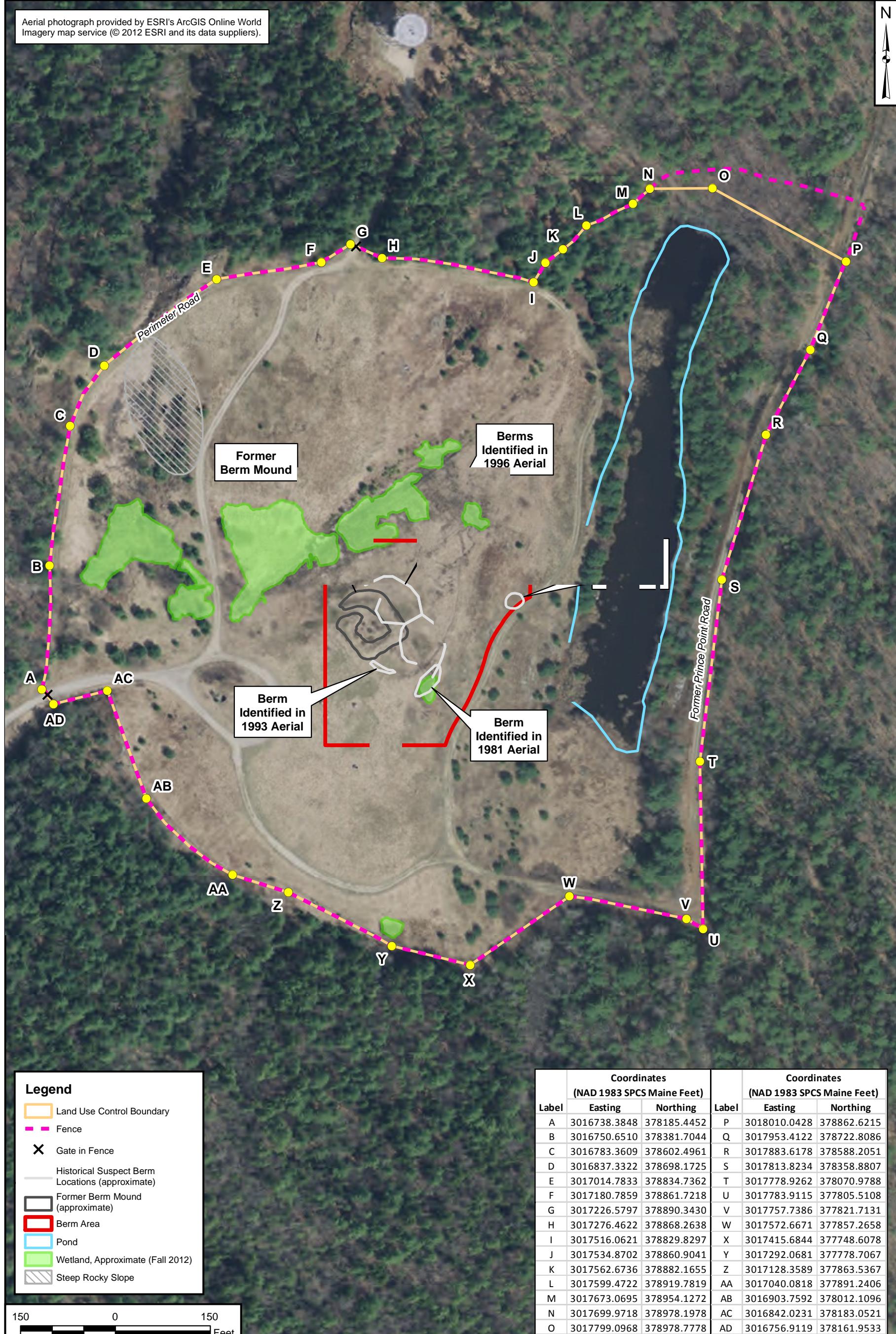


SITE 12, EXPLOSIVE ORDNANCE DISPOSAL AREA  
FORMER NAVAL AIR STATION BRUNSWICK  
BRUNSWICK, MAINE

CTO	N4008518F5894
DRAWN BY	DATE
K. MOORE	04/30/20
CHECKED BY	DATE
R. MILLER	04/30/20
FIGURE NUMBER	
6-1	



Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2012 ESRI and its data suppliers).



Label	Coordinates (NAD 1983 SPCS Maine Feet)		Label	Coordinates (NAD 1983 SPCS Maine Feet)	
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B	3016750.6510	378381.7044	Q	3017953.4122	378722.8086
C	3016783.3609	378602.4961	R	3017883.6178	378588.2051
D	3016837.3322	378698.1725	S	3017813.8234	378358.8807
E	3017014.7833	378834.7362	T	3017778.9262	378070.9788
F	3017180.7859	378861.7218	U	3017783.9115	377805.5108
G	3017226.5797	378890.3430	V	3017757.7386	377821.7131
H	3017276.4622	378868.2638	W	3017572.6671	377857.2658
I	3017516.0621	378829.8297	X	3017415.6844	377748.6078
J	3017534.8702	378860.9041	Y	3017292.0681	377778.7067
K	3017562.6736	378882.1655	Z	3017128.3589	377863.5367
L	3017599.4722	378919.7819	AA	3017040.0818	377891.2406
M	3017673.0695	378954.1272	AB	3016903.7592	378012.1096
N	3017699.9718	378978.1978	AC	3016842.0231	378183.0521
O	3017799.0968	378978.7778	AD	3016756.9119	378161.9533

150 0 150  
 Feet

TELE & TELE

DRAWN BY J. ENGLISH	DATE 12/09/15	 <b>TETRA TECH</b>	CONTRACT NUMBER 0645	CTO NUMBER 069
CHECKED BY R. MILLER	DATE 02/10/16	SITE 12, EXPLOSIVE ORDNANCE DISPOSAL AREA LAND USE CONTROL BOUNDARIES FORMER NAVAL AIR STATION BRUNSWICK, MAINE	APPROVED BY ____	DATE ____
REVISED BY ____	DATE ____		APPROVED BY ____	DATE ____
SCALE AS NOTED			FIGURE NO. 6-3	REV 1

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## **7.0 OU10, Quarry Area**

### **7.1 Site Description**

The Quarry Area is approximately 21 acres in size and includes the Waste Disposal/Fill Area and MEC/MPPEH Kick-Out-Area. The Waste Disposal/Fill Area consists of reworked soil and debris in the northern portion of the site, and the surrounding Kick-Out Area is where ejection of undetonated devices during past munitions disposal operations could have impacted surface soil.

### **7.2 Site Chronology**

A list of important Quarry Area historical events and relevant dates in the site chronology is shown below. The identified events are illustrative, not comprehensive. Further information about activities and actions at the site can be found in the Administrative Record available as part of the Information Repository at the Curtis Memorial Library, 23 Pleasant Street, Brunswick, Maine, 04011-2261.

<b>Event</b>	<b>Date</b>
Rock quarrying activities	1940s and 1950s
Draft Final Supplemental RI Report	August 1991
Landfarming of petroleum-contaminated soils	1992 to 1995
Munitions Program Preliminary Assessment	2007
Munitions Program Site Inspection	2009
Exploratory MEC Investigation	2010
TCRAs	2011, 2012, and 2013
Groundwater Investigations	2012 and 2013
RI for NMC and Other Chemicals	2012 to 2017
MEC RI	2012 to 2017
MEC Interim Removal Action	2016
FS	2017
ROD	2017
Remedial Action Work Plan	2018

Event	Date
Residual MEC Clearance and Soil Cover Installation	2018
Draft 2020 Update to Base-Wide LUCIP/LUC RDs	2020
Draft Remedial Action Completion Report	2019

## 7.3 Background

### 7.3.1 Physical Characteristics

The Waste Disposal/Fill Area of the site occupies approximately 2.8 acres and is relatively flat, but there is a steep slope in the northeastern portion of the site and a steep rock face along the eastern side of this area, a remnant of former quarrying activities. Vegetation in the level portion of the site inside the fenced area consists of thick tall grasses and other rapidly growing native vegetation. Most of the area outside of the fence consists of dense mature forest with very heavy canopy and minimal understory.

### 7.3.2 Land and Resource Use

The Quarry Area is currently inactive. Rock quarrying activities took place at the site in the 1940s and 1950s. From 1992 to 1995, landfarming to remediate petroleum-contaminated soil from NAS Brunswick was conducted by the Navy, in coordination with MEDEP, in previously quarried areas in the eastern portions of the Waste Disposal/Fill Area. The petroleum-contaminated soil was placed directly on top of existing soil and was then fertilized and tilled to promote bioremediation. Significant amounts of debris were observed throughout the southern end of the quarried area, including partially buried scrap metal, tires, and concrete, especially along the rock face. Very little historical information was otherwise available for the site. However, anecdotal accounts indicated that a portion of the Waste Disposal/Fill Area of the site was used for EOD activities. Based on munitions debris identified during MEC investigations and removal actions completed to date, EOD operations were sporadically performed within the previously quarried area, and the area around the quarry was also reportedly used for military/security training exercises using small arms blanks, practice grenades, and smoke grenades.

### 7.3.3 History of Contamination

Evidence that the Quarry Area was used for undocumented munitions disposal was mentioned in the 1991 Supplemental RI Report and was confirmed during the PA and

SI. Subsequently, in 2010 through 2014, several investigations were conducted to address munitions items on the ground surface and to investigate the subsurface via trenches and pits. Findings included 2.75- and 3.5-inch rocket parts, grenade fuzes, flares, unknown fuzes, small-arms training debris, and non-munitions-related construction, cultural, and household debris and some crushed drums.

### **7.3.4 Initial Response and Basis for Taking Action**

The Quarry Area was not included in the 1983 IAS that detailed historical hazardous material usage and waste disposal practices at NAS Brunswick. The 1991 Draft Final Supplemental Remedial Investigation Report included a statement based on a 1989 interview with the EOD detachment that undocumented reports exist of past EOD activities in a rock quarry located southwest of runways (E.C. Jordan Company, 1991). This report was confirmed by installation personnel that were employed at the base in the 1960s and 1970s. During site walks performed in 2007 in support of the SI, a significant amount of debris, including partially buried scrap metal, tires, and concrete, was observed, especially along the rock face at the eastern end of the Quarry Area.

In the Kick-Out Area surrounding the Waste Disposal/Fill Area, most munitions-related items that were recovered as part of removal and post-ROD remedial actions were within the top 6 inches of the ground surface, but the depth cleared of MEC is approximately 18 inches. At the time the ROD was signed, the Kick-Out Area was considered cleared with the exceptions of the fence line, which created interference with metal detection equipment, and areas beneath large boulders on the eastern slope of quarried area. These areas were cleared during post-ROD activities. As a result of past activities at the Quarry Area, PAHs at concentrations associated with unacceptable risks are present in surface and subsurface soil in the Waste Disposal/Fill Area, and MEC/MPPEH items that may result in an explosive hazard to human receptors are presumed to be present in the subsurface in the Waste Disposal/Fill Area. There is a low potential for explosive hazard conditions to exist at the Quarry Area based on the results of the MEC HAs for future land use; however, based on the nature of explosive hazards, even a low potential for these conditions may constitute an imminent and substantial endangerment to on-site personnel and local populations. Because unacceptable chemical risks and potential explosive hazards exist at the site under current and planned future land uses, a response action is necessary to protect human health and the environment from actual or threatened explosive hazards that may present an imminent and substantial endangerment to public health or welfare.

The only unacceptable chemical risks determined for the site under the CERCLA program are for hypothetical future child and lifelong residents exposed to PAHs in surface and subsurface soil in the Waste Disposal/Fill area of the site, from the ground

surface to the depth of fill material (approximately 2 feet in the western end and up to 12 feet in the eastern end). Prior to finalization of the ROD, surface and subsurface MEC clearance in the Waste Disposal/Fill Area was completed to a depth of 6 inches below ground surface for small items (less than 2 inches) and to 12 inches for larger items. After completion of ROD-required clearance activities along fence lines and under boulders on the eastern slopes of the quarried area, surface and subsurface MEC clearance was also completed in the Kick-Out Area. Based on the results of these clearances, MEC/MPPEH items and associated explosive hazards are potentially present in the subsurface in the Waste Disposal/Fill Area only. Based on sampling results and the heterogeneous nature of the fill material, it is determined that PAH contaminated soil and potential MEC/MPPEH are interspersed throughout the Waste Disposal/Fill Area.

## 7.4 Remedial Actions

### 7.4.1 Remedy Selection

The 2017 ROD established the following RAOs for the Quarry Area:

- Prevent the direct contact explosive hazard associated with potential exposure to MEC/MPPEH items in subsurface soil in the Waste Disposal/Fill Area and in limited uncleared kick-out areas along the site fence and areas between large boulders on the eastern slope of the quarried area.
- Prevent residential exposure to surface and subsurface soil with PAH concentrations associated with unacceptable CERCLA risk in the Waste Disposal/Fill Area.

No COCs or cleanup levels were identified in the ROD for the Quarry Area. Because the PAH-contaminated soil is co-mingled with potential MEC/MPPEH items in subsurface soil in the Waste Disposal/Fill Area, the remedial alternatives in the FS assumed that prevention of exposure to all of the soil in this area was required to be protective.

The selected remedy for the Quarry Area includes the following major components:

- Clearance/removal of potential MEC items in limited uncleared areas of the site.
- Installation of a soil cover to prevent exposure to PAH-contaminated soil and potential MEC in the Waste Disposal/Fill Area of the site.

- Implementation of LUCs in the Waste Disposal/Fill Area of the site to ensure that future site use is limited to non-intrusive, passive, outdoor, recreational and educational uses (e.g., hiking, jogging, bird watching, and hunting), to ensure that uncontrolled intrusive activities do not occur at the site, and to inform the public about site hazards via a public education program and posting of caution/unexploded ordnance (UXO) hazard warning signs at the site.

No unacceptable CERCLA risks were identified for site-related contaminants in groundwater, but because a portion of the site was previously used as a disposal area (for munitions- and non-munitions-related materials), the Navy agreed to conduct additional groundwater monitoring to evaluate any future potential migration of groundwater contaminants from the Waste Disposal/Fill Area at concentrations of concern (to comply with state solid waste regulations based on waste left in place in this area). Based on the lack of unacceptable groundwater risks, there are no RAOs for the site related to groundwater, although the agreement to conduct groundwater monitoring is also documented in the ROD.

The selected remedy was determined to be protective of human health and the environment, to attain ARARs, and to be cost effective.

#### **7.4.2 Remedy Implementation**

##### **Residual MEC/MPPEH and MDAS Clearance**

Clearance of potential MEC items was conducted in the limited uncleared areas of the Kick-Out Area of the site (along fence lines, after removal of the fence, and in areas between and under large boulders on steep slopes adjacent to the eastern slope [i.e., quarried rock wall]) to prevent direct contact with explosive hazards. A portion of a soil berm in the western portion of the Waste Disposal/Fill Area was removed to allow proper grading and placement of the protective soil cover because the cover edge intersected the soil berm. MEC clearance was also conducted in this berm area, although not required by the remedy, to facilitate construction of the soil cover.

MEC and MPPEH detection digital geophysical mapping (DGM) equipment was used to locate metallic anomalies to identify targets along the fence line within the Quarry Area. All DGM selected targets and hand-held detector targets were excavated with shovels if possible. A DGM sensor was used to survey the uninvestigated area along the perimeter fence line after the fence and posts were removed. DGM was used for this portion of the site because this is the only area that has not been previously digitally mapped and completed the DGM data set for Quarry Area. Hand-held all-metals detectors, able to detect non-ferrous and ferrous items, were used to perform

MEC/MPPEH “mag and dig” removal and detector-aided visual searches along the base of the quarry wall face and in stockpiled soil berm material. MEC/MPPEH items identified during intrusive investigation were only encountered in the quarried wall area and were removed and properly disposed of. Scrap metal and MDAS was found in the berm area, quarried wall area, and fence areas. No radiological-containing devices or material was encountered in any area. Radiation scanning of MPPEH/MEC, MDAS, and debris encountered was conducted for health and safety and waste disposal purposes. No MPPEH/MEC, MDAS, or debris of radiological concern were detected.

### **Soil Cover Installation**

An approximately 2.8-acre soil cover consisting of 1 foot of soil underlain by a geotextile barrier was installed over the Waste Disposal/Fill Area of the site to prevent contact with potential MEC/MPPEH items and with PAH-contaminated soil in this area of the site. Following grading of the sub-base surface, the 2.8-acre Waste Disposal/Fill Area was capped with a soil cover with a minimum thickness of 1 foot. To demarcate the cover from the sub-base and to provide a warning barrier to prevent disturbing the subsurface, the 1-foot soil cover was underlain by approximately 17,000 square yards of an orange, permeable, non-woven, geotextile barrier (Mirafi 160N/O). The geotextile was covered with a 6-inch layer of common fill (gravel) that was graded to allow proper drainage. A topsoil layer with a minimum thickness of 6 inches was added on top of the common fill, resulting in an approximately 1-foot-thick soil cover. Intermediate and final surveys were conducted to ensure the appropriate thicknesses and slope of the common fill and topsoil layers. All earthwork activities, including material testing, excavation, compaction, and surveying, were performed in accordance with the Final Work Plan. UXO construction support was provided during cover installation activities, but no MEC/MPPEH or MDAS were encountered.

During berm regrading, a 55-gallon drum containing approximately 6 gallons of liquid was encountered. The drum bung was open, and it appeared that rainwater had entered the drum over time. The drum was secured, and the area was screened for MEC/MPPEH during removal of the drum. No MEC/MPPEH or MDAS was discovered. The contents of the 55-gallon drum were tested and pumped out of the drum directly to the Eastern Plume groundwater extraction treatment system (GWETS) for treatment, with Navy approval. In another area of the site outside of the clearance areas, a sealed 20-gallon drum was discovered that contained MDAS and less than 1 gallon of liquid (condensate). The MDAS was removed for disposal, and, with Navy approval, the liquid contents of the 20-gallon drum were directly disposed of at the GWETS for treatment.

## **LUCs**

LUCs in the Waste Disposal/Fill Area of the site will limit use of the property and to prevent intrusive activities that could result in exposure to munitions items potentially remaining in the subsurface and exposure to unacceptable concentrations of PAHs in soil in this area of the site. The LUC boundaries for the Quarry Area are shown on Figure 7-2. The LUCs required to meet the RAOs for the site are as follows:

- Prohibit use of the site for anything other than non-intrusive passive recreational activities in the Waste Disposal/Fill Area. Only those recreational uses that would not significantly alter the environment will be permitted (e.g., hiking, jogging, bird watching, and hunting). Residential, industrial/commercial, intrusive recreational, and agricultural uses of the site will be prohibited.
- Prohibit any kind of intrusive activities, below the ground surface, within the LUC boundary, unless prior written approval is obtained from the Navy, EPA, and MEDEP.
- Maintain the integrity of all current and future remediation and monitoring systems/components.

The Base-Wide LUCIP was finalized prior to the signing of the Quarry Area ROD; therefore, a LUC RD for this site was not included. The LUCIP is currently being updated to include a LUC RD for the Quarry Area and to make other necessary changes (Tetra Tech, 2020). Although LUCs have not been formally implemented at this site (via finalization of a LUC RD), the objectives of the LUCs are currently being met because, based on current Navy control of the site, the site is not being used for any purpose. The Navy's on-site representative at the Caretaker Site Office performs periodic inspections to confirm that LUC objectives continue to be met. In addition to restrictions on use of the Waste Disposal/Fill Area portion of the site, caution/UXO hazard warning signs were posted at site access points, and a kiosk containing a UXO information sheet was installed at the site to inform the public of potential hazards and to warn against intrusive activities that could result in exposure to potential explosive hazards. ROD-required LUCs will be included in any future real estate property documents (i.e., deeds or leases) associated with future sale or lease of the Waste Disposal/Fill Area of the Quarry site. When the site is transferred out of Navy control, future construction activities at the site will require approval by the Navy, in consultation with EPA and MEDEP. Any future construction activities will require the property owner to submit a Brunswick Landing Construction Permission Request Form to the Navy for approval before the Town of Brunswick will approve a construction permit. Annual LUC inspections at former NAS Brunswick will include inspection of LUCs required at the

Quarry Area, maintenance (of the soil cover and other LUC components) will be performed as necessary, and inspection and maintenance activities will be documented in annual Base-Wide LUC Inspection Reports.

### **7.4.3 System Operation/Operation and Maintenance**

As discussed in the previous section, the Navy will conduct annual LUC inspections at the Quarry Area to confirm the continued implementation and effectiveness of the LUCs, including maintenance of the soil cover.

## **7.5 Progress Since the Last Five-Year Review**

The Quarry Area was not included in the previous five-year review because the ROD was signed in 2017.

## **7.6 Five-Year Review Process**

### **7.6.1 Document and Analytical Data Review**

Documents reviewed as part of this five-year review are referenced throughout the text and are included in the reference section (Section 10). As presented in Section 7.4.1, no unacceptable CERCLA risks were identified for site-related contaminants in Quarry Area groundwater. Nonetheless, the Navy will conduct post-remedial action monitoring to assess any potential migration of soil concentrations of concern in groundwater from the Waste Disposal/Fill Area. This groundwater monitoring will be performed at the site in fall 2020.

### **7.6.2 Site Inspections**

Although the LUC RD has not yet been finalized, based on the draft LUC RD, the Quarry Area was included in the annual LUC inspections conducted on September 20, 2019. Photographs taken during this inspection are included in Appendix A. No issues impacting remedy protectiveness were noted during the 2019 LUC inspection, and based on the results of the inspection, the Quarry Area remedy is functioning as intended and remains protective.

### 7.6.3 Interviews

The Navy holds regular Restoration Advisory Board (RAB) meetings for former NAS Brunswick to discuss the process of the cleanup program and ongoing investigations, Navy property transfer actions, and/or site status. Interview questionnaires were emailed to 11 potential interviewees, and four completed questionnaires were returned. The list of interviewees and returned questionnaires are included in Appendix C. No concerns related to remedy protectiveness at any of the sites were included in the responses, although general incidences of vandalism at Brunswick Landing were mentioned. The findings of this fifth five-year review will be presented at a future RAB meeting after finalization of this report in September 2020.

## 7.7 Technical Assessment

### 7.7.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?

All available information indicates that the Quarry Area remedy is functioning as intended by the 2017 ROD. As discussed in Section 7.4.2, although LUCs have not been formally implemented, the LUC objectives are currently being met and will continue to be met until the updated LUCIP is finalized. The remedial actions are being implemented as designed and include measures that prevent exposure to munitions items potentially remaining in the subsurface at the site. The required remedial actions (LUCs) are operating as designed, and the RAO is being met. Based on the completed and ongoing activities, the intent and goals of the Quarry Area ROD have been met.

### 7.7.2 Question B: Are the Assumptions, Toxicity Data, Cleanup Values, and RAOs Used at the Time of the Remedy Selection Still Valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. A LUC RD for Quarry Area is included as an appendix to the 2020 Update to Base-Wide LUCIP and include provisions that LUCs be incorporated into any future leases or property transfer documents and that EPA and MEDEP be notified of any transfer actions. According to the Brunswick Naval Air Station Reuse Master Plan (Matrix Design Group, 2007), planned future use of the Quarry Area is as a College Use Conservation District (Education/Natural Area) and/or Education/Mixed Use Space. These future use scenarios were relied upon to assess potential site risk as part of the RI human health risk assessment.

#### **7.7.2.1 ARARs and Site-Specific Action Level Changes**

The ARARs established in the Quarry Area ROD were evaluated to determine if any changes to these ARARs would call into question the protectiveness of the remedy. No changes to site ARARs were identified as part of this review.

#### **7.7.2.2 *Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods***

There have been no changes in physical conditions, exposure pathways, or land use that would affect the protectiveness of the Quarry Area remedy.

The exposure assumptions used are considered to be conservative and reasonable in evaluating risk and developing risk-based cleanup levels. No changes to these assumptions or the cleanup levels developed from them is warranted. There have been no changes to the standardized risk assessment methodology since the 2017 ROD that could affect the protectiveness of the remedy.

VOCs were not detected at the Quarry Area at concentrations of concern; therefore, vapor intrusion is not a pathway of concern at the site.

#### **7.7.3 Question C: Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?**

No additional human health or ecological risks have been identified, and no weather-related events have affected the protectiveness of the remedy. No other information has been identified that calls into question the protectiveness of the remedy.

#### **7.7.4 Technical Assessment Summary**

Based on the data reviewed and the site inspection, the remedy is or will be functioning as intended by the 2017 ROD. There have been no changes in the physical conditions at the sites or to the standardized risk assessment methodology that would affect the protectiveness of the remedy. There is no other information that calls into question the protectiveness of the remedy.

## 7.8 Issues

No deficiencies were identified during this five-year review of the Quarry Area remedy, and no issues related to site operations, conditions, or activities prevent the remedy from being protective at this time or in the future.

## 7.9 Recommendations and Follow-Up Actions

Because no issues affecting the protectiveness of the remedy were identified, there are no recommendations for the Quarry Area, and no follow-up actions are required.

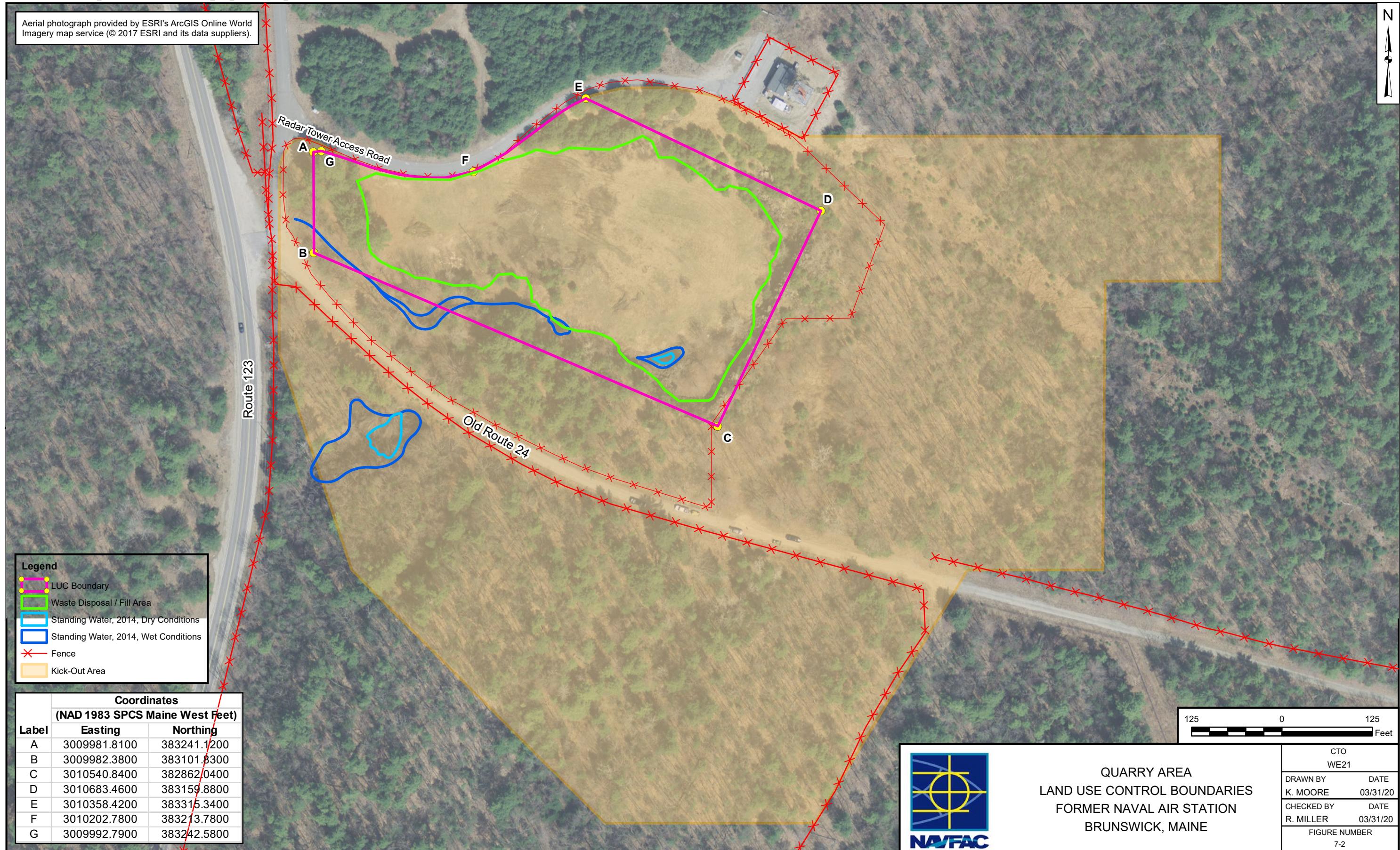
Additional of the Quarry LUC RD to the Base-Wide LUCIP is recommended; the Quarry ROD was not finalized at the time the original LUCIP was finalized in 2016. The LUCIP is currently being revised and, the draft includes a LUC RD for the Quarry. This recommendation does not affect the protectiveness determination for the site but is associated with ensuring continued protectiveness.

## 7.10 Protectiveness Statement

<b>Protectiveness Statement(s)</b>		
<i>Operable Unit:</i> OU10, Quarry Area	<i>Protectiveness Determination:</i> Protective	<i>Planned Completion Date:</i>
<p><i>Protectiveness Statement:</i> The remedy for the Quarry Area is protective of human health and the environment. Installation and maintenance of the soil cover and LUCs (informally implemented until finalization of the draft LUC RD) limit use of the property and prohibit intrusive activities that could result in exposure to potential munitions items and PAH-contaminated soil remaining in the subsurface at the site. The soil cover remedial action that has been completed and is operating as designed. Although Quarry Area LUCs have not been formally implemented at this site (via finalization of a LUC RD), the objectives of the LUCs are currently being met. The Navy continues to control the site and prohibits any use of the area. The Navy's on-site representative performs periodic inspections to confirm that LUC objectives continue to be met. In addition to restrictions on use of the Waste Disposal/Fill Area portion of the site, caution/UXO hazard warning signs were posted at site access points, and a kiosk containing a UXO information sheet was installed at the site to inform the public of potential hazards and to warn against intrusive activities that could result in exposure to potential explosive hazards. Long-term protectiveness of the remedy will be verified by continued LUC inspections in accordance with the LUC RD and revised Base-Wide LUCIP to ensure continued maintenance of the LUCs implemented upon finalization of the LUC RD. Based on the activities that are completed and ongoing, the intent and goals of the Quarry Area ROD have been met.</p>		

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## **8.0 OU2, Eastern Plume**

### **8.1 Introduction**

The Eastern Plume is located in the east-central portion of NAS Brunswick (Figure 8-1) and consists of groundwater contamination that has been attributed to past activities at Site 4 – Acid Caustic Pit, Site 11 – Fire Training Area, and Site 13 – DRMO, located west of the plume in the area between Sites 1 and 3 and Site 9. From 1969 to 1974, Site 4 was used for disposal of liquid wastes via pouring into a pit approximately 4 feet square and 3 feet deep. Site 11 was used over a 30-year period for fire training exercises during which waste liquids (fuels, oils, degreasing solvents) were used as fuel for the fires. Site 13 consists of three former underground storage tanks (USTs), one for diesel fuel and the other two for waste fuels, oils, and degreasing solvents. The Eastern Plume consists of a chlorinated volatile organic compound (CVOC)-contaminated groundwater plume in the eastern portion of former NAS Brunswick, with the eastern edge extending to Merriconeag Creek in some areas, and north of Old Gurnet Road. Field investigations conducted by the Navy, in response to the documented historical storage, handling, use, and releases of PFAS-containing AFFF at the former NAS Brunswick, identified Site 11/Eastern Plume as one of main areas of the former base where groundwater has been significantly impacted above EPA's LHAs for PFOS and PFOA.

The dissolved-phase plume associated with disposal activities at Sites 4, 11, and 13 was found to consist primarily of CVOCs including, among others, PCE, 1,1,1-trichloroethane (TCA), and TCE. A GWETS began operation in June 1995 to remediate the northern and southern lobes of the Eastern Plume, to provide hydraulic control of the VOC plume, and to remove dissolved-phase VOCs from groundwater. Six extraction wells are currently in operation (EW-01, EW-02A, EW-04, EW-05B, EW-08, and EW-09).

### **8.2 Site Chronology**

A list of important Eastern Plume historical events and relevant dates in the site chronology is shown below. The identified events are illustrative, not comprehensive. Further information about activities and actions at the site can be found in the Administrative Record available as part of the Information Repository at the Curtis Memorial Library, 23 Pleasant Street, Brunswick, Maine, 04011-2261.

Event	Date
Draft Final RI Report	August 1990
Draft Final Supplemental RI Report	August 1991
FS	August 1991
Interim ROD signed	June 1992
Remedial Design Summary Report	May 1993
Eastern Plume LTMP	August 1994
GWETS operation	June 1995 to present
Extraction well EW-02 installed to remove a hotspot of VOC contamination near MW-311	1998
Final ROD signed	February 1998
LTMP updated	February 2000
First Five-Year Review Report signed	March 2000
ESD for the change in treatment from ultraviolet oxidation to air stripping, moving the discharge point from the publicly owned treatment works (POTW) to an infiltration gallery, and addition of LUCs	December 2000
Operating Instruction NASBINST 5090.1B issued	31 December 2000
O&M Manual updated	September 2003
Analysis for 1,4-dioxane added for select LTM wells	April 2004
MEDEP, EPA, and Navy pore water sampling effort determined there is potential for Eastern Plume upwelling into Mere Brook and Merriconeag Stream	August - September 2005
Second Five-Year Review signed	4 October 2005
Revised Screening Values for Surface Water, Seep Water and Sediment finalized	January 2006
Investigation determining that the Eastern Plume was upwelling into Mere Brook and Merriconeag Stream	February and September 2007
Extraction well EW-05B installed to remove localized high levels of chlorinated VOCs and 1,4-dioxane but not activated because the GWETS was not yet equipped to treat for the 1,4-dioxane	Fall 2007
Final LTMP for the Eastern Plume issued	February 2008
Operating Instruction NASBINST 5090.1C issued	5 March 2008
Revision Pages to the Final LTMP issued	24 March 2008
Field work for the Supplemental RI for 1,4-Dioxane in the Eastern Plume and Bedrock	August 2008-September 2009
Final Groundwater Modeling Summary Report for the Eastern Plume and Sites 1 and 3 Landfill issued providing recommended locations for two new extraction wells to increase plume capture	April 2009
Final Technical Memorandum: Evaluation of Eastern Plume Extraction Well Network and Sites 1 and 3 Landfill	August 2009
GWETS treatment train modified to include a HiPOx unit to treat CVOCs and 1,4-dioxane	October 2009

Event	Date
New extraction wells EW-08 and EW-09 installed	October 2009
EW-05A deactivated and EW-05B began pumping CVOC- and 1,4-dioxane-contaminated water to the GWETS	September 2009
Twelve-week pilot test of HiPOx system	November 2009 to January 2010
New extraction wells EW-08 and EW-09 were activated	March 2010
ESD to document change in groundwater treatment from air stripping to HiPOx (advanced chemical oxidation process) and to document addition of 1,4-dioxane and vinyl chloride cleanup goals.	September 2010
Supplemental RI Report for 1,4-Dioxane in the Eastern Plume and Bedrock	February 2012
Long-Term Monitoring Optimization Report for the Eastern Plume	June 2013
Revision of the Long-Term Monitoring Plan for the Eastern Plume	October 2013
GWETS sampling confirmed PFOS and PFOA concentrations exceeding EPA LHAs	November 2014
LUC ESD for Sites 1 and 3, 2, 4, 7, 9, and the Eastern Plume	April 2015
Draft LUCIP, including LUC RDs for Sites 1 and 3, 2, 4, 7, 9, and the Eastern Plume	August 2015
Draft Base-Wide QAPP for the LTM Program, 2015 Revision	August 2015
Evaluation of PFAS treatment options for GWETS, as reported in the November 2016 GWETS Perfluorinated Compound Assessment Technical Memorandum (Resolution, 2016)	November 2015 to September 2016
Base-Wide LUCIP, including the combined LUC RD for Sites 1 and 3, Site 2, and Eastern Plume	September 2016
Draft 2020 Update to Base-Wide LUCIP/LUC RDs	2020
LTM	1995 to present

## 8.3 Background

### 8.3.1 Physical Characteristics

The plume is predominately located in the overburden, but two small areas of localized contamination have been identified in bedrock, one near well MW-308 (just south of Huey Drive) and another near MW-323 where a bedrock knob is present downgradient of the fire training area. The ground surface slopes gently in the eastern and southern directions toward Merriconeag Stream and Mere Brook. Approximately 90 percent of the Eastern Plume is covered by vegetation, and several areas contain forested wetland. A ball field and cemetery are located in the northern portion of the Eastern Plume, just south of Picnic Pond, and a historic cemetery is located immediately north of the confluence of Merriconeag Stream and Mere Brook. Merriconeag Stream is

located east of the northern and central portions of the Eastern Plume. Mere Brook flows from west to east bisecting the Eastern Plume and then continues south of its confluence with Merriconeag Stream near the eastern boundary of the Eastern Plume. No other surface water bodies occur within the Eastern Plume boundary. Generally, the western boundary of the Eastern Plume coincides with the 50-foot topographic contour. Overland drainage flows towards the surface water bodies of Picnic Pond to the northeast and Mere Brook and Merriconeag Stream to the south and east, respectively.

COCs migrated from source areas through preferential pathways in the shallow sandy aquifer that is connected to a confined lower sandy aquifer and also through interbedded sands silts and clays. Groundwater flow and contaminant migration is generally in an east-to-southeast direction toward Merriconeag Stream and Mere Brook. Upward vertical hydraulic gradients in the vicinity of Merriconeag Stream and Mere Brook and higher heads in wells on the eastern side of these streams indicate that these are natural discharge areas. Figures 8-2 and 8-3 present groundwater contours based on data from October 2019 for shallow and deep groundwater, respectively, at the site. The primary hydrogeologic units and contaminant migration pathways at the Eastern Plume site area are summarized below:

- The Upper Sand (fine to coarse sand) extends from the ground surface throughout the Eastern Plume to depths ranging from approximately 5 to 40 feet. Depths to groundwater range from a few feet to 10 feet or more and is unconfined. COCs are present at very low concentrations in isolated areas of the Upper Sand.
- The Transition unit (interbedded fine sand, silt and clay) occurs beneath the Upper Sand and is up to approximately 50 feet thick; it pinches out west of Merriconeag Road in the vicinity of Sites 4, 11, and 13, where the Upper Sand and Lower Sand are in contact. Groundwater in the Transition Unit migrates through the interbedded sand layer that is semi-confined or confined. COCs dissolved in groundwater migrate preferentially through interconnected sand beds within this unit.
- The Lower Sand (fine to medium sand) occurs within the Transition Unit and is up to approximately 37 feet thick; it extends beneath Mere Brook in a southerly direction and pinches out to the east in the vicinity of Merriconeag Stream. The Lower Sand is confined and artesian in the vicinity of Mere Brook and Merriconeag Stream, which are natural groundwater discharge areas. COCs dissolved in groundwater migrate preferentially through the Lower Sand toward the Mere Brook and Merriconeag Stream floodplain. The current extraction well network intercepts a significant portion of the VOCs.

- The Presumpscot clay (plastic clay with silt and fine sand) is up to 80 feet thick. The clay occurs beneath the Lower Sand and blankets fractured bedrock, except east of Site 11 and in the mid-portion of the plume. The clay unit thins out to east of Merriconeag Stream and Mere Brook near the NAS Brunswick boundary. The clay unit acts as an aquitard that limits downward movement of groundwater and COCs into the bedrock.
- The bedrock consists primarily of folded and fractured mica schist (Cape Elizabeth Formation) with pegmatite (coarse granite) intrusions. A bedrock high is present in the vicinity of Site 11 and also as a separate structural high in the midportion of the plume. These are limited areas where the Transition Unit is in contact with the bedrock. COCs have historically been detected sporadically and at low concentrations. The migration pathway for contamination in the MW-08 vicinity is via the Transition Unit that is in contact with the fractured bedrock. The vertical extent of contamination is limited, and upward hydraulic gradient prevents deeper migration of contamination into the bedrock aquifer.

### **8.3.2 Land and Resource Use**

The northern one-third of the plume is located beneath wooded areas and a recreational and picnic area. Residential property borders the site to the east outside of the boundary of the former facility. Surface water bodies in this area include Picnic Pond and Merriconeag Stream. The southern two-thirds of the plume is located in a previously restricted section of the base (former Weapons Compound). The land in the southern two-thirds of the plume includes woodland, wetlands, and paved access roads. Surface water bodies in this area include Mere Brook and Merriconeag Stream.

Mere Brook is located in the southern portion of the plume, Merriconeag Stream runs approximately parallel to the eastern boundary of the plume, and the confluence of Mere Brook and Merriconeag Stream is located near the southeastern extent of the plume. Mere Brook flows into the Atlantic Ocean at Harpswell Cove, which is designated as a potential aquaculture area by the State of Maine and which supports various commercially important fish species (U.S. Navy, 1994).

### **8.3.3 History of Contamination**

Eastern Plume groundwater contaminants are presumed to be the result of past operations at the following sites located north-northwest of the current plume:

- **Site 4** – a former acid and caustic pit approximately 4 feet square and 3 feet deep used from 1969 to 1974 for disposal of an unknown quantity of liquid wastes. Wastes, including transformer oil, battery acid, caustics, solvents (including TCE) and paint thinners, were poured into the pit for disposal. Building 584 was reportedly constructed on at least a portion of the pit in 1975.
- **Site 11** – a former fire training area used regularly over a 30-year period ending in 1990. As part of training operations, waste fuel, oil, solvents, and other miscellaneous combustible liquids were spread on the soil for fuel and ignited. The Navy has identified Site 11 as one of the main areas of the former NAS Brunswick where PFAS-containing AFFF was released to the environment as part of aircraft fire training activities.
- **Site 13** - the DRMO area immediately south of Building 584 and Site 4 consisting of three underground storage tanks, one for diesel fuel and the other two for storing waste fuels, oils, and degreasing solvents. All three tanks were removed in the late 1980s. The diesel tank was replaced with a fiberglass underground storage tank; however, this tank was subsequently removed and replaced with an aboveground tank.

Removal activities at Sites 4, 11, and 13 in the early 1990s were effective in reducing continued impacts to groundwater and as a result, these areas no longer act as sources for Eastern Plume groundwater contamination. An evaluation conducted as part of the Supplemental RI confirmed that Sites 4, 11 and 13 were likely former sources of groundwater contamination of the Eastern Plume (Tetra Tech, 2012). Contamination associated with Sites 4, 11, and 13 corresponds to the contaminants identified in the Eastern Plume, each site is hydraulically upgradient, and a migration pathway exists between the sites and the Eastern Plume. However, the current-day boundary of the Eastern Plume occurs east of Sites 4, 11, and 13; and no other source(s) of the Eastern Plume have been identified. The primary Eastern Plume COCs currently include the CVOCs PCE, TCE, 1,1,1-TCA and associated breakdown products and 1,4-dioxane. Current-day TCE and 1,4-dioxane exceedances are relevant indicators of the extent of the residual plume.

#### 8.3.4 Initial Response and Basis for Action

The RI conducted during the early 1990s identified that contaminated groundwater originating from Sites 4, 11, and 13 exceeded target risk levels, federal MCLs, and state MEGs. An interim ROD was signed to allow Eastern Plume groundwater contamination to be addressed while investigative activities continued (U.S. Navy, 1992). At Site 4,

subsurface soil samples collected did not contain detectable levels of VOCs, and VOCs were detected in groundwater from only one of six monitoring wells at the site (TCE to 26 µg/L). Based on these results, it was concluded that Site 4 no longer contributed to groundwater contamination in the Eastern Plume. The tanks at Site 13 were removed in the late 1980s, and VOC concentrations in groundwater have been decreasing since that time; therefore, Site 13 was assumed to no longer be a source of Eastern Plume groundwater contamination. Between the interim and final RODs, two soil removal actions were conducted at Site 11 to remove contaminated soil above the water table. However, as stated in the 1998 final ROD, contaminated soil may still exist below the water table and may continue to contribute to groundwater contamination in the area.

During the RI, the baseline human health risk assessment estimated unacceptable human health risks associated with ingestion of VOC-contaminated groundwater from the Eastern Plume. The ecological risk assessment conducted during the RI evaluated only potential risks to terrestrial organisms from contaminant exposure at Sites 4, 11, and 13. Because data at that time indicated that the Eastern Plume had not migrated beyond the most downgradient wells, exposure to aquatic receptors in Harpswell Cove was not evaluated.

The cleanup levels established for the Eastern Plume in the 1998 ROD are listed below.

VOC	Cleanup Level (µg/L)	Basis
1,1-DCE	7	Maine MEG at time of ROD; current residential RAG is 290 µg/L
1,1-DCA	5	Maine MEG at time of ROD; current residential RAG is 28 µg/L
1,2-DCA	5	Federal MCL and Maine MEG at time of ROD; current residential RAG is 1.7 µg/L
cis-1,2-DCE	70	Federal MCL and Maine MEG at time of ROD; current residential RAG is 35 µg/L
trans-1,2-DCE	70	Maine MEG at time of ROD; current residential RAGs is 300 µg/L
1,1,1-TCA	200	Federal MCL and Maine MEG at time of ROD; current residential RAG is 8,000 µg/L
1,1,2-TCA	3	Maine MEG at time of ROD; current residential RAG is 0.42 µg/L
TCE	5	Federal MCL and Maine MEG at time of ROD; current residential RAG is 2.8 µg/L
PCE	3	Maine MEG at time of ROD; current residential RAGs is 41 µg/L

The 2010 Eastern Plume ESD documented the addition of vinyl chloride and 1,4-dioxane as COCs, with interim cleanup goals of 0.15 µg/L (1992 Maine MEG) and 3.5

µg/L (EPA risk-based value), respectively. Current residential RAGs are 0.19 and 4.6 µg/L, for vinyl chloride and 1,4-dioxane, respectively.

## **8.4 Remedial Actions**

### **8.4.1 Remedy Selection**

An Interim ROD was signed in 1992 to allow the Navy to begin extraction, treatment, and discharge of Eastern Plume groundwater to address dissolved-phase solvent-contaminated groundwater. The interim remedial action was intended to control and prevent further migration of contaminated groundwater toward Harpswell Cove and to begin to reduce the amount of contamination in the Eastern Plume (U.S. Navy, 1992). RAOs identified in the interim ROD were as follows:

- Reduce VOC contamination in groundwater to concentrations considered protective of human health.
- Evaluate groundwater quality and measure contaminant concentrations in groundwater, surface water, sediment, and leachate through long-term environmental monitoring.
- Conduct additional source investigations of possible source areas of contamination both north and south of Neptune Drive.
- The remedial action in the interim ROD was designed to:
  - Extract, treat, and discharge groundwater
  - Maximize the collection of contaminated groundwater
  - Contain the southern end of the plume
  - Collect contaminated groundwater from the northern part of the plume
  - Implement a monitoring program

In February 1998, the ROD for No Further Action at Sites 4, 11, and 13, and a Remedial Action for the Eastern Plume groundwater monitoring was finalized. NFA for soil was determined to be appropriate for Sites 4, 11, and 13 because soil did not pose an unacceptable risk via direct contact or incidental ingestion.

The RAOs identified in the final ROD were as follows:

- Minimize further migration of the Eastern Plume.
- Minimize any future negative impact to surface water resulting from discharge of contaminated groundwater.
- Reduce the potential risks associated with ingestion of contaminated groundwater to acceptable levels.
- Restore the aquifer.

The remedial action in the final ROD was designed to:

- Prevent further movement of contaminants toward surface water.
- Reduce concentrations of contaminants in the portions of the plume with maximum concentrations.
- Together with natural degradation, achieve cleanup levels throughout the plume over an estimated time period of 13 to 71 years.

The selected remedy chosen to meet the RAOs was a continuation of the remedy implemented in accordance with the 1992 interim ROD and including the following components:

- Operation of the GWETS installed in 1995.
- Discharge of treated water to the POTW.
- LTM to evaluate the effectiveness of the extraction system and confirm that the source areas are not continuing to impact the groundwater.
- Conducting five-year reviews.

#### **8.4.2 Remedy Implementation**

##### **GWETS**

In May 1993, the Remedial Design Summary Report for the Eastern Plume was finalized (U.S. Navy, 1993), and in accordance with the interim ROD, the GWETS, consisting of five extraction wells and ultraviolet oxidation treatment equipment, began operating in June 1995. The GWETS initially provided pretreatment to remove turbidity and inorganics, initial ultraviolet-oxidation to destroy VOCs, initial discharge of treated

water to the local POTW, and periodic disposal of filter press sludge from the inorganics treatment process. The original extraction system consisted of five extraction wells (EW-01 through EW-05) and underwent subsequent changes to improve operational efficiency, as discussed in Section 6.4.3.

In December 2000, an ESD for the Eastern Plume altered the original GWETS to remove the ultraviolet oxidation system and replace it with an air stripping system with carbon polishing and to replace discharge to the Brunswick Sewer District with discharge to an infiltration gallery. The updated treatment system went online in January 2001, and the infiltration gallery began operating in February 2002. A second ESD finalized in September 2010 documents the change in the GWETS from air stripping with liquid- and vapor-carbon polishing to HiPOx with only liquid-phase carbon polishing. HiPOx operations began in October 2009. This ESD also documents the selection of interim cleanup goals for 1,4-dioxane and vinyl chloride (Tetra Tech, 2010d).

### **LUCs**

The 1998 ROD did not include LUCs, but the Eastern Plume institutional control boundary was documented in the December 2000 ESD and included in the December 2000 and March 2008 versions of the NAS Brunswick Operating Instruction (5090.1B and 5090.1C, respectively). The LUC component of the remedy for the Eastern Plume was modified as documented in the 2015 multi-site ESD to clarify the LUC objectives in light of base closure. Based on the proximity of Sites 1 and 3, Site 2, and the Eastern Plume, their LUC boundaries were combined into a single area, with groundwater restrictions across the entire combined area, referred to as the groundwater management zone, and soil restrictions as required in separate soil management zone. The LUC performance objectives for the Eastern Plume, as documented in the ESD, are as follows:

- Prevent uncontrolled human exposure to and/or use of contaminated groundwater within the groundwater management zone.
- Prevent unacceptable human exposure to volatile vapors potentially migrating from contaminated groundwater to the indoor air of future habitable structures within the groundwater management zone.
- Prevent changes in hydrology within the groundwater management zone that have the potential to negatively impact the nature and extent of delineated groundwater contamination.

- Manage future construction activities within the soil and groundwater management zones to prevent uncontrolled human exposure and/or transport/migration of contaminated soil and groundwater.
- Prevent uncontrolled human exposure to and/or use of surface and subsurface soils within the soil management zone.
- Protect the integrity and operation of all remediation and monitoring systems within soil and groundwater management zones.

The LUCs required to achieve these performance objectives for the soil and groundwater management zones, as provided in the LUC RD for Sites 1, 2, 3, and Eastern Plume are as follows:

### **Soil Management Zone**

- Prohibit residential use of the soil management zone unless prior written approval is obtained from the Navy, EPA, and MEDEP. Prohibited residential uses shall include, but are not limited to, any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent or nursing care facilities.
- Prohibit soil excavation/disturbance or any construction activities not associated with monitoring, maintenance, or other necessary remedial actions within the soil management zone.
- Protect the integrity of all current and future remedial systems/components in the soil management zone. Based on this restriction, any use or activity that would interfere with the implementation or effectiveness of the remedy is prohibited.

### **Groundwater Management Zone**

- Prohibit all uses of groundwater underlying the groundwater management zone unless prior written approval is obtained from the Navy, EPA, and MEDEP.
- Protect the integrity of all current and future remedial systems/components within the groundwater management zone. Based on this restriction, any use or activity that would interfere with the implementation or effectiveness of the remedy is prohibited.
- Prohibit construction of habitable structures in the groundwater management zone without evaluation and potential mitigation of vapor intrusion and unless prior written approval is obtained from the Navy, EPA, and MEDEP.

These LUCs were implemented upon finalization of the LUC RD, which is included as an appendix to the Base-Wide LUCIP, and the LUCs will be monitored, maintained, enforced, and reported on in accordance with provisions in the LUC RD. The LUC RD also documents the requirements for continuation of the LUCs if all or part of the Eastern Plume property is transferred out of Navy ownership. Any future construction activities will also require the property owner to submit a Brunswick Landing Construction Permission Request Form to the Navy for approval before the Town of Brunswick will approve a construction permit. The Base-Wide LUCIP is also in the process of being revised and will include the Brunswick Landing Construction Permission Request process as one of the LUC implementing actions.

## **LTM**

The purpose of Eastern Plume LTM is to assess the performance of the groundwater extraction system and to ensure that contamination currently in groundwater does not continue migrating toward surface water. The LTMP for the Eastern Plume was originally issued in August 1994 as part of implementation of the interim ROD and was updated in 2002, 2008, and 2013. The goals of the plan are as follows:

- Provide a tiered approach to attain the requirements of MEDEP water quality standards.
- Monitor changes in the plume boundaries and potential migration pathways.
- Monitor changes in groundwater contamination.
- Monitor the effectiveness of the remedial action for the protection of human health and the environment.
- Monitor the treatment plant effluent.

As of fall 2019, a total of 54 Eastern Plume LTM events have been conducted. The Long-Term Monitoring Optimization Report, finalized in June 2013, included an evaluation of progress toward meeting Eastern Plume cleanup goals and provided recommendations for optimizing the monitoring program based on recent investigations, optimization of the extraction well network, and evolving data needs for fully monitoring the hydrologic system. The revised monitoring program was documented in the Long-Term Monitoring Plan for the Eastern Plume, 2013 Revision, which was finalized in October 2013, and the revised LTM program was implemented beginning with the fall 2013 sampling event. The revised LTM program was incorporated into the Base-Wide QAPP (Tetra Tech, 2015).

## PFAS Detected at the Eastern Plume and Other Areas within NAS Brunswick

The Navy's assessment of PFAS contamination is ongoing at the former NAS Brunswick on a site-wide basis. The Navy published a comprehensive report in August 2019 (Resolution Consultants, 2019) presenting PFAS data collected as part of numerous on- and off-base investigations. These investigations were initiated in response to the Navy's documented historical storage, handling, use, and releases of PFAS-containing AFFF when NAS Brunswick was an active installation.

Concentrations detected in groundwater at several locations across the former base exceeded EPA's LHAs of 0.07 µg/L for PFOS and PFOA, individually or combined (EPA, 2016a and 2016b). In addition, the Navy also completed groundwater sampling of both private and public drinking water supplies on and outside of Brunswick Landing. The results from all sampled drinking water sources were less than EPA LHAs.

Within the Eastern Plume, PFOS/PFOA concentrations exceeding EPA's LHAs were detected throughout the shallow and deep overburden aquifer. In bedrock groundwater, PFOS/PFOA concentrations exceeded EPA LHAs in monitoring well MW-323 located just downgradient of the former Site 11 source area. Bedrock monitoring well MW-EP-342B1, located within the central portion of the Eastern Plume, had PFOA concentrations greater than the EPA LHA.

Although groundwater concentrations of COCs as well as PFOS/PFOA are greater than their cleanup goals or EPA LHAs within the Sites 1, 2, 3, and the Eastern Plume GMZ, LUCs are in place to prevent groundwater use in the short term. Similarly, exposure to PFAS-impacted groundwater in other areas of the former base that has been transferred outside the Navy is controlled by restrictions placed in the transfer deeds. Nonetheless, the Navy is recommending completion of an RI for the former NAS Brunswick to evaluate risks associated with PFAS contamination and determine if additional actions are needed to address any unacceptable risk. The Navy will proceed with planning and implementing an RI in accordance with CERCLA, the NCP, and the Brunswick Naval Air Station FFA to determine the nature and extent of contamination associated with historical PFAS releases to the environment.

### 8.4.3 System Operation/Operation and Maintenance

The cumulative chlorinated VOC mass removed from the plume since the GWETS began operation is approximately 1,181 pounds (through November 2018). Various changes have been made to the system during its years of operation to increase efficiency and to address data collected after operation of the original system began. In addition, general maintenance activities are performed as needed, as documented in monthly GWETS operation reports provided to MEDEP and EPA.

Extraction wells currently operating as part of the GWETS include the following:

- EW-01, located at the southern end of the Eastern Plume north of MW-229B, provides VOC removal and hydraulic control in this area.
- EW-02A, located in the vicinity of MW-311, was activated on June 12, 1998, to provide additional VOC removal and hydraulic control in this area (deeper replacement for EW-02).
- EW-04, located north of piezometer P-111, provides additional VOC removal and hydraulic control in this area.
- EW-05B was installed in June 2007 and located northeast of MW-308 to extract groundwater with elevated VOC and 1,4-dioxane concentrations located in a topographic depression in the clay surface. EW-05B was activated in September 2009 with initial discharge to the Brunswick Sewer District until the 1,4-dioxane treatment system was fully operational.
- The GWETS treatment train was modified in October 2009 to include a HiPOx unit to treat CVOCs and 1,4-dioxane.
- EW-08 and EW-09, located in the vicinity of the Mere Brook-Merriconeag Stream confluence, were installed in October 2009 and began operating in March 2010 based on preliminary results from the Supplemental RI and results of groundwater modeling conducted by the Navy.

In October 2009, the GWETS treatment train was modified to include advanced oxidation treatment using a HiPOx unit. This treatment technology uses hydrogen peroxide and ozone to treat CVOCs and 1,4-dioxane. A 12-week pilot test of the new HiPOx system was conducted between November 2009 and January 2010, and EW-08 and EW-09 were brought online in March 2010 after the HiPOx treatment unit became fully operational.

Groundwater samples collected from the GWETS in November 2014 confirmed the presence of PFAS, specifically PFOS and PFOA, at concentrations exceeding EPA LHAs. An evaluation of the GWETS to treat site contaminants as well as PFAS was conducted in 2015 because the existing GAC within the treatment vessel was at the end of its service life and needed to be replaced. Based on the evaluation, on November 10, 2015, GAC in the first 5,000-pound vessel (lead vessel) was replaced with TIGG 5DC 1240 coconut GAC, and GAC in the second 5,000-pound vessel (lag vessel) was replaced with Calgon Filtrasorb 600 GAC. Weekly sampling at the plant influent, HiPOx effluent, GAC mid-point, and plant effluent occurred for the first month followed by

monthly monitoring. Sampling of the HiPOx effluent was discontinued after the first monthly sample because PFAS concentrations were unchanged, indicating that HiPOx was not effective in treatment of PFAS. Results of the first 10 months of sampling (November 2015 through September 2016) were documented in the November 2016 *GWETS Perfluorinated Compound Assessment Technical Memorandum* (Resolution Consultants, 2016). In September 2016, the PFOA concentration in the GAC mid-point effluent was 0.07 µg/L, equal to the EPA LHA. Therefore, on October 12, 2016, the GAC in the lead vessel was changed out and replaced with Filtrasorb 600 GAC. Monthly monitoring continued and in September 2018, PFOA was detected at 0.072 µg/L, just above the EPA LHA. Therefore, on December 3, 2018, GAC in the lead and lag vessels were changed out and replaced with Filtrasorb 600 GAC. Monthly monitoring of the plant influent, GAC midpoint, and plant effluent continues. Since replacement of fresh carbon in November 2015, PFOS and PFOA in the plant effluent samples have either been not detected or detected at concentrations significantly less than EPA LHAs.

## 8.5 Progress Since the Last Five-Year Review

No non-compliance issues were identified during the fourth five-year review of the Eastern Plume remedial action. The review found that the Eastern Plume remedy was protective of human health and the environment and was functioning as designed. As previously discussed, groundwater concentrations of PFOS/PFOA are greater than EPA LHAs within the Sites 1, 2, 3, and the Eastern Plume GMZ, and LUCs are in place to prevent groundwater use in the short term. The Navy will proceed with planning and implementing a base-wide RI to determine the nature and extent of contamination associated with historical PFAS releases at former NAS Brunswick, including in the Eastern Plume and in other areas of the former facility.

## 8.6 Five-Year Review Process

### 8.6.1 Document and Analytical Data Review

Documents reviewed as part of this five-year review are referenced throughout the text and are included by site in the reference section (Section 10). Eastern Plume monitoring began in March 1995, and as of fall 2019, a total of 54 LTM events have been completed, including sampling and analysis of groundwater (from monitoring, extraction, and residential wells and piezometers), surface water, sediment, pore water, and leachate seeps. The optimization recommendations described in the LTM

Optimization Report and 2013 Revision of the LTMP for the Eastern Plume, as summarized above, were implemented beginning with the fall 2013 LTM event and were incorporated into the Base-Wide QAPP.

The conclusions for the Eastern Plume LTM program, based historical and current monitoring results, are as follows:

- CVOCs have not been detected in samples from a residential well located east of Merriconeag Stream since September 2011, and 1,4-dioxane has not been detected since October 2013. This residential well is sampled as part of the Eastern Plume LTM program.
- Since October 2013, CVOCs have not been detected in surface water samples, and 1,4-dioxane was detected only once in surface water (in 2017) at a low concentration less than the cleanup level since sampling was initiated in October 2013.
- Concentrations of 1,4-dioxane in 2018 pore water samples were the maximum detected to date in any medium. The highest concentrations were detected at three pore water locations consistent with the CVOC plume area for the shallow aquifer.
- Slight increases in total CVOC concentrations have been detected at shallow overburden wells MW-EP-340S and MW- MB-06A since sampling was initiated in 2013. TCE concentrations exceeded the cleanup goal in samples from both wells. Groundwater at MW-MB-06A, located in the southeastern portion of the site, has had TCE concentrations greater than the cleanup level since 2014. TCE concentrations at many of the deeper wells in the vicinity of MW-MB-06A also exceeded the cleanup level.
- Sample results associated with GWETS extraction wells have shown overall decreasing trends in concentrations of CVOCs and 1,4-dioxane. TCE concentrations exceeding the cleanup level were detected in groundwater from extraction wells WE01, EW-02A, EW-04, EW-05A, EW-05B, EW-08, and EW-09. PCE was detected in excess of the cleanup level at EW-02A and EW-08. At wells EW-05A and EW-05B, 2018 concentrations of 1,4-dioxane were greater than the cleanup level. Combined influent TCE concentrations also exceeded the cleanup level in 2018. GWETS effluent results for 2018 were either less than detection limits or less than cleanup goals, indicating the effectiveness of the GWETS in continuing to remove contaminants from extracted groundwater.

- During 2018 sampling, maximum concentrations of 1,4-dioxane in deep groundwater were detected in the vicinity of the pore water sampling locations with elevated 1,4-dioxane concentrations. In deep groundwater located in the northern portion of the site and near Picnic Pond, 1,4-dioxane concentrations are lower but still exceed the cleanup goal.
- Deep wells MW-335, MW-337, MW-MB-05C, and MW-306R have increasing CVOC trends. MW-335 and MW-337, located on the southern edge of the site, had a slug of CVOCs that appeared at MW-335 in September 2010 and then at downgradient MW- 337 in September 2014. CVOC concentrations, particularly TCE, in MW-335 and MW-337 have fluctuated at concentrations greater and less than cleanup goals. MW-MB-05C, located in the eastern portion of the site, has historically had TCE at concentrations exceeding the cleanup goal. MW-306R, located in the northwestern portion of the Eastern Plume, had an increase in CVOCs from 2017 to 2018, but concentrations remained less than criteria.
- Groundwater from SEEP-11, sampled on a 5-year frequency, did not have detectable levels of CVOCs or 1,4-dioxane during 2018 sampling.

## **8.6.2 Site Inspections**

Site inspections are conducted during each long-term monitoring sampling event in the fall of each year. The most recent LTM event was completed in October 2019. In addition, the annual LUC inspection was conducted on September 20, 2019.

Photographs taken during this inspection are included in Appendix A. The results of the inspections conducted during monitoring events are documented in the monitoring event reports generated for each LTM event. No issues impacting remedy protectiveness were noted during the 2019 LUC inspection, and based on the results of the inspection, the Eastern Plume remedy is functioning as intended and remains protective.

## **8.6.3 Interviews**

The Navy holds regular Restoration Advisory Board (RAB) meetings for former NAS Brunswick to discuss the process of the cleanup program and ongoing investigations, Navy property transfer actions, and/or site status. Interview questionnaires were emailed to 11 potential interviewees, and four completed questionnaires were returned. The list of interviewees and returned questionnaires are included in Appendix C. No concerns related to remedy protectiveness at any of the sites were included in the responses, although general incidences of vandalism at Brunswick Landing were

mentioned. The findings of this fifth five-year review will be presented at a future RAB meeting after finalization of this report in September 2020.

## **8.7 Technical Assessment**

### **8.7.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?**

The review of documents, risk assumptions, and results of the site inspection indicate that the Eastern Plume remedy is functioning as intended by the 1998 ROD and 2000 and 2010 Eastern Plume ESDs, and 2014 multi-site LUC ESD. The GWETS has been successful at reducing COC concentrations and minimizing migration of Eastern Plume COCs, although VOC removal efficiency has decreased over time as is expected for groundwater extraction and treatment remedies. Implementation of LUCs to prevent groundwater use currently provides protection of human health and the environment until groundwater cleanup goals are met. The LTM program is ongoing and indicates progress in reaching target cleanup levels.

The remedial actions are being implemented as designed and include measures that prevent exposure. The remedial actions that are currently in operation (groundwater extraction, treatment, and discharge and LUCs) and actions that are ongoing (LTM) are operating as designed, and the data indicate progress toward meeting the RAOs. Based on the completed and ongoing activities, the intent and goals of the Eastern Plume ROD have been or will be met.

### **8.7.2 Question B: Are the Assumptions, Toxicity Data, Cleanup Values, and RAOs Used at the Time of the Remedy Selection Still Valid?**

There have been no changes in the physical conditions of the site that would affect the current protectiveness of the remedy. The change in site conditions associated with the closing of the base was addressed via the multi-site LUC ESD, as described above. In addition, the combined LUC RD for Sites 1 and 3, Site 2, and the Eastern Plume (included as an appendix to the Base-Wide LUCIP) includes provisions that LUCs be incorporated into any future leases or property transfer documents and that EPA and MEDEP be notified of any transfer actions.

### **8.7.2.1 ARAR and Site-Specific Action Level Changes**

The ARAR evaluation did not identify any changes that would call into question the protectiveness of the remedy.

Groundwater cleanup goals for the Eastern Plume, as documented in the ROD, were based on federal MCLs and Maine MEGs. Although MCLs have not changed, MEGs have been replaced by RAGs for residential and construction worker scenarios (see Section 8.3.4). These changes are not expected to have a negative impact on the remedy or to have impacted the remedy selected at the time of the ROD and do not affect current or future protectiveness because LUCs prohibit groundwater use in the area and will continue to be implemented until COC concentrations in groundwater decrease to the MCLs/RAGs in place at the time it is decided that the LUCs are no longer required.

### **8.7.2.2 Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods**

There have been no changes in physical conditions, exposure pathways, or land use that would affect the protectiveness of the Eastern Plume remedy.

Based on EPA's 2013 updated Integrated Risk Information System toxicity information and standard Superfund risk assessment approach, EPA's carcinogenic risk range of  $10^{-6}$  to  $10^{-4}$  for 1,4-dioxane equates to a concentration range of 0.46 to 46  $\mu\text{g/L}$ . The cleanup level of 3.5  $\mu\text{g/L}$  established by the 2010 ESD falls within the risk-based levels and therefore continues to be protective. The current Maine RAG for 1,4-dioxane is 4.6  $\mu\text{g/L}$ . The Eastern Plume 1,4-dioxane groundwater cleanup goal is less than the RAG and therefore continues to be protective.

In 2014, EPA finalized a Directive to determine groundwater exposure point concentrations (EPCs) (<https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236917>). This Directive provides recommendations to develop groundwater EPCs. The recommendations to calculate the 95-percent upper confidence limit (UCL) of the arithmetic mean concentration for each contaminant from wells within the core/center of the plume, using the statistical software ProUCL, could result in lower groundwater EPCs than the maximum concentrations routinely used for EPCs as past practice in risk assessment, leading to changes in groundwater risk screening and evaluation. In general, this approach could result in slightly lower risk or higher screening levels. (EPA. 2014).

In 2014, EPA finalized a Directive to update standard default exposure factors and frequently asked questions associated with these updates. <https://www.epa.gov/sites/>

production/files/2015-11/documents/oswer\_directive\_9200.1-120\_exposurefactors\_corrected2.pdf. Many of these exposure factors differ from those used in the risk assessment supporting the ROD. These changes in general would result in a slight decrease of the risk estimates for most chemicals (EPA. 2014). Although calculated risks from potential exposure pathways at former NAS Brunswick sites may differ from those previously estimated, slightly higher for some contaminants and slightly lower for others, the revised methodologies themselves are not expected to affect the protectiveness of the remedy. A review of site information identifies that these updates do not call into question the protectiveness of the remedy. Finally, these changes in risk assessment methods do not affect the protectiveness of the Eastern Plume remedy because exposure to contaminated groundwater is prevented by the establishment and implementation of LUCs.

In February 2018, EPA launched an online Vapor Intrusion Screening Level (VISL) calculator that can be used to obtain risk-based screening level concentrations for groundwater, sub-slab soil gas, and indoor air. The VISL calculator uses the same database as the Regional Screening Levels (RSLs) for toxicity values and physiochemical parameters and is automatically updated during the semi-annual RSL updates. As discussed in the Fourth Five-Year Review Report, vapor intrusion was not addressed as a potential pathway during previous Eastern Plume investigations, although VOCs were detected in several groundwater. Because site conditions have not changed since the human health risk assessment (i.e., sites are still inactive with no structures present), evaluation of this potential pathway continues to be unnecessary. Additionally, vapor intrusion considerations were incorporated into the clarified LUC objectives for the Eastern Plume, as documented in the 2015 LUC ESD, and associated LUCs to address potential vapor intrusion issues in potential future habitable structures built on site are included in the LUC RD.

The exposure assumptions used are considered to be conservative and reasonable in evaluating risk and developing risk-based cleanup levels. No changes to these assumptions or the cleanup levels developed from them is warranted. There have been no changes to the standardized risk assessment methodology, other than those noted above, that could affect the protectiveness of the remedy.

### **8.7.3 Question C: Has any other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?**

As discussed above, the Navy's assessment of PFAS contamination is ongoing at former NAS Brunswick on a base-wide basis.

Maine has not promulgated drinking water or groundwater standards for PFAS. The Maine Department of Health and Human Services has issued a fact sheet adopting EPA's LHA of 0.070 µg/L for PFOA and PFOS, individually and combined, in drinking water. According to Maine Remedial Action Guidelines for Sites Contaminated with Hazardous Substances Rules,<sup>1</sup> MEDEP recommends that the EPA LHA be applied at sites where groundwater is currently being used, or may be used in the future, for human consumption.

Field investigations conducted by the Navy, in response to the documented historical storage, handling, use, and releases of PFAS-containing AFFF at former NAS Brunswick, identified Site 11/Eastern Plume as one of main areas of the former base where groundwater has PFOS and PFOA concentrations significantly greater than EPA LHAs. Although groundwater concentrations of COCs as well as PFOS/PFOA are greater than their cleanup goals or EPA LHAs within the Sites 1, 2, 3, and the Eastern Plume GMZ, LUCs are in place to prevent groundwater use in the short term. Similarly, exposure to PFAS-impacted groundwater in other areas of the former base that have been transferred outside the Navy is controlled by restrictions placed in the transfer deeds.

No additional human health or ecological risks have been identified, and no weather-related events have affected the protectiveness of the remedy. No other information has been identified that calls into question the protectiveness of the remedy.

#### **8.7.4 Technical Assessment Summary**

Based on the data reviewed and the site inspection, the remedy is functioning as intended by the 1998 ROD as modified by the 2000 and 2010 Eastern Plume ESDs and 2015 multi-site LUC ESD. There have been no changes in the physical conditions at the site, toxicity factors for the COCs, or to the standardized risk assessment methodology that would affect the protectiveness of the remedy. Issues related to the change in land use associated with closure of the base have been addressed via the LUC ESD and RD. There is no other information, except for the detection of PFAS as explained below, that calls into question the protectiveness of the remedy.

Although PFAS contamination is being evaluated on a base-wide basis, remedy protectiveness associated with PFAS was conducted in conjunction with the Eastern

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<sup>1</sup> Maine Remedial Action Guidelines for Sites Contaminated with Hazardous Substances Rules, effective October 19, 2018 <https://www.maine.gov/dep/spills/publications/guidance/rags/ME-Remedial-Action-Guidelines-10-19-18cc.pdf>

Plume remedy. As discussed in Section 1.3, groundwater is not used as drinking water at the former facility, and a groundwater use prohibition has or will be included in the transfer documentation for any parcel of property transferred out of Navy ownership. Therefore, current and future exposure via drinking water to PFAS in groundwater at the facility is and will continue to be prohibited.

## 8.8 Issues

Remedial measures implemented at the Eastern Plume are protective of human health and the environment in the short term. Although groundwater concentrations of site COCs and PFOS/PFOA are greater than ROD cleanup goals and EPA LHAs, respectively, within Sites 1, 2, 3 and Eastern Plume GMZ, LUCs are in place to prevent groundwater use. However, the nature and extent of PFAS contamination at the Eastern Plume and in other areas of the former NAS Brunswick is not fully understood. Therefore, completion of a base-wide PFAS RI for NAS Brunswick is needed to determine if additional action is required under CERCLA. This recommendation is being provided as part of the protectiveness determination for the Eastern Plume remedy, although PFAS have also been detected in excess of LHAs in other areas of the base. Based on the results of the PFAS RI, future five-year reviews may include PFAS protectiveness evaluations as part of the Eastern Plume evaluation and/or evaluations for other existing sites or on a base-wide basis.

## 8.9 Recommendations and Follow-Up Actions

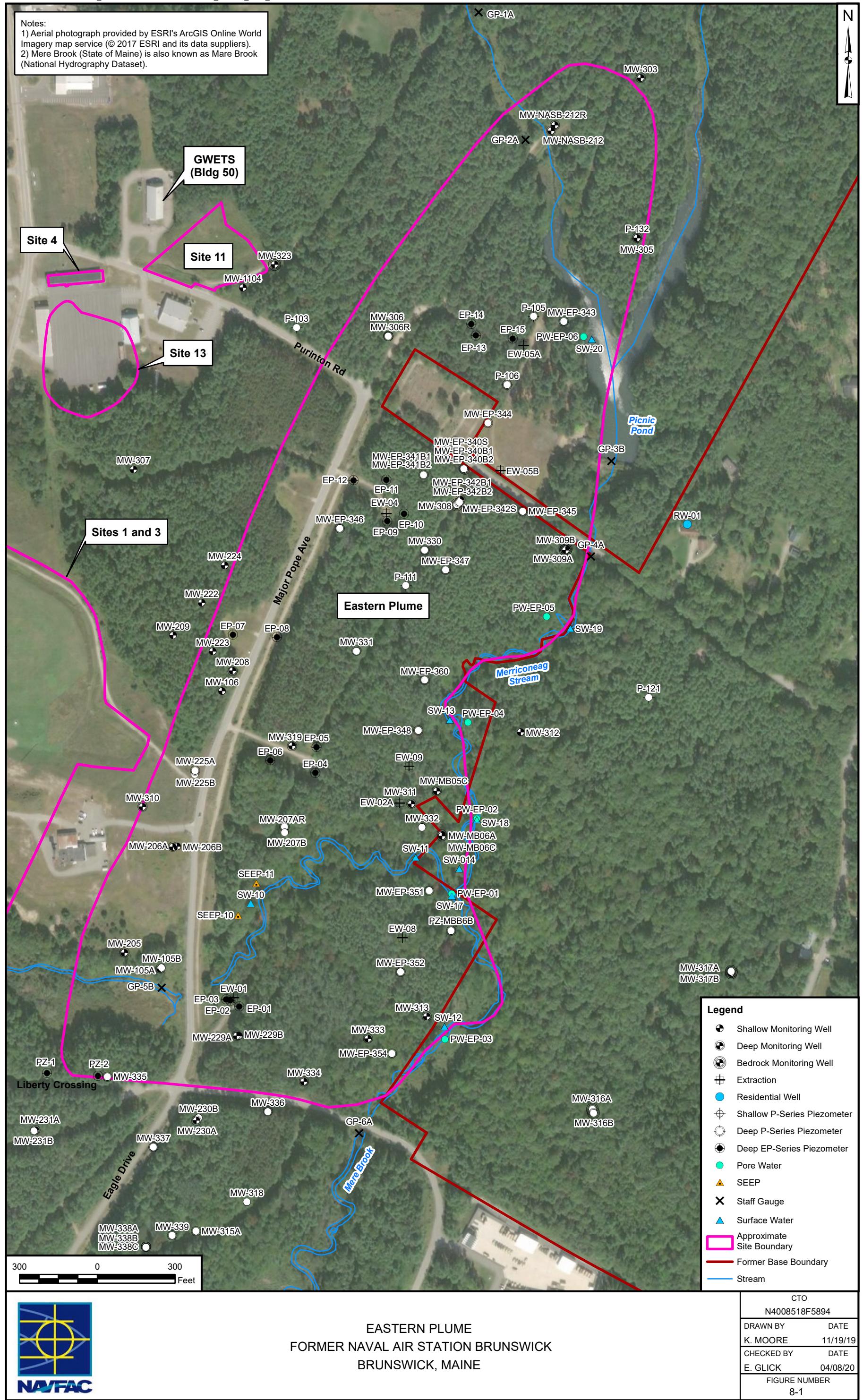
A PFAS RI should be completed for NAS Brunswick including the Eastern Plume to determine if additional action is required to address CERCLA risk.

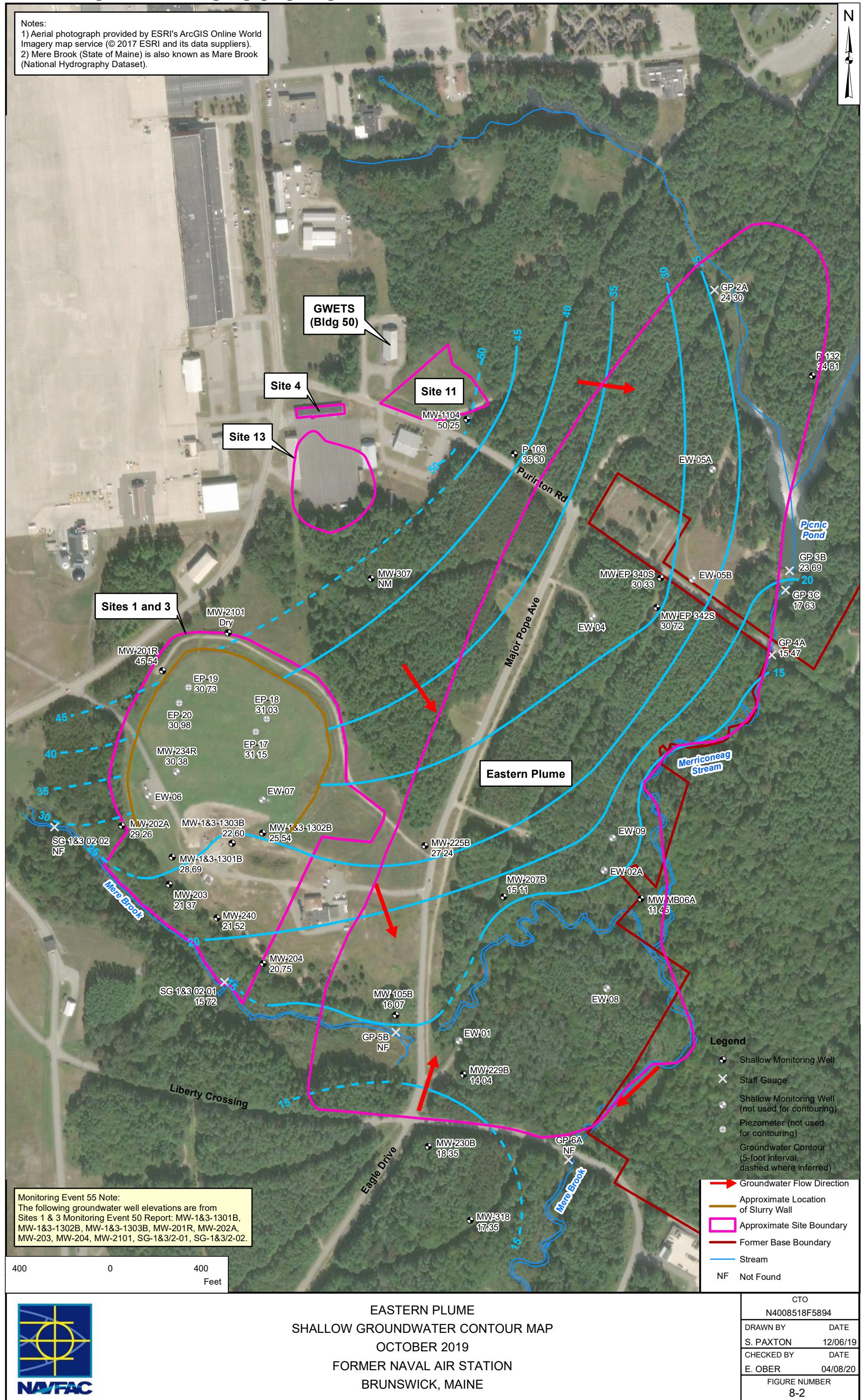
## 8.10 Protectiveness Statement

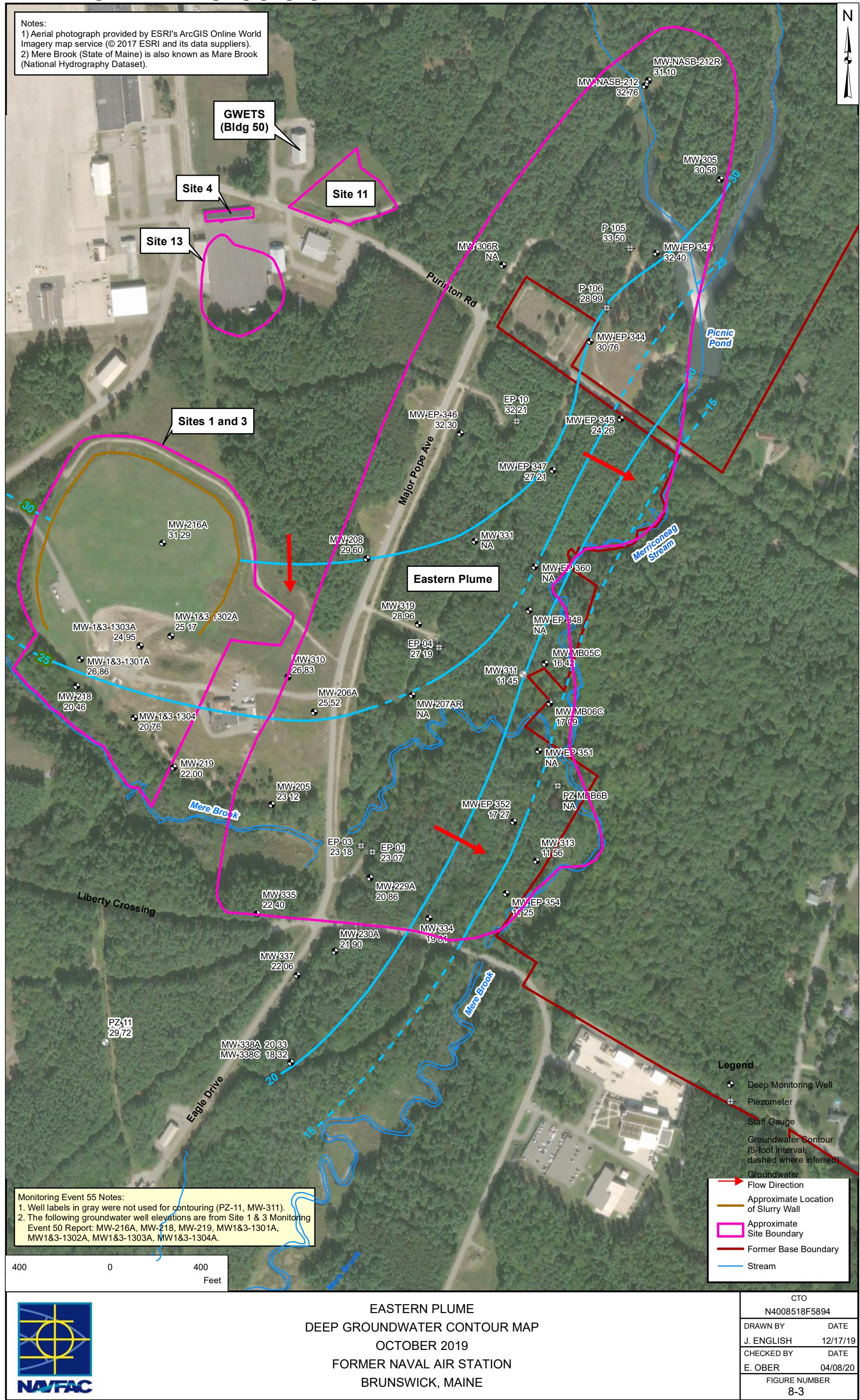
Protectiveness Statement(s)		
<i>Operable Unit:</i> OU12, Eastern Plume	<i>Protectiveness Determination:</i> Short-Term Protective	<i>Planned Completion Date:</i> December 2022
<i>Protectiveness Statement:</i> Remedial measures implemented at the Eastern Plume are protective of human health and the environment in the short term. Although groundwater concentrations of site COCs and PFOS/PFOA are greater than ROD cleanup goals and EPA LHAs, respectively, within Sites 1, 2, 3 and Eastern Plume GMZ, LUCs are in place to prevent groundwater use. However, the nature and extent of PFAS contamination at the Eastern Plume		

and other areas of the former NAS Brunswick is not fully understood. Therefore, completion of a base-wide PFAS RI for NAS Brunswick is needed to determine if additional action is required under CERCLA and whether the remedy is protective in the long term.

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## 9.0 Summary of Issues and Recommendations

<b>Issues/Recommendations</b>				
<b>OU(s) without Issues/Recommendations Identified in the Five-Year Review:</b>				
OU1, Sites 1 and 3; OU7, Site 2 and Site 7; OU6, Site 9; OU9, Site 12; and OU10, Quarry Area				
<b>Issues and Recommendations Identified in the Five-Year Review:</b>				
<b>OU(s): 2</b>	<b>Issue Category:</b> Other <i>Potential for human exposure to PFOS/PFOA was not anticipated in the OU2 ROD</i>			
	<b>Issue:</b> <i>Potential for unacceptable CERCLA risk due the presence of PFOS/PFOA at NAS Brunswick, including the Eastern Plume</i>			
	<b>Recommendation:</b> <i>To be protective in the long term, investigations are recommended for the Eastern Plume as part of a larger base-wide RI.</i>			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	Federal Facility	EPA/State	December 2022

## 9.1 Sitewide Protectiveness Statement

The protectiveness statements for each OU/site are provided in Sections 3 through and 8. The Sitewide Protectiveness Statement is as follows.

<b>Sitewide Protectiveness Statement</b>	
<i>Protectiveness Determination:</i> Short-Term Protective	<i>Planned Completion Date:</i> December 2022
<i>Protectiveness Statement: The potential for exposure to PFAS was not anticipated in the OU2 ROD. Investigations are recommended for the Eastern Plume as part of a larger base-wide RI for the former NAS Brunswick to ensure protectiveness in the long term. The remedies at all other former NAS Brunswick OUs/sites are protective of human health and the environment.</i>	

## 9.2 Next Review

This report represents the fifth five-year review conducted for IR Program sites at NAS Brunswick. The next five-year review will be required within 5 years of the signature date of this review, September 2025.

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## **APPENDIX A**

## **PHOTOGRAPHS**

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## SITES 1 AND 3

















## SITE 2





## SITE 7



## SITE 9









**SITE 12**





# NOTICE

THIS IS THE LOCATION OF A FORMER NAVAL AIR STATION BRUNSWICK TRAINING AND DISPOSAL AREA WHERE SMALL QUANTITIES OF EXPLOSIVE MUNITIONS ITEMS WERE HISTORICALLY USED AND DISCARDED. THE NAVY HAS COMPLETED EXTENSIVE MUNITIONS CLEARANCE ACTIVITIES AT THIS SITE, KNOWN AS THE QUARRY SITE, AS WELL AS CONSTRUCTION OF A PROTECTIVE SOIL COVER OVER THE FORMER DEBRIS AREA SUCH THAT THE SITE NO LONGER POSES SAFETY RISKS TO THE PUBLIC.

THERE ARE PROHIBITIONS AGAINST DISTURBING THE PROTECTIVE SOIL COVER. DO NOT DIG. POTENTIAL MUNITIONS ITEMS DISCOVERED BY THE PUBLIC SHOULD BE CONSIDERED DANGEROUS REGARDLESS OF SIZE OR AGE. THE NAVY IS PROVIDING NOTICE OF FORMER MUNITIONS DISPOSAL ACTIVITIES AT THE QUARRY SITE TO INFORM AND EDUCATE THE PUBLIC SHOULD ANY MUNITIONS ITEMS BE ENCOUNTERED.

IF YOU ENCOUNTER A SUSPICIOUS-LOOKING ITEM, REMEMBER THE THREE R's OF EXPLOSIVE SAFETY:

**RECOGNIZE:** Recognize when you may have encountered a munitions item.

**RETREAT:** Do not touch, move or disturb it, but carefully leave the area

the way you entered.

**REPORT:** Call 911. Immediately notify local law enforcement of what you saw and where you saw it.



- MUNITIONS ITEMS CAN COME IN MANY SHAPES AND SIZES.

- MUNITIONS ITEMS CAN LOOK LIKE A:

- POINTED PIPE
- SODA CAN
- BASEBALL
- MUFFLER

## MUNITIONS ITEMS MAY:

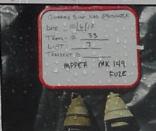
- BE VISIBLE ON THE SURFACE OR BE BURIED
- BE EXPOSED BY EROSION OR FIRES
- LOOK NEW OR OLD
- BE COMPLETE OR IN PARTS
- BE FOUND ALONE OR IN GROUPS
- SHOULD BE CONSIDERED DANGEROUS REGARDLESS OF SIZE OR AGE

## EXAMPLES OF MUNITIONS ITEMS FOUND AND REMOVED AT THIS SITE

SMALL ARMS AMMUNITION



ROCKET FUZE



ILLUMINATION FLARE



RIFLE GRENADE



GRENADE FUZE



MISCELLANEOUS MUNITIONS / FRAGMENTS



[www.ComplianceSigns.com](http://www.ComplianceSigns.com)

## QUARRY AREA







## EASTERN PLUME









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**APPENDIX B**  
**PUBLIC NOTICE OF THE START OF THE FIVE-YEAR REVIEW**

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Tuesday, June 2, 2020 The Times Record B5

Public Notices are a permanent and independent of government and court action. These include state and local government meetings, rule making, available contracts, zoning changes, and many more, as required by law. In addition, parties to some court proceedings, such as foreclosures, probate and estate actions are required to publish notices to ensure notification of affected parties, as well as the general public. These notices also alert business owners, large and small, to potential government contractual jobs, helping to ensure economic activity across a level playing field. Public notices have existed to ensure transparency in all levels of government since the founding of the United States.

State and local notices are published in Maine newspapers and are also recorded at [mainenotices.com](http://mainenotices.com), where anyone can browse or search notices, and sign up to receive email alerts when relevant notices appear.

## Articles For Sale

1974 HONDA MOTOR-CYCLE 550-4 good cond. \$1000 729-8866

ELECTRIC SCOOTER/BICYCLE \$1000. Call 319-5126.

SHOPSMITH 9 in 1. \$100. Call 798-4547.

WOMANS Golf Clubs set of Ping-eyo 2 trons, like new, \$90. 729-4491

## Wanted To Buy

FAMILY LETTERS, photos, mementos, scrapbooks, film, ledgers, scrapbooks. John 443-2092.

HANDTOOLS WANTED Stanley planes, chisels, adzes, gouges, axes, combination wrenches, Machinist tools, Estate & shop lots, collections, antiques. [davistownmuseum.org](http://davistownmuseum.org) 888-405-2007

## Houses For Rent

BATH 3 bedroom, heat, water, electric included. No pets. \$1200/month + security. Call 442-9133



## Public Notices

## Public Notice

COUNTY OF SAGADAHOC BOARD OF COMMISSIONERS PUBLIC NOTICE

Tuesday, June 9, 2020 at 3:00 p.m.

The Board of Commissioners will hold its regular monthly meeting via a remote Zoom meeting. Any person wishing to speak may contact the Administrative Office at 443-8202 for connection information.



**PUBLIC NOTICE**  
**FIFTH FIVE-YEAR REVIEW**  
**FOR**  
**FORMER NAVAL AIR STATION**  
**BRUNSWICK, ME**

The Department of the Navy, in conjunction with the United States Environmental Protection Agency (EPA) Region 1 and Maine Department of Environmental Protection (MEDEP), is conducting the fifth five-year review of the selected remedies being implemented to address environmental contamination at Former Naval Air Station (NAS) Brunswick, Maine. The purpose of the five-year review is to evaluate the implementation and performance of the remedies to ensure that the selected remedies are effectively protecting public health and the environment as intended.

Under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (also known as Superfund), reviews of long-term remedial actions are required every 5 years to ensure continued protection of human health and the environment until the sites are deemed suitable for unlimited use and unrestricted exposure. This fifth five-year review will focus on the continued effectiveness of the remedies at sites at the Former Brunswick Naval Air Station for which Records of Decision (RODs) documenting selection of CERCLA remedial actions have been signed, including Sites 1 and 3, 2, 7, 9, 12, Quarry Area, and the Eastern Plume. The Navy plans to complete this review by September 30, 2020. A subsequent public notice will announce the completion of the Fifth Five-Year Review Report and its availability at the Former NAS Brunswick Information Repository located at Curtis Memorial Library, 23 Pleasant Street, Brunswick, Maine, 04011, (207) 725-5242, [www.curtislibrary.com](http://www.curtislibrary.com), and the Navy's BRAC website, [www.bracpmo.navy.mil](http://www.bracpmo.navy.mil).

Public participation in the five-year review process is encouraged and welcomed. If you are interested in participating in the review process or if you have questions or would like more information about the sites under review, please contact:

**Mr. David A. Barney**  
BRAC Program Management Office East  
P.O. Box 169  
South Weymouth, MA 02190  
Phone: 781-626-0105  
Email: [david.a.barney@navy.mil](mailto:david.a.barney@navy.mil)

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or 443-9752**

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**APPENDIX C**  
**INTERVIEW QUESTIONNAIRES**

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## INTERVIEW QUESTIONS

### FIFTH FIVE-YEAR REVIEW FORMER NAVAL AIR STATION BRUNSWICK



*Please use other side for additional comments.*

1. What is your overall impression of the remedial actions conducted or planned at the active environmental sites at the base (Sites 1 and 3, Site 2, Site 7, Site 9, Site 12, Quarry Area, and Eastern Plume)?

The Navy has been highly responsive to the regulators, MRRA and the community regarding remediation actions. However, the process is much slower than hoped.

2. Have the Navy's environmental cleanup activities had any effects on the surrounding communities?

Not in a negative way. The Navy has been very transparent in their efforts since day 1.

3. Are you aware of any community concerns regarding cleanup activities at the active sites at the base? Please provide details.

The PFOA/PFOS issue seems to prevail the majority of community concerns at this time. I think some members of the community would prefer a significant slowdown of the redevelopment effort until the property is completely remediated. However, they are a minority. The vast majority appreciate the Navy's efforts.

4. Are you aware of any complaints, incidents, unusual activities (vandalism, trespassing), or emergency responses by local authorities at any of the active environmental sites?

There has been some trespassing and vandalism on Navy property that is still undergoing remedial actions.

5. Do you feel well informed about the environmental cleanup activities and progress?

Yes. We have a good working relationship with the Navy.

6. Do you have any comments, suggestions, or recommendations regarding the management of the active environmental sites?

Just speed it up and transfer the property. The sooner you can get us the properties, the sooner we can get into productive reuse.

Name: Steven Levesque

Title: Executive Director

Organization/Community: Midcoast Regional Redevelopment Authority

Please return to: Mr. David Barney, Remedial Project Manager  
BRAC Program Management Office East  
571 Shea Memorial Drive, South Weymouth, MA 02190  
e-mail: [david.a.barney@navy.mil](mailto:david.a.barney@navy.mil)



## INTERVIEW QUESTIONS

### FIFTH FIVE-YEAR REVIEW FORMER NAVAL AIR STATION BRUNSWICK



*Please use other side for additional comments.*

1. What is your overall impression of the remedial actions conducted or planned at the active environmental sites at the base (Sites 1 and 3, Site 2, Site 7, Site 9, Site 12, Quarry Area, and Eastern Plume)?

My overall impression is that the remedial actions conducted to date and planned have been well planned, executed, and communicated. As Bowdoin College is an abutter to the Quarry Area, I have paid most attention to plans for the Quarry remediation. The College has been well-informed through documentation, RAB meetings and meetings with Navy personnel.

2. Have the Navy's environmental cleanup activities had any effects on the surrounding communities?

I believe the surrounding communities will benefit from this environmental remediation - and from the environmental data and studies that have been conducted as a result. I'm not aware of any negative impacts on the surrounding communities.

3. Are you aware of any community concerns regarding cleanup activities at the active sites at the base? Please provide details.

I am aware of issues raised historically by BACSE, and the more recent issue regarding remediation of the east-side storm water ponds and/or restoration of the stream that was altered when the ponds were created.

4. Are you aware of any complaints, incidents, unusual activities (vandalism, trespassing), or emergency responses by local authorities at any of the active environmental sites?

While I am not aware of specific vandalism at the remediation sites, the College has had some issues with vandalism and trespass (gate and fence destruction, illegal camping) on our property on west side of the former NASB this summer. We communicate with the other landowners (Town, Navy and MRRA) when incidents occur.

5. Do you feel well informed about the environmental cleanup activities and progress?

I do feel well-informed about the environmental cleanup activities. The past few months have been more challenging given the impact of COVID on the regular RAB meetings and the opportunity to meet in person with Navy personnel.

6. Do you have any comments, suggestions, or recommendations regarding the management of the active environmental sites?

I think the Brunswick community has benefitted from the RAB model and the open dialogue and information it has provided to landowners and residents. I hope that Navy will continue to find a way to keep the community informed about the activities and management of the active sites during this time of limited on site meetings and contact.

Name: Catherine Ferdinand

Title: Government Relations and Land Use Specialist

Organization/Community: Bowdoin College

Please return to: Mr. David Barney, Remedial Project Manager  
BRAC Program Management Office East  
571 Shea Memorial Drive, South Weymouth, MA 02190  
e-mail: [david.a.barney@navy.mil](mailto:david.a.barney@navy.mil)



## INTERVIEW QUESTIONS

### FIFTH FIVE-YEAR REVIEW FORMER NAVAL AIR STATION BRUNSWICK



*Please use other side for additional comments.*

1. What is your overall impression of the remedial actions conducted or planned at the active environmental sites at the base (Sites 1 and 3, Site 2, Site 7, Site 9, Site 12, Quarry Area, and Eastern Plume)?

The remedial actions appear to be deliberately planned and thoroughly executed.

2. Have the Navy's environmental cleanup activities had any effects on the surrounding communities?

MEARNG has experienced a direct positive effect from the Navy's clean up, which has allowed us to acquire military training facilities in a desirable high-growth area of the state.

3. Are you aware of any community concerns regarding cleanup activities at the active sites at the base? Please provide details.

MEARNG is aware of community concern with PFAS compounds on site.

4. Are you aware of any complaints, incidents, unusual activities (vandalism, trespassing), or emergency responses by local authorities at any of the active environmental sites?

No.

5. Do you feel well informed about the environmental cleanup activities and progress?

Communications are generally very good. However, as a landowner, developer and lessor of multiple properties at the Former NASB, MEARNG wishes FOST documents were more easily accessible. MEARNG (and likely other developers) would appreciate having the FOSTs made available on the BRAC website document library.

6. Do you have any comments, suggestions, or recommendations regarding the management of the active environmental sites?

No.

Name: Andrew Flint

Title: Environmental Branch Chief

Organization/Community: Maine Army National Guard

Please return to: Mr. David Barney, Remedial Project Manager  
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## INTERVIEW QUESTIONS

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3. Are you aware of any community concerns regarding cleanup activities at the active sites at the base? Please provide details.

4. Are you aware of any complaints, incidents, unusual activities (vandalism, trespassing), or emergency responses by local authorities at any of the active environmental sites?

5. Do you feel well informed about the environmental cleanup activities and progress?

6. Do you have any comments, suggestions, or recommendations regarding the management of the active environmental sites?

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Organization/Community: \_\_\_\_\_

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