UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NEW ENGLAND REGION
FIVE POST OFFICE SQUARE, SUITE 100, BOSTON, MA 02109

September 15, 2020

Bruce Thompson
de maximis, inc.
200 Day Hill Road, Suite 200
Windsor, CT 06095

Re: Approval of de maximis inc. report titled *Remedial Design Work Plan* (the "RDWP"), dated September 2020.

Nuclear Metals, Inc. Superfund Site

Dear Mr. Thompson:

EPA, in consultation with the Massachusetts Department of Environmental Protection, has completed its review of the *Remedial Design Work Plan*, dated September 2020. The RDWP was revised in response to EPA comments dated July 16, 2020 and August 31, 2020. The RDWP is subject to the terms and conditions specified in the Consent Decree (CD) for Remedial Design / Remedial Action (RD/RA) for the Nuclear Metals, Inc. Site, which has an effective Date of December 6, 2019.

EPA has reviewed the revisions to the RDWP and finds that they are acceptable. Therefore, EPA approves the RDWP. EPA is providing separate approval for the RDWP appendices.

If there is any conflict between the Performance Standards as stated in the Work Plan and the Performance Standards as stated in the CD and statement of work (SOW), the CD and SOW shall control.

Please do not hesitate to contact me at (617) 918-1339 or at smith.christopher@epa.gov should you have any questions in this regard.

Sincerely,

Christopher Smith
Project Manager

NUCLEAR METALS, INC. SUPERFUND SITE

CONCORD, MASSACHUSETTS

Remedial Design

Work Plan

de maximis, inc.
200 Day Hill Road, Suite 200
Windsor, CT 06095

September 2020

Executive Summary

On October 17, 2019 the United States Environmental Protection Agency (USEPA) lodged a Consent Decree (CD) with the United States District Court for the District of Massachusetts Eastern Division in connection with Civil Action No. 19-12097-RGS. The CD was entered by the Court on December 6, 2019. The CD and its accompanying Statement of Work (SOW) describe the Remedial Design/Remedial Action (RD/RA) work to be performed for the Nuclear Metals, Inc. (NMI) Superfund Site in Concord, Massachusetts (the NMI Site or Site). The RD/RA work will be undertaken by the Settling Defendants (SDs) to the CD, with funding contributions from the Settling Federal Agencies (SFAs).

This *Remedial Design Work Plan* (RDWP) addresses the requirements of SOW Section 3.1. It summarizes pertinent Site-related background information, identifies and describes the scopes and procedures for various pre-design investigations, describes the anticipated RD process, and discusses the RD-related deliverables and schedule.

The NMI Site encompasses the property located at 2229 Main Street in Concord, Middlesex County, MA and surrounding areas where groundwater contamination has come to be located. The property also has soil and sediment contamination but off property contamination is limited to groundwater. The NMI property includes a sphagnum bog, a cooling water recharge pond, a former landfill and a holding basin. The Site is surrounded by residential and woodland areas to the east and south, light commercial and industrial areas to the west, and Main Street (Route 62) and the Assabet River to the north. NMI purchased approximately 30 acres of undeveloped property on August 29, 1957 and constructed and occupied the original facility buildings in March 1958.

Past operations at the Site involved fundamental research and development in physical metallurgy, chemical metallurgy, engineering and product development, fuel element development and manufacture, and high temperature materials (Nuclear Metals, Inc (NMI), 1961). In September 1972, NMI employees purchased the operation. After the 1972 purchase, NMI developed a large-scale depleted uranium (DU) manufacturing operation, which included, but was not limited to, the manufacturing of penetrators, or bullets, from DU as a defense contractor for the United States (US) Army. Other work included manufacture of DU shields, and counterweights, manufacture of metal powders, beryllium and beryllium alloy parts production, and manufacture of specialty titanium parts.

On October 1, 1997, NMI was renamed Starmet Corporation. Starmet, its subsidiaries, affiliates, and related entities (collectively, the Starmet Parties) continued to perform small scale operations at the Site through October 2011. On May 12, 2003, the Massachusetts Department of Public Health – Radiation Control Program (MADPH-RCP) modified Starmet's Radioactive Materials License to allow only possession of radioactive materials on-site. Starmet officially vacated the property on November 2, 2011. The Radioactive Materials License was terminated by the MADPH-RCP on November 8, 2011.

The Site was placed on the National Priorities List (NPL) on June 14, 2001, pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605. As required by an Administrative Order by Consent (AOC) dated June 13, 2003, a Remedial Investigation/ Feasibility Study (RI/FS) was completed for the Site. Results of the RI/FS included information sufficient to:

- Define the source(s), nature, and distribution of contaminants released;
- Calculate and assess the current and future potential risks to human health and to the environment; and
- Evaluate remedial alternatives, conceptually design actions, and select a remedy.

The RI Report (***de maximis, inc.***, April 2014) includes a more detailed Site history and a comprehensive summary of investigative and removal activities conducted prior to and during the RI. These included:

- investigations of groundwater, soils, sediments and sludge by Starmet required by the Massachusetts Department of Environmental Quality Engineering (MADEQE) and its successor, the Massachusetts Department of Environmental Protection (MassDEP),
- a 1997 action by Starmet that removed approximately 8,000 cubic yards of soil and sludge from the Holding Basin (HB),
- a 2002 Time-Critical Removal Action (TCRA) by EPA that installed a temporary cover system (cap) over the Old Landfill Area and over the HB,
- a 2004 drum removal action in the area north of the HB and south of the Cooling Water Pond (conducted pursuant to the RI field work),
- a 2005-2006 drum and bulk material removal action by MassDEP that removed significant quantities of uranium (U) and U-impacted materials from the Site buildings, and
- a second EPA TCRA in 2007 that removed hazardous and flammable materials from the Site buildings.

EPA signed an approval memorandum in December 2007 that required performance of an Engineering Evaluation / Cost Analysis (EE/CA) to evaluate alternatives to address the Site buildings and their contents. The EE/CA was completed in February 2008, and EPA issued an Action Memorandum in September 2008 that authorized a Non-Time-Critical Removal Action (NTCRA) to empty the contents of the buildings, demolish them, and dispose of contents and building materials off-site. The Administrative Settlement Agreement and Order on Consent (AOC) for the building NTCRA became effective in August 2011 and Site work was completed in August 2016. A final report for the building NTCRA was approved by EPA in May 2017 (***de maximis, inc.,*** May 2017). Post-removal Site control (PRSC) commenced at the completion of the NTCRA and continued through entry of the RD/RA CD. The Building NTCRA terminated upon entry of the RD/RA CD, but the PRSC will continue as a requirement under the RD/RA CD.

EPA issued the Record of Decision (ROD) in September 2015. The ROD describes the selected remedy for the Site and is the basis for the RD/RA CD and SOW which detail the activities to be undertaken. Key elements of the selected remedy are as summarized as follows:

- Excavation and off-site disposal of approximately 82,500 cubic yards of contaminated sediments, underground drain lines and debris, and non-Holding Basin (HB) soils (contaminated with depleted uranium (DU), polychlorinated biphenyls (PCBs), and other contaminants of concern found in Tables L-2 through L-4) in various areas of the Site;
- In-situ sequestration (ISS) of DU contaminated soils in the HB via injection of a stabilization agent such as apatite (e.g., Apatite II™) or other comparable stabilization agent to prevent leaching of contaminants to groundwater, and ISS of DU in overburden groundwater and natural uranium in bedrock groundwater;
- Containment of HB soils with a low-permeability vertical wall and horizontal sub-grade cover to isolate the stabilized soils and further limit mobility of contaminants by removing the flow of groundwater;
- Extraction and *ex-situ* treatment of volatile organic compounds (VOCs) and 1,4-dioxane in overburden and bedrock aquifers;
- Long-term monitoring to monitor effectiveness of *in-* and *ex-situ* treatment; and
- Institutional Controls to: 1) prevent unacceptable exposures to, and to prevent disturbance of, the HB area; 2) prohibit use of contaminated groundwater until cleanup levels are met; and 3) require installation of vapor mitigation systems should future structures be built above the VOC plume before groundwater cleanup levels are met, unless an evaluation of vapor intrusion risks is performed to show such systems are not required.

The ROD included an Action Memorandum to authorize performance of a Groundwater NTCRA including, but not limited to groundwater extraction and ex-situ treatment of VOCs and 1,4-dioxane. An AOC for a Groundwater NTCRA became effective in July 2016. To date, work under the Groundwater NTCRA has included delineation of the extent of VOCs and 1,4-dioxane in overburden groundwater, installing an extraction well and performing an aquifer pump test, installing and operating a temporary ex-situ treatment system that allowed for early containment of the VOC and 1,4-dioxane contamination, ongoing groundwater monitoring, performing a treatability study to select the best demonstrated technology to treat VOCs and 1,4-dioxane, and design and installation of the final ex-situ treatment system. That system is in operation. The work initiated under the Groundwater NTCRA will continue and be incorporated into the RD/RA work.

The selected remedy will be divided into five Remedial Action (“RA”) projects to facilitate efficient implementation as outlined in Section 1.4 of the SOW. Each RA project will proceed on its own track after approval of this RDWP, resulting in separate schedule for pre-design, remedial design through remedial action until final EPA approval of the Remedial Action report. The five RA projects are:

1) excavation and off-site disposal of contaminated sediments, underground drain lines and debris, and non-HB soils, or "site-wide soils and sediments";
2) ISS of DU in HB soils, DU in overburden groundwater, and natural uranium in bedrock groundwater, or "ISS";
3) containment of HB stabilized soils with a low-permeability vertical wall and low-permeability horizontal sub-grade cover, or "HB containment";
4) ex-situ treatment of VOCs and 1,4-dioxane in groundwater (in progress started under the Groundwater NTCRA); and,
5) Delineation and treatment of 1,4-dioxane and VOCs in bedrock groundwater.

As required by Section 3.3(a) of the SOW, Pre-Design Investigation Work Plans (PDI WPs) have been prepared to collect data needed for the design. Ex-situ treatment of VOCs and 1,4-dioxane is in the Operations and Maintenance phase and does not require further PDI work. However, the extent of 1,4-dioxane and VOCs in bedrock groundwater in the area up gradient from the extraction well needs further delineation. Separate PDI WPs were prepared for each remedial component, and are attached as follows:

- Site-wide Soils and Sediment PDI WP (Appendix A)
- ISS PDI WP (Appendix B)
- HB Containment PDI WP (Appendix C)
- 1,4-dioxane and VOCs in Bedrock Groundwater PDI WP (Appendix D)

Section 3.4(a) of the SOW requires performance of Treatability Studies (TS) to support the ISS component of the remedy. Separate studies are needed to evaluate and select treatment materials/reagents, respectively, for high concentration DU within the HB, low concentration DU outside the HB, and isotopically natural U in bedrock. In addition to reagent selection, each of these media will require evaluation of the best means to apply the selected reagent. The overall Treatability Study Work Plan (TSWP) is attached as Appendix E.

This RDWP includes the following plans or "Supporting Deliverables" required by ¶10.b of the CD and Section 6.7 of the SOW:

- Post Removal Site Control Plan (PRSCP) - Appendix F. The PRSCP is provided to continue the requirements established pursuant to the Building NTCRA.
- Health and Safety Plan (HASP) – Appendix G
- Emergency Response Plan (ERP) – Appendix H
- Sampling and Analysis Plan: Field Sampling Plan (FSP) – Appendix I
- Sampling and Analysis Plan: Quality Assurance Project Plan (QAPP) – Appendix J
- Site Wide Monitoring Plan (SWMP) – Appendix K

- Community Relations Support Plan (CRSP) – Appendix L

After the PDI for a remedial component is completed, a PDI Evaluation Report will be developed and submitted for EPA comment. After the TS are completed, a TS Evaluation Report will be developed and submitted to EPA for comment. The Preliminary (30%) RD will be submitted to EPA for comment 90 days after EPA approves the PDI Evaluation Report, and if needed, the TS Evaluation Report. Separate 30% RDs will be submitted for each remedial component. Required elements of the 30% RD are described in SOW Section 3.5. The 30% RD will be accompanied by updated "supporting deliverables" as appropriate, and the following additional supporting deliverables:

- Construction Quality Assurance / Quality Control Plan,
- Transportation and Off-Site Disposal Plan,
- Operations and Maintenance (O&M) Plan, and
- O&M Manual.

In addition, an Institutional Controls Implementation and Assurance Plan (ICIAP) deliverable will be submitted with the 30% RD for the containment of HB stabilized soils.

The SOW allows for bypass of the Intermediate (60%) RD, if EPA agrees following review of the 30% RD. It is our goal to bypass the 60% RD deliverables, which will lead to submission of a Pre-Final (95%) RD within 60 days after receipt of EPA's comments on the 30% RD. The requirements for the 95% RD are provided in SOW Section 3.7. A Final (100%) RD will be submitted for EPA review 14 days after receipt of EPA's comments on the 95% RD.

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G – Health and Safety Plan (HASP)

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I - Sampling and Analysis Plan: Field Sampling Plan (FSP)

J - Sampling and Analysis Plan: Quality Assurance Project Plan (QAPP)

K – Site Wide Monitoring Plan (SWMP)

L - Community Relations Support Plan (CRSP)

Acronyms and Abbreviations

Note: The following is a comprehensive listing of the acronyms and abbreviations used in this Remedial Design Work Plan and associated attachments.

1,1-DCA	1,1-dichloroethane
1,1,1-TCA	1,1,1-trichloroethane
AOC	Administrative Settlement Agreement and Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
AOI	Area of Investigation
BACT	Best Available Control Technology
bgs	below ground surface
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFD	Concord Fire Department
COCs	Constituents of Concern
CWA	Clean Water Act
ddms	*de maximis* Data Management Solutions
DO	dissolved oxygen
DQA	Data Quality Assessment
DQOs	Data Quality Objectives
DU	Depleted Uranium
EA	Exposure Areas
ELCR	Excess Lifetime Cancer Risk
°F	degrees Fahrenheit
f_{oc}	fraction of solid organic carbon in soil
FS	Feasibility Study
FSP	Field Sampling Plan
GAC	granular activated carbon
gpm	gallons per minute
GZA	Environmental Consulting Firm
H&A	Haley and Aldrich
HB	Holding Basin
HI	Hazard Index
IRIS	Integrated Risk Information System
ISS	In-situ Sequestration
MassDEP	Massachusetts Department of Environmental Protection
MCLs	Maximum Contaminant Levels
MCLG	Maximum Contaminant Level Goal
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
MNA	Monitored Natural Attenuation
NGVD	National Geodetic Vertical Datum

NO_2^-	nitrite
NO_3^-	nitrate
NRC	Nuclear Regulatory Commission
NTCRA	Non-Time-Critical Removal Action
O&M	Operations and Maintenance
OMM	Operation, Maintenance and Monitoring
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	tetrachloroethylene
PDI	Pre-Design Investigation
POP	Project Operations Plan
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PRGs	Preliminary Remediation Goals
QAPP	Quality Assurance Project Plan
RAOs	Remedial Action Objectives
RAWP	Remedial Action Work Plan
RDWP	Remedial Design Work Plan
RD/RA	Remedial Design/Remedial Action
Redox	Reduction-Oxidation
RI	Remedial Investigation
ROD	Record of Decision
RSL	Remedial Investigation Screening Levels
SAP	Sampling and Analysis Plan
SCM	Site Conceptual Model
SDs	Settling Defendants
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOCs	semi-volatile organic compounds
TAL	Target Analyte List
TCE	trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TSCA	Toxic Substances Control Act
ug/L	micrograms per liter
USEPA	United States Environmental Protection Agency
VI	Vapor Intrusion
VOC	volatile organic compound

1 Introduction

On October 17, 2019, the United States Environmental Protection Agency (USEPA) lodged a Consent Decree (CD) with the United States District Court for the District of Massachusetts in connection with Civil Action No. 1-19-cv-12097-RGS. The CD was entered by the Court on December 6, 2019. The CD and its accompanying Statement of Work (SOW) describe the Remedial Design/Remedial Action (RD/RA) activities to be performed for the Nuclear Metals, Inc. (NMI) Superfund Site in Concord, Massachusetts (the NMI Site or Site). The RD/RA activities are to be undertaken by the Settling Defendants (SDs) to the CD, with funding contributions from the Settling Federal Agencies (SFAs).

1.1 Purpose and Scope

This *Remedial Design Work Plan* (RDWP) was developed to be consistent with Section VI of the CD and Section L of the Record of Decision (ROD) (EPA, September 2015), to provide the necessary and relevant information to fulfill the SOW requirements, and to provide a pathway through the RD phase of the remedy. It summarizes pertinent Site-related background information, identifies and describes the scopes and procedures for various pre-design investigations, describes the anticipated RD process, and discusses the RD-related deliverables and schedule.

1.2 Document Content and Organization

Section 3.1 of the SOW states that the RDWP must include:

(a) Plans for implementing all RD activities identified in this SOW, in the RDWP, or required by EPA to be conducted to develop the RD;

(b) A description of the overall management strategy for performing the RD, including a description of each RA project, and how the pre-design investigation, design and construction will be phased for that RA project;

(c) A description of the proposed general approach to contracting, construction, operation, maintenance, and monitoring of the RA as necessary to implement the Work;

(d) A description of the responsibility and authority of all organizations and key personnel involved with the development of the RD;

(e) Descriptions of any areas requiring clarification and/or anticipated problems (e.g., data gaps);

(f) Description of any proposed pre-design investigation (PDI);

(g) Description of any proposed treatability study (TS);

(h) Descriptions of any applicable permitting requirements and other regulatory requirements;

(i) Description of plans for obtaining access in connection with the Work, such as property acquisition, property leases, and/or easements; and

(j) The following supporting deliverables described in SOW ¶ 6.7 (Supporting Deliverables): Field Sampling Plan; Quality Assurance Project Plan; Health and Safety Plan; Emergency Response Plan; and Site Wide Monitoring Plan. A Community Relations Support Plan (CRSP) has been included at EPA's request, based on public comments on the entered CD.

This RDWP is organized into six sections. The content of each section following this Introduction is briefly summarized as follows:

Section 2 – Background Information: Section 2 summarizes pertinent background information, including Site operational history, regulatory status, investigatory, remedial and removal actions, setting, Site conceptual model and nature of Site impacts, and a summary of the objectives, scope, and Performance Standards associated with the selected remedial action.

Section 3 – Project Management Approach: Section 3 addresses the following SOW requirements:

- A description of the overall management strategy for performing the RD, broken down to describe each RA, and how PDIs, design, and construction will be phased for each RA project,
- A description of general approach to contracting, construction, operation, maintenance, and monitoring of the RA,
- A description of the responsibility and authority of all organizations and key personnel,
- Description of plans for obtaining access in connection with the work, such as property acquisition, property leases, and/or easements, and
- Technical specifications for submission of sampling, monitoring, and spatial data.

Section 4 - Overview of Pre-Design Support Activities: The SOW requires the RDWP to describe any areas requiring clarification and/or anticipated problems (e.g., data gaps); and to also provide the various pre-design and design-related investigations and treatability evaluations. This section of the RDWP addresses these SOW requirements.

Section 5 – Summary of Remedial Design Process: The remedial design process and deliverables described in the SOW are presented in Section 5.

Section 6 – Schedule: The schedule for the deliverables associated with the remedial design process is described in Section 6.

Section 7 – References: The various documents cited within this RDWP are listed in Section 7.

Tables, figures, appendices, and attachments are also included with this RDWP and referenced within the text.

2 Background Information

The NMI Site includes the property located at 2229 Main Street in Concord, MA and downgradient properties where groundwater contamination has come to be located (see Figure 1). The property also has soil and sediment contamination but off property contamination is limited to groundwater. The areal extent of contaminants in groundwater extend beyond the Assabet River and include properties west of the river in the Town of Acton, MA. The NMI property is bordered by residential and woodland areas to the east and south, light commercial and industrial areas to the west, and Main Street (Route 62) and the Assabet River to the north.

2.1 Operational History

Past operations at the Site involved research and development in fundamental research, physical metallurgy, chemical metallurgy, engineering and product development, fuel element development and manufacture, and high temperature materials (NMI, 1961). Most of the operations at the Site were conducted under contracts with the United States Atomic Energy Commission and the United States Department of Defense, along with some contracts for private industry. These operations included the investigation and development of materials for missiles, airframes, and other components.

In September 1972, NMI employees purchased the operation. After the 1972 purchase, NMI developed a large-scale depleted uranium (DU) manufacturing operation, which included, but was not limited to, the manufacturing of penetrators, or bullets, from DU as a defense contractor for the United States (US) Army. Other work included manufacture of DU shields, and counterweights, manufacture of metal powders, beryllium and beryllium alloy parts production, and manufacture of specialty titanium parts.

On October 1, 1997, NMI was renamed Starmet Corporation. Starmet, its subsidiaries, affiliates, and related entities (collectively, the Starmet Parties) continued to perform small scale operations at the Site through October 2011.

2.2 Site Setting and Features

NMI purchased approximately 30 acres of undeveloped property on August 29, 1957 and constructed and occupied the original facility buildings in March 1958. In 1990, NMI acquired adjacent properties designated as Parcels A and B from the Memorial Drive Trust (MDT), which owned land to the west and south of the NMI property. At the same time, MDT acquired Lots C and D from NMI. The current NMI property consists of approximately 46.4 acres.

A more detailed review of site features is provided in the Field Sampling Plan submitted with the Remedial Investigation Work Plan (Mactec, 2004). For purposes of the RI, the Site was divided into "Areas of Investigation" or "AOIs." These AOI designations are used in this RDWP for consistency and shown on Figure 2. Significant features of the site relevant to the RD/RA are presented below in Section 2.2.1 through 2.2.10.

2.2.1 Holding Basin (AOI-1)

The Holding Basin (HB) was constructed in 1958. A pre-existing glacial depression was enlarged by removing soil to flatten the floor and construct an earthen dike on its face. It was actively used from 1958 to September 1985 for disposal of waste sludge until discharges ceased due to a change in waste processing methods. The sludge was produced from neutralization of the waste stream derived from pickling copper-clad depleted uranium rods in hydrogen peroxide, nitric and other acids. The current dimensions of the basin are approximately 180 feet in length and approximately 100 feet in width.

2.2.2 Drum Burial Area (AOI-2)

The Drum Burial Area was located between the Cooling Water Recharge Pond and the Holding Basin. The location of the Drum Burial Area was identified based on previous environmental studies. According to labeled photographs taken at the time of disposal, a trench was excavated, and drums were placed within it in March 1968. In December 2004, a removal action was implemented as part of the RI field activities to remove and dispose of the waste materials from the Drum Burial Area and the Cooling Water Recharge Pond.

2.2.3 Old Landfill (AOI-3)

The Old Landfill is located south of the Sphagnum Bog. An area of cleared land and possibly a borrow pit pre-date construction of the Site. Anecdotal reports indicate laboratory equipment and waste that resulted from the initial relocation to the facility were buried in this area along the southern shore of the Sphagnum Bog. Anecdotal reports also indicate that local residents disposed of white goods (such as refrigerators and washing machines) in this area. In 2002, after limited investigation found drum fragments and evidence of radiological and chemical impacts, USEPA completed a limited removal and capping of the landfill. Aerial photographs indicate that additional areas of fill may lie to the south of the landfill cap.

2.2.4 Cooling Water Recharge Pond (AOI-4)

The Cooling Water Recharge Pond (Pond) is in a natural topographic depression in the center of the Site, with its southern end approximately 75 feet north of the Holding Basin. The Pond was created by placing a sand dam across the swale. Non-contact cooling water, roof drains, and some storm water run-off was discharged to this pond during facility operations. Wastewater discharged into the HB reportedly overflowed into the Pond on at least two occasions (January 1982 and April 1986) (NMI, 1993). The water level of the Pond significantly decreased following removal of the buildings and termination of discharge from those roof drains to the Pond.

2.2.5 Sphagnum Bog (AOI-6)

The Sphagnum Bog (bog) is a palustrine, broad-leafed evergreen, scrub-shrub, saturated, acidic wetland located in the eastern part of the Site that covers an area of approximately 3.5 acres (Tetra Tech, 2000). The bog is composed primarily of sphagnum peat. The substrate of the bog varies from growing sphagnum at the surface, to decomposed peat below the surface. It is a glacial kettle feature that has no surface water inlets or outlets, so receives the bulk of its moisture from precipitation and run-off. The surface of the bog lies at an elevation of about 162 ft MSL. The surface of the bog is perched above the general Site water table, which lies at approximately 145 MSL as measured in adjacent monitoring wells. The bog is surrounded by higher ground, with the lowest adjoining topographic divide separating the bog from the Cooling Water Recharge Pond (AOI 4) to the west. The western edge of the bog is located approximately 75 feet east of the Cooling Water Recharge Pond and the HB.

2.2.6 Former Waste Storage Area (AOI-7)

AOI 7 consists of a former hazardous waste handling and storage area and surrounding grounds that included loading docks, aboveground chemical tanks, and various types of waste storage. The Former Waste Storage Area was located south of former Building C and much of its footprint lies beneath former Building E. Since the quantities of wastes stored and the location of those wastes varied over time, AOI 7 includes the former storage area, as well as the area by the former Building C loading docks, the shipping and receiving area surrounding former Buildings B-1 and B-2, and the soils south and southeast of former Building E.

2.2.7 Sweepings and Fill Area (AOI-8)

The Sweepings and Fill Area (Sweepings Area) area is located southwest of former Building A, just south of the access road to the facility shipping and receiving area. The area contains piles of sand, coarse gravel, and other fill that are distributed across an area approximately 150 ft by 150 ft. According to an earlier investigation report, floor sweepings from the NMI facility were discarded in this area (GZA, 1994). Most of the fill piles contain cobbles and gravel and do not appear to be floor sweepings; however, the source of the material is unknown. Based on RI characterization data that shows similarity of contaminants to those found in the Cooling Water Recharge Pond, it is likely the piles are the result of the excavation of pond sediment.

2.2.8 Pavement Drain Outfalls (AOI-9)

Three separate networks of pavement stormwater drains are present at the Site and investigated as part of the RI. These collect stormwater from various parking areas or paved surfaces during rain events. Each discharges locally to surface soil drainage pathways via outfalls.

A linear series of stormwater drains collect stormwater from pavement to the northeast of Building D. This network is hereafter termed the North Pavement Drain Outfall. This outfall discharges approximately 25 feet to the northeast of the paved parking area above the northeast septic leach field. Photographs found during the Building NTCRA show water being pumped from the Cooling Water Recharge Pond and discharged in this area.

A second drain network serves a portion of the paved access road located to the south of Buildings A and B-2 (RI Field Sampling Plan Figure 3.9.2). This network will hereafter be termed the South Pavement Drain Outfall. Stormwater runoff discharges to a shallow swale that trends northwest alongside the access road. Runoff infiltrates along the length of the swale and it appears that the pathway disappears after approximately 100 feet of transport. This swale terminates in the "Sweepings and Fill Area."

A third series of stormwater drains serves the parking lots that are located to the north of Buildings A and D, as well as the access road entering the facility from Main Street (RI Field Sampling Plan Figure 3.9.3). The outfall from this drain network, hereafter termed the Off-site Pavement Drain Outfall, is a large culvert located beneath Main Street. This culvert discharges along the north edge of Main Street to a steep slope that extends northward to a wetland that is part of the Assabet River floodplain.

2.2.9 Northeast Wetland (AOI-10)

The Northeast Wetland is located approximately 200 feet north of the Cooling Water Recharge Pond, and just south of Route 62. This wetland possibly was formed by the construction of Main Street to prevent further runoff to the north. It is a palustrine, forested, broad-leafed, deciduous wetland, subject to seasonal flooding. The low-lying area associated with this wetland covers approximately 0.8 acres.

2.2.10 Drain Line Area (AOI-11)

The Drain Line Area encompasses the area east of former Buildings C and D, north of former Building E, and west of the former Tank House and the Cooling Water Recharge Pond. Numerous underground lines, including waste acid drain lines, acid fill lines, septic lines, and storm water discharge lines, run through the area. According to historical photographs, storage trailers and other various materials were staged in this area. Most of the Drain Line Area was paved in 1983, associated with construction of Building E. Prior to that time, the area was gravel and soil. Although the area immediately behind former Buildings C and D is relatively flat, most of the area slopes easterly, towards the Holding Basin.

2.3 Land Use

The existing land use at the NMI property is a mix of industrial property, fenced undeveloped property, and unfenced undeveloped property. The industrial portion of the NMI property is represented by the remaining building foundations and associated paved parking lots, paved staging areas, and small landscaped areas (mowed grass).

A security fence with locking gates restricts access to the southern and eastern sides of the portion of the property where the buildings are located. The fence extends from that area to the Sphagnum Bog, encompassing the Cooling Water Recharge Pond, Holding Basin, and Old Landfill areas. This area is essentially 'restricted' open space and is unpaved with varying amounts of vegetation (e.g., brush and grass) and wooded areas. The unfenced portion of the property is located outside of the security fence. This area is open space that is generally wooded. The Northeast Wetland and the Sphagnum Bog are within this area.

2.4 Geology

The geology of the Site includes glacially derived stratified drift deposits underlain by crystalline bedrock.

2.4.1 Site Overburden Geology

The Site topography consists of an irregular series of steeply sided hills with depressions throughout. Some of these depressions, such as the Sphagnum Bog, Cooling Water Recharge Pond and Holding Basin may have been glacial kettles formed by ice-contact sediments deposited around residual blocks of ice. As the blocks melted, the resulting morphology was hummocky. The surface elevation of the Site varies from approximately 137 feet above mean sea level (msl) to 213 feet above msl, rising generally from north to the south.

The predominantly medium sand overburden is thickest (i.e., about 140 to 150 feet thick) at the hill on the northwest corner of the property from GZW-11 to MW-BS28. Where present, the sandy overburden is thinnest (i.e., about 45 feet thick) near ML-3, located in a depression between Route 62 and the northern parking lot for the facility. Below the building foundations, the sandy overburden decreases from about 100 feet thick east of the buildings to about 60 to 80 feet thick west of the buildings. In the region downgradient of the HB, the sands are fairly homogenous medium sands, with lesser amounts of silt. Sandy overburden below the Holding Basin and Cooling Water Recharge Pond is estimated to be 50 to 60 feet thick.

Till of varying thickness is found below the sandy portion of the overburden at the Site. Up gradient of and beneath the Holding Basin, the till is approximately 5 to 15 feet thick. To the southwest, at MW-BS-10 (adjacent to SW-2A), the till is over 25 feet thick. A till mound north of the former Building D is 20 to 35 feet thick in the area of ML-1 and ML-2. The till is approximately 30 feet thick at GZW-8 adjacent to the Assabet River.

2.4.2 Site Bedrock Geology

The depth to bedrock has been measured at 30 locations at or near the Site. The bedrock is highest on the eastern side of the Site beneath the Old Landfill and the Sphagnum Bog (110 to 120 feet above msl) and slopes westward to a low of less than 30 feet at MW-BS14 and MW-BS31. There is a bedrock ridge extending from the area north of former Building D to approximately the SW-1 area, from where the bedrock then slopes downward and northward to the Assabet River to an elevation of less than 15 feet at GZW-8-2. From the Holding Basin to the Assabet River, the top of bedrock elevation drops approximately 90 feet. Evaluation of lithology from the pre-RI bedrock borings (seven of eight had core data) indicate the bedrock consists predominantly of gneiss and schist, and, except for the upper few feet of core at ML-1, GZW-6 and GZW-8, the rock is relatively unweathered and unfractured at the locations cored.

Information relative to deeper bedrock structure was collected at three locations: MW-BM03; MW-BM15; and SW-2A. A deep core was collected at MW-BM03 and borehole geophysical logging was completed at MW-BM03 and SW-2A. The RQD values ranged from extremely fractured (0% RQD) to generally massive (100% RQD). At MW-BM03, located near the center of the Site, the rock was highly fractured in the upper 15 ft, and became more competent with depth. At MW-BM15, located near the Assabet River, the rock was more highly fractured with depth. However, the borehole at MW-BM15 was not cored as deep as MW-BM03.

The Bedrock Geologic Map of Massachusetts shows the Site to be underlain by the Assabet Quartz Diorite, with the older Shawsheen Gneiss of the Nashoba Formation to the North and the Andover Granite to the South. However, evidence from bedrock wells at the W.R. Grace Site north of the Assabet River (GeoTrans, 2002a), the new bedrock map created for a study of the Rockland Avenue Well Site in Maynard (Walsh, 2001), and rock cores from the Site indicate that the Site is most likely underlain by the Shawsheen Gneiss of the Nashoba Formation. Most cores from the Site are described as gneiss, not quartz diorite, and significant sulfide mineralization was observed in bedrock fractures in GZW-8, which is also indicative of the Nashoba Formation. Some core descriptions noted pegmatite zones including GZW-10 and GZW-6. Quartzite or quartz-rich fracture filling was noted in MW-BM03, MW-BS12, MW-BS17 and GZW-8-2. Based on these observations, the State Bedrock Map may incorrectly depict the contact between the Assabet Quartz Diorite and the Shawsheen Gneiss of the Nashoba north of the Site.

2.5 Hydrogeology

The Site lies within the Assabet River basin. No natural streams are present on the NMI Property. The only apparent surface water body that pre-dates development of the Site is the Sphagnum Bog located in the eastern-central portion of the Site. The Assabet River flows in an easterly direction and merges with the Sudbury River to form the Concord River approximately 3.5 miles downstream of the Site.

A surface water divide is in the upland to the south of the Site, surface water runoff from areas north of this divide flow north to the Assabet River. Surface water runoff from areas south of this divide flow south to Second Division Brook, which flows in an easterly direction, and then north to join with the Assabet River.

Groundwater is found both in the unconsolidated and bedrock formations and migrates northward, towards the Assabet River.

2.6 Regulatory Status and Remedial History

In March 1980, chlorinated solvents were detected in NMI's overburden water supply well (SW-1) during sampling by the Massachusetts Department of Environmental Quality Engineering (MADEQE) as part of a regional groundwater quality evaluation. This led to significant investigation by NMI of site soil, sediment, ground water between 1980 and 1999.

In 1997, Starmet, with the financial support of the US Army, excavated approximately 8,000 cubic yards of soil contaminated with depleted uranium and copper from the Holding Basin and disposed of these soils at an off-site low-level radioactive waste disposal facility. The cleanup halted in late 1998 when Starmet determined that the cleanup level set by MassDEP could not be met without excavating significantly more material.

EPA placed the Site on the National Priorities List (NPL) by publication in the Federal Register on June 14, 2001, 66 Fed. Reg. 32235, 32241. From April 2002 to April 2003, EPA performed a Time-Critical Removal Action (TCRA) at the Site, which included, among other things, the installation of a temporary cover over the Holding Basin and the installation of a temporary cap over the Old Landfill.

On May 12, 2003, the Massachusetts Department of Public Health – Radiation Control Program (MADPH-RCP) modified Starmet's radioactive materials license to allow only possession of radioactive materials on-site.

On June 13, 2003, EPA, the Respondents (former owner/operators of NMI) and the SFAs entered into an Administrative Order by Consent for Remedial Investigation/Feasibility Study (RI/FS) (U.S. EPA Docket No. CERCLA 01-2003-0021) for the Site, which was amended on February 13, 2008 as set forth in the Amendment to Administrative Order By Consent for RI/FS, U.S. EPA Docket No. CERCLA 01-2008-0007 (jointly, these two agreements are referred to herein as the Administrative Order by Consent (AOC) for RI/FS). The RI/FS began in June of 2003. The AOC for RI/FS also required the completion of one or more EE/CAs, if requested to do so by EPA.

In 2004, the Massachusetts Department of Environmental Protection (MassDEP) and the United States Army (Army) entered into an agreement whereby the Army financed the removal of approximately 3,800 drums of depleted uranium and other Waste Materials that were stored at the Site. MassDEP performed this drum removal from September 2005 to March 2007.

On June 26, 2007, a small fire occurred at the Site, causing minimal damage to the buildings. Following the fire, the Concord Fire Department (CFD) requested that EPA remove hazardous materials present inside the buildings that posed a fire safety threat. From January 7, 2008 to September 24, 2008, EPA performed a second TCRA at the Site to remove hazardous substances from inside the buildings that posed a threat of fire or explosion. CFD also requested that a Fire Hazards Analysis and Fire Protection & Life Safety Assessment (FHA) be performed to provide a comprehensive evaluation of the fire risks posed by the buildings, their contents, and to assess the appropriate levels of fire protection and life safety once the facility is vacated by the Starmet Parties. EPA requested Respondents perform this evaluation, which was completed in August 2009 (Hughes Associates, 2009).

In December 2007, EPA signed an Approval Memorandum for performance of an EE/CA to evaluate various alternatives to address the buildings located on-site and their contents. The Respondents to the AOC for RI/FS performed the EE/CA, as required by EPA. EPA issued the completed EE/CA in February 2008. In April 2008, EPA issued a fact sheet providing notice of the completion of the EE/CA and EPA's proposed NTCRA to address the deteriorating, contaminated buildings. EPA provided an opportunity to the public to comment on the proposed NTCRA. On September 23, 2008, EPA issued an Action Memorandum, which authorizes the performance of a NTCRA at the Site to demolish and dispose off-site of the buildings and their contents.

EPA, the Respondents, and SFAs entered into an Administrative Settlement Agreement and Order on Consent (AOC) for the Building NTCRA that became effective on August 9, 2011. Starmet officially vacated the property on November 2, 2011. The Radioactive Materials License was terminated by the MADPH-RCP on November 8, 2011. Building Demolition was completed in August 2016. A final report for the Building NTCRA was approved by EPA on June 28, 2017. In that approval EPA determined that all Building NTCRA work had been fully performed in accordance with the Building NTCRA AOC, except for continuing obligations that include: Post-Removal Site Control (PRSC), payment of Future Response Costs, and record retention. PRSC is being performed pursuant to a PRSC Plan approved on May 31, 2017.

The RI was completed in April 2014 and the FS was completed in November 2014. EPA published notice of the completion of the FS and the Proposed Plan outlining EPA's preferred remedial action alternative on October 31, 2014. EPA's Record of Decision (ROD) was issued on September 28, 2015 and requires remedial measures including excavation and off-site disposal of approximately 82,500 cubic yards of contaminated materials, stabilization and capping of materials within the "Holding Basin" area of the site, in-situ and ex-situ treatment of contaminated groundwater. The ROD also included an Action Memo to accelerate a portion of the groundwater cleanup to be performed as a second NTCRA while negotiations proceeded for implementation of the full remedy.

Additional delineation of the extent of the 1,4-dioxane and VOC plumes in the downgradient area was performed September – December 2015, between issuance of the ROD and the effective date of the Groundwater NTCRA AOC. This work included groundwater profiling, monitoring well installations, groundwater quality and water level monitoring, and hydraulic conductivity testing. To delineate the area of hydraulic influence for Municipal Wells Assabet 1A and 2A, a shutdown and restart test of these wells was performed in March 2016.

EPA, Respondents and SFAs entered into an AOC for Groundwater NTCRA that became effective on July 11, 2016. Work under the Groundwater NTCRA has included performance of an aquifer pump test, installation and operation of a temporary treatment system, completion of treatability testing for a permanent treatment system, and design and construction of the final treatment system. At lodging of the Consent Decree, remaining work under the NTCRA for Groundwater will be completed as part of the RD/RA.

2.7 Basis for Remedial Action

The ROD addresses remediation of groundwater, soil, and sediment contamination. Ingestion of water extracted from the overburden and bedrock aquifers poses a current and potential risk to human health because EPA's acceptable risk range is exceeded, and concentrations of contaminants are greater than the Maximum Contaminant Levels (MCLs) for drinking water (as specified in the Safe Drinking Water Act), with the exception of 1,4-dioxane which currently does not have a MCL. Exposure to certain Site soils also poses a future risk to human health, and exposure to certain Site sediments poses a current and future risk to ecological and human health. The ROD presents a comprehensive remedy for the Site and addresses the principal threat at the Site through treatment and containment of source area soils within the Holding Basin.

2.7.1 Chemicals of Concern

The chemicals of concern (COCs) are summarized in Tables G-1 through G-4 of the ROD for sediment, surface and subsurface soil, and groundwater, respectively, and include but are not limited to the following:

Natural uranium, as found in the Earth's crust, is a mixture largely of two isotopes: uranium-238 (U-238), accounting for 99.28% and uranium-235 (U-235) about 0.72%. It also contains a very small amount of U-234 (about 0.005%). The RI found that, as a result of Site activities, natural uranium in the bedrock has been released into the bedrock groundwater at levels that exceed the MCL for uranium of 30 micrograms/liter (µg/L).

Depleted Uranium is uranium that has been stripped of most of the radioactive isotope U-235, such that it is comprised of mostly U-238, the least radioactive of the three isotopes. It also contains a very small amount (less than 0.001%) of U-234. Depleted uranium contains approximately 0.2% U-235 and 99.78% U-238. It is about half as radioactive as natural uranium. The RI found that as the result of disposal activities in the HB that the overburden groundwater is contaminated with DU in excess of the MCL for uranium (listed above). There are also widespread contaminated soils and sediments throughout the Site in excess of risk-based cleanup levels.

Other Metals. Metals of concern other than DU/natural uranium found in Site groundwater include thorium, chromium, arsenic, barium, cobalt, copper, iron, manganese, and molybdenum.

PAHs or Poly Aromatic Hydrocarbons are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. They can also be found in asphalt pavement and roofing products, and a few are used in medicines or to make dyes, plastics, and pesticides. PAHs were detected at low concentrations but above risk-based cleanup levels in surface soil at the Site, particularly in soils that received runoff from parking lots. The PAHs found in the Site soils above ROD cleanup levels are: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene.

PCBs or Polychlorinated Biphenyls are manmade chemicals that were used in electrical manufacturing and were banned in 1979. Areas of the Site such as the Cooling Water Recharge

Pond and the Sweepings Piles that accepted wastewater and dredged materials from the Pond, respectively, have been contaminated with PCBs above the cleanup level of 1 ppm.

VOCs or Volatile Organic Compounds include a variety of chemicals that are used in glue, paint, solvents, and other products and easily evaporate. VOCs found in Site groundwater include 1,1-Dichloroethane (1,1-DCE), trichloroethylene (TCE), tetrachloroethene (PCE) and Vinyl Chloride (VC); each of these VOCs exist in Site groundwater at concentrations that exceed the MCL or risk-based cleanup level.

SVOCs or Semivolatile Organic Compounds are chemicals that have limited volatility at room temperature. The SVOC 1,4-dioxane is present in groundwater at the Site above the risk-based cleanup level of 0.46 µg/L and is believed to have been included as a stabilizer in solvents historically used at the Site.

2.7.2 Principal and Low-Level Threat Wastes

The principal and low-level threat wastes addressed by the ROD are summarized in the following table:

Principal Threat Wastes	**Contaminant(s)**	**Action to Be Taken**
Holding Basin Soils	Depleted Uranium (DU)	In-Situ Sequestration/ Containment
Low-Level Threat Wastes	**Contaminant(s)**	**Action to Be Taken**
Site-wide Soils and Sediments	DU, PCBs, PAHs, Copper	Excavation/Off-Site Disposal

2.7.3 Conceptual Site Model

The Conceptual Site Model (CSM) for contaminated soil, sediment, and groundwater at the Site is provided in Figure E-1 in Appendix C of the ROD. The CSM is a three-dimensional “picture” of site conditions that illustrates contaminant sources, release mechanisms, exposure pathways, and migration routes. Potential human and ecological receptors are presented in Section G of the ROD, which documents current and potential future site conditions and shows what is known about human and environmental exposure through contaminant release and migration to potential receptors. The risk assessment and response action for the contaminated soil, sediment, and groundwater at the Site is based on this CSM.

The AOIs found in the risk assessment process to pose unacceptable risk, including their sources and receiving media, are discussed below:

- AOI 1 – Holding Basin Soil: Neutralized nitric acid solution containing dissolved copper and DU was discharged to an unlined Holding Basin between 1958 and 1985. Certain facility process drain lines from the buildings also appear to have discharged to the Holding Basin. The primary receiving media were vadose zone soils and saturated soil below, adjacent, and surrounding the Holding Basin, and groundwater below the Holding Basin. The Holding Basin contains the highest concentration of DU in on-site soil, with an average concentration of 93 mg/kg, and a maximum concentration of approximately 12,000 mg/kg. The volume of DU impacted soil in the Holding Basin is approximately 32,000 cubic yards.

- AOI 2 – Drum Burial Area Soil: In addition to drums in the Old Landfill area (AOI 3), drums containing beryllium and possibly other materials were found (and subsequently removed) in a buried trench located between the Cooling Water Recharge Pond and the Holding Basin. Soil and groundwater would be the primary receiving media from drums that may have leaked or been damaged. Concentrations of DU in this area are generally two-times the cleanup level of 2.7 mg/kg.

- AOI 3 – Old Landfill Soil: The Old Landfill was reportedly used for disposal of solid waste that could include materials from the research and development laboratories, drummed material containing various metals, including DU and beryllium, and municipal and office waste. Soil would be the primary receiving medium from drums that may have leaked or been damaged.

- AOI 4 – Cooling Water Recharge Pond Surface Water, Sediment, and Bank Soil**:** Building floor drains and roof drains discharged to the Cooling Water Recharge Pond. Roof drains are a potential source of metals, because if machining dusts were deposited on the roofing material, they would collect in the roof drain system. The Cooling Water Recharge Pond also received direct discharge from the Holding Basin on at least two occasions. Non-contact cooling water pumped from on-site wells contained VOCs, DU, and natural uranium. The primary receiving media include surface water and sediment in the Cooling Water Recharge Pond, and groundwater below the pond. In addition, sediments from the Cooling Water Recharge Pond may have been dredged and placed on the banks surrounding the pond and, in an area known as the "sweepings" area (AOI 8), to increase the capacity of the Cooling Water Recharge Pond. Therefore, soil surrounding the Cooling Water Recharge Pond may also be a primary receiving medium. Surface water did not show unacceptable risk during the risk assessment process.

- AOI 6 – Sphagnum Bog Surface Water and Sediment: Supernatant liquid from the Holding Basin was reportedly discharged to the Sphagnum Bog between 1958 and possibly as late as the 1970s. In addition, sink and floor drains from laboratories located in Building A discharged to the Sphagnum Bog between 1958 and approximately 1975. The primary receiving media were surface water, sediment, and peat in the Sphagnum Bog, although surface water did not show unacceptable risk during the risk assessment process.

- AOI 7 – Former Waste Handling Area Soil: An area located to the south of and beneath the former Building E was formerly used for waste handling and storage, prior to the construction of Building E. During that time, this area was not paved. The primary receiving medium for material that may have been spilled or disposed is soil.

- AOI 8 – Sweepings and Fill Area Soil: An area southwest of the main parking lot contains piles that reportedly include sweepings from building floors. It was later discovered that this area received dredged sediments from the Cooling Water Recharge Pond. The deposited material has soil-like characteristics (e.g., sand and gravel).

- AOI 9 Northern and Southern Pavement Drain Outfalls: Runoff from pavement and/or water pumped from the Cooling Water Recharge Pond carried contamination to the surface soils at these outfalls.

- AOI 11 – Drain Lines Soil: Drain lines carried process wastes, cooling water and stormwater from the facility buildings to the Holding Basin, Sphagnum Bog, and Cooling Water Recharge Pond. If contaminated liquids leaked from underground piping, they would be released to soil beneath the pipes, and potentially to groundwater. Drain lines are generally located beneath the area of land east of Buildings C and D.

- AOI 14 – Down-Wind Surface Soils: Particulate emissions from the air handlers and stacks on the facility buildings may have migrated in the ambient air and been deposited in surficial soils down-wind of the buildings.

- AOI 16 – Groundwater: Although groundwater was not an original source of contaminants, leaching is known to have occurred in the Holding Basin, where continuous discharge of liquids containing DU, copper, and nitrate, and possibly other chemicals, has resulted in elevated concentrations of these constituents in deep subsurface soils and groundwater beneath the HB. The sources of VOCs and 1,4-dioxane are likely related to historic disposal of chlorinated solvents such as tetrachloroethene and 1,1,1-trichloroethane (which likely contained 1,4-dioxane as a stabilizer) to the Holding Basin, Cooling Water Recharge Pond, and/or Old Landfill. A uranium plume in bedrock groundwater was identified. However, the uranium in bedrock groundwater exhibits a natural isotopic signature, suggesting that it is not directly related to release of DU at the Site. Evaluation of bedrock groundwater data suggests that the presence of elevated concentrations of natural uranium in bedrock groundwater may be a result of Site-related activities that may have altered bedrock groundwater geochemistry, resulting in release of natural uranium from the bedrock. Surface water did not show unacceptable risk during the risk assessment process.

The major aspects of the CSM for the Site are as follows:

Primary Release Mechanisms (All Media). Constituents were released or disposed in ways that resulted in contamination that extends across multiple AOIs. Specifically, disposal or release of these contaminants appears to have occurred through:

- Direct disposal, spills, or leaks from drain lines (AOI 1 – Holding Basin, AOI 2 – Drum Burial Area, AOI 7 – Former Waste Storage Area, AOI 11 – Drain Lines; AOI 15 – Transformer Pads);

- Disposal of dredging materials and/or land filling (AOI 3 – Old Landfill, AOI 4 – Cooling Water Recharge Pond, AOI 8 – Sweepings and Fill Area); and

- Aerial deposition (AOI 14 – Perimeter Soils), and subsequent storm water runoff and deposition (AOI 9 – Pavement Drain Outfalls).

Primary Soil Impacts. Among the constituents released by these mechanisms, DU, PCBs, and PAHs show the greatest frequency of contamination in unsaturated soil.

Primary Sediment Impacts. Among the constituents released by these mechanisms, PAHs, PCBs, and metals, including DU and copper, are considered the primary contaminants of potential concern for human and ecological receptors, although VOCs were also detected but at low frequency or low concentrations.

Primary Groundwater Impacts. Groundwater data suggest that DU migrated to the overburden groundwater, natural uranium migrated with bedrock groundwater and chlorinated VOCs, and 1,4-dioxane migrated to the overburden and bedrock groundwater. The groundwater flow is toward the north and northwest, resulting in overburden and bedrock plumes of VOCs and 1,4-dioxane that extend off the facility property toward and beneath the Assabet River. The 1,4-dioxane plume associated with the Site extends to deeper overburden as evidenced by monitoring results from wells located just south and northwest of the Assabet River.

2.7.4 Exposure Pathways, Areas and Media Posing Significant Risk

Section G of the ROD discusses risks characterized in the Baseline Human-Health and Ecological Risk Assessments. The risk pathways and areas posing unacceptable risk are summarized in the following table:

	Exposure Pathway					
Area of Site	**Future Resident (adult and young child)**	**Recreational Visitor (young child)**	**Trespasser older child / adolescent**	**Outdoor Worker**	**Const-ruction Worker**	**Ecological Risks**
AOI 1 Holding Basin (surface and subsurface soil)	**X**	**X**			**X**	
AOI 2 & 4 Cooling Pond Soils (surface and subsurface soil)	**X**	**X**			**X**	
AOI 7 & 11 Industrial Area East (surface and subsurface soil)	**X**	**X**		**X**	**X**	

Area of Site	Exposure Pathway					
	Future Resident (adult and young child)	Recreational Visitor (young child)	Trespasser older child / adolescent	Outdoor Worker	Const-ruction Worker	Ecological Risks
AOI 7 & 11 Industrial Area East (subsurface soil)	X	X			X	
AOI 8 Sweepings Area (surface and subsurface soil)	X	X			X	
AOI 14 North (surface soil)	X					
Groundwater: on-property bedrock and overburden, off-property bedrock and overburden	X					
Cooling Water Recharge Pond (sediment)	X	X	X			X
Bog (sediment)						X

In the spring of 2014, during the Building NTCRA (and following completion of the RI), several discrete pieces of DU metal and/or pieces of yellow oxidized uranium were identified during work outside the buildings (DDES, 2014). A surficial soil survey in the vicinity of the buildings and of the paved surfaces surrounding the buildings was conducted, resulting in the identification and removal of 21 additional pieces of DU metal. All identified pieces of DU metal, yellow oxidized DU and surrounding soil were removed, followed by additional confirmatory radiation surveys. After the completion of the survey work, several locations exist where soil or asphalt readings remain elevated above the instrument background. These areas, along with the pavement and upper foot of soil adjacent to former Buildings A, B, C, D and E, were incorporated in the total volumes for which remediation was selected in the ROD.

2.7.5 Groundwater NTCRA Investigation

The RI/FS delineated 1,4-dioxane in groundwater to different target levels as the project progressed. Risk-based target concentrations dropped over time, from 6.1 µg/L (RI phase), to 0.67 µg/L (FS phase), and to the ROD cleanup level of 0.46 µg/L. After EPA issued the Proposed Plan that specified a 1,4-dioxane clean up level of 0.46 µg/L, supplementary plume delineation was implemented under the RI/FS AOC to complete delineation to that target. The initial phase was completed pursuant to a Groundwater Investigation Work Plan (Geosyntec, August 20, 2015). Work during this phase included groundwater profiling from ground surface into bedrock, with the installation of 26 additional monitoring wells at 9 locations (most wells were installed in clusters that monitor multiple depths). Target well depths were selected based on the highest 1,4-dioxane concentrations in screening samples, or the depth with highest hydraulic conductivity (if 1,4-dioxane and VOCs were non-detect).

Groundwater elevations were monitored during a March 2016 shutdown and re-start of the Assabet 1A and 2A municipal wells in order to better establish their area of its influence. An Extraction Well Installation and Pump Test Work Plan was developed (Geosyntec, June 21, 2016), and approved by EPA on July 15, 2016. The Groundwater NTCRA AOC became effective on July 11, 2016. An additional five monitoring wells were proposed in the pump test work plan and installed to complete the delineation of the extent of downgradient, off-NMI property 1,4-dioxane and VOCs in groundwater. The groundwater investigation and the shutdown test results were summarized in the Extraction Well Installation and Pump Test Work Plan (Geosyntec, 2016a) approved by EPA on July 15, 2016 (USEPA, 2016b). The activities outlined in the Extraction Well Installation and Pump Test Work Plan were conducted between August and November 2016 and results were summarized in the Pre-Design Investigation Report submitted to USEPA on December 21, 2016.

A Groundwater Modeling Work Plan was submitted on June 13, 2016. This plan proposed to combine the existing groundwater flow models that were previously developed for the W.R. Grace Site in Acton, MA and the NMI Site into a new model that could be used to support the Groundwater NTCRA process. A draft model report was submitted in July 2017; however, it did not adequately represent the W.R. Grace site. A comprehensive round of water levels was obtained at all available monitoring wells in August 2017. These new data were used by both the NMI and W.R. Grace teams to adjust and calibrate the existing model, resulting in a “Joint Regional Model” which was documented in a final Groundwater Model Report submitted to EPA on May 6, 2019. EPA did not formally approve the model, but agreed it was appropriate for the intended uses.

A temporary treatment system for the groundwater NTCRA, which used bag filters and granular activated carbon (GAC) (repurposed from the Building NTCRA) for treatment, was installed as documented in the 100% Removal Design, Temporary Treatment System (Geosyntec, June 2017). This system began operation in May 2017 and provided containment of the plume up gradient of the municipal well while a final ex-situ treatment approach was determined, designed, and installed.

A treatability study to determine the Best Demonstrated / Best Available Technology (BDT/BACT) for 1,4-dioxane treatment was performed using criteria of effectiveness, implementability, and cost; as well as environmental footprint metrics such as material usage, waste generation, and energy, air and water impacts (Treatability Study Work Plan, Geosyntec and O&M, Inc., May 1, 2017). The treatability study incorporated a field pilot study of an innovative Advanced Oxidation technology that tested various oxidant dosing rates and UV lamp modes. This study was performed between June and September 2017 (Treatability Study Report, ***de maximis, inc***. and O&M, Inc., April 20, 2018). The results of the field pilot study were presented to EPA and MassDEP on September 26, 2017. EPA and MassDEP concurred with the recommendation to proceed with the design of the final treatment system that would use the Vanox™ oxidation technology that was successfully demonstrated in the field pilot study. The final treatment system removal design was split to address the treatment system and treatment system building separately.

A 90% Removal Design (RD) for Final Treatment System was submitted January 12, 2018. Agency comments on the 90% RD were incorporated into the 95% RD submitted April 17, 2018. Agency comments on the 95% RD were incorporated into the 100% RD submitted October 23, 2018. A 100% RD for Treatment System Building was submitted August 21, 2018. Agency comments were incorporated into a revised 100% RD submitted on October 23, 2018.

Treatment system and building procurement and construction proceeded in parallel with agency review and comment on the removal design documents. Building construction started on September 6, 2018 and was completed on May 5, 2019. Treatment system installation started on January 4, 2019 and was completed on April 24, 2019. Treatment system operation and the "shake down" period of operation began on April 24, 2019. Initial operation identified ineffective manganese removal in the pre-treatment component of the system. A design change to add pH adjustment prior to the DMI-65 multi-media filter was submitted on June 14, 2019 and approved on June 19, 2019. A construction completion inspection was performed with EPA and MassDEP on June 20, 2019. An optimization plan to test and optimize UV lamp intensity levels and sodium persulfate dosing rates was submitted on June 21, 2019 and approved on July 2, 2019. The pH adjustment skid was installed and programed on October 18, 2019. Optimization testing was performed in December 2019 and January 2020 and documented in a February 13, 2020 report. EPA approved the Optimization Report on March 16, 2020. The revised Construction Completion and Final Report for this aspect of the remedy was submitted on May 29, 2020. EPA issued a Certificate of Completion of the Groundwater NTCRA on June 15, 2020.

2.7.6 Scope of Remedial Action

The selected remedy is a comprehensive remedy which utilizes source control and management of migration components to address the principal Site risks in soil, sediment, and groundwater. Source control measures will address soil and sediment at the Site that present unacceptable risks to human health or to environmental receptors, and/or exceed ARARs. The management of migration component addresses contaminants in groundwater underlying the Site that exceed ARARs or otherwise pose an unacceptable risk.

The Scope of the Remedy includes the following actions described in Section L of the ROD, including:

- Excavation and off-site disposal of approximately 82,500 cubic yards of contaminated sediments, underground drain lines and debris, and non-Holding Basin soils (contaminated with DU, PCBs, and other contaminants of concern found in ROD Tables L-2 through L-4) in various areas of the Site (See Figure 3);

- *In-situ* stabilization of DU contaminated soils in the Holding Basin via injection of a stabilization agent such as apatite (e.g., Apatite II™) or other comparable stabilization agent to prevent leaching of contaminants to groundwater, and *in-situ* treatment of DU in overburden groundwater and natural uranium in bedrock groundwater (See Figure 4);

- Containment of HB stabilized soils with a low-permeability vertical wall and a low-permeability horizontal sub-grade cover to isolate the stabilized soils and further limit mobility of contaminants by removing the flow of groundwater (See Figure 5);

- Extraction and *ex-situ* treatment of volatile organic compounds (VOCs), 1,4-dioxane and other contaminants found in ROD Table L-1 in overburden and bedrock aquifers (See Figure 6a);

- Long-term monitoring of effectiveness of *in-* and *ex-situ* treatment; and

- Institutional Controls to: 1) prevent unacceptable exposures to, and to prevent disturbance of, the HB area; 2) prohibit use of contaminated groundwater until cleanup levels are met; and 3) require installation of vapor mitigation systems should future structures be built above the VOC plume before groundwater cleanup levels are met, unless an evaluation of vapor intrusion risks is performed to show such systems are not required.

2.7.7 Remedial Action Objectives

Remedial Action Objectives (RAOs) are medium-specific goals that define the objective of remedial actions to protect human health and the environment. RAOs specify the Contaminants of Concern (COCs), potential exposure routes and receptors and provide a general description of what the cleanup will accomplish. The RAOs are based on available information and standards, such as applicable or relevant and appropriate requirements (ARARs) and site-specific risk-based levels. These RAOs were developed to mitigate, restore and/or prevent existing and future potential threats to human health and the environment.

The RAOs for the selected remedy for the Site are to:

(1) Prevent direct human exposure by a future resident (by dermal contact, ingestion, inhalation, or ionizing radiation) to soils or sediments with contaminants (DU, PCBs, PAHs, and other inorganics) that exceed risk-based standards;

(2) Prevent migration of DU/uranium from soils in the HB that would result in groundwater concentrations exceeding ARARs;

(3) Prevent potential future exposure to contaminated indoor air by a future resident/ commercial worker;

(4) Prevent potential human exposure (ingestion, dermal contact, vapor inhalation) by a future resident to groundwater impacted by the Site that may be used as a domestic water supply with VOC, SVOC, DU, or inorganic contaminant concentrations that exceed ARARs or risk-based standards;

(5) Protect ecological receptors from exposure to contaminants (PCBs, copper) in sediments indicative of adverse effects at the Cooling Water Recharge Pond;

(6) Protect ecological receptors from exposure to contaminants (PCBs, copper, mercury, and lead) in sediments indicative of adverse effects at the Sphagnum Bog while maintaining the physical and ecological integrity of the bog;

(7) Restore groundwater within the contaminant plumes to its beneficial use as a potential drinking water supply by meeting ARARs including federal MCLs, or in their absence, by meeting cleanup levels protective of human health; and

(8) Limit migration of VOCs, SVOCs, uranium (depleted and/or naturally occurring), PAHs, and other inorganics in groundwater within the contaminant plumes at concentrations that would exceed ARARs or risk-based standards.

2.7.8 Performance Standards

Cleanup levels for groundwater are specified by the EPA in Table L-1 of the ROD. Cleanup levels for soil are specified in Table L-2 of the ROD. Cleanup levels for sediment are specified in Table L-3 and L-4 of the ROD. These cleanup levels are summarized in Tables 1 - 3 of this RDWP.

2.7.9 Applicable or Relevant and Appropriate Requirements (ARARs)

Remedial actions conducted under CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) must attain or, if unattainable, provide the basis to waive federal standards, requirements, limitations, or more stringent state standards determined to be legally applicable or relevant and appropriate to the circumstances at a given site. Applicable or relevant and appropriate requirements (ARARs) are federal and state environmental and facility citing requirements and guidelines used to: (1) evaluate the appropriate extent of site cleanup; (2) define and formulate remedial action alternatives; and (3) govern implementation and operation of the selected action. Inherent in the interpretation of ARARs is the assumption that protection of human health and the environment is ensured.

Definition of ARAR Components. To properly consider ARARs and to clarify their function in the remedy selection process, the NCP defines two ARAR components: (1) applicable requirements; and (2) relevant and appropriate requirements. These definitions are discussed in the following paragraphs:

Applicable Requirements. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site (52 FR 32496, August 27, 1987). To be applicable a requirement must directly and fully address a CERCLA activity. For example, the Resource Conservation and Recovery Act (RCRA) regulations governing the operation and design of a hazardous waste incinerator (40 Code of Federal Regulations [CFR] Part 264, Subpart O) apply to hazardous waste incinerators used at Superfund sites.

Relevant and Appropriate Requirements. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the site that their use is well-suited to the particular site (52 FR 32496). For example, RCRA landfill design standards could be relevant and appropriate to a landfill at a Superfund site, if the wastes being disposed were sufficiently similar to RCRA hazardous wastes.

Compliance with the substantive and administrative requirements is required for all off-site activities. Requirements under federal or state law may be either applicable or relevant and appropriate to CERCLA cleanup actions, but not both. However, requirements must be both relevant and appropriate for compliance to be necessary. In the case where both a federal and a state ARAR are available, or where two potential ARARs address the same issue, the more stringent regulation must be selected. The NCP states that a state standard must be legally enforceable and more stringent than a corresponding federal standard to be relevant and appropriate (USEPA, 1990). CERCLA §121(d)(2)(C) forbids state standards that effectively prohibit land disposal of hazardous substances.

Substantive requirements pertain directly to the actions or conditions at a site, while **administrative requirements** facilitate their implementation. CERCLA on-site remedial response actions must only comply with all substantive requirements that are "applicable" or "relevant and appropriate," and not the administrative requirements, such as obtaining federal, state, or local permits (CERCLA §121(e)). The NCP defines on site as "the areal extent of contamination and all areas in very close proximity to the contamination necessary for implementation of the response action." EPA recognizes that certain administrative requirements, such as consultation with state agencies and reporting, are accomplished through the state involvement and public participation requirements of the NCP. Off-site response actions must comply with both the substantive and administrative requirements of an applicable (but not a relevant and appropriate) regulation.

In the absence of federal- or state-promulgated regulations, there are many criteria, advisories, and guidance values that are not legally binding, but may serve as useful guidance for response actions. These are not potential ARARs but are "to-be-considered" (TBC) guidance. These guidelines or advisory criteria should be identified if used to develop clean-up goals or if they provide important information needed to properly design or perform a remedial action. Three categories of TBC information are (1) health effects information with a high degree of certainty (e.g., reference doses); (2) technical information on how to perform or evaluate site investigations or response actions; and (3) regulatory policy or proposed regulations.

The remedy will comply with all federal and any more stringent state ARARs that pertain to the Site. A detailed list of ARARs/TBCs requirements was provided in Appendix D of the ROD. ARARs/TBCs for the RD/RA are summarized Tables 4-7 of this RDWP.

2.7.10 Superfund Program Expectations

USEPA has selected a remedy for a site considering the Superfund program's "goal and expectations" which are stated in the NCP as follows:

Program Goal (40 CFR 300.430(a)(1)(I))

The national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste.

Program Expectations (40 CFR 300.430(a)(1)(iii))

A. USEPA expects to use treatment to address the principal threats posed by a site, wherever practicable. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials.

B. USEPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable.

C. USEPA expects to use a combination of methods, as appropriate, to achieve protection of human health and the environment.

D. USEPA expects to use institutional controls, such as water use and deed restrictions, to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances, pollutants, or contaminants.

E. USEPA expects to consider using innovative technology when such technology offers the potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies.

F. USEPA expects to return usable ground waters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. When restoration of groundwater to beneficial uses is not practicable, USEPA expects to prevent further migration of the plume, prevent exposure to contaminated groundwater and evaluate further risk reduction.

2.7.11 Permits

With respect to permits, ¶ 8.a of the CD states "As provided in Section 121(e) of CERCLA, 42 U.S.C. § 9621(e), and Section 300.400(e) of the NCP, no permit shall be required for any portion of the Work conducted entirely on-site (i.e., within the areal extent of contamination or in very close proximity to the contamination and necessary for implementation of the Work). Where any portion of the Work that is not on-site requires a federal or state permit or approval, SDs shall submit timely and complete applications and take all other actions necessary to obtain all such permits or approvals."

"On-site" is defined as "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action," which means the definition of the site is not limited by property boundaries. This is addressed in EPA's Directive, "Permits and Permit "Equivalency" Processes for CERCLA On-site Response Actions," OSWER Directive 9355.7-03, February 19, 1992. No "off-site" work other than disposal is anticipated. Accordingly, at this time, no permits are anticipated to be needed to implement the remedy.

3 Project Management Approach

This section of the RDWP addresses requirements set forth in SOW Sections 3.1(b), (c), (d), (h), (i), and 6.4.

3.1 Overall RD Management Strategy

The remedy will be divided into five Remedial Action ("RA") projects to facilitate efficient implementation of the remedy, as outlined in Section 1.4 of the SOW. Each RA project will proceed on its own track after approval of this RDWP, resulting in separate schedule for pre-design, remedial design, and remedial action through EPA approval of each RA report. The five RA projects are:

1. excavation and off-site disposal of contaminated sediments, underground drain lines and debris, and non-HB soils, or "site-wide soils and sediments";
2. ISS of DU in HB soils and of DU and natural uranium in overburden and bedrock groundwater or "ISS";
3. containment of HB stabilized soils with a low-permeability vertical wall and horizontal sub-grade cover or "HB containment";
4. ex-situ treatment of VOCs and 1,4-dioxane in groundwater (already initiated under the Groundwater NTCRA); and,
5. 1,4-dioxane and VOCs in bedrock groundwater.

PDI WPs have been developed as needed to support the design of each RA project, with the intention that once approved by EPA, the PDIs for the site-wide soils and sediments, ISS and HB containment, and 1,4-dioxane in bedrock groundwater RA projects will proceed independently.

After the PDI for a RA project is completed, a PDI Evaluation Report will be developed and submitted for EPA comment. A TS WP has been developed for the ISS RA project. It will also proceed independently, after EPA approval of that TS WP. After the TS is completed, a TS Evaluation Report will be developed and submitted for EPA comment.

This RDWP presents Pre-Design Investigation Work Plans (PDI WPs) and treatability study work plans (TS WPs) for the five RA projects. These PDI WPs are presented in appendices to this report as identified below; also attached is a TS WP for uranium ISS in overburden and bedrock. Providing PDI and TS WPs in this way is consistent with the strategy described above and allows pre-design work to advance in parallel (and adjust independently if necessary) for each remedy component.

- Site-wide Soils and Sediment PDI WP (Appendix A)
- ISS PDI WP (Appendix B)
- HB Containment PDI WP (Appendix C)
- 1,4-dioxane and VOCs in Bedrock Groundwater PDI WP (Appendix D)
- ISS TS WP (Appendix E).

In addition to the scopes of work provided in Appendices A through E, work described in this RDWP will have several "Supporting Deliverables". Supporting Deliverables include the following.

- Post-Removal Site Control (PRSC) Plan pursuant to the Building NTCRA - Appendix F.
- Health and Safety Plan (HASP) – Appendix G
- Emergency Response Plan (ERP) – Appendix H
- Sampling and Analysis Plan: Field Sampling Plan (FSP) – Appendix I
- Sampling and Analysis Plan: Quality Assurance Project Plan (QAPP) – Appendix J
- Site Wide Monitoring Plan (SWMP) – Appendix K
- Community Relations Support Plan (CRSP) – Appendix L

The Preliminary (30%) RD will be submitted for EPA comment 90 days after EPA approves the PDI Evaluation Report, and for the ISS RA project, the TS Evaluation Report. Separate 30% RDs will be submitted for each remedial component. Required elements of the 30% RD are described in SOW Section 3.5 and Section 5 of this RDWP. The 30% RD will be accompanied by updated "supporting deliverables" as appropriate, and the following additional supporting deliverables:

- Construction Quality Assurance / Quality Control Plan
- Transportation and Off-Site Disposal Plan
- Operations and Maintenance (O&M) Plan, and

- O&M Manual.

In addition, an Institutional Controls Implementation and Assurance Plan (ICIAP) deliverable will be submitted with the 30% RD for the HB containment RA project. 95% and 100% versions of the ICIAP will be developed and submitted with those respective deliverables for the HB containment RA project.

The SOW allows for bypass of the Intermediate (60%) RD, if EPA agrees following review of the 30% RD. Based on the project team's background and understanding of the work, we anticipate bypassing the 60% RD submittal process for each RA project, which will lead to submission of a Pre-Final (95%) RD within 60 days after receipt of EPA's comments on the 30% RD. The requirements for the 95% RD are provided in SOW Section 3.7 and Section 5 of this RDWP. A Final (100%) RD will be submitted for EPA review 14 days after receipt of EPA's comments on the 95% RD.

Remedial Action Work Plans (RAWPs) will be developed for each RA project and submitted for EPA review within 90 days after EPA notice to proceed on a RA project. RA Reports will be developed for each RA project and will be due to EPA within 45 days of EPA's final inspection or within 45 days of the end of the shakedown period, as applicable.

3.2 General Approach to Contracting, Construction and Operations, Maintenance & Monitoring (OM&M)

de maximis, inc. (de maximis) will serve as the Project Coordinator and Supervising Contractor (as defined in the CD), and General Contractor (GC) for the performance of all Work required by the CD. de maximis will execute sub-contracts with consultants, contractors, laboratories and waste transporters and disposal facilities, as necessary, to implement the Work.

As the GC, de maximis personnel will act as the Site Project Manager and Construction Manager(s) during the PDI / TS work. For the RA, we anticipate adding a Site Operations Manager, Health and Safety Manager, and Shipping Coordinator.

de maximis data management solutions (ddms, inc.) will provide database management, data validation, lab coordination, file management (Project Portal), GIS, and website maintenance (see www.nmisite.org). In addition, de maximis has retained O & M Inc. to continue to perform the operations and maintenance of the Groundwater Extraction System installed to perform the ex-situ treatment of 1,4-dioxane in the downgradient groundwater.

Prior to development of this RDWP, de maximis issued two Requests for Proposals (RFPs) that allowed us to:

- retain consultants to prepare and implement the PDIs and TS. We expect those firm(s) will subsequently prepare the RD, act as the engineer of record during the implementation of the RA, and then prepare the RA Report for their RA projects; and,

- retain analytical laboratories to support QAPP development and perform PDI and TS analysis.

After submission of this RDWP and review of the projected off-site disposal waste types and volumes, de maximis will issue a RFP for transportation and disposal services. All disposal facilities must be approved by EPA.

Co-incident with submission of each 95% RD deliverable for EPA review, de maximis expects to issue RFPs for contracting services associated with that RA project. A similar process will be used once the scope of necessary OM&M services is finalized.

3.3 Responsibility and Authority of Organizations and Key Personnel

The key management personnel for the RD are presented below followed by a description and communication roles of each person or party in Sections 3.3.1 through 3.3.5. Regulatory entities involved in the project include USEPA and MassDEP as well as local authorities. USEPA is the lead regulatory agency.

Organization	Role	Contact Information
USEPA	Lead regulatory agency overseeing the RD/RA	Christopher Smith Remedial Project Manager (RPM) USEPA Region 1 5 Post Office Square MC OSRR07-4 Boston, MA 02109 (617) 918-1339 Smith.christopher@epa.gov
MassDEP	State regulatory agency involved in project review and providing support to USEPA	Garry Waldeck Environmental Engineer MassDEP-BWSC 1 Winter Street Boston, MA 02108 (617) 348-4017 garry.waldeck@state.ma.us
AECOM	EPA oversight contractor	Andrew Schkuta 250 Apollo Drive Chelmsford, MA 01824 (978) 905-3180 – Voice andrew.schkuta@aecom.com

Organization	Role	Contact Information
Settling Defendants (SDs)	Signatories to the CD, responsible for overall performance of RD/RA	c/o Bruce Thompson of ***de maximis, inc.*** (see below)
de maximis, inc.	General and Supervising Contractor	Project and Community Involvement Coordinator Bruce Thompson ***de maximis, inc.*** 200 Day Hill Road, Suite 200 Windsor, CT 06095 (860) 298-0541 brucet@demaximis.com
de maximis Data Management Services, Inc. (ddms)	Subcontractor for data management services, including data validation and database management, and maintenance of www.nmisite.org	Database, GIS, and Website - Heidi R. V. Gaedy, PMP, GISP ddms, Inc. 60 Plato Boulevard East, Suite 150, St. Paul, Minnesota 55107 (651) 842-4236 HGaedy@ddmsinc.com Validation - Polly Newbold ddms, Inc. 186 Center Street, Suite 290 Clinton, NJ 08809 pnewbold@ddmsinc.com
O&M, Inc	Subcontractor for general work at the Site (site inspections, maintenance, snow removal) Groundwater Treatment System O&M	David Fuerst O&M, Inc. 450 Montbrook Lane Knoxville, Tennessee 37919-2705 (865) 691-6254 - Voice dfuerst@oandm-inc.com

Organization	Role	Contact Information
Haley & Aldrich, Inc.	• Subcontractor for sitewide soils and sediment remedy and HB containment remedy components • Develop and implement project plans (PDI etc) • Engineering and design support • Engineer of Record for respective design components	Mark D. Kelley, P.E.(MA) Haley & Aldrich, Inc. 465 Medford Street |Suite 2200 Boston, MA 02129-1400 T: (617) 886.7338 C: (857) 498.1276 mkelley@haleyaldrich.com
Geosyntec Consultants	• Subcontractor for ISS remedy component • Develop project plans (PDI and TS) • Engineering and design support • Engineer of Record for respective design component	Carl R. Elder, Ph.D., P.E (MA, KS). Geosyntec Consultants 289 Great Road, Suite 202 Acton, MA 01720 tel. 978-263-9588 cell 978-844-4172 celder@geosyntec.com
Lab(s)	• Laboratory analytical services	Alpha Analytical Dave Sanford Project Manager 8 Walkup Drive Westborough, MA 0158 Email: dsanford@alphalab.com Direct: 508-439-5157 GEL Laboratories, LLC Edith M. Kent Project Manager 2040 Savage Road, Charleston, SC 29407 E-Mail: emk@gel.com Direct: 843.769.7385
Driller	• PDI Drilling services	TBD

3.3.1 Agencies

All formal communication from the Agencies (EPA and MassDEP) regarding the Site will be directed to the Project Coordinator and the Settling Defendants, as provided in the CD.

3.3.2 Settling Defendants

The SDs are the signatories to the CD. All formal communication from the SDs regarding the Site will be directed to the Project Coordinator and the Agencies, as provided in the CD.

3.3.3 General Contractor/Project Coordinator

The SDs have retained de maximis to function as the General Contractor and Bruce Thompson of de maximis as their Project Coordinator.

3.3.4 General / Supervising Contractor

On December 12, 2019, the SDs designated de maximis as their General and Supervising Contractor. On December 31, 2019, EPA approved de maximis for this role. All RD/RA-related work performed by the SDs pursuant to the CD will be carried out under the direction and supervision of de maximis.

3.3.5 Project Coordinator

On behalf of the SDs, Mr. Bruce Thompson will serve as the Project Coordinator. The Respondents designated Mr. Thompson as their Project Coordinator in a December 12, 2019 letter to USEPA. On December 31, 2019, EPA approved Mr. Thompson. The Project Coordinator will coordinate and supervise all Work under the RD/RA CD. In accordance with Paragraph 5.1 of the SOW, Monthly Progress Reports will be compiled and submitted to the Agencies by the Project Coordinator on behalf of the Respondents. The Project Coordinator is the primary contact for the Settling Defendants with EPA, MassDEP, and the community.

3.3.6 Subcontractors

Haley & Aldrich, Inc. (H&A), Geosyntec Consultants, Inc. (Geosyntec) and O&M, Inc. have been retained for various aspects of the RD process, as further explained below. Other subcontractors for the RD have been and will continue to be procured based on specific scopes of work. These are anticipated to include analytical laboratory services, overburden and bedrock drilling. Subcontractors will report directly to the Project Coordinator or appropriate contractor, who in turn will report to the Project Coordinator. A project organization chart provided in Attachment 1.

3.3.6.1 Haley & Aldrich, Inc.

Haley & Aldrich will be responsible for the Sitewide Soil and Sediment and the Holding Basin containment aspects of the remedy, including preparing and performing Pre-Design

Investigations, preparing the Pre-Design Investigation Report, the Remedial Design, and acting as the Engineer of Record for these remedial components. An organization chart for the Haley & Aldrich team is provided in Attachment 2.

3.3.6.2 Geosyntec Consultants, Inc.

Geosyntec will be responsible for the In-Situ Sequestration and 1,4-Dioxane in Bedrock Groundwater aspects of the remedy, including preparing and performing Pre-Design Investigations and Treatability Studies, preparing the Pre-Design Investigation and Treatability Study Reports, the Remedial Design, and acting as the Engineer of Record for these remedial components. An organization chart for the Geosyntec team is provided in Attachment 3.

3.3.7 Non-Project Personnel

Due to interest among the neighboring communities regarding the conditions at the Site and underlying groundwater, inquiries about the project work status may be made by persons who are not officially associated with the project. The following procedures will be implemented by representatives of the general public to gain information about the Site:

- Telephone inquiries shall be directed to EPA RPM;
- Citizen groups will work with the EPA Community Involvement Coordinator; and
- During the work, on-Site staff will direct public inquiries to the on-Site Supervisor. Non-project persons will be asked not to violate Site access guidelines described in the HASP. The Site Supervisor will state the company they are employed with and indicate that the company is working for *de maximis.* The supervisor will state the specific task being performed at the time (i.e., groundwater sampling) and direct the non-project persons to the EPA RPM if additional information is requested. The inquiries from non-project persons will be documented in the project field notes.

3.4 Plans for Obtaining Access and Easements

Access to the 2229 Main Street property for the purpose of conducting the Building NTCRA was granted by Starmet in an Access Agreement and Release dated September 22, 2011. This Access Agreement and Release provides the requisite access to conduct the RD/RA and OM&M activities. A lease was signed with Acton Water Supply District pursuant to the Groundwater NTCRA that provides the necessary access for RD/RA purposes.

Paragraph 21 of the CD addresses securing access agreements to complete the Work. Access Agreements to needed properties were obtained pursuant to the Groundwater NTCRA. We expect to update those agreements for the RD/RA to include continued access, easements, and agreements to implement NAULs. The access properties for the RD/RA are shown on Figure 7 and include:

Property ID	Town	Owner	Address	Current Use
J3-37	Acton	Valley Sports, Inc. 2320 Main Street, Concord, MA 01742	112 Powder Mill Road	Skating Rink
2324-2	Concord		2320 Main Street	
2324-1	Concord	Concord Medical Realty Holdings, LLC, c/o Paul D'Ambrosio, 774 Barretts Mill Road, Concord, MA 01742	2284 Main Street	Medical Office / Primary Care
2325	Concord	Reafs Edge LLC, 6 Tenney Circle, Acton, MA 01720	2250 Main Street	Office / Residential
2325-1	Concord	Town of Concord, 22 Monument Square, Concord, MA 01742	225B Main Street	Storm Drain
2326-1	Concord	Town of Concord	222B Main Street	open space
2971-1	Concord	Minuteman ARC for Human Services, Inc. 1269 Main Street, Concord, MA 01742	35 Forest Ridge Road	office building
2970-1	Concord	Starmet NMI Corp	2229 Main Street	CERCLA Site
J3-34	Acton	Water Supply District, PO Box 953, Acton, MA 01720	284 High Street	Water Department
J3-34-5	Acton		16 Knox Trail-28	Water Dept / Solar

3.5 Technical Specifications

Section 6.4 of the SOW provides requirements for sampling, monitoring, and spatial data. If requested, sampling and monitoring data will be submitted to EPA in their standard Electronic Data Deliverable (EDD) format. If requested, spatial data will be submitted to EPA in the ESRI file geodatabase using decimal degree format using North American Datum 1983 (NAD83) or World Geodetic System 1984 (WGS84) as the datum.

3.5.1 Environmental Data

Data generated by the project may include the following:

- Field Observation Data
- Field Screening or Quality Measurement Data
- Lithologic Data from Soil Borings
- Well Construction information
- Hydrogeologic data
- Geotechnical data
- High Frequency sensor data (weather stations, transducers)
- Compliance monitoring
- Operations and Maintenance
- Laboratory Data (chemistry)
- Validation Data
- Spatial or Survey Data (i.e. coordinates, elevations)

Due to the variety of sources and magnitude of data that may be generated, there is a need for a centralized data management system to accurately capture, standardize, and preserve data and allow secure rapid access to project team members. Behind the scenes, ddms internally utilizes an EQuIS data management system (database) to, normalize, store and manage numerous different kinds of technical environmental data.

This platform supports the full environmental data workflow from sample planning, field-data collection, analytical data checking, data verification and validation, through reporting and analysis. When environmental data are integrated with GIS, the data can be seamlessly visualized and analyzed.

Both the environmental database and GIS components are made accessible to the project team via Project Portal.

3.5.2 Data Exchange and Communication

Communicating and exchanging these data among laboratories, sub-contractors, agencies and clients is one of the essential functions of any project team. Understanding data vehicles such as Electronic Data Deliverable (EDD) formats and being able to both import and export them can dramatically reduce costs and increase project efficiency. The Data Manager will employ the latest in data communication formats and techniques including XML (Extensible Markup Language), Web Services and SOA (Service Orientated Architectures).

4 Overview of Pre-Design Support Activities

Each of the RD activities will proceed independently along its own path, with the team considering the appropriate sequencing of the Remedial Action work to optimize the work. As part of this process, each removal design will include its own Pre-Design Investigation (PDI) and Treatability Studies (TS). The following sections outline the expected Pre-Design Investigations and Treatability studies to be completed at the Site. The PDI and TS are designed to address the known data gaps necessary to complete the RD process.

4.1 Descriptions of Areas Requiring Clarification and/or Anticipated Problems

Section 3.1 of the SOW requires the RDWP to include: Descriptions of any areas requiring clarification and/or anticipated problems (e.g., data gaps). The following summarizes the known aspects of the remedy specified in the CD that require clarification or that may pose problems during the RD.

All aspects of the RD/RA process will need to carefully consider and minimize impacts on abutting properties (see Figure 8) to the maximum practicable extent. Most likely impacts include noise, vibration, and dust. Dust control is incorporated into site worker safety, so is not expected to require additional management. Noise and vibration minimization, monitoring, and controls will need to be integrated into the design process, and then addressed in the community relations program. Perimeter air monitoring is not anticipated to be necessary during the PDIs but may be necessary during the RA. Dust control (and limits) for site worker safety will likely not have the same limits as fence line criteria for protection of the public, so it is assumed that perimeter air monitoring may be necessary for some of the remedial activity components and will be included in the RD as appropriate.

Example remedial work areas and approximate distances to abutters are below.

Work Area / Work	**Abutters**	**Approximate Distance from Work Area**
Northern Pavement Drain Area (tree clearing, excavation, restoration)	18 – 24 Cranberry Lane	150 – 200’
Potential Backfill Borrow Area Along North-Western portion of 2229 Main St (Tree clearing, excavation)	35 Forest Ridge Road	250 – 300’
Sweepings Piles (tree clearing, excavation, restoration)	Black Birch Condos	300 – 400’
Old Landfill Area (tree clearing, excavation, restoration)	Thoreau Hills (384 Hayward Mill Road)	300 – 400’
Former Building Slabs (concrete breaking and processing)	All abutters	700 – 1000’
Holding Basin and Cooling Water Pond (heavy civil)	All abutters	700 – 1000’

The following areas requiring clarification and/or anticipated problems will be addressed and resolved through the PDI/TS process, and/or through the design submittals.

4.1.1 Site- wide Soil and Sediment Remedy

4.1.1.1 Use of On-Site Borrow for Excavation Backfill

Use of on-site borrow for backfill of excavations would reduce truck traffic and associated greenhouse gas emissions and eliminate the cost of procuring that material. A prospective borrow source is in the north-west area of the 2229 Main Street property. Further analysis is needed to determine the available volume in this area.

4.1.1.2 Final Grading / Site Configuration

The Town of Concord is actively considering taking the NMI property and is considering a range of possible future uses. Potential future uses would benefit from maximizing the amount of flat, buildable space. Use of the on-site borrow area would potentially create one area. The most cost-effective remedial approach needs to integrate a vision of the final grading of the site considering necessary excavation and backfill needs. As discussed in the Slope Stability section, different approaches to soil and sediment excavation near the gabion wall will either result in restoration of the site to the pre-1983 conditions or retain the small northern parking area. The Cooling Water Recharge Pond is expected to be re-purposed for storm water management.

4.1.1.3 Site-wide Soil and Sediment Remedy Excavation Sequencing and Duration

There is a significant quantity of soil and sediment targeted for excavation and off-site disposal. This volume is expected to vary from the FS/ROD estimates following further delineation and adjustment of planned excavation boundaries and depths.

The excavation plan will need to consider and integrate the other remedial projects, traffic patterns, and production rates for various media.

Using the FS/ROD estimated volume (~82,500 $yards^3$) and a typical conversion factor of 1.5 tons / $yard^3$, there are ~124,000 tons of soil and sediment to be transported off-site. With weight "over the road" limited to 20 tons (for interstate trucking), this is ~6,200 truckloads. If shipping remains within Massachusetts, the limit per truck increases to 30 tons, or ~4,100 truckloads. Assuming 100% of the excavation volume is replaced with off-site backfill, that is another 4,100 to 6,200 truckloads of fill soils to be brought to the Site.

Our experience during the ~1,000 truckloads of off-site shipment during the Building NTCRA was that two factors control the rate of waste shipment: 1) the availability of containers and 2) the loading and shipping process. The disposal sites capable of receiving this material are likely limited to facilities in Idaho, Texas, Utah, or Michigan. Therefore, the most efficient shipping approach will be to move containers by truck from the Site to the closest available rail facility to be loaded on railroad cars. The waste containers will cycle from the Site to the facility and back. The total available containers (empties awaiting loading on-site, filled containers in transit, filled containers at the facility awaiting disposal, and empties in transit back to the site) and the cycle duration will control the number of containers per day that can leave the site. The likely loading and shipping process for each container includes loading and tarping, radiological scanning, weighing and completion of bills of lading (or manifests), and safety checks of the transport vehicles. During the Building NTCRA, trucks leaving the Site were required to avoid rush hours and school bus transit times. The container availability and shipping process limitations result in a maximum of 10 – 15 containers per day. This process could be accelerated by increasing the available containers and/or shortening the shipping cycle, both options will be investigated during the Transportation & Disposal (T&D) RFP process. The T&D RFP process will also establish acceptable material and debris sizes, necessary to determine means and methods for removal and sizing of the former building foundations.

At the FS/ROD estimated excavation volume, this results in 410 – 620 "working days" for waste shipping. Accordingly, to minimize the total duration of the Remedial Action, the excavation sequencing will begin with the isolated areas (Surface Soil North, Sweepings Piles, Old Landfill Area) and then proceed with the building foundations, so that this work can proceed in parallel, but not interfere with the Holding Basin remedy.

4.1.1.4 Former Building Foundation Removal and Sizing

The technical approach to removing and sizing foundation concrete will be determined by the required material sizes to meet disposal facility Waste Acceptance Criteria and noise / vibration limits. This design requirement will be determined after the volume for disposal is determined and the selected receiving facility is selected.

4.1.1.5 Soil and Sediment Stockpiling and Shipping

We anticipate using at least two Sprung-style modular structures to allow for all-season work during the RA. The first would be used for stockpiling and loading excavated materials. The second would cover the existing weight scale, where conveyance cleaning, tarping, and manifesting would occur. A third structure might be needed to house concrete and asphalt size reduction processing. The need for and locations of these structures need to be evaluated during the design process.

4.1.1.6 Application of Soil Cleanup Levels

The RAO for this aspect of the remedy states:

> "Prevent direct human exposure by a future resident (by dermal contact, ingestion, inhalation, or ionizing radiation) to soils or sediments with contaminants (DU, PCBs, PAHs, and other inorganics) that exceed risk-based standards."

The risk assessment evaluated risks in multiple exposure areas. Those areas with unacceptable risks were evaluated for remedial action in the FS. There are exposure areas that did not pose unacceptable risk, but which contain point sample locations that exceed the ROD cleanup levels, typically for uranium (where the background and cleanup level concentrations are similar). There are a few areas of soil with relatively high DU (e.g., multiples of the ROD cleanup level) concentrations in EAs that did not pose unacceptable risk. Those areas will be incorporated into the planned excavation, to result in an overall lower residual risk at the NMI

Property at the completion of the RA. Section L.4 of the ROD (Expected Outcomes of the Selected Remedy) states:

> "The determination that all cleanup levels have been met should consider historical and current monitoring data, contaminant distribution, trend analysis, and the appropriateness of the compliance monitoring program (i.e., locations, frequency of monitoring, sampling parameter). After all groundwater, soil, and sediment cleanup levels (as shown in **Tables L-1** to **L-3** (of the ROD) have been met as determined by EPA consistent with Agency guidance, EPA will perform a risk evaluation which considers additive risk from remaining COCs considering all potential routes of exposure to document the residual risk based on exposure to soil, sediment, and/or groundwater at the Site. The residual risk evaluation will document the potential risk associated with the concentrations of the COCs remaining in soil, sediment, and/or groundwater at the Site (if detected). "

The RD process will incorporate a proactive evaluation of residual risk associated with this approach to the site-wide soil and sediment remedy, to demonstrate that soils outside the excavation areas meet EPA's allowable risk levels.

4.1.1.7 Demonstration of Compliance Approach

If only the soil above cleanup levels in areas with "unacceptable risk" is targeted for remediation, then the RD process will need to establish a basis to establish excavation boundaries between exposure areas, where soil concentrations may still exceed the cleanup level, but do not pose an unacceptable risk (when evaluated as an exposure point concentration (EPC) based on the 95% UCL across an exposure area).

Regardless, the RD process will establish a Demonstration of Compliance approach that will outline the sampling and analysis program (e.g., sidewall and bottom of excavation sampling frequency and data evaluation) to be used to demonstrate the success of the excavation program. The demonstration of compliance approach for PCB impacted areas will need to comply with the substantive requirements of TSCA Sections 761.61(a) and 761.61(c).

The cleanup level for uranium is 2.7 mg/kg, which is about two-times the background value of 1.3 mg/kg. Both these concentrations are at or below the minimum detectable concentration for on-site gamma spectroscopy measurements. ICP-MS can reliably quantify uranium to these levels but can only be performed at an off-site laboratory. Based on this information, a time- and cost-effective soil characterization approach could consist of:

- Using on-site gamma-spectroscopy (fast turnaround times) to identify soil with uranium concentrations down to the minimum detectable concentration (expected to be ~`5 – 30 mg/kg, or five to ten times higher than the remedial goal). These data would be used to determine whether to continue excavation or proceed to verification sampling.
- Using off-site laboratory ICP-MS analysis for verification / compliance sampling.

The approach for demonstrating compliance with the remedial goal will be based on demonstrating that uranium has been reduced to concentrations consistent with acceptable residual risks in accordance with Section L.4 of the ROD, using an EPC approach with the ICP-MS confirmatory soil sampling.

A field study will be necessary to establish the site-specific minimum detectable concentrations using gamma spectroscopy. An initial evaluation will be made as part of the ISS PDI, when the on-site radiation instruments will be used to evaluate HB samples, to confirm that soil samples will "high" (hundreds of mg/kg) levels of DU are used for treatability studies. We expect that a different instrument may be needed to obtain low enough detection limits to be useful for initial confirmation of excavation limits. A field study proposal will be submitted later in the design process, once the on-site radiation laboratory is fully functional.

4.1.1.8 Side-wide Soil and Sediment Data Needs

Additional delineation is needed to plan excavation limits and refine estimates of soil and sediment volumes for excavation and off-site disposal. This delineation is described in Appendix A. A separate delineation effort will be performed to evaluate the potential presence of DU penetrators. An initial survey for DU penetrators in soil and fixed radiological contamination in paving was completed during the Building NTCRA (DDES, September 2014). This initial survey resulted in removal of DU penetrator fragments and soil within 12 inches of the DU metal piece. The DU penetrator study to be completed as a PDI will start with additional excavation and confirmatory sampling at areas where penetrators were already located and removed. This study is also described in Appendix A.

The design of excavations at the bottom of steep slopes will need to consider the potential for slope failure, and if determined to be an issue, incorporate appropriate stabilization techniques into the design. This potential issue has been identified for the northern and eastern sides of the Cooling Water Recharge Pond and the south-western corner of the Sphagnum Bog.

4.1.1.9 Bog and Cooling Water Recharge Pond

The wetland boundaries, habitat types, and resident species need to be defined to develop adequate restoration plans.

4.1.1.10 Slope Stability

The design of excavations at the bottom of steep slopes will need to consider the potential for slope failure. This potential issue has been identified for the northern and eastern sides of the Cooling Water Recharge Pond and the south-western corner of the Sphagnum Bog.

Another area of concern is the gabion wall at the northern end of the Cooling Water Recharge Pond. This wall was constructed in 1983 along with the septic field for former Building E was installed, along with the overlying parking area. There is evidence of settlement of the gabions. There is subsidence of an area of the asphalt over the gabions, suggesting settlement or erosion of the fill materials. Safe excavation of the sediment and soil will necessitate appropriate stabilization techniques into the design. Removal of the gabion wall would be the most direct and reliable approach but would cut off access to the northern parking area.

4.1.1.11 Fill Between Gabions

As noted above, the gabion wall was constructed in 1983. No direct investigation of the fill behind the gabion walls has been conducted. One area of subsidence has been noted. A Ground Penetrating Radar (GPR) survey and potentially targeted soil sampling in this area is appropriate.

4.1.1.12 Former Building E Sub-Slab Impacts

Building E was constructed in 1983. It was constructed on the former location of the NMI waste handling facility, which was housed in Butler Building B-3 (Weaver, 1981). It is not clear that all impacted materials were removed during the decontamination of Building B-3. The extent of impacts and associated soil remediation requirements under the Building E slab cannot be determined until it is removed.

4.1.1.13 Removal of Former Tank House Foundation

The Tank House was located adjacent to the Holding Basin. This structure and all equipment were removed during the Building NTCRA. After equipment removal, the basement of the building was filled with flowable fill. The Former Tank House poses an obstruction to the installation of the vertical barrier wall, and the grading of the cap will need to tie into the existing structure. As described in section 4.1.3, stability of the building when nearby soils are disturbed, and the permanent condition of a low-permeability vertical containment wall has to be evaluated as well as how the building itself may and may not be part of the contained area.

4.1.2 Holding Basin Vertical Barrier Wall (VBW) and ISS Performance Standard

Design of the Holding Basin remedy needs a performance standard applicable to evaluating the performance of a remedy that combines containment (VBW) and treatment (ISS). The HB soils are considered "principal threat" media. The NCP expectation is to:

> "Use treatment to address the principal threats posed by a site, wherever practicable; and "use a combination of methods, as appropriate, to achieve protection of human health and the environment. In appropriate site situations, treatment of principal threats posed by a site, with priority placed on treating waste that is liquid, highly toxic or highly mobile, will be combined with engineering controls (such as containment) and institutional controls, as appropriate, for treatment residuals and untreated waste."

The NCP (see 55 FR 8721) establishes a guideline that treatment as part of CERCLA remedies should generally achieve reductions of 90 to 99 percent in the concentration or mobility of individual contaminants of concern. The relevant RAO from the ROD states "Prevent migration of DU/uranium from soils in the HB that would result in groundwater concentrations exceeding ARARs".

Groundwater immediately downgradient of the HB contains ~3,000 µg/L DU. The cleanup level MCL for DU is 30 µg/L. Accordingly, the combined remedy will need to achieve more than two orders of magnitude (99%+) reduction of mobility and/or concentration. Conceptually, the

VBW component can be expected to achieve at least two orders of magnitude (99%) reduction in groundwater mobility. For example, this degree of reduction would result from a wall with a hydraulic conductivity of 10^{-6} cm/sec installed to surround the HB soils that have a hydraulic conductivity of 10^{-4} cm/sec. Different wall types can achieve lower hydraulic conductivities; however, this may result in higher costs with an increased difficulty to implement. The VBW could extend through the overburden to the till, through the till to top of rock, or into the upper layer of bedrock. The design will evaluate the effects on containment associated with where the wall terminates.

The expected reduction in concentration of DU through ISS component is not as easily estimable, as there is less experience in this aspect. Initial expectations are for at least a 50% reduction in aqueous phase DU concentration within the HB. This would lead to a combined 99.5% reduction in mobility and concentration downgradient of the HB wall. The PDI and TS process will provide data needed to estimate changes in DU concentration in groundwater below the Holding Basin resulting from ISS, and these results can be used to determine whether the combined remedy will achieve the RAO.

4.1.3 Holding Basin VBW and Cap

The current topography along the probable alignment of the VBW (the perimeter of the HB) varies by ~15', from ~169' AMSL on the northern and eastern sides, to ~185' AMSL on the southern and western sides. The foundation of the former Tank House is a significant feature on the western side. A variety of sub-surface piping is expected to be encountered on the western side of the HB. The alignment of the VBW and installation approach will need to incorporate the removal or encapsulation of the former Tank House foundation and the stability of that slope after removal and during VBW installation.

The potential benefit of cutting down the berms surrounding the HB to reduce the total wall depth needs to be considered and incorporated if cost effective. Regrading or cutting the berms may also improve stability during installation of the barrier and simplify construction.

In addition, the specific type of VBW and depth of installation will be evaluated during design. One aspect of that evaluation will be how effectively each wall installation method will cope with subsurface obstacles (such as boulders).

Field investigations, most likely a series of test pits, are needed to evaluate and confirm the presence, depth, construction and orientation of drain lines near the former Tank House and that may cross the alignment of the VBW.

A drilling program is needed along the alignment of the VBW to determine geologic conditions, the depth to top of till and top of rock, and bedrock quality. Monitoring wells are needed up gradient of, within, and down gradient of the VBW to determine hydraulic gradients between the geologic units (overburden, till, and bedrock). Seepage modeling will utilize these data to support the determination of the target depth of the VBW (e.g., will it need to key into till, top of rock, or some extent into rock). Similarly, the need for bedrock sealing (grouting) under the former HB will need to be determined.

One applicable ARAR for the VBW is Nuclear Regulatory Commission regulation 10 CFR Part 40, Appendix A, Criterion 6(1). The relevant aspect of this ARAR is that the containment wall and cover will be constructed to be maintained for 1,000 years to the extent reasonably achievable and in any case for a minimum of 200 years. Accordingly, the VBW will need to be designed to withstand earthquakes. Appropriate data is needed to support a seismic hazard analysis to determine the design peak ground acceleration in bedrock. The bedrock ground motion will be used to estimate ground motions propagating through overburden, which will be utilized in the VBW design.

4.1.4 In-situ stabilization of Depleted Uranium in Overburden and Uranium in Bedrock Groundwater Design

This remedial task includes geochemical stabilization/sequestration of DU within the Holding Basin and in groundwater downgradient of the Holding Basin, and of U in bedrock groundwater with apatite or a comparable stabilizing agent. The current extents of DU in overburden groundwater and U in bedrock groundwater are shown on Figure 6b. Apatite works to immobilize the DU in the soils. Treatment with apatite (a form of calcium phosphate) sequesters uranium in two ways: 1) dissolution of apatite and subsequent precipitation of U(VI)phosphate minerals, such as autunite (which has very low solubility and dissolution kinetics); and 2) direct sorption of uranium on the apatite mineral itself. The apatite stabilization technique assumes that sorbed uranium on soils that could become solubilized would encounter the apatite media or phosphate within the saturated zone and become sequestered.

Proof-of-concept bench scale tests performed at the Site using apatite have proven successful in uranium sequestration (Further information on the bench scale study results can be found in Appendix J of the Feasibility Study). However, these tests were performed using Site groundwater and 100% Apatite II. Because in-situ concentrations after ISS will be much lower (i.e., amendment will be mixed with soil), amendment performance may differ from the results of the FS bench scale tests. The performance of Apatite II when mixed with soils at low concentrations will be evaluated in proposed bench tests, and then tested in-situ during pilot testing. Further, the stabilized soils within the Holding Basin will be contained within a low-permeability vertical containment wall and beneath a low-permeability cover. This containment is expected to result in reducing groundwater conditions, which differs from current conditions, so testing is included to assess an appropriate sequestration amendment for the expected future geochemistry for groundwater beneath the HB.

Apatite (or ZVI, another ISS amendment) is a solid and therefore poses a challenge to “inject” into the subsurface. Testing will jet injection at locations spaced close together to assess delivery and propagation of the amendment for stabilization of uranium within the holding basin.

For DU in overburden groundwater, the selected remedy includes in-situ treatment (sequestration) of DU using agents such as apatite or Zero Valent Iron (ZVI) (or other comparable agent) in In Situ Reactive Zones (ISRZs) where sequestration agents emplaced in a closely-spaced network of locations to create an in-situ treatment zone. The ISRZ technology using apatite is based on an evaluation of existing literature and Site data, a Site-specific pilot study discussed in the Feasibility Study, and the applicability of this technology to the hydrogeochemical conditions in the DU plume. The ISRZs used in this alternative will be passive (no mechanical operation required) and will not require in-situ redox control of the aerobic groundwater. Pilot testing and pre-design studies will be conducted to identify appropriate injection methods, media, and well spacing for remedial design.

The selected remedy component for uranium in bedrock groundwater includes in-situ treatment (sequestration) of uranium by creating ISRZs. Unlike overburden, bedrock poses significant challenge for amendment delivery. The delivery of particulate amendments like apatite and ZVI into rock could be infeasible or ineffective. A soluble amendment is a more reasonable option in terms of implementability, although the low permeability of the rock may even make delivery of liquid amendments challenging. Prior to designing an injection program for in-situ uranium sequestration, additional investigations will be completed in order to delineate the vertical extent of the uranium plume and evaluate hydraulic connectivity between the bedrock wells. Characterization activities will include bedrock drilling, borehole geophysics, monitoring well installations. Pumping tests will also be performed to identify and understand hydraulic connections within the bedrock and explore the feasibility of removing uranium in bedrock via groundwater extraction. Since the extend of uranium in bedrock is relatively small, amendment delivery may have significant challenges and the porosity of bedrock is low, removing uranium from bedrock via hydraulic extraction may be a more feasible means for achieving performance standards. Testing would also include sampling to assess whether bedrock groundwater uranium concentrations rebound (and therefore require further pumping or treatment) or decline over time during/after pumping.

4.1.4.1 Treatability Studies

To plan for the ISRZ remedy, bench and potentially pilot testing will be needed to select the best amendment and understand the degree of uranium sequestration possible given the aquifer mineralogy and groundwater geochemistry. The ISRZs are intended to be passive remedies but could require some temporary hydraulic manipulation (e.g., groundwater recirculation) to distribute amendments during or immediately following injection periods. A field-scale injection pilot in bedrock will be performed if hydraulic extraction of uranium proves infeasible. If a pilot test in bedrock is necessary, it will use amendment(s) selected during the treatability study. Such testing would focus on assessing amendment delivery and distribution as well as appropriate well spacing to create a treatment zone.

Pilot testing in overburden will need to be performed to identify appropriate injection methods, injection spacing, pressure, radius of influence, etc. Pilot testing will include monitoring at several observation wells for amendment presence, geochemical changes during and after injections, and change in uranium concentration. It is likely that this alternative could include more injection rounds at a limited number of injection points compared to the ISRZs in overburden.

The limited number of injection points in bedrock is due to the more difficult nature of installing deep open bedrock boreholes, the anticipated presence of a limited discrete fracture network in low porosity bedrock, and the likelihood of needing temporary pumping to distribute amendments in bedrock.

Implementing ISS will require further delineation of the DU plume in overburden and the U plume in bedrock. Limited additional DU delineation in overburden will be completed to confirm the extent and shape of the DU plume requiring treatment. Soil samples for use in TS of DU in overburden groundwater and of DU in HB media will be collected during monitoring well installation. Three different ISS applications will need to be evaluated through TS:

- ISS of DU in overburden groundwater beneath the HB
- ISS of DU in overburden groundwater downgradient of the Holding Basin, and
- ISS of U in bedrock groundwater.

Results of the TSs will provide the most appropriate reagent for each of the ISS target areas as well as a target concentration for field application. A field pilot study will be needed to evaluate the means to deliver reagents into overburden and in bedrock (if needed). Pilot testing will also determine the achievable radius of influence (ROI) per injection point for the selected reagent(s) as well as the expected reagent distribution within the ROI.

4.1.4.2 Reagent Injection within Holding Basin

The sequencing of ISS of DU within the HB and construction of the VBW will need to be managed since injection pressure necessary to perform ISS within the HB could damage the VBW. The expected ROI will be assessed during pilot testing and considered, along with appropriate construction sequencing, to develop a design that minimize this concern. Most likely, ISS within the HB will need to be completed prior to starting VBW construction.

4.1.4.3 Reagent Injection in Overburden Groundwater

Once the appropriate reagent for DU in overburden groundwater is identified, the appropriate injection design will need to consider the following to arrive at the most cost-effective approach:

- Vadose zone ~60' thick
- Target saturated treatment zone varying from ~45' thick (near HB) to ~15' thick (distal end of plume)
- Goal to meet MCLs in all groundwater. Timing (and costs) likely dependent on whether reagent placed in permeable reactive walls or injected throughout plume in spot pattern or both.

4.1.4.4 Bedrock Studies

It is possible that the continued presence of elevated U is because insufficient migration time has occurred for the U to attenuate; there are low estimated seepage rates in the bedrock (~<0.05 ft/d[1]). It is possible that aggressive pumping from the bedrock to essentially increase seepage rates may result in enough U concentration reduction to alleviate the need for ISS in bedrock groundwater. However, it is not known whether U concentrations will rebound following pumping, and if there is rebound, how much. Predesign testing includes installation of groundwater extraction wells with open bedrock rock sockets in the bedrock U plume, testing these wells to determine impacted water bearing zones and pumping from the wells. Data will be collected from the extraction and nearby wells to assess the effectiveness of pumping. Monitoring will continue after pumping to determine if U concentrations rebound after pumping ceases.

4.1.5 Ex-situ Treatment of VOCs and 1,4-dioxane in Groundwater

Design and construction of this remedial project was completed pursuant to an Administrative Order on Consent and Settlement Agreement for Non-Time-Critical Removal Action for Groundwater. Operations and maintenance of this system is being performed by O&M, Inc.

4.1.5.1 Descriptions of Areas Requiring Clarification and/or Anticipated Problems

None noted.

4.1.6 1,4-Dioxane and VOCs in Groundwater

Work performed pursuant to the RIFS and Groundwater NTCRA AOCs delineated the downgradient, off-NMI property extent of 1,4-dioxane and VOCs in groundwater. Operation of the extraction well, with treatment in the temporary and final systems, successfully contained the further migration of 1,4-dioxane and VOCs to the Assabet 1A production well.

However, there remains 1,4-dioxane and VOCs up gradient of the extraction well in both overburden and bedrock. There is no apparent "source area" of higher concentration 1,4-dioxane and VOCs to directly remediate. The highest 1,4-dioxane concentration measured during the RI was 116 µg/L in November 2012, at shallow bedrock well MW-BS15 (located east

[1] Based on hydrogeologic parameter data from the NMI RI Report.

of the skating rink, between Rt 62 and the Assabet River). A comprehensive sampling event was performed in November 2019. These data are discussed in Appendix B under PDI-ISS-1. The total mass of 1,4-dioxane and VOCs in the entire overburden groundwater plume was estimated in the FS to be 5.45 kg. The total mass of 1,4-dioxane and VOCs in the entire bedrock plume was estimated in the FS to be 0.07 kg. This very low estimate of the total mass of 1,4-dioxane in bedrock is due to the small percentage of fractures to the overall rock mass within the plume area, low porosity of bedrock, and lack of appreciable sorption of contamination into the overall bedrock matrix.

The on-property 1,4-dioxane and VOC plumes are superimposed on, respectively, the overburden DU and bedrock U plumes. Further delineation of the extent of 1,4-dioxane and VOCs will occur during the PDI for overburden and bedrock ISS. Additional monitoring locations may be needed beyond those planned for ISS PDIs.

ISS treatment of DU in overburden and U in bedrock in not expected to affect the concentrations of 1,4-dioxane or VOCs. Soil excavation, in particular, the removal of building foundations, may increase recharge and therefore attenuate overburden 1,4-dioxane and VOCs. Groundwater extraction planned as a PDI for U in bedrock may have a beneficial effect on 1,4-dioxane and VOC concentrations, by removing impacted groundwater from the fractures. This program is proposed to be expanded in the PDI for 1,4-dioxane and VOCs in groundwater.

4.1.7 Institutional Controls

¶ 21.b of the CD sets forth requirements with respect to Institutional Controls (ICs). Section 6.7(j) of the SOW details the requirements for an IC Implementation and Assurance Plan ("ICIAP") to be progressively developed and submitted concurrent with the 30%, 60% (or 95%) and 100% RD deliverables for the HB RA project. The forms of ICs contemplated in the CD are "Notices of Activity and Use Limitation" or "NAULs". Implementing a NAUL requires the assent of the owner of the property. In the case of the 2229 Main Street property, if an owner is not available to execute the NAUL, an alternative approach will become necessary.

4.2 Pre-Design Investigations

As part of the preliminary design process, it is necessary to complete PDIs to gather information sufficient to design each remedial component. The sections below summarize each PDI. If needed, additional PDIs will be identified and submitted as needed.

4.2.1 Site-wide Soils and Sediments

The ROD identified the remedy for non-Holding Basin soils, sediments, underground drain lines and debris (including the Old Landfill area) exceeding cleanup levels as excavation and off-site disposal. Figure 3 shows the extent of the proposed soil and sediment required to be excavated. An overview of the PDIs that will be implemented for these areas is provided below and is summarized in Table 4 of the PDI WP for Site-Wide Soils and Sediments, which is attached as Appendix A. The sections below provide a review of these PDIs.

4.2.1.1 PDI SSS-1 – Remedial Excavation Soil Characterization

Areas A4 (AOI 9), A5 (AOI 8), and B2 (AOIs 2 and 4) require remediation because they pose cumulative human health risks above 1×10^{-4} and/or a Hazard Index (HI) above 1 for residential use. The principal contributor to the risks in these areas is PCBs (i.e., in the absence of PCBs, cumulative risks at these areas would not have exceeded 1×10^{-4} or an HI of 1). The remediation in these areas will address COCs to ensure that the RAOs in the ROD are met. The objective of PDI activities for these areas are to refine remedial excavation boundaries.

Area A6 (AOIs 7 and 11) requires remediation because it poses a cumulative risk above 1×10^{-4} and HI above 1 for residential use based primarily on the presence of depleted uranium, as well as PCBs. The remedial excavation is planned to extend to the boundaries of the Area, and in doing so will address COCs above remedial goals within this area. It is anticipated that COCs above remedial goals in subsurface soil within Area A6 (e.g., resulting from potential leaks in drain lines) will be defined as a component of the confirmatory sampling, to be conducted during the remedial implementation. A PDI to support remedial design at Area A6 is therefore not considered necessary, however additional surface soil sampling is planned between the boundary of Area A6 and Area A2 to help refine the remedial design.

4.2.1.2 PDI SSS-2 – Depleted Uranium Penetrator Investigation

Investigations were completed during the building NTCRA to characterize areas of the Site where DU metal fragments (e.g., penetrators and penetrator fragments) may exist in surface soil. The characterization efforts, which are described in the "Depleted Uranium Metal Exterior Site Characterization Survey Report ([NTCRA Survey]"; September 2014), identified discrete fragments of DU metal in soil near the edge of parking areas, building exteriors, and the fence line, as well as elevated radiation measurements on some paved surfaces. Metal fragments identified during the characterization activities, as well as the adjacent soil, were removed during the NTRCA. However, these findings resulted in incorporating the paved surfaces surrounding the buildings and the adjacent wood line/fence line areas into the Site-wide soil remediation, under the assumption that soil, paved surfaces, and potentially soil beneath paved surfaces, could contain DU fragments.

Areas of the Site that contain DU fragments require remediation to remove the metal fragments. In addition, DU metal oxidation in the environment can result in soil contamination with DU, as evidenced by yellow/green discoloration of soil surrounding penetrators during the NTCRA Survey. The objective of the PDI activities for the DU penetrators are to identify DU fragments in shallow soil and characterize uranium concentrations in soil where fragments are identified. Soil beneath paved areas will be evaluated for the presence of penetrators when the pavement is removed as a component of the remedial implementation.

4.2.1.3 PDI SSS-3 – Sub-slab Soil Characterization

Soil beneath the building floor slabs was not investigated during the RI/FS. However, a sub-slab soil investigation was performed during the building NTRCA. The results of the sub-slab soil investigation indicated that contamination in soil beneath the floor slabs is primarily limited to uranium. No VOCs or PCBs were detected above screening levels and PAH detections above remedial goals were limited to a single sample that was co-located with elevated uranium concentrations above the remedial goal. Thorium was also detected in several samples at concentrations above the remedial goal. However, the thorium concentrations were within the range of concentrations reported during the RI, which were determined to be consistent with background, and the pattern of thorium concentrations in sub-slab soil had no apparent association with uranium or other constituents.

The sub-slab soil sampling did not establish the lateral and vertical extent of uranium above the remedial goal. However, nearly half of the samples exhibited uranium at concentrations below the remedial goal, and only 7 out of 26 samples exhibited uranium at significantly elevated concentrations (e.g., more than ten-times the remedial goal). Complete delineation of soil beneath the floor slabs can only be performed once the building floor slabs are removed as a component of sampling during the remedial implementation. However, a PDI will be performed for soil beneath the floor slabs in areas identified as having utilities and the potential for impacts at depth. The objective of the PDI is to further evaluate potential releases from floor drains, sumps, and sub-slab piping, as well as the vertical extent of uranium above the remedial goal.

4.2.1.4 PDI SSS-4 –Cooling Pond, Sphagnum Bog, and Landfill Excavation Evaluations

Remediation of the Cooling Pond sediment is based on ecological risks associated with copper and PCBs, and human health risks associated with PCBs. The extent of the sediment remediation is defined by the physical boundaries of the pond (as existed during the RI). However, excavation of pond sediments may compromise the stability of the gabion wall on the north end of the pond and the surrounding side slopes.

The area north of the Cooling Pond will be surveyed using Ground Penetrating Radar (GPR). Restoration of the pond will need to consider its function and value as a wetland as well as the potential for contaminated groundwater to migrate into the pond and potentially re-contaminated clean substrate used to reconstruct the pond.

The objectives of the PDI for the Cooling Pond include:

- Evaluating stability of the gabion wall and surrounding slopes;
- Evaluating the potential for buried debris on the upland side of the gabion wall using a geophysical survey;
- Evaluating groundwater-surface water interaction; and
- Identifying the function and values of the Cooling Pond as a wetland resource.

Remediation of the Sphagnum Bog sediment is based on ecological risks associated with several COCs, including PCBs, uranium, and copper. The remedial boundary was determined by the area of the lag zone in the southwestern portion of the bog that contained the highest concentrations of the COCs. The purpose of the PDI for the bog is to identify the sediment that can be removed, and the methods appropriate for removing them, without causing irreparable harm to the bog. The PDI for the bog will also evaluate the toe of the Landfill along the edge of the bog with respect to slope stability and methods of excavation.

Area B1/A2 (AOI 3 Landfill) was identified for remediation based on a commitment to remove the buried debris defined in the RI. The risk assessment demonstrated that risks associated with this area did not exceed EPA risk management thresholds; therefore, no COCs were identified as remedial drivers for this area. However, the presence of buried debris precluded full soil investigation within the Landfill during the RI and will preclude additional intrusive investigation of soil as a component of the PDI. The remediation of the landfill will address the buried debris within the Landfill. As a component of the buried debris removal, confirmatory soil samples will be collected, and soil will be remediated to ensure that the RAOs in the ROD are met. To provide information on the location of buried debris in the landfill, a geophysical survey of the landfill will be performed as a PDI. The GPR survey will assist in delineating the depth necessary to excavate and to identify if there are known metallic objects.

4.2.1.5 PDI SSS-5 – Borrow Source Evaluation and Regrading Evaluations

Remedial soil excavations will require backfilling so there will be a need for either off-site fill or on-site material. The purpose of this PDI is to perform a chemical and geotechnical characterization of soil on-Site that could potentially be used as a borrow source.

4.2.2 In-situ Sequestration (ISS)

Four PDIs that focus on gathering data needed for design of the uranium remedies in overburden and bedrock are described in Appendix B. The sections below briefly describe the purpose and scope of these PDIs. Detailed information for each of the PDIs is provided in Appendix B.

4.2.2.1 PDI-ISS-1: Baseline Groundwater Sampling

This PDI was pre-emptively performed by the project team in November 2019. The work involved collecting water levels and groundwater samples from wells throughout the Site. The purpose of doing this work was to obtain a snapshot of current groundwater conditions at the beginning of the RD process.

PDI-ISS-1 includes a description of the scope and field methods utilized during the November 2019 sampling event. Results of water level monitoring, field-collected geochemical data and laboratory analytical data are also presented in tables and figures, including uranium and 1,4-dioxane distribution in overburden and bedrock. Because the results from the sampling event provide a "baseline" for the RD work, subsequent figures in the PDI work plans often show

November 2019 data for reference – for example, figures showing proposed locations include the November 2019 isoconcentration contours to aid in understanding why well locations were selected.

4.2.2.2 PDI-ISS-2: Bedrock Pumping and Rebound Analysis for Uranium in Bedrock Groundwater

The purpose of this PDI is to evaluate changes in bedrock uranium concentrations during and after groundwater extraction from new bedrock wells installed within the uranium plume. If groundwater extraction shows promise as a viable approach for decreasing bedrock concentrations to below 30 μg/L, then pumping will likely be proposed as the remedy for the bedrock uranium plume. If this PDI shows that groundwater extraction is ineffective at reducing uranium concentrations in bedrock, but pumping/injection can facilitate delivery of fluids (i.e., ISS amendments) into bedrock then additional work will be triggered. Additional work would include treatability testing for amendment and dose selection (Appendix E Treatability Study) and injectability testing for ISS of uranium in bedrock (PDI-ISS-4).

The general scope of work for this PDI includes the following.

- Three bedrock wells will be installed in the uranium plume. Two of these wells will be used exclusively for testing the viability of pumping as a remedy for uranium in bedrock whereas the third well will be used to test the viability of pumping as a remedy for uranium and pumping as a remedy for 1,4-dioxane in bedrock (pumping for 1,4-dioxane removal is described in Appendix E).
    - Prior to initiating drilling, monitoring wells near the test well locations will be instrumented with transducers to assess aquifer response during drilling.
    - Extraction wells for pump testing will then be installed with casing to the top of bedrock and "open-rock" for approximately 50 feet into bedrock.
    - Following well development, geophysics will be performed on the open-rock portions of the wells to identify water bearing zone and then groundwater will be sampled from discrete water-bearing zones through use of packers. These samples will be used to assess uranium concentrations from these discrete intervals.
- The open bedrock will be pumped from a selected interval of the well that demonstrates uranium impacts and yield based on the geophysics and sampling. Pumping at a constant rate will be preceded by a step test at each well and over the target interval to select a pumping rate; constant-rate pumping will then begin.
- Groundwater extracted from the well will be discharged into fractionation tanks for off-site disposal.
- Samples of groundwater for uranium analysis will be collected throughout groundwater extraction to assess temporal changes in concentration. Drawdown versus time data will also be collected from the pumping wells and monitoring wells during the pumping and then used to assess hydraulic conductivity of the bedrock.

- Following the cessation of pumping, groundwater sampling and analysis for uranium will continue so that rebound of uranium concentrations over time, if occurring, can be evaluated.

4.2.2.3 PDI-ISS-3: Pilot Testing of ISS in Overburden

The purpose PDI-ISS-3 is to test the feasibility of delivering ISS amendments into the overburden aquifer, and to assess the performance of these amendments at pilot scale. Design information gained from this testing will include criteria such as a refinement of the injection method(s), radius of influence (ROI), reagent distribution with depth, predictability of reagent distribution, injectate concentration (i.e., mass loading), and target injection volume. Initial steps of this PDI will be performed early in the pre-design field program but the majority of this PDI will be performed after completing the treatability studies described in Appendix E since the treatability studies will inform which amendments to pilot test.

The general scope of work for this PDI includes the following.

- Initial Steps
    - Initial steps will include the installation of overburden monitoring wells in the two pilot test areas. Monitoring wells will be 2-inch diameter and likely installed using rotosonic methods.
    - During installation of these wells, soils will be collected for subsequent use during treatability testing described in Appendix E.
    - Groundwater samples will be collected from new monitoring wells after they have been developed to provide initial uranium concentrations (and geochemistry) at the pilot test locations.
- Pilot Testing
    - Pilot testing will be performed in two areas. Area 1 is near MW-S24 where current uranium concentrations are approximately 2,700 μg/L and pilot test Area 2 is closer to MW-8A where uranium concentrations are approximately 250 μg/L.
    - Area 1 and Area 2 are expected to test different uranium concentrations and ISS amendments. The ISS amendment and dose used for pilot testing will be based on the outcome of treatability studies described in Appendix E.
    - At each test area, three injections will be performed using the selected amendment and dose for that area based on treatability study results. The three injections within each area will use varying pressures to assess the feasibility of amendment delivery and refine injection approach.
    - Monitoring will be performed during and immediately after the injections to estimate the ROI for each injection in both areas.
    - Groundwater monitoring at wells within the expected ROI and downgradient from the test areas (but beyond the expected ROI) will be performed after amendments are delivered to assess changes in uranium concentration over time resulting from amendment delivery.

4.2.2.4 PDI-ISS-4: Pilot Testing of ISS in Bedrock

The purpose of this PDI is to investigate the feasibility of delivering ISS amendments into bedrock and the effectiveness of these amendments at decreasing uranium concentration in bedrock. The scope for PDI-ISS-4 will be developed if results from PDI-ISS-2 show that pumping is an ineffective remedy for reducing uranium concentrations in bedrock, but amendments can feasibly be delivered hydraulically into bedrock.

4.2.3 Holding Basin Containment

The ROD identified in-situ stabilization and subsequent containment of material located within the Holding Basin as the selected remedy for principal threat source materials within the Holding Basin. The ROD specifies that the remedy involves containment of the stabilized soils with a low-permeability vertical wall and horizontal cover to isolate the stabilized soil and limit mobility of containments through groundwater.

The Holding Basin containment wall will be designed to prevent groundwater from flowing out of the basin for up to 1,000 years to the extent reasonably achievable, and in any case for at least 200 years, as required by 10 CFR Part 40, Appendix A, Criterion 6(1). The containment wall will extend into glacial till or bedrock to a depth to be determined during the hydrogeologic study and will likely consist of concrete with Xypex additive to reduce the permeability as required to satisfy the design criteria. The wall will be constructed using hydromill equipment capable of advancing through overburden and into bedrock. A low permeability cover will also be constructed to cap the Holding Basin.

Other key aspects of demonstrating compliance with the ARAR include:

- Designing the cutoff wall to withstand earthquakes, and
- Designing the cutoff wall to retard groundwater flow into and out of the Holding Basin footprint.

An overview of the PDIs that will be implemented for these areas is provided below and summarized in Table 1. PDI WPs for Holding Basin containment that describe proposed testing in detail are attached as Appendix C.

4.2.3.1 PDI HB-1: Bedrock and Soil Characterization for Containment Wall Design

The purpose of this PDI is to collect subsurface information needed to design the HB containment wall. A principal data gap that this PDI plans to address is information on the geotechnical and hydrogeologic properties of the overburden and bedrock aquifers. This information will be used to design the containment wall thickness and depth. Information on the physical properties of the bedrock is needed to evaluate constructability factors for hydromilling to install the containment wall.

The proposed containment wall runs through the former tank house. While the above-ground portion of the tank house has been demolished, the below-grade foundations and slabs are still in place. The limits of the below-grade structures as they are understood from historic drawings need to be confirmed for the containment wall design. This PDI will also include an evaluation to identify any potential utilities or structures which may penetrate the below-grade portion of the former tank house.

This PDI includes a subsurface exploration program and a geophysical analysis of the boreholes to determine bedrock fracture zones. Information on fracture zones will be used in the subsequent installation of observation wells and Continuous multi-level tubes (CMTs). A series of hydrogeologic tests will be performed on the newly installed wells to characterize groundwater flow within the proposed containment wall alignment. Soil and bedrock samples will be collected and analyzed for physical and geotechnical properties, and groundwater samples will be collected and analyzed for chemical quality.

4.2.3.2 PDI HB-2: Seismic Evaluation and Data Collection for Containment Wall Design

Based on 10 CFR Part 100, the closure remedy will be designed to withstand the Safe Shutdown Earthquake (SSE), including an assessment of the potential for surface deformation and faulting, liquefaction potential, and stability of the adjacent slope extending downward to the bog. The purpose of this PDI is to collect information on seismic conditions to support the design requirements of 10 CFR Part 100 as well as 10 CFR Part 40.

This PDI includes drilling a series of boreholes, performing cross-hole seismic testing at two boreholes at a time in accordance with ASTM D4428M-14, and a subsequent seismic analysis. U.S. Geological Survey data will be used to determine bedrock ground motions for a 2,475-year return period earthquake.

Using the ground motion parameters of the bedrock and the shear wave measurements from the cross-hole geophysics, a kinematic analysis of the proposed containment wall will be completed. The goal of this analysis is to determine the seismically induced loads that the containment wall will need to withstand. This information will be used to evaluate the need for reinforcing the containment wall to prevent cracking during the design seismic event. In addition, seismic design information obtained during this effort will be used to evaluate liquefaction potential of soils at the HB and perform pseudo-static slope stability analyses for the slope adjacent to the HB extending downward to the bog.

4.2.3.3 PDI HB-3: Bench Scale Testing of Containment Wall Mix Designs

The purpose of this PDI is to evaluate potential containment wall mix designs. Hydraulic conductivity is a critical aspect of the containment wall design, and information is needed on the ranges of hydraulic conductivities achievable using slurry wall construction methods with different mix designs. The mix designs will also be used to verify that the design will prevent groundwater flow over the time frame stipulated in 10 CFR Part 40.

This PDI includes preparation of bench scale samples using different mix designs, and a series of tests to evaluate the physical properties of the samples, including permeability and unconfined strength.

4.2.3.4 PDI HB-4: Characterization of Soils for Cover Design and Slope Stability

The purpose of this PDI is to investigate the geotechnical properties of sloped areas of the site. Existing slopes in some areas of the site pose risk for slope failure or limit access for equipment during investigatory activities and future remedial activities, including around the HB, the Cooling Pond (including the gabion wall at the northern end), and the Sphagnum Bog. Maintaining stable slopes with adequate safety factors is critical for executing the PDIs outlined in this Work Plan and implementing the selected remedial actions outlined in the ROD. Information on the slopes at the HB is also required for the design of the HB cap. Work performed for this PDI will also obtain subsurface information to be used for HB cover design.

This PDI includes test borings within the HB for cover design, shallow hand probes at sloped areas of the site, and shallow hand probes and field vane shear testing at the Sphagnum Bog. Figure 4 in Appendix C shows the areas of the site requiring investigation and analysis related to slope stability. In addition, the data collected from the subsurface explorations will be used to perform slope stability analyses for the HB, the Cooling Pond and associated gabion wall, and the Sphagnum Bog.

4.2.3.5 PDI HB-5: Seepage Analysis for Containment Wall Design

The purpose of this PDI is to evaluate the seepage potential within the overburden and bedrock aquifers. The analysis and results from this PDI will inform the design of the hydraulic and physical properties of the proposed containment wall. The containment wall will be keyed into glacial till or bedrock, and the data collected in this PDI will be used to design the depth, thickness, and hydraulic conductivity of the wall.

This PDI will use hydrogeologic information collected from PDI HB-1 to develop a seepage model using SEEP/w software.

4.2.4 1,4-dioxane and VOCs in Bedrock Groundwater

Appendix D describes a PDI that has been designed to (1) refine the delineation of 1,4-dioxane concentrations in shallow bedrock and (2) assess the effect pumping groundwater from shallow bedrock wells will have on the 1,4-dioxane concentrations in bedrock. The general scope of work for this PDI is described below:

- Delineation
    - Five bedrock monitoring wells will be installed to refine delineation of the 1,4-dioxane plume in bedrock above the remedial goal of 0.46 µg/L.
    - Following well installation and development, these wells will be sampled and 1,4-dioxane concentration results will be combined with data from the

November 2019 baseline sampling event to enhance delineation of the 1,4-dioxane bedrock plume.

- Groundwater Extraction
  - Three new open bedrock wells will be installed in the 1,4-dioxane plume and pumped to assess the effectiveness of groundwater extraction as a 1,4-dioxane remedy. The general scope for the groundwater extraction testing is the same as that described above for PDI-ISS-2 (groundwater extraction testing for uranium in bedrock).
  - Another bedrock extraction well, installed under PDI-ISS-2 and located where the uranium and 1,4-dioxane plumes in bedrock overlap, will also be used to assess a pumping remedy for 1,4-dioxane in bedrock.
  - The testing program for pumping and rebound analysis of 1,4-dioxane in bedrock.

The PDI WP for 1,4-dioxane and VOCs in groundwater is attached as Appendix D.

4.3 Treatability Studies

Section 3.4(a) of the SOW requires performance of TS to support the ISS component of the remedy. Separate studies will be needed to evaluate and select treatment materials/reagents, respectively, for high concentration DU within the HB, low concentration DU outside the HB, and isotopically natural U in bedrock. In addition to reagent selection, each of these media will require evaluation of the best means to apply the selected reagent.

The purpose of this treatability study (TS) is to select the amendment(s) type and dose for ISS in overburden beneath and downgradient of the Holding Basin, and bedrock. Testing includes several phases:

- Soil and groundwater media collection;
- TS-ISS-1: Testing of ISS amendments for depleted uranium in overburden soils beneath the Holding Basin;
- TS-ISS-2: Testing of ISS amendments for overburden groundwater downgradient of the Holding Basin, and
- TS-ISS-3: Testing of ISS amendments in bedrock groundwater (optional).

The sections below provide a brief review of these phases of treatability testing. The detailed TS Work Plan is attached as Appendix E.

- Sample Collection
  - Samples of soil with elevated uranium concentrations will be collected from beneath the Holding Basin using a sonic (or comparable) drilling rig;
  - Soil samples from these borings, along with groundwater collected from select monitoring wells (i.e., one with higher uranium concentrations and one with lower uranium concentration), will be sent to the treatability laboratory.

- Samples of soil and bedrock collected during well installation for PDI-ISS-2 (bedrock) and PDI-ISS-3 (overburden) will also be sent to the treatability laboratory.

- TS-ISS-1: Testing of ISS amendments for depleted uranium in overburden soils beneath the Holding Basin
  - Three column studies will be performed using soils collected from beneath the Holding Basin and Site groundwater.
  - Columns include:
    - Control (i.e., soil without an ISS amendment)
    - Soil and groundwater with ISS amendment Apatite II®
    - Soil and groundwater with ISS amendment zero valent iron
  - Groundwater will be passed through the columns and the uranium concentration in effluent from the columns will be monitored over time.
  - At the end of the test, the oxidation-reduction (redox) state of the groundwater pumped through the columns will be changed to determine if uranium remains sequestered under changing redox.
- TS-ISS-2: Testing of ISS amendments for overburden groundwater downgradient of the Holding Basin
  - Batch testing will be performed using soil from downgradient of the Holding Basin and Site groundwater with lower uranium concentration.
    - Batch tests will include bottles representing:
      - Control (soil plus groundwater)
      - Soil and groundwater plus ISS amendment Apatite II®
      - Soil and groundwater plus ISS amendment zero valent iron
      - Soil and groundwater plus ISS amendment soluble phosphate
    - Batch tests at three doses will be prepared for each ISS amendment.
    - Batch tests will also be prepared for three different reaction durations for each ISS amendment and dose[2].
  - The most effective dose for each amendment will be carried forward to column testing.
    - Column testing will include a control and all three amendments (at one dose for each amendment).
    - Columns will run for approximately seven weeks and be sampled weekly.
    - Alkalinity of influent will be adjusted during the last week of column testing to determine stability of sequestered uranium under changing geochemistry.
    - Columns will be dismantled at the conclusion of column testing and samples of soil from columns will undergo solid phase testing to evaluate

[2] Batch test bottles will be sacrificed when collecting samples for analysis, so individual bottles are need for each amendment, dose and duration.

sequestration mechanism and possible formation of uranyl phosphate precipitates.

- TS-ISS-3: Testing of ISS amendments in bedrock groundwater (contingent on PDI-ISS-2)
  - Bedrock from installation of wells described in PDI-ISS-2 will be collected and held by the treatability laboratory for potential testing.
  - If PDI-ISS-2 shows that groundwater extraction is ineffective as a remedy for uranium in bedrock but that amendments could be effectively delivered into bedrock through wells, then TS-ISS-3 may be performed. TS-ISS-3 is a series of batch tests using rock and groundwater collected from within the uranium plume in bedrock. The testing would be used to select an amendment and dose appropriate for pilot testing ISS in bedrock.

5 Summary of Remedial Design Process

Entry of the CD triggered the RD process. Specific paragraphs of the CD mandated certain activities, including:

- CD ¶ 9.a and b - Identification and approval of SDs Project Coordinator and Supervising Contractor. This activity was completed in CD para. 9.c(4), which identified Bruce Thompson of de maximis as the Project Coordinator and de maximis as the Supervising Contractor.

- CD ¶ 10.b - Continuation of obligations enumerated in ¶124 of the Building NTCRA AOC under the CD (consisting of Post-Removal Site Control and records retention).

- CD ¶10.c – Submission of a detailed summary of on-going tasks under the Groundwater NTCRA AOC within five days after the effective date of the CD, which was December 6, 2019. This summary was provided on December 11, 2019. The Construction Completion Report, which also serves as the Final Report for the Groundwater NTCRA was submitted on May 29, 2020. On June 15, 2020, EPA issued a Certification of Completion of Work pursuant to ¶125 of the Groundwater NTCRA AOC, noting that all continuing obligations of that RA project will subsequently be performed pursuant to the RD/RA CD.

- CD ¶ 37 – Submission of the fully executed RD/RA Trust Agreement for EPA approval within 30 days after the effective date of the CD. Within 30 days after EPA approval of the RD/RA Trust Agreement, SD’s made initial payments into the RD/RA Trust Fund.

- CD ¶ 32.b – As soon as reasonably practicable after EPA’s approval of the RD/RA Trust Agreement, SFAs made initial payments into the RD/RA Trust Fund.

- CD ¶ 33.a – After EPA’s approval of the RD/RA Trust Agreement, funds remaining in the Building NTCRA Trust Fund will be transferred into the RD/RA Trust Fund.

- CD¶ 33.b – Upon EPA's issuance of a Notice of Completion of Work for the Groundwater NTCRA and after EPA's approval of the RD/RA Trust Agreement, funds remaining in the Groundwater NTCRA Trust Fund will be transferred into the RD/RA Trust Fund.

5.1 Design Initiation Phase

The design initiation phase includes the development and submittal of the RDWP, which includes the PDI WPs and TS WP, and Supporting Deliverables (HASP, ERP, FSP, QAPP and SWMP). The elements of this RDWP are described throughout this document, and generally include a summary of pertinent Site information, a summary of the RD process, identification of RD-related deliverables, and identification of various pre-design activities proposed to support development of later stages of the RD. As required by the CD, this work plan is intended to gather data that will yield a design which will achieve the Performance Standards and other requirements included in the ROD, CD and SOW.

The deadline to submit this RDWP was 60 days after the later of (a) EPA's Authorization to Proceed regarding Supervising Contractor under CD ¶ 9.c. or (b) the first payment to the RD/RA Trust made under CD ¶¶ 32.b., 33.a., or 37.

Consistent with CD ¶ 10.b, the Building NTCRA Post-Removal Site Control Plan has been updated for the RD/RA as the Post-Removal Site Control Plan" (PRSCP). It is provided as Appendix F to this RDWP.

The content for the Supporting Deliverables is set forth in SOW ¶ 6.7. These are summarized in the following table.

RDWP Appendix	Scope/Content
F – Post Removal Site Control Plan" (PRSCP)	The PRSCP provides for continued Site control and maintenance until the completion of the RA consistent with CD ¶ 10.b. The PRSCP incorporates the work initiated under the Building NTCRA Post-Removal Site Control Plan.
G –Health and Safety Plan (HASP)	The HASP establishes the minimum procedures, personnel responsibilities and training necessary to protect the health and safety of all on-site personnel during the RD activities, including routine but potentially hazardous field activities and unexpected site emergencies.

RDWP Appendix	Scope/Content
H – Emergency Response Plan (ERP)	The ERP describes the procedures for responding to and mitigating fire and other emergency situations that may occur during the RD/RA. The objective of the ERP is to minimize hazards to human health and the environment from fires, releases of hazardous constituents or other emergency conditions. The ERP describes the actions personnel must take to respond to emergencies or unplanned releases at the Site during the RD/RA, arrangements with local, state and federal emergency responders to coordinate emergency services, identification of the roles and responsibilities of the emergency coordinator and alternates, supply and maintenance of on-site emergency equipment, and stop work and emergency evacuation planning. The ERP includes a hazard communications plan and names and contact information for planned notifications in the event of an emergency.
I - Sampling and Analysis Plan: Field Sampling Plan (FSP)	The FSP establishes sample collection and field monitoring methods and procedures to ensure that sample collection and investigatory activities are conducted in a consistent manner and in accordance with technically acceptable protocols. The objective of the FSP is to facilitate the collection of environmental monitoring data that meets Data Quality Objectives (DQOs) established in the QAPP.
J - Sampling and Analysis Plan: Quality Assurance Project Plan (QAPP)	The QAPP supplements the RDWP and presents the sampling and analytical methods and procedures that will be used during RD investigations at the Site. The QAPP integrates the technical and quality aspects of the project into an approach for obtaining the type and quality of environmental data and information needed for a specific decision or use.

RDWP Appendix	Scope/Content
K – Site Wide Monitoring Plan (SWMP)	The SWMP provides guidance on procedures to be taken when performing baseline data measuring to identify the extent of contamination. The SWMP lays the foundation for identifying necessary remedial efforts in different Areas of Interests across the Site. As required in Section 6.7 (c) of the SOW, the SWMP includes descriptions of: • monitoring locations, frequency, analytical parameters and methods to be employed relevant to specified constituents and media, • how performance data will be analyzed, interpreted and reported, • verification sampling procedures, • deliverables to be generated for reporting purposes (i.e. sampling schedules, monthly and annual reports, etc.), and • monitoring contingencies to be considered if monitoring indicates changes in conditions or identifies any sources of data gaps.
L – Community Relation Support Plan (CRSP)	The CRSP describes a range of community involvement activities by the SDs, including: • preparing information regarding the Work for dissemination to the public, including mass media and/or Internet notification, and • participating in public meetings that may be held or sponsored by EPA to explain activities at or relating to the Site.

Section 3 of the SOW describes the requirements for the RD phase of the work. Each RA project will undergo an independent design process that will start upon EPA approval of the PDI Report. The HB containment RA project and the HB component of the ISS RA project have a dependency, and those designs and RA implementation schedules will consider and integrate that dependency so that both projects are successfully completed. The requirements for each design submittal are summarized in the following Sections 5.2 – 5.6.

5.2 Preliminary (30%) RD.

The Preliminary RD for each RA project will include:

(a) A design criteria report, as described in the *Remedial Design/Remedial Action Handbook*, EPA 540/R-95/059 (June 1995);

(b) Preliminary drawings and specifications;

(c) Descriptions of permit requirements, if applicable;

(d) Preliminary Operation and Maintenance (O&M) Plan and O&M Manual;

(e) A description of how the RA will be implemented in a manner that minimizes environmental impacts in accordance with EPA's *Principles for Greener Cleanups* (Aug. 2009);

(f) A description of monitoring and control measures to protect human health and the environment, such as air monitoring and dust suppression, during the RA;

(g) Any proposed revisions to the RA Schedule that is set forth in ¶ 7.3 (RA Schedule); and

(h) Updates of all supporting deliverables required accompanying the RDWP and, as appropriate, the following additional supporting deliverables described in ¶ 6.7 (Supporting Deliverables): Site Wide Monitoring Plan; Construction Quality Assurance/Quality Control Plan; Transportation and Off-Site Disposal Plan; O&M Plan; and O&M Manual.

The Institutional Controls Implementation and Assurance Plan (ICIAP) deliverable shall be submitted with the 30% RD for the RA project consisting of containment of Holding Basin stabilized soils.

5.3 Intermediate (60%) RD.

If required, an Intermediate (60%) RD will be prepared for EPA's comment. The Intermediate RD must: (a) be a continuation and expansion of the Preliminary RD; (b) address EPA's comments regarding the Preliminary RD; and (c) include the same elements as are required for the Preliminary (30%) RD. Following EPA's review of the 30% RD, SDs may propose to EPA to bypass the 60% RD and move directly to the 95% RD.

5.4 Pre-final (95%) RD

The Pre-final (95%) RD for each of the RA projects will be a continuation and expansion of the previous design submittal and must address EPA's comments regarding the Intermediate RD (or the Preliminary RD in the event EPA approves bypassing the Intermediary RD). The Pre-final RD will serve as the approved Final (100%) RD if EPA approves the Pre-final RD without comments. The Pre-final RD will include:

(a) A complete set of construction drawings and specifications that are: (1) certified by a registered professional engineer; (2) suitable for procurement; and (3) follow the Construction Specifications Institute's MasterFormat 2012. If proceeding as a design/build, sufficiently detailed drawings and performance specifications to demonstrate to EPA the adequacy of the design.

(b) A survey and engineering drawings showing existing Site features, such as elements, property borders, easements, and Site conditions;

(c) Pre-final versions of the same elements and deliverables as are required for the Preliminary/Intermediate RD;

(d) A specification for photographic documentation of the RA; and

(e) Updates, as necessary, of all supporting deliverables required to accompany the Preliminary (30%) RD.

The 95% Institutional Controls Implementation and Assurance Plan (ICIAP) deliverable shall be submitted with the 95% RD for the RA project consisting of containment of Holding Basin stabilized soils.

5.5 Final (100%) RD

The Final (100%) RD for each of the RA projects will address EPA's comments on the Pre-final RD and must include final versions of all Pre-final RD deliverables. The 100% ICIAP deliverable will be submitted with the 100% RD for the RA project consisting of containment of Holding Basin stabilized soils.

5.6 Supporting Deliverables for RD

Additional Supporting Deliverables will be provided with the RD submissions. These will include updates to the HASP, ERP, FSP and QAPP, as appropriate and necessary to conduct the RA. Other Supporting Deliverables are summarized in the following table.

RD Supporting Deliverable	Scope/Content
Construction Quality Assurance/ Quality Control Plan (CQA/QCP).	The Construction Quality Assurance Plan (CQAP) will describe planned and systemic activities that will provide confidence that the RA construction will satisfy all plans, specifications, and related requirements, including quality objectives. The purpose of the Construction Quality Control Plan (CQCP) is to describe the activities to verify that RA construction has satisfied all plans, specifications, and related requirements, including quality objectives. The CQA/QCP must: • Identify, and describe the responsibilities of, the organizations and personnel implementing the CQA/QCP; • Describe the Performance Standards (PS) required to be met to achieve Completion of the RA; • Describe the activities to be performed: (i) to provide confidence that PS will be met; and (ii) to determine whether PS have been met; • Describe verification activities, such as inspections, sampling, testing, monitoring, and production controls, under the CQA/QCP; • Describe industry standards and technical specifications used in implementing the CQA/QCP; • Describe procedures for tracking construction deficiencies from identification through corrective action; • Describe procedures for documenting all CQA/QCP activities; and • Describe procedures for retention of documents and for final storage of documents.
Transportation and Off-Site Disposal Plan (TODP)	The Transportation and Off-Site Disposal Plan (TODP) will describe plans to ensure compliance with ¶ 4.4 (Off-Site Shipments). The TODP must include: 1. Proposed routes for off-site shipment of Waste Material; 2. Identification of communities affected by shipment of Waste Material; and 3. Description of plans to minimize impacts on affected communities.

RD Supporting Deliverable	Scope/Content
Operation and Maintenance (O&M) Plan	The O&M Plan will describe the requirements for inspecting, operating, and maintaining the RA, including all components designed or constructed during the GW NTCRA. SDs shall develop the O&M Plan in accordance with *Operation and Maintenance in the Superfund Program*, OSWER 9200.1 37FS, EPA/540/F-01/004 (May 2001). The O&M Plan must include the following additional requirements: 1. Description of PS required to be met to implement the ROD; 2. Description of activities to be performed: (i) to provide confidence that PS will be met; and (ii) to determine whether PS have been met; 3. O&M Reporting. Description of records and reports that will be generated during O&M, such as daily operating logs, laboratory records, records of operating costs, reports regarding emergencies, personnel and maintenance records, monitoring reports, and monthly, quarterly, and annual reports to EPA and State agencies; 4. Description of corrective action in case of systems failure, including: (i) alternative procedures to prevent the release or threatened release of Waste Material which may endanger public health and the environment or may cause a failure to achieve PS; (ii) analysis of vulnerability and additional resource requirements should a failure occur; (iii) notification and reporting requirements should O&M systems fail or be in danger of imminent failure; and (iv) community notification requirements; and 5. Description of corrective action to be implemented in the event that PS are not achieved; and a schedule for implementing these corrective actions.
O&M Manual	The O&M Manual serves as a guide to the purpose and function of the equipment and systems that make up the remedy. SDs shall develop the O&M Manual in accordance with *Operation and Maintenance in the Superfund Program*, OSWER 9200.1 37FS, EPA/540/F-01/004 (May 2001). The O&M Manual will be combined with the O&M Plan.

RD Supporting Deliverable	Scope/Content
Institutional Controls Implementation and Assurance Plan (ICIAP)	The Institutional Controls Implementation and Assurance Plan (ICIAP) will describe plans to implement the Institutional Controls (ICs) including Notices of Activity and Use Limitation (NAULs) at the Site. The ICIAP will be developed in accordance with *Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites*, OSWER 9355.0-89, EPA/540/R-09/001 (Dec. 2012), *Institutional Controls: A Guide to Preparing Institutional Controls Implementation and Assurance Plans at Contaminated Sites*, OSWER 9200.0-77, EPA/540/R-09/02 (Dec. 2012), and provisions of the Massachusetts Contingency Plan, 310 CMR 40.0000, including without limitation, 310 CMR 40.1070 and 40.1074. The initial draft of the ICIAP will be submitted with the Preliminary (30%) RD for the Holding Basin RA project must include the following: (1) Locations of recorded real property interests (e.g., easements, liens) and resource interests in the Affected Property that may affect ICs (e.g., surface, mineral, and water rights) including accurate mapping and geographic information system (GIS) coordinates of such interests; and (2) Legal descriptions and survey maps that are prepared according to current American Land Title Association (ALTA) Survey guidelines and certified by a licensed surveyor.

RD Supporting Deliverable	Scope/Content
Institutional Controls Implementation and Assurance Plan (ICIAP, cont.)	The revised ICIAP will be submitted with the Intermediate (60%) RD or Pre-Final (95%) RD in the event EPA approves a request to bypass the Intermediate (60%) RD, for the Holding Basin RA project shall include the following: (1) Record Title Evidence. A title report and certification by an insured title examiner or other title evidence acceptable to EPA that: (i) covers the Affected Property that is to be noticed; (ii) demonstrates that the person or entity that will execute the NAUL is the owner of such Affected Property; (iii) identifies all record matters that affect title to the Affected Property, including all prior liens, claims, rights (such as leases, easements, mortgages, and other encumbrances (collectively, "Prior Encumbrances")); and (iv) includes a summary of and complete, legible copies of such Prior Encumbrances; and (2) Non-Record Title Evidence. A report of the results of an investigation, including a physical inspection of the Affected Property, which identifies non-record matters that could affect the title, such as unrecorded leases or encroachments. The revised ICIAP will be submitted with the Final (100%) RD for the Holding Basin RA project shall include the following: (1) Draft NAULs. All draft NAULs (including copies of all referenced survey plans), draft IC Design Statements, draft notice letters to current holders of any record interest in accordance with 310 CMR 40.1074(1) (d), documentation verifying that the signatory to the NAUL has the authority to sign such document (if the signatory is not an individual), and any other documentation or evidence required by the applicable provisions of 310 CMR 40.1070 and 40.1074; and (2) Schedule for recording final NAULs. Such schedule will acknowledge that the NAUL for the 2229 Main Street property will not be finalized until the "as built" records are completed for the project consisting of the containment of Holding Basin stabilized soils.

6 Schedule

The RD schedule is provided in ¶7.2 of the SOW, which is replicated below. A critical-path method schedule that combines the process for all remedial components is provided in Attachment 4.

	Description of Deliverable, Task	¶ Ref.	Deadline
1	RDWP (one RDWP for entire remedy)	3.1	60 days after the later of (a) EPA's Authorization to Proceed regarding Supervising Contractor under CD ¶ 9.c. or (b) the first payment to the RD/RA Trust made under ¶¶ 32.b., 33.a., or 37.
2	PDIWP	3.3(a)	Part of the RDWP, so same deadline as RDWP.
3	TSWP	3.4(b)	Part of the RDWP, so same deadline as RDWP.
4	Preliminary (30%) RD	3.5, 3.3(b), 3.4(c)	90 days after EPA approves both the PDI Evaluation Report and, if needed, the TS Evaluation Report
5	Intermediate (60%) RD	3.6	60 days after EPA comments on Preliminary (30%) RD
6	Pre-final (90/95%) RD	3.7	60 days after EPA comments on Intermediate (60%) RD (or Preliminary (30%) RD in the event EPA approves a request to bypass the Intermediate (60%) RD)
7	Final (100%) RD	3.8	14 days after EPA comments on Pre-final (95%) RD

7 References

de maximis et. al., 2014 Remedial Investigation/Feasibility Study Report, Nuclear Metals, Inc. Superfund Site, Concord, MA, October 2014

de maximis, 2017 Building NTCRA - Final Report, Nuclear Metals, Inc. Superfund Site, Concord, MA, May 2017

de maximis, 2018, Groundwater NTCRA – 100% Building Design Report, Nuclear Metals, Inc. Superfund Site, Concord, MA, August 2018

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Geosyntec, 2015, Groundwater Investigation Work Plan, Nuclear Metals Superfund Site.

Geosyntec, 2016a, Extraction Well Installation and Pump Test Work Plan, Nuclear Metals Superfund Site, 21 June 2016.

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Geosyntec and O&M, Inc., 2017, Treatability Study Work Plan, Nuclear Metals Superfund Site, 2 February 2017.

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MACTEC, Engineering and Consulting, Inc. 2004, RI Field Sampling Plan, September 29, 2004

Nuclear Metals, Inc. (NMI), 1993, Site Characterization Report for the Holding Basin, Submitted to Region 1, Nuclear Regulatory Commission' February 12, 1993

U.S. District Court for the District of Massachusetts Eastern Division, Remedial Design / Remedial Action Consent Decree, Civil Action No. 19-12097-RGS, effective December 6, 2020

U.S. Environmental Protection Agency, 2011. *Administrative Settlement Agreement and Order on Consent for Non-Time-Critical Removal Action, Nuclear Metals, Inc. Superfund Site, Concord, Massachusetts, Docket No. CERCLA-01-2011-004 (includes Statement of Work as Appendix C).* August 9, 2011.

U.S. Environmental Protection Agency, 2014, Proposed Plan, Nuclear Metals, Inc. Superfund Site, Concord, MA, October 2014.

U.S. Environmental Protection Agency, 2015, Record of Decision (ROD), Nuclear Metals, Inc. Superfund Site, Concord, MA, September 2015.

U.S. Environmental Protection Agency, 2016, *Administrative Settlement Agreement and Order on Consent for Non-Time-Critical Removal Action for Groundwater, Nuclear Metals, Inc. Superfund Site, Concord, Massachusetts, Docket No. CERCLA-01-2015-008 (includes Statement of Work as Appendix C).* July 7, 2016

Figures

Figure 1

Site Location Map

Nuclear Metals, Inc. Site
Remedial Design Work Plan

Concord, Massachusetts

Description:

2229 Main Street Property

Map Legend:

Site Boundary

Spatial Projection:

Coordinate System: MA State Plane Mainland
FIPS Zone: 2001
Units: US Survey Feet
Datum: NAD83

Plot Info:

File: Fig01_SiteLoc.mxd
Project No.: 3252
Plot Date: 11/19/2019
Arc Operator: LS
Reviewed by: HG

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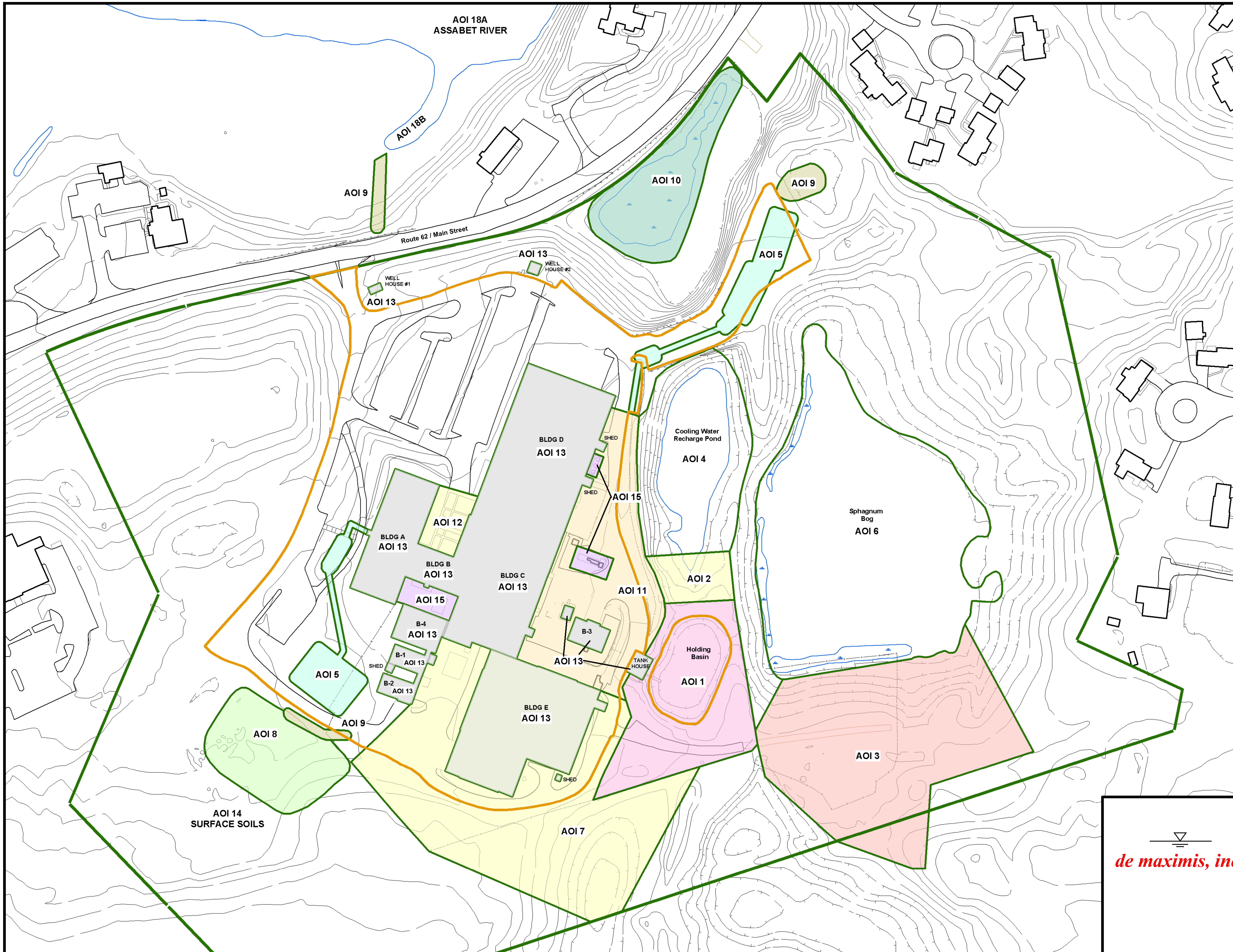


AOI #	AOI Name
1	Holding Basin
2	Drum Burial Area
3	Old Landfill
4	Cooling Water Recharge Pond
5	Septic Fields
6	Sphagnum Bog
7	Former Waste Storage Area
8	Sweepings and Fill Area
9	Pavement Drain Outfalls
10	Northeast Wetland
11	Drain Line Area
12	UST Area
13	Site Structures
14	Surface Soils
15	Transformer Pads
16	Groundwater (Site-wide)
17	Background Areas (Off-site)
18A	Assabet River Main Channel
18B	Assabet River Embayment

Legend

Pavement Outline

N

0 40 80 Feet

Prepared by BJR | Checked by AMR

Figure 2

Areas of Investigation

de maximis, inc.

Remedial Design Work Plan

Nuclear Metals, Inc.
Concord, Massachusetts

Document: P:\Nuclear Metals\GIS\Mapdocuments\nmi_22x34.mxd PDF: P:\Nuclear Metals\Nuclear Metals RI FS EECA\Ecological Risk Assessment\BERA\Figures\Figure 1-2 - Areas of Investigation.pdf 12/17/2009 2:35 PM bjroden

Figure 3

Soil and Sediment Excavation Areas

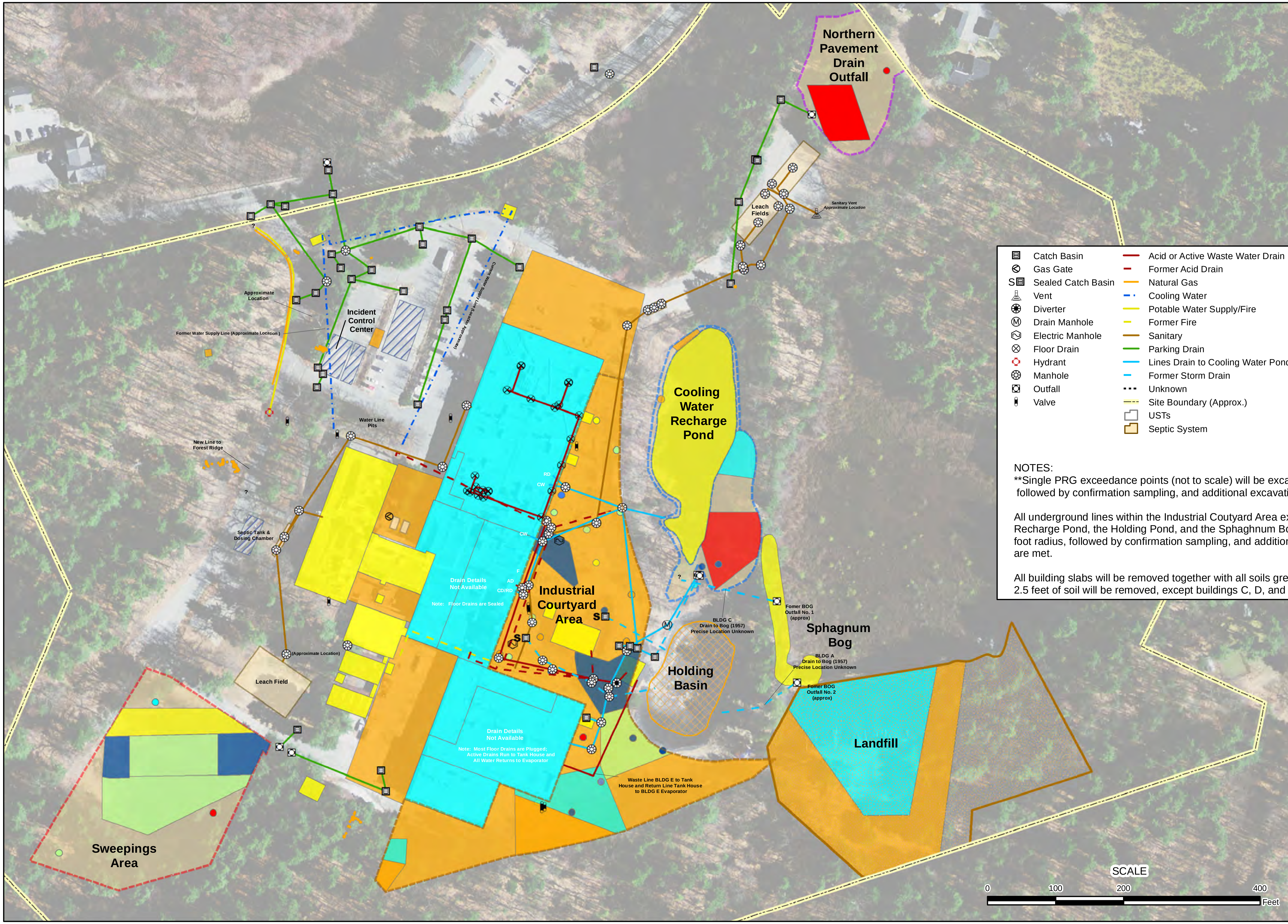
Nuclear Metals, Inc. Site
Remedial Design Work Plan

Concord, Massachusetts

Source:

RI/FS database and
Site MACTEC Utility layers
from Site Engineering Drawings

Map Legend:



Spatial Projection:

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FIPS Zone: 2001
Units: US Survey Feet
Datum: NAD83

Plot Info:

File: Fig04_Soil_Sed_Excav.mxd
Project No.: 3252
Plot Date: 11/19/2019
Arc Operator: HG
Reviewed by: HVR/BT

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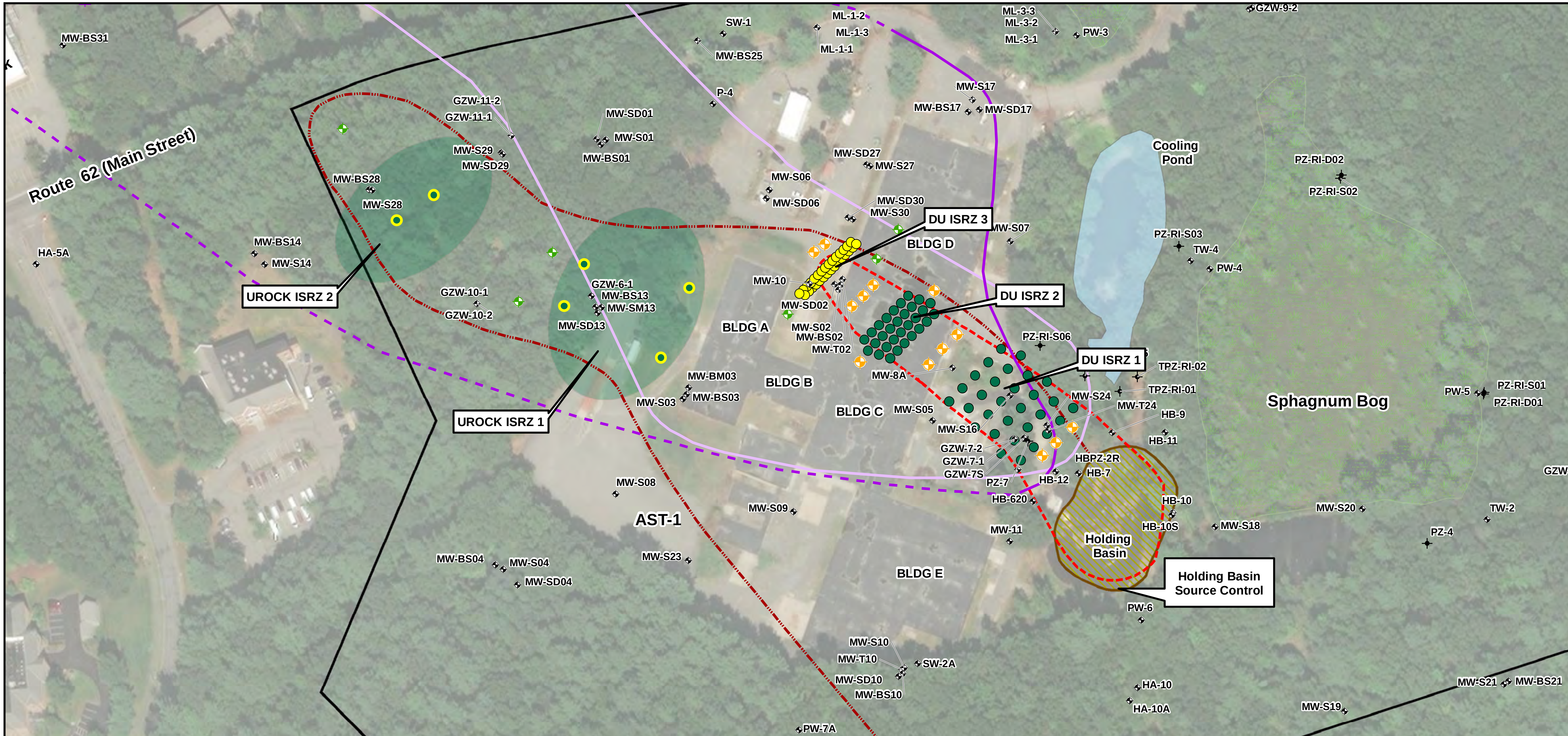

Legend

- Proposed Extraction Well in Bedrock
- Proposed Extraction Well in Overburden
- Monitoring Well
- Piezometer
- Wetlands
- Surface Water
- Site Boundary
- Proposed ISRZ Reactive Zone Monitoring Well
- Proposed Media Injection Point (Apatite)
- Proposed Media Injection Point (Zero Valent Iron (ZVI))
- Proposed Media Injection Point in Bedrock (Apatite or ZVI)
- Proposed Monitoring Well
- Holding Basin Source Control Area
- ISRZ in Bedrock
- 1,4-Dioxane above the Site PRG (0.67 µg/L) in Overburden
- Estimated 1,4-Dioxane above the Site PRG (0.67 µg/L) in Overburden
- 1,4-Dioxane above the Site PRG (0.67 µg/L) in Bedrock
- Estimated 1,4-Dioxane above the Site PRG (0.67 µg/L) in Bedrock
- Uranium above the MCL (>30 µg/L)
- Depleted Uranium above the MCL (>30 µg/L)

Notes:
1. The illustrated capture zone for the 1,4-Dioxane overburden well assumes an extraction rate of approximately 6.0 gpm, based on a hydraulic gradient of 0.011, a hydraulic conductivity of 4.3 ft/day, a plume width of 200 ft and a plume thickness of 50 ft.
2. The illustrated capture zone for the two 1,4-Dioxane bedrock wells assumes an extraction rate of approximately <0.5 gpm, based on a hydraulic gradient of 0.004, hydraulic conductivity of 0.22 ft/day, a plume width of 430 ft and a plume thickness of 25 ft.
3. The locations of conveyance lines, treatment building, and discharge line would be selected during remedial design.
4. The upgradient portions of the 1,4-Dioxane plumes have been cut off for figure clarity.
5. ISRZ = In-situ Reactive Zone, DU = depleted uranium, UROCK = Isotopically natural Uranium in Bedrock.

InSitu Sequestration Area

Nuclear Metals, Inc. Site - Remedial Design Work Plan
Concord, Massachusetts

Feet: 130 65 0 130

Geosyntec consultants | de maximis, inc. | Figure 4

Acton, Massachusetts | June 2014

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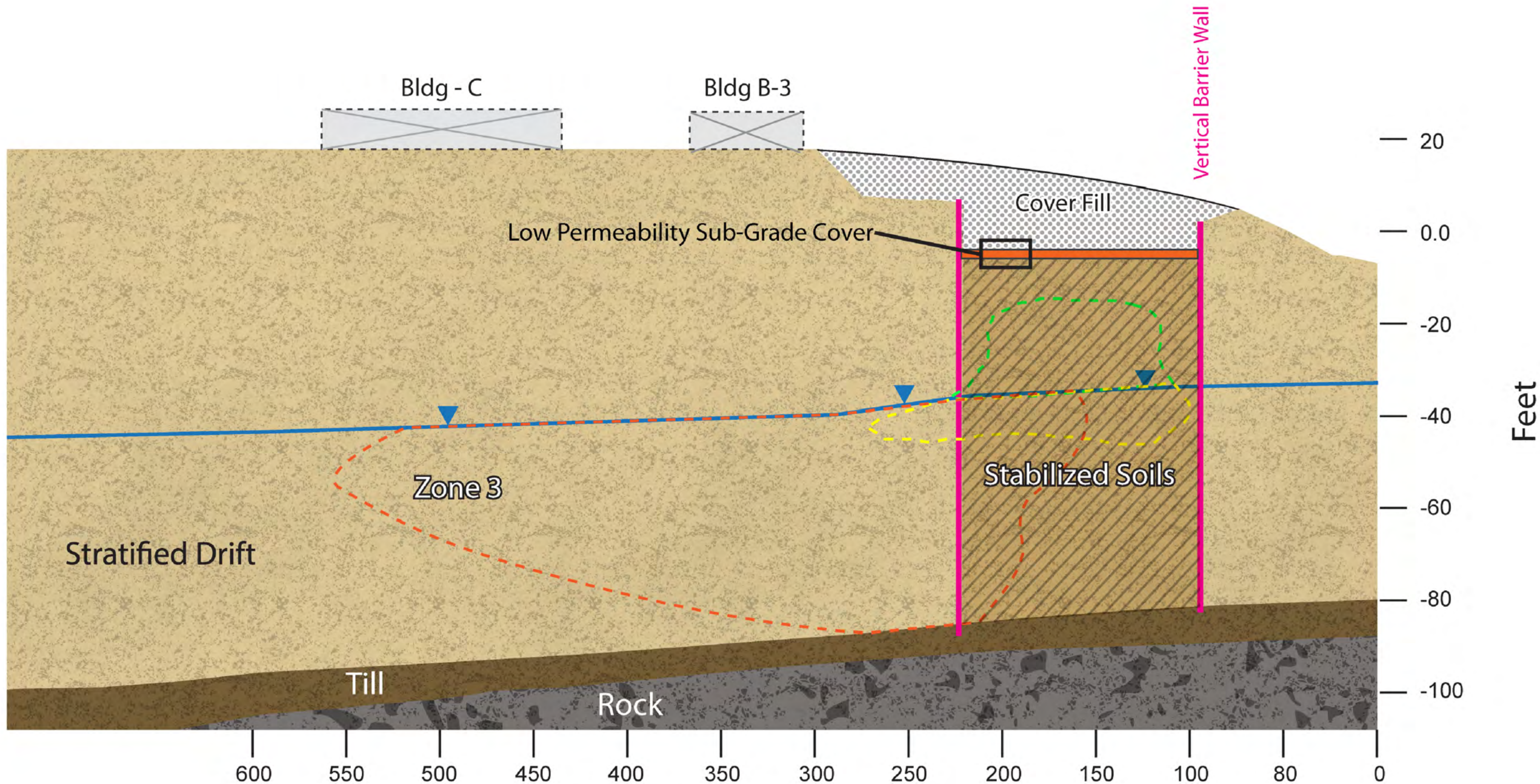
Figure 5

Holding Basin Remedy

Nuclear Metals, Inc. Site
Remedial Design Work Plan

Concord, Massachusetts



Description:

Map Legend:

Zone 1: Uranium > 30 mg/kg in Vadose Zone Soils

Zone 2: Uranium > 30 mg/kg in Saturated Zone Soils

Zone 3: Uranium > 30 ug/l in Groundwater

Building to be demolished

Groundwater

Units depicted are feet (ft)

Spatial Projection:

Plot Info:

File: Fig06_Holding_Basin.mxd
Project No.: 3252
Plot Date: 11/19/2019
Arc Operator: LS
Reviewed by: HG

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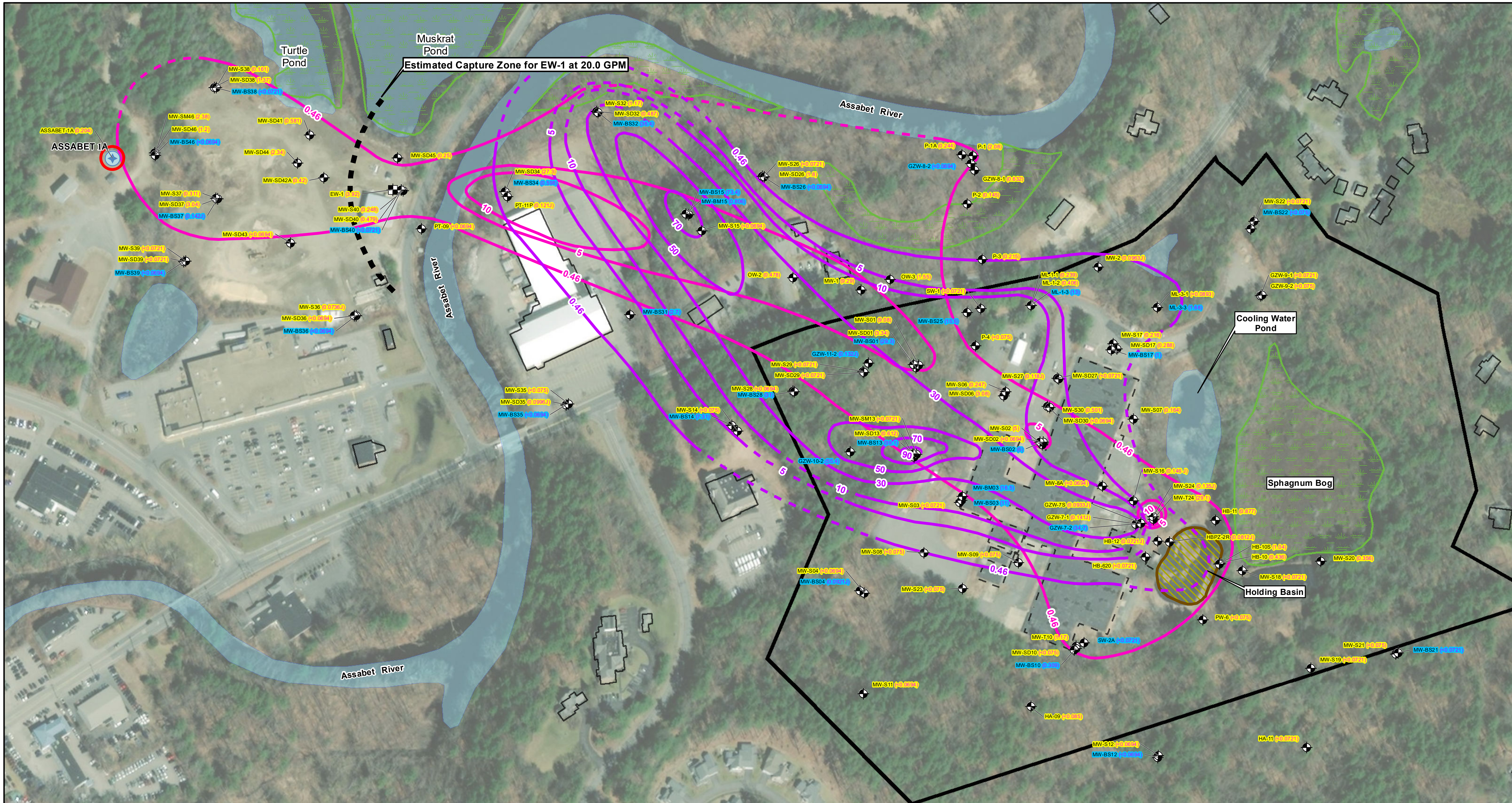


Legend

- Monitoring Well
- Extraction Well
- Active Public Water Supply Well
- Wetlands
- Surface Water
- Site Boundary
- Former Building Concrete Foundation
- Building Outline
- 1,4-Dioxane Isoconcentration Contour in Overburden (µg/L) November 2019
- Estimated 1,4-Dioxane Isoconcentration Contour in Overburden (µg/L) November 2019
- 1,4-Dioxane Isoconcentration Contour in Bedrock (µg/L) November 2019
- Estimated 1,4-Dioxane Isoconcentration Contour in Bedrock (µg/L) November 2019

DRAFT

- (99.1) 1,4-Dioxane Concentration November 2019 (µg/L)
- MW-S32 Overburden Monitoring Well
- MW-BS32 Bedrock Monitoring Well

N

0 200 Feet

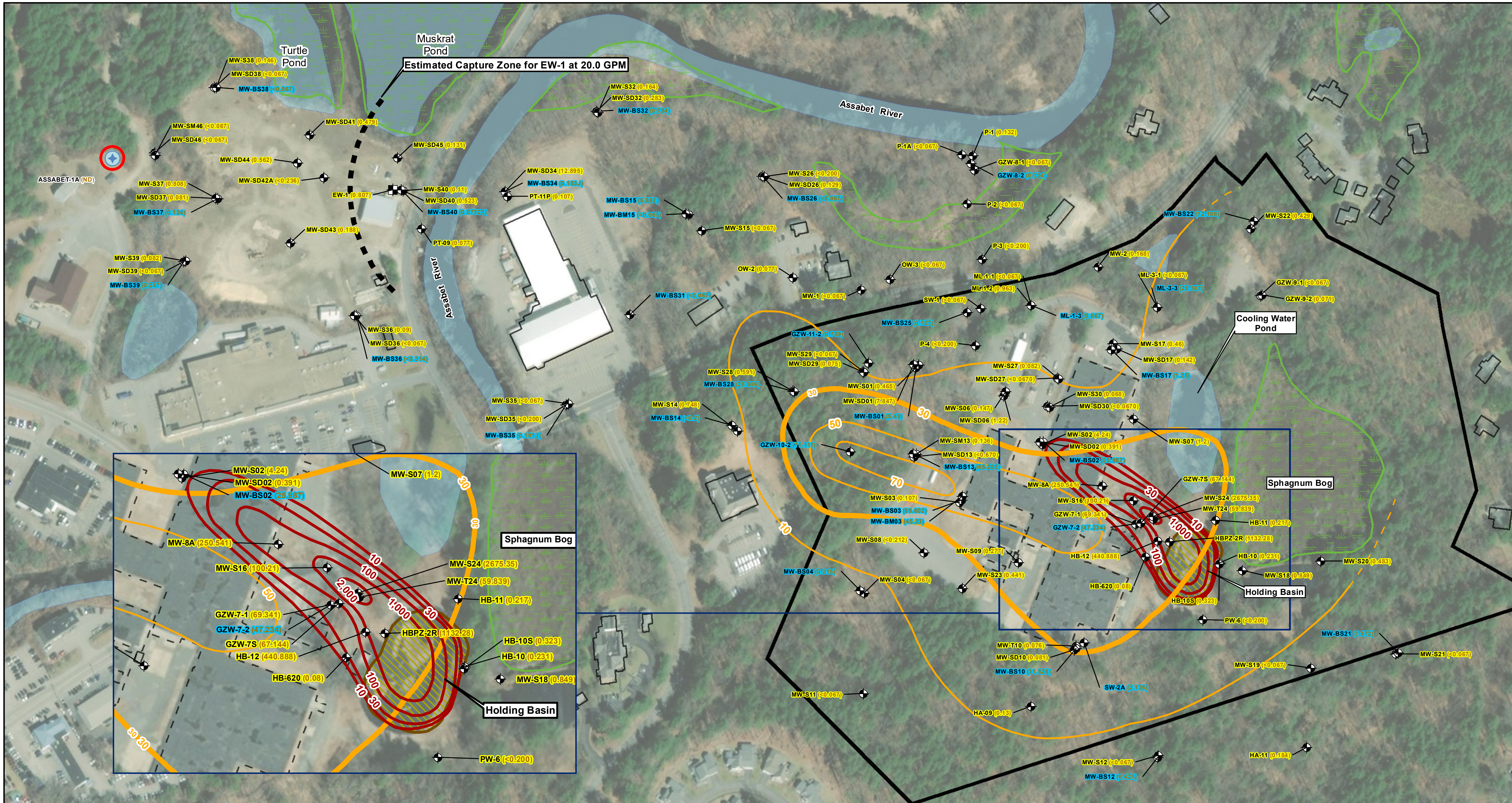
1,4-Dioxane Distribution in Overburden and Bedrock Groundwater November 2019

Nuclear Metals, Inc. Superfund Site
Concord, Massachusetts

Geosyntec consultants | de maximis, inc. | Figure 6a

Acton, Massachusetts | August 2020

Q:\GISProjects\BR0090-NMISite\Projects\Updates_2020\Figure 6a – 1,4-dioxane in OB and BDRK_v2.mxd 8/4/2020 3:08:23 PM



Legend

- Monitoring Well
- Extraction Well
- Active Public Water Supply Well
- Wetlands
- Surface Water
- Site Boundary
- Former Building Concrete Foundation
- Building Outline
- Uranium ISO Contour in Bedrock November 2019 (µg/L)
- Estimated Uranium ISO Concentration Contour in Bedrock November 2019 ug/L
- Uranium Contour in Overburden Groundwater, November 2019 (µg/L)

DRAFT

(99.1) Uranium Distribution November 2019 (µg/L)

MW-S32 Overburden Monitoring Well

MW-BS32 Bedrock Monitoring Well

N

0 200 Feet

Uranium Distribution in Overburden and Bedrock Groundwater November 2019

Nuclear Metals, Inc. Superfund Site
Concord, Massachusetts

Geosyntec consultants

de maximis, inc.

Figure 6b

Acton, Massachusetts | August 2020

Q:\GISProjects\BR0090-NMISite\Projects\Updates_2020\Figure 6b – Uranium in OB and BDRK_v2.mxd 2/26/2020 10:45:24 AM

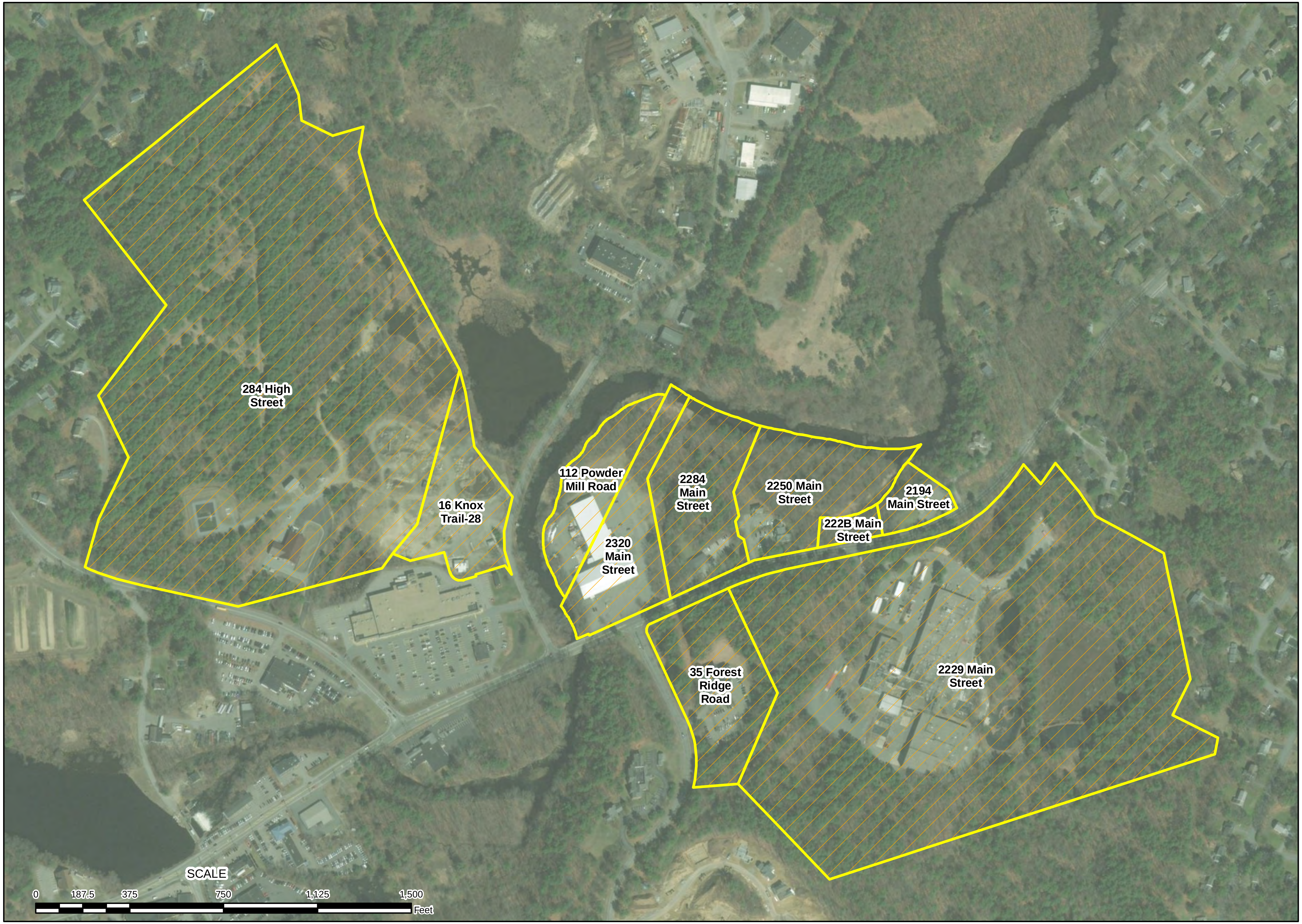


Figure 7

AFFECTED PROPERTY

Nuclear Metals Inc. (NTCRA)
Concord, Massachusetts

Description:

Affected property parcels in Concord and Acton, MA.

Map Legend:

- Affected Parcels
- Access Needed

Spatial Projection:

Coordinate System: MA State Plane Mainland
FIPS Zone: 2001
Units: US Survey Feet
Datum: NAD83

Plot Info:

File: NMI_Affected_Property.mxd
Project No.: 3243
Plot Date: 1 February, 2018
Arc Operator: AM
Reviewed by: HG

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Figure 8

Abutting Properties

Nuclear Metals, Inc. Site
Remedial Design Work Plan

Concord, Massachusetts

Description:

Abutting property parcels in Concord and Acton, MA.

Map Legend:

- Minuteman ARC (residential care facility for intellectual and physically disabled)
- Black Birch Condos (~25 Units)
- Camp Thoreau Children's Day Camp
- Thoreau Hills Subdivision
- Cranberry Lane Condos (~15 units)
- 2229 Main Street Property

Spatial Projection:

N

Coordinate System: MA State Plane Mainland
FIPS Zone: 2001
Units: US Survey Feet
Datum: NAD83

Plot Info:

File: Fig02_Abutt_Props.mxd
Project No.: 3252
Plot Date: 11/20/2019
Arc Operator: LS
Reviewed by: HG

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Attachments

RD Project Team

MassDEP
Garry Waldeck
Project Manager

EPA
Chris Smith
Remedial Project Manager
Sarah White
Community Relations

AECOM
Andy Schukta
EPA Oversight Contractor

Community Groups
Town of Concord
Reuse Cmte
2229 Main St Cmte
CREW
Green Acton

***de maximis, inc.* - General Contractor**

Bruce Thompson - Project Coordinator

Jessie McCusker - Site-Wide Soils and Sediments and Holding Basin Containment

Amy Hoffman – ISS and Sitewide Monitoring

Nathan Hunt – HCTS O&M and1,4-D in Bedrock

Geosyntec Consultants
Carl Elder, Ph.D., P.E. – Overall PM

ISS Task Manager - Dave Adilman, P.G

1,4-D in Bedrock Task Manager -
Dariusz Chelibica, P.G. -

Haley & Aldrich, Inc.
Mark Kelley, P.E. – Overall PM

Site-Wide Soils and Sediments Task Manager -
Mark Kelley, P.E.

Holding Basin Containment Task Manager - Tim Crowl, P.E.

ddms, inc.
Heidi Gaedy
Database Website, GIS, Project Portal

Polly Newbold
Data Validation

Laboratories
Alpha Analytical
GEL

DDES, Inc.
Matt Norton, CIH, CSP
Radiation Safety Officer

O&M, Inc.
Nicolas Carabillo
HCTS O&M Task Manager

Drilling
TBD

RDWP Attachment 2

Haley & Aldrich, Inc. Organization Chart

Project Coordinator
Bruce Thompson, ***de maximis***

Site-Wide Soil & Sediment and Holding Basin Containment Task Manager
Jessie McCusker, ***de maximis***

Project Director
Mark Kelley, PE

Asst. Project Manager
Peter Zawadzkas

Health & Safety
Brian Fitzpatrick

Site Wide Soil & Sediment Lead
Mark Kelley, PE

Technical Resources

Nadia Glucksberg
TSCA and Radiological Regulatory

Jay Peters
Cleanup Goal Compliance and Risk Assessment

Heath Downey, CHP
DU Penetrator and Radiological Regulatory

Bob Hartzel
Bog and Cooling Pond Restoration

PDI Implementation and RD Reporting

Kenneth Alepidis
Field Operations Lead

Elizabeth Christmas, EIT
Engineering Design and Reporting

Kimberly Scalise
Reporting

Field technicians
Soil Sampling

Radiological field technicians
DU Investigations

Holding Basin Lead
Tim Crowl, PE

Technical Resources

Mark Haley, PE
Grouting; Soil Structural Analysis

Jean Louis Locasin, PE
Seismic and Slope Stability Analysis

Damien Siebert, PE
Structural Analysis

Mark Kelley, PE
Cover Design

James Kaklamanous, PhD; Kaklamanous, Inc.
Seismic Analysis

Mark Blackey; Geophysical Applications, Inc.
Geophysics Analysis

Mario Muaro; Trevi Icos
Constructability

PDI Implementation and RD Reporting

Kenneth Alepidis
Field Operations Lead

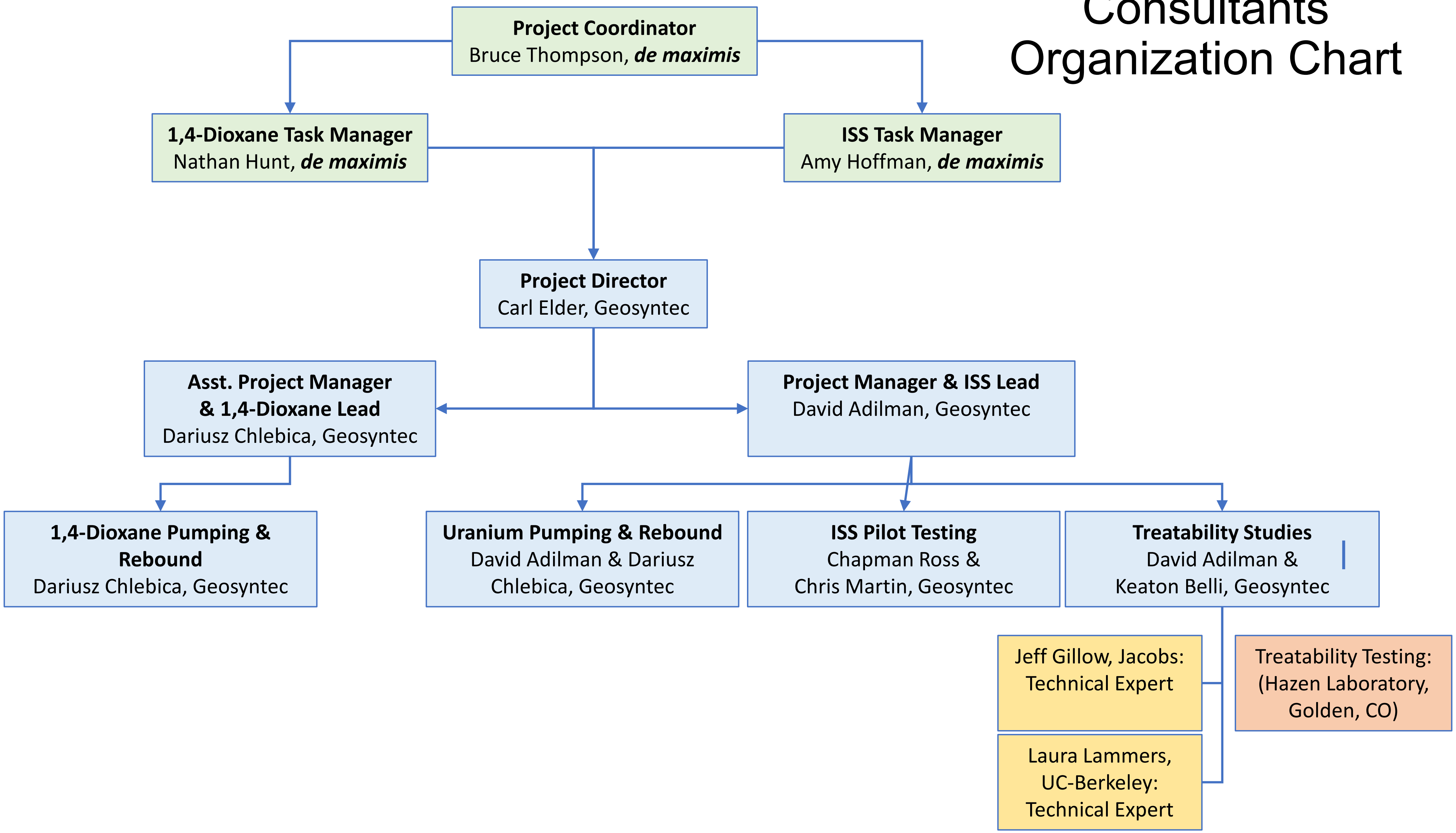
Christopher Jones
Hydrogeology

Wystan Carswell, PE, PhD
Design and Reporting

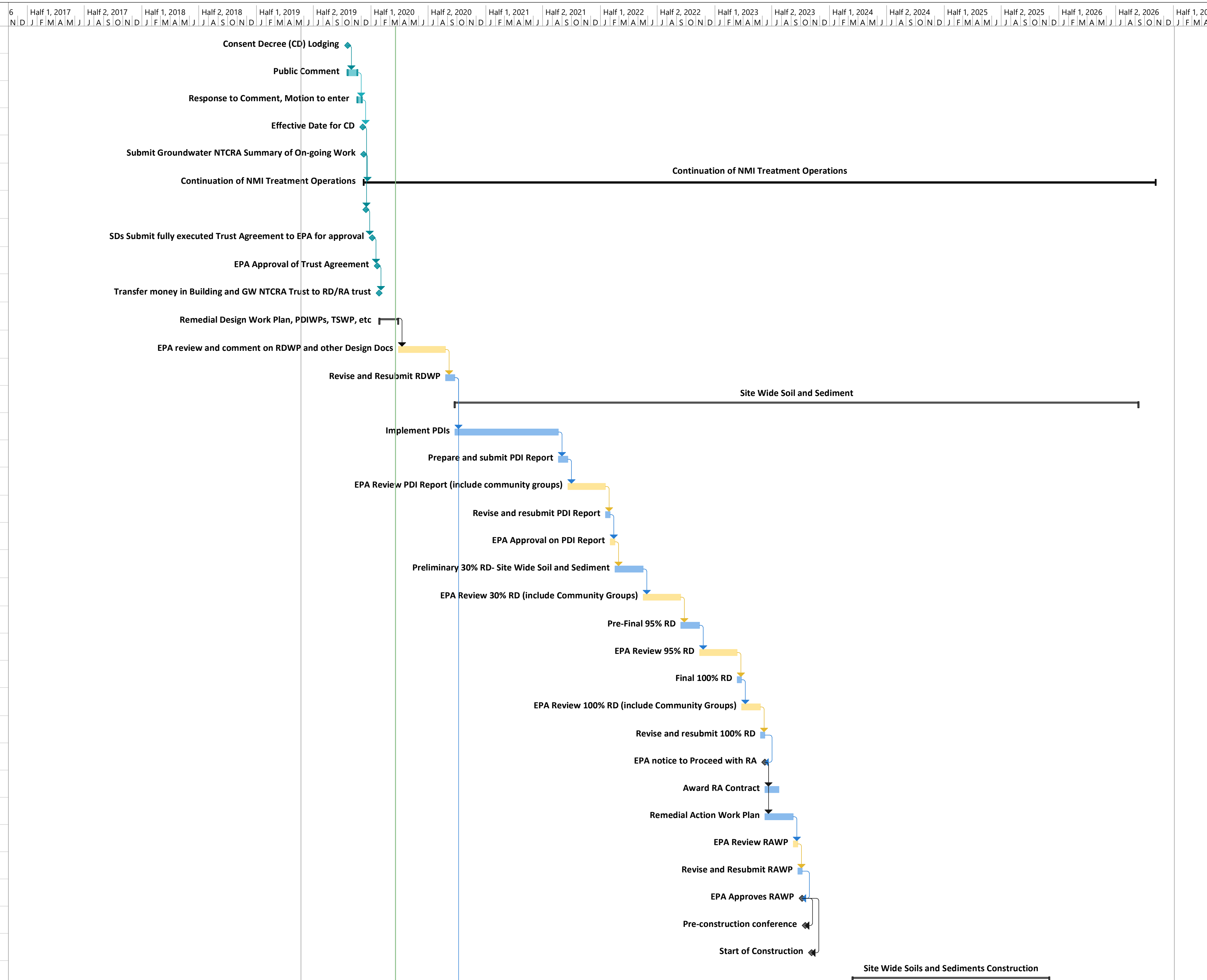
Kimberly Scalise
Reporting

RDWP Attachment 3

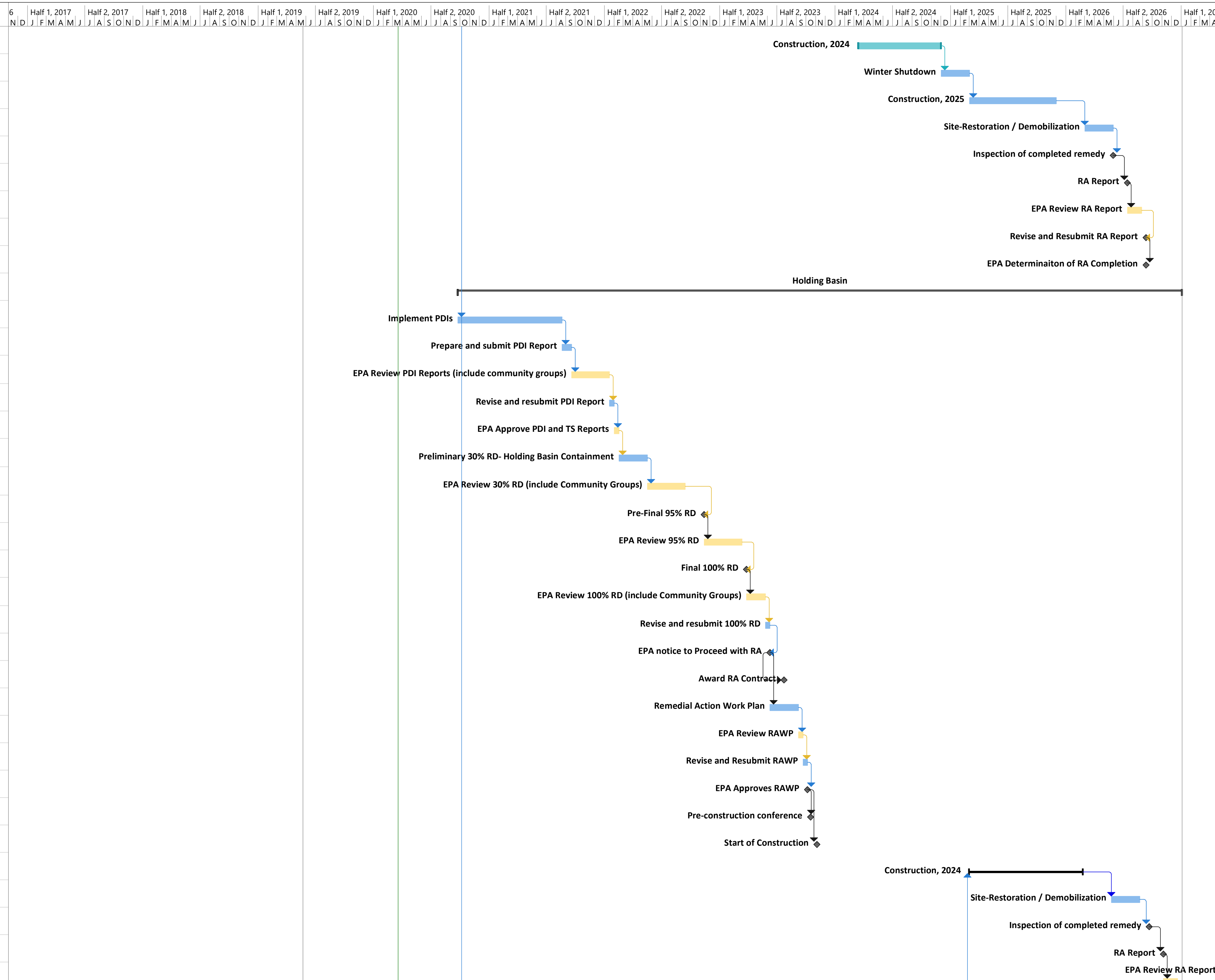
Geosyntec Consultants Organization Chart



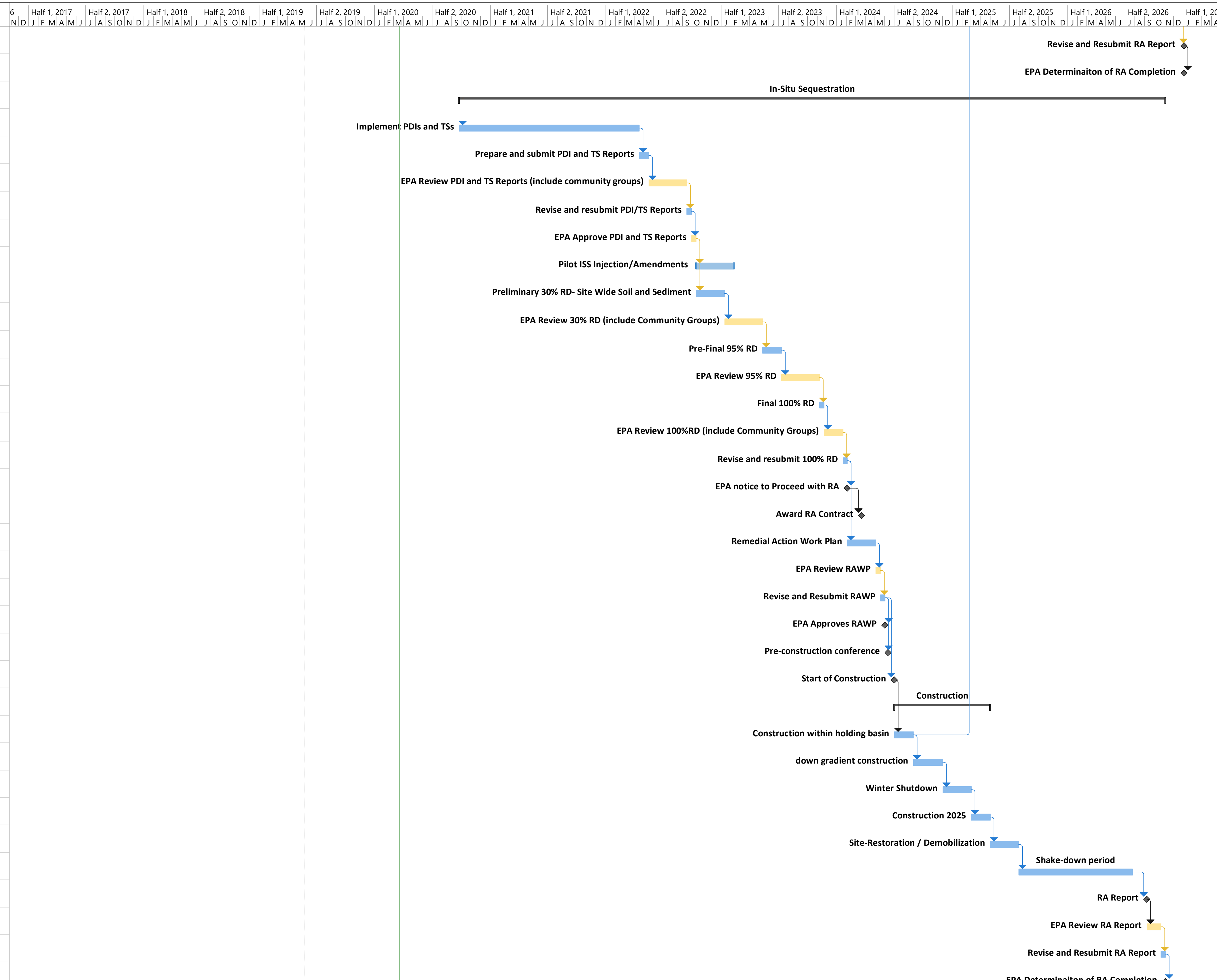
ID	Task Name	Start	Finish
1	Consent Decree (CD) Lodging	Sat 10/19/19	Sat 10/19/19
2	Public Comment	Sat 10/19/19	Mon 11/18/19
3	Response to Comment, Motion to enter	Tue 11/19/19	Mon 12/2/19
4	Effective Date for CD	Fri 12/6/19	Fri 12/6/19
5	Submit Groundwater NTCRA Summary of On-going Work	Mon 12/9/19	Mon 12/9/19
6	Continuation of NMI Treatment Operations	Mon 12/9/19	Thu 11/5/26
7	Settling Defendants (SDs) designate Project Coordinator and Supervising Contractor	Mon 12/16/19	Mon 12/16/19
8	SDs Submit fully executed Trust Agreement to EPA for approval	Sun 1/5/20	Sun 1/5/20
9	EPA Approval of Trust Agreement	Tue 1/21/20	Tue 1/21/20
10	Transfer money in Building and GW NTCRA Trust to RD/RA trust	Mon 1/27/20	Mon 1/27/20
11	**Remedial Design Work Plan, PDIWPs, TSWP, etc**	**Tue 1/28/20**	**Fri 3/27/20**
20	EPA review and comment on RDWP and other Design Docs	Sat 3/28/20	Mon 8/24/20
21	Revise and Resubmit RDWP	Tue 8/25/20	Wed 9/23/20
22	**Site Wide Soil and Sediment**	**Thu 9/24/20**	**Fri 9/11/26**
23	Implement PDIs	Thu 9/24/20	Thu 8/19/21
24	Prepare and submit PDI Report	Fri 8/20/21	Sat 9/18/21
25	EPA Review PDI Report (include community groups)	Sun 9/19/21	Sun 1/16/22
26	Revise and resubmit PDI Report	Mon 1/17/22	Mon 1/31/22
27	EPA Approval on PDI Report	Tue 2/1/22	Tue 2/15/22
28	Preliminary 30% RD- Site Wide Soil and Sediment	Wed 2/16/22	Mon 5/16/22
29	EPA Review 30% RD (include Community Groups)	Tue 5/17/22	Tue 9/13/22
30	Pre-Final 95% RD	Wed 9/14/22	Sat 11/12/22
31	EPA Review 95% RD	Sun 11/13/22	Sun 3/12/23
32	Final 100% RD	Mon 3/13/23	Sun 3/26/23
33	EPA Review 100% RD (include Community Groups)	Mon 3/27/23	Thu 5/25/23
34	Revise and resubmit 100% RD	Fri 5/26/23	Thu 6/8/23
35	EPA notice to Proceed with RA	Thu 6/8/23	Thu 6/8/23
36	Award RA Contract	Fri 6/9/23	Sun 7/23/23
37	Remedial Action Work Plan	Fri 6/9/23	Wed 9/6/23
38	EPA Review RAWP	Thu 9/7/23	Thu 9/21/23
39	Revise and Resubmit RAWP	Fri 9/22/23	Thu 10/5/23
40	EPA Approves RAWP	Thu 10/5/23	Thu 10/5/23
41	Pre-construction conference	Sun 10/15/23	Sun 10/15/23
42	Start of Construction	Sun 5/15/22	Sat 11/4/23
43	Site Wide Soils and Sediments Construction	Fri 3/15/24	Mon 12/1/25



ID	Task Name	Start	Finish
44	Construction, 2024	Fri 3/15/24	Sun 12/1/24
45	Winter Shutdown	Mon 12/2/24	Sat 3/1/25
46	Construction, 2025	Sun 3/2/25	Mon 12/1/25
47	Site-Restoration / Demobilization	Mon 3/2/26	Sat 5/30/26
48	Inspection of completed remedy	Sat 5/30/26	Sat 5/30/26
49	RA Report	Tue 7/14/26	Tue 7/14/26
50	EPA Review RA Report	Wed 7/15/26	Fri 8/28/26
51	Revise and Resubmit RA Report	Fri 9/11/26	Fri 9/11/26
52	EPA Determinaiton of RA Completion	Fri 9/11/26	Fri 9/11/26
53	**Holding Basin**	**Thu 9/24/20**	**Sun 1/3/27**
54	Implement PDIs	Thu 9/24/20	Thu 8/19/21
55	Prepare and submit PDI Report	Fri 8/20/21	Sat 9/18/21
56	EPA Review PDI Reports (include community groups)	Sun 9/19/21	Sun 1/16/22
57	Revise and resubmit PDI Report	Mon 1/17/22	Mon 1/31/22
58	EPA Approve PDI and TS Reports	Tue 2/1/22	Tue 2/15/22
59	Preliminary 30% RD- Holding Basin Containment	Wed 2/16/22	Mon 5/16/22
60	EPA Review 30% RD (include Community Groups)	Tue 5/17/22	Tue 9/13/22
61	Pre-Final 95% RD	Sat 11/12/22	Sat 11/12/22
62	EPA Review 95% RD	Sun 11/13/22	Sun 3/12/23
63	Final 100% RD	Sun 3/26/23	Sun 3/26/23
64	EPA Review 100% RD (include Community Groups)	Mon 3/27/23	Thu 5/25/23
65	Revise and resubmit 100% RD	Fri 5/26/23	Thu 6/8/23
66	EPA notice to Proceed with RA	Thu 6/8/23	Thu 6/8/23
67	Award RA Contract	Sun 7/23/23	Sun 7/23/23
68	Remedial Action Work Plan	Fri 6/9/23	Wed 9/6/23
69	EPA Review RAWP	Thu 9/7/23	Thu 9/21/23
70	Revise and Resubmit RAWP	Fri 9/22/23	Thu 10/5/23
71	EPA Approves RAWP	Thu 10/5/23	Thu 10/5/23
72	Pre-construction conference	Sun 10/15/23	Sun 10/15/23
73	Start of Construction	Sat 11/4/23	Sat 11/4/23
74	Construction, 2024	Sat 3/1/25	Mon 2/23/26
75	Site-Restoration / Demobilization	Mon 5/25/26	Sat 8/22/26
76	Inspection of completed remedy	Mon 9/21/26	Mon 9/21/26
77	RA Report	Thu 11/5/26	Thu 11/5/26
78	EPA Review RA Report	Fri 11/6/26	Sun 12/20/26



ID	Task Name	Start	Finish
79	Revise and Resubmit RA Report	Sun 1/3/27	Sun 1/3/27
80	EPA Determinaiton of RA Completion	Sun 1/3/27	Sun 1/3/27
81	**In-Situ Sequestration**	**Thu 9/24/20**	**Thu 11/5/26**
82	Implement PDIs and TSs	Thu 9/24/20	Sat 4/16/22
83	Prepare and submit PDI and TS Reports	Sun 4/17/22	Mon 5/16/22
84	EPA Review PDI and TS Reports (include community groups)	Tue 5/17/22	Tue 9/13/22
85	Revise and resubmit PDI/TS Reports	Wed 9/14/22	Wed 9/28/22
86	EPA Approve PDI and TS Reports	Thu 9/29/22	Thu 10/13/22
87	Pilot ISS Injection/Amendments	Fri 10/14/22	Fri 2/10/23
88	Preliminary 30% RD- Site Wide Soil and Sediment	Fri 10/14/22	Wed 1/11/23
89	EPA Review 30% RD (include Community Groups)	Thu 1/12/23	Thu 5/11/23
90	Pre-Final 95% RD	Fri 5/12/23	Mon 7/10/23
91	EPA Review 95% RD	Tue 7/11/23	Tue 11/7/23
92	Final 100% RD	Wed 11/8/23	Tue 11/21/23
93	EPA Review 100%RD (include Community Groups)	Wed 11/22/23	Sat 1/20/24
94	Revise and resubmit 100% RD	Sun 1/21/24	Sat 2/3/24
95	EPA notice to Proceed with RA	Sat 2/3/24	Sat 2/3/24
96	Award RA Contract	Tue 3/19/24	Tue 3/19/24
97	Remedial Action Work Plan	Sun 2/4/24	Fri 5/3/24
98	EPA Review RAWP	Sat 5/4/24	Sat 5/18/24
99	Revise and Resubmit RAWP	Sun 5/19/24	Sat 6/1/24
100	EPA Approves RAWP	Sat 6/1/24	Sat 6/1/24
101	Pre-construction conference	Tue 6/11/24	Tue 6/11/24
102	Start of Construction	Mon 7/1/24	Mon 7/1/24
103	**Construction**	**Tue 7/2/24**	**Wed 4/30/25**
104	Construction within holding basin	Tue 7/2/24	Fri 8/30/24
105	down gradient construction	Sat 8/31/24	Sun 12/1/24
106	Winter Shutdown	Mon 12/2/24	Sat 3/1/25
107	Construction 2025	Sun 3/2/25	Wed 4/30/25
108	Site-Restoration / Demobilization	Thu 5/1/25	Tue 7/29/25
109	Shake-down period	Wed 7/30/25	Fri 7/24/26
110	RA Report	Mon 9/7/26	Mon 9/7/26
111	EPA Review RA Report	Tue 9/8/26	Thu 10/22/26
112	Revise and Resubmit RA Report	Fri 10/23/26	Thu 11/5/26
113	EPA Determinaiton of RA Completion	Thu 11/5/26	Thu 11/5/26



Tables

Nuclear Metals, Inc. Site
Remedial Design Work Plan
Table 1

Table L-1: Groundwater Cleanup Levels					
Carcinogenic Chemical of Concern	**Cancer Classification**	**Overburden Cleanup Level**		**Bedrock Cleanup Level**	
		µg/L	**Basis**	**µg/L**	**Basis**
1,1-Dichloroethane	C	NA	NA	2.7	ILCR = 10^{-6} (Residential)
Tetrachloroethene	Likely to be carcinogenic to humans	5	MCL	5	MCL
Trichloroethene	Carcinogenic to humans	5	MCL	5	MCL
Vinyl chloride	A	2	MCL	2	MCL
1,4-Dioxane	Likely to be carcinogenic to humans	0.46	ILCR = 10^{-6} (Residential)	0.46	ILCR = 10^{-6} (Residential)
bis(2-Ethylhexyl) phthalate	B2	6	MCL	6	MCL
Arsenic	A	10	MCL	10	MCL
Chromium	Likely to be carcinogenic to humans	100	MCL	100	MCL
Thorium	A	0.33	ILCR = 10^{-6} (Residential)	0.33	ILCR = 10^{-6} (Residential)
Non-Carcinogenic Chemical of Concern	**Target Endpoint**	**Overburden Cleanup Level**		**Bedrock Cleanup Level**	
		µg/L	**Basis**	**µg/L**	**Basis**
1,1-Dichloroethane	Kidney	NA	NA	2.7	ILCR = 10^{-6} (Residential)
Tetrachloroethene	CNS	5	MCL	5	MCL
Trichloroethene	Developmental / Immune System	5	MCL	5	MCL
Vinyl chloride	Liver	2	MCL	2	MCL
1,4-Dioxane	Liver / Kidney / Respiratory	0.46	ILCR = 10^{-6} (Residential)	0.46	ILCR = 10^{-6} (Residential)
bis(2-Ethylhexyl) phthalate	Liver	6	MCL	6	MCL
Arsenic	Skin	10	MCL	10	MCL
Barium	Kidney	NA	NA	2,000	MCL
Chromium	GI System	100	MCL	100	MCL
Cobalt	Thyroid	6.0	HI = 1 (Residential)	6.0	HI = 1 (Residential)
Copper	GI System	1,300	Action Level	NA	NA
Iron	GI System	14,000	HI = 1 (Residential)	14,000	HI = 1 (Residential)
Manganese	CNS	300	Health Advisory	300	Health Advisory
Molybdenum	Kidney	100	HI = 1 (Residential)	100	HI = 1 (Residential)
Depleted Uranium	Kidney	30	MCL	30	MCL
Natural Uranium	Kidney	30	MCL	30	MCL
Nitrate-N	Hematological	10,000	MCL	10,000	MCL
Nitrite-N	Hematological	1,000	MCL	1,000	MCL

Key

1. See Appendix E of this ROD for cleanup level development and basis:

Health Advisory - Health Advisory on Manganese (EPA-822-R-04-003; January 2004)

HI - Hazard Index

MCL - Maximum Contaminant Level

ILCR - Incremental Lifetime Cancer Risk; 10^{-6} = 1 in 1,000,000

NA - Not applicable

Cancer Classification

A - Human carcinogen

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

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

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

Nuclear Metals, Inc. Site
Remedial Design Work Plan
Table 2

Table L-2: Soil Cleanup Levels for the Protection of Human Health				
Carcinogenic Chemical of Concern	**Cancer Classification**	**Cleanup Level[1]**		**Basis[1]**
		mg/kg	**pCi/g**	
Benzo(a)anthracene	B2	0.34	NA	ILCR = 10^{-6} (Residential)
Benzo(a)pyrene	B2	0.22	NA	ILCR = 10^{-6} (Residential)
Benzo(b)fluoranthene	B2	0.34	NA	ILCR = 10^{-6} (Residential)
Indeno(1,2,3-cd) pyrene	B2	0.34	NA	ILCR = 10^{-6} (Residential)
PCBs	B2	1	NA	Policy
Arsenic	A	13.7	NA	Background
Uranium	A	2.7	1.1	ILCR = 10^{-6} (Residential)
U-238	A	NA	0.90	ILCR = 10^{-6} (Residential)
U-235	A	NA	0.01	ILCR = 10^{-6} (Residential)
U-234	A	NA	0.15	ILCR = 10^{-6} (Residential)
Thorium	A	7.4	0.81	Background
Th-232	A	NA	0.81	Background
Non-Carcinogenic Chemical of Concern	**Target Endpoint**	**Cleanup Level[1]**		**Basis[1]**
		mg/kg	**pCi/g**	
PCBs	Immune System	1	NA	Policy
Arsenic	Skin	13.7	NA	ILCR = 10^{-6} (Residential)
Uranium	Kidney	2.7	1.1	ILCR = 10^{-6} (Residential)

Key

NA - Not applicable

1. See Appendix E of this ROD for cleanup level development and basis:

Policy - Cleanup level for PCBs based on CERCLA Policy (Guidance on Remedial Actions for Superfund Sites with PCB Contamination, OSWER Directive #9355.4-01, EPA/540/G-90/007, August 1990

Background - If risk-based cleanup levels were below background concentrations for the site, the background concentration was selected.

ILCR - Incremental Lifetime Cancer Risk; 10^{-6} = 1 in 1,000,000

Cancer Classification

A - Human carcinogen

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

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

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

Nuclear Metals, Inc. Site
Remedial Design Work Plan
Table 3

Table L-3: Sediment Cleanup Levels for the Protection of Human Health

Carcinogenic Chemical of Concern	Cancer Classification	Cleanup Level[1] mg/kg	Basis[1]
PCBs	B2	2.7	ILCR = 10^{-6} (Abutting Resident/Recreational Visitor)
Non-Carcinogenic Chemical of Concern	**Target Endpoint**	**Cleanup Level[1] mg/kg**	**Basis[1]**
PCBs	Immune System	1	Policy

Key

NA - Not applicable

1. See Appendix B of FS for cleanup level development and basis:
   Policy - Cleanup level for PCBs based on CERCLA Policy (Guidance on Remedial Actions for Superfund Sites with PCB Contamination, OSWER Directive #9355.4-01, EPA/540/G-90/007, August 1990

Cancer Classification

A - Human carcinogen

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

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

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

Habitat Type/Name	Exposure Medium	COC	Protective Level	Units	Basis	Assessment Endpoint
BENTHIC INVERTEBRATE COMMUNITY						
Sphagnum Bog	Sediment	mean PEC [1]	0.64		Site-specific MATC[2]	Survival and growth of benthic invertebrate community
		Total PCBs	1.08	mg/kg	Site-specific MATC	
		Copper	176	mg/kg	Site-specific MATC	
		Lead	97.3	mg/kg	Site-specific MATC	
		Mercury	1.3	mg/kg	Site-specific MATC	

Table L-4: Sediment Cleanup Levels for the Protection of Ecological Receptors

Notes:

(1) See Appendix A of the Feasibility Study (*de maximis*, 2014b) for discussion of development of PEC-Q values based on the results of the sediment toxicity tests.

(2) The site-specific MATC (set as the geometric mean between the NOEC and LOEC values) has been selected as the protective level for each COC.

COC - Chemical of Concern

NOEC - No observed effect concentration. The NOEC was set as the higher of the concentrations observed at locations with no observed effects.

LOEC - Lowest observed effect concentration. The LOEC was set as the lower of the concentrations observed at locations with observed toxicity to benthic invertebrates.

MATC - Maximum Acceptable Toxic Concentration

PEC-Q - Probable Effect Concentration - Quotients for mixtures consisting of metals, PAHs, and PCBs (unitless)

Remedial Design Work Plan
Nuclear Metals, Inc. Site
Table 4 - Action-Specific ARARs

Regulatory Authority	Action/Trigger	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain ARAR
Soil and Sediment (Alternative SS-4)					
Federal	Management of PCB-contaminated soil	TSCA PCB Remediation Waste (40 CFR 761.61(c))	Applicable	This section of the TSCA regulations provides risk-based cleanup and disposal options for PCB remediation waste based on the risks posed by the concentrations at which the PCBs are found. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, USEPA Region 1.	The cleanup and disposal of PCB contaminated soil and sediment will be performed in a manner to comply with TSCA. EPA has determined that the method of excavation and disposal of the ≥ 50 ppm PCB-contaminated sediment and soil as described in the TSCA determination will not pose an unreasonable risk of injury to health and the environment. (See TSCA Determination in Appendix G)
Federal	Management of waste radioactive material	Nuclear Regulatory Commission, Licensing of Radioactive Material (10 CFR Part 40, Appendix A, Criterion 6)	Relevant and Appropriate	10 CFR Part 40 Appendix A, Criterion 6(1) requires the disposal of waste byproduct radioactive material to be closed with a design which provides reasonable assurance of control of radiological hazards to be effective for 1,000 years, to the extent reasonably achievable, and in any case, for at least 200 years.	These requirements will be incorporated in the design of the vertical containment wall and horizontal cover for the solidified/stabilized soils remaining on-site in the Holding Basin.
State	Radiation containment design requirements	Massachusetts Regulations for the Control of Radiation, Standards for Protection Against Radiation, Vacating Premises (105 CMR 120.245)	Relevant and Appropriate	These regulations specify that the annual total effective dose equivalent (TEDE) from any specific environmental source during decommissioning activities should not exceed ten millirem above background and that the annual TEDE to any individual after the Site is released for unrestricted use should not exceed ten millirem above background.	The 10 mRem above background criteria was used during the development of cleanup goals and will be used in the design of the containment wall and cover.
Soil, Sediment, and Groundwater (Alternatives SS-4 and GW-4)					
Federal	Radiation protection program	Nuclear Regulatory Commission, Radiation Protection Programs (10 CFR Part 20 - Appendix B)	Relevant and Appropriate	Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage.	ALIs and DACs will be determined for protection of workers during remedial activities.
Federal	Control of surface water runoff, Direct discharge to surface water	Clean Water Act NPDES Permit Program (40 CFR Part 122,125)	Applicable	The NPDES permit program specifies the permissible concentration or level of contaminants in the discharge from any point source, including surface runoff, to waters of the United States.	Any discharges to surface waters will meet the substantive discharge standards.

Remedial Design Work Plan
Nuclear Metals, Inc. Site
Table 4 - Action-Specific ARARs

Regulatory Authority	Action/Trigger	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain ARAR
Federal	Discharge to publicly owned treatment works	CWA, General Pretreatment Program (40 CFR Part 403)	Applicable	Discharge of nondomestic wastewater to POTW must comply with the general prohibitions of this regulation, as well as categorical standards, and local pretreatment standards.	Discharge to POTW will be sampled to evaluate compliance with pre-treatment standards.
Federal	Storage and treatment of low-level mixed waste (hazardous waste containing low-level radioactive waste)	RCRA Conditional Exemption for Low-Level Mixed Waste Storage, Treatment, Transportation, and Disposal (40 CFR Part 266 Subpart N)	Applicable	Low-level mixed waste (LLMW) (hazardous waste containing low-level radioactive waste) is exempted from RCRA storage, treatment, transportation and disposal requirements. LLMW must still be managed as radioactive waste according to Nuclear Regulatory Commission (NRC) regulations (Title 10, Chapter I, of the Code of Federal Regulations).	LLMW will be managed as radioactive waste according to NRC regulations.
Federal	Use of a treatment, storage or disposal facility for hazardous waste	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (40 CFR Part 264)	Applicable	Establishes minimum national standards for the management of hazardous waste, including closure and post-closure requirements. Applies to owners and operators of all facilities which treat, store, or dispose of hazardous waste. Such facilities include landfills, containers, tank systems, waste piles, and miscellaneous units.	The use of treatment, storage or disposal facilities for hazardous waste that does not contain low-level radioactive waste will be done in accordance with these requirements.
Federal	Identification of hazardous waste	RCRA Identification and Listing of Hazardous Waste (40 CFR 261.3 and 40 CFR 264.13)	Applicable	These regulations include rules to identify hazardous waste. If waste exhibits the characteristics of a hazardous waste and does not contain low-level radioactive waste, RCRA waste regulations are applicable.	Any waste generated as part of the remedial activities will be tested for hazardous waste characteristics as well as low-level radioactive waste to determine whether it should be managed as hazardous waste.
Federal	Storage and disposal of hazardous wastes	RCRA Standards Applicable to Generators of Hazardous Waste (40 CFR Part 262)	Applicable	These standards govern storage, labeling, accumulation times, and disposal of hazardous waste. These regulations establish standards for generators of hazardous waste. RCRA Subtitle C established standards applicable to treatment, storage, and disposal of hazardous waste and closure of hazardous waste facilities.	Any hazardous waste generated during remedial action activities that does not contain low-level radioactive waste will be managed in accordance with these standards.
State	Receipt, ownership, possession, use, transfer, or disposal of any radiation source	Massachusetts Regulations for the Control of Radiation (105 CMR 120)	Applicable	Massachusetts regulates all sources of radiation including naturally occurring radioactive material, byproduct material and special nuclear material. These regulations pertain to source material, byproduct material, and special nuclear materials in quantities not sufficient to form a critical mass and apply to the protection of workers and individuals against radiation, termination of licenses, decommissioning of facilities, and transportation of radioactive material.	The substantive requirements of this regulation will be followed during the cleanup of the Site.

Remedial Design Work Plan
Nuclear Metals, Inc. Site
Table 4 - Action-Specific ARARs

Regulatory Authority	Action/Trigger	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain ARAR
State	Identification and management of hazardous waste	Massachusetts Hazardous Waste Management Rules (310 CMR 30.000)	Applicable	These regulations outline requirements and procedures for handling, storage, treatment, disposal, and record keeping at hazardous waste facilities.	Any waste generated as part of the remedial activities will be tested for hazardous waste characteristics as well as low-level radioactive waste to determine whether it should be managed as hazardous waste in accordance with these standards.
State	Discharges to surface water	Massachusetts Surface Water Discharge Permit Program (314 CMR 3.00)	Applicable	These regulations establish a permit program to regulate pollutant discharges to surface waters of the Commonwealth and to confer sufficient authority to the Massachusetts Department of Environmental Protection to assume the delegated administration of the NPDES permit program within the Commonwealth.	Any discharge to surface water of extracted groundwater, monitor well purge water, and investigation derived waste water will be treated and controlled to meet the requirements of these regulations. Construction activities will be controlled to meet surface water discharge requirements.
State	Discharges to surface water	Massachusetts Surface Water Quality Standards (314 CMR 4.00)	Applicable	Through these regulations MassDEP will limit or prohibit discharges of pollutants to surface waters to assure that surface water quality standards of the receiving waters are protected and maintained or attained. The level of treatment for an individual discharger will be established by the discharge permit in accordance with 314 CMR 3.00 (Massachusetts Surface Water Discharge Permit Program).	Any discharge to surface water of extracted groundwater, monitor well purge water, and investigation derived waste water will be treated and controlled to meet the requirements of these regulations. Construction activities will be controlled to meet surface water quality standards.
State	Activities that affect ambient air quality	Massachusetts Air Pollution Control Regulations (310 CMR 7.00)	Applicable	These regulations set emission limits necessary to attain ambient air quality standards, including standards for Visible Emissions (310 CMR 7.06); Dust, Odor, Construction and Demolition (310 CMR 7.09); Noise (310 CMR 7.10); and Volatile Organic Compounds (310 CMR 7.18).	Remedial activities will be conducted to meet these air quality standards, including standards for Visible Emissions (310 CMR 7.06); Dust, Odor, Construction and Demolition (310 CMR 7.09); Noise (310 CMR 7.10); and Volatile Organic Compounds (310 CMR 7.18).
Groundwater (Alternative GW-4)					
Federal	Use of air stripping	Clean Air Act National Emissions Standards for Hazardous Air Pollutants (NESHAPs), (40 CFR Part 61)	Applicable	These regulations set standards for emissions of 189 Hazardous Air Pollutants that are listed in Section 112(b)(1) of the Clean Air Act.	If air stripping is selected during remedial design as a component of the groundwater remedy and any of the 189 hazardous air pollutants will be emitted, engineering and other controls will be implemented to comply with these standards.
Federal	Underground injections	SDWA Underground Injection Control Program (40 CFR Part 144, 146, and 147 Subpart W)	Relevant and Appropriate	These regulations outline the minimum program and performance standards for underground injection programs. Technical criteria and standards for siting, operation and maintenance, closure, and reporting and recordkeeping as required for permitting are set forth in Part 146.	If treated groundwater is re-injected into the aquifer, these standards would be met since the treated groundwater would meet MCLs and would not be considered hazardous waste.

Remedial Design Work Plan
Nuclear Metals, Inc. Site
Table 4 - Action-Specific ARARs

Regulatory Authority	Action/Trigger	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain ARAR
State	Activities that affect ambient air quality	Massachusetts Ambient Air Quality Standards (310 CMR 6.00)	Applicable	These regulations set primary and secondary standards for emissions of sulfur dioxide, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead.	If air stripping is selected during remedial design as a component of the groundwater remedy, it will be designed, constructed, and operated in accordance with these requirements.
State	Discharge of treated groundwater to groundwater	Massachusetts Groundwater Discharge Permit Program [3.14 CMR 5.10 (Permit Conditions) and 5.11 (Groundwater Standards)]	Relevant and Appropriate	These regulations require MassDEP to control the discharge of pollutants to the ground waters of the Commonwealth through the issuance of permits to assure that groundwaters are protected for their actual and potential use as a source of potable water and surface waters are protected for their existing and designated uses.	If treated groundwater is re-injected into the aquifer, the discharge of any pollutant to groundwater will controlled so that groundwaters are protected for their actual and potential use as a source of potable water and surface waters are protected for their existing and designated uses.

Key:

ARAR = Applicable or Relevant and Appropriate Requirement
BACT = best available control technology
CAA = Clean Air Act
CERCLA = Comprehensive Environmental Response, Compensation and Liability Act
CFR = Code of Federal Regulations
CMR = Code of Massachusetts Regulations
CWA = Clean Water Act
DCLG = Derived Concentration Guideline Level

LDRs = Land Disposal Restrictions
NCP = National Contingency Plan
NESHAP = National Emission Standards for Hazardous Air Pollutants

NPDES = National Pollutant Discharge Elimination System
PCBs = polychlorinated biphenyls

POTW = publicly owned treatment works
ppm = parts per million
RCRA = Resource Conservation and Recovery Act
SDWA = Safe Drinking Water Act

TSCA = Toxic Substances Control Act
UIC = Underground Injection Control

USEPA = U.S. Environmental Protection Agency

USC = United States Code

Remedial Design Work Plan
Nuclear Metals, Inc. Site
Table 5 - Chemical-Specific ARARs for Groundwater

Regulatory Authority	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain ARAR
Federal	Safe Drinking Water Act, National Primary Drinking Water Regulations, MCLs and MCLGs [40 CFR Parts 141.60 - 141.63 and 141.50 - 141.52]	Relevant and Appropriate	The National Primary Drinking Water Regulations establish Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) for several common organic and inorganic contaminants. MCLs specify the maximum permissible concentrations of contaminants in public drinking water supplies. MCLs are federally enforceable standards based in part on the availability and cost of treatment techniques. MCLGs specify the maximum concentration at which no known or anticipated adverse effect on humans will occur. MCLGs are non-enforceable health-based goals set equal to or lower than MCLs.	MCLs and nonzero MCLGs were used during the development of cleanup goals. Cleanup actions will be designed and implemented to attain the concentration limits of these regulations.
Federal	USEPA Risk Reference Doses	To Be Considered	Risk reference doses (RfDs) are estimates of daily exposure levels that are unlikely to cause significant adverse non-carcinogenic health effects over a lifetime.	RfDs were considered during the development of cleanup goals.
Federal	USEPA Carcinogen Assessment Group, Cancer Slope Factors (CSFs)	To Be Considered	CSFs are used to compute the incremental cancer risk from exposure to site contaminants and represent the most up-to-date information on cancer risk from USEPA's Carcinogen Assessment Group.	CSFs were considered during the development of cleanup goals.
Federal	Guidelines for Carcinogen Risk Assessment (EPA/630/P-03/001F, March 2005)	To Be Considered	Guidance values are to be used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	These guidelines were considered during the development of cleanup goals.
Federal	Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (EPA/630/R-03/003F, March 2005)	To Be Considered	Guidance values are to be used to evaluate the potential carcinogenic hazard to children caused by exposure to contaminants.	This guidance was considered during the development of cleanup goals.
Federal	EPA Office of Water, Drinking Water Health Advisories (EPA 822-R-06-013)	To Be Considered	Health Advisories (HAs) are estimates of acceptable drinking water levels for chemical substances based on health effects information; an HA is not a legally enforceable federal standard, but serves as technical guidance to assist federal, state and local officials.	HAs were considered during the development of cleanup goals. In particular, HAs were used if a constituent does not have a promulgated MCL or MCP GW-1 [or MA MCL] standard.
State	Massachusetts Regulations for the Control of Radiation, Standards for Protection Against Radiation, Vacating Premises (105 CMR 120.245)	Relevant and Appropriate	These regulations specify that the annual TEDE dose from any specific environmental source during decommissioning activities should not exceed ten millirem above background and that the annual TEDE to any individual after the Site is released for unrestricted use should not exceed ten millirem above background.	The 10 mRem above background criterion was used during the development of cleanup goals.

Remedial Design Work Plan
Nuclear Metals, Inc. Site
Table 5 - Chemical-Specific ARARs for Groundwater

Regulatory Authority	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
State	Massachusetts Contingency Plan (MCP) [310 CMR 40.0000], Method 1 GW-1 Standards	To Be Considered	The MCP Method 1 groundwater standards assume exposure to concentrations of hazardous material in groundwater under current or foreseeable future conditions. These standards contain a list of numerical, risk-based limitations on particular contaminants in groundwater based on the groundwater classification.	These standards were considered during development of cleanup goals.
State	Massachusetts Drinking Water Regulations [310 CMR 22.00]	Relevant and Appropriate	These standards establish Massachusetts Maximum Contaminant Levels (MA MCLs) for organic and inorganic contaminants that have been determined to adversely affect human health in public drinking water supply systems.	MA MCLs were used during development of cleanup goals.

Key:

ARAR = Applicable or Relevant and Appropriate Requirement
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
CMR = Code of Massachusetts Regulations
CSF = cancer slope factor
DCGL = Derived Concentration Guideline Level

MCLs = Maximum Contaminant Levels

MCLGs = Maximum Contaminant Level Goals

MA MCLs = Massachusetts Maximum Contaminant Levels
RfD = reference dose

TEDE = total effective dose equivalent
TSCA = Toxic Substances Control Act
USEPA = United States Environmental Protection Agency

Table 6 - Chemical-Specific ARARs for Soil and Sediment

Regulatory Authority	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain ARAR
Federal	USEPA Risk Reference Doses	To Be Considered	Risk reference doses (RfDs) are estimates of daily exposure levels that are unlikely to cause significant adverse non-carcinogenic health effects over a lifetime.	RfDs were considered during the development of cleanup goals.
Federal	USEPA Carcinogen Assessment Group, Cancer Slope Factors (CSFs)	To Be Considered	CSFs are used to compute the incremental cancer risk from exposure to site contaminants and represent the most up-to-date information on cancer risk from USEPA's Carcinogen Assessment Group.	CSFs were considered during the development of cleanup goals.
Federal	Guidelines for Carcinogen Risk Assessment (EPA/630/P-03/001F, March 2005)	To Be Considered	Guidance values are to be used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	These guidelines were considered during the development of cleanup goals.
Federal	Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (EPA/630/R-03/003F, March 2005)	To Be Considered	Guidance values are to be used to evaluate the potential carcinogenic hazard to children caused by exposure to contaminants.	This guidance were considered during the development of cleanup goals.
Federal	A Guide on Remedial Actions at Superfund Sites with PCB Contamination, OSWER Directive #9355.4-01FS, August 1990	To Be Considered	Establishes a policy that a cleanup level of 1 mg/kg PCBs in residential area soil reflects a protective quantifiable concentration.	This policy was considered during the development of cleanup levels for soils and sediments.
Federal	Prediction of sediment toxicity using consensus-based freshwater sediment quality guidelines. EPA 905/R-00/007. June 2000	To Be Considered	The methodology presented in this document represent USEPA’s best recommendation as to the concentration of a substance that may be present in sediment while still protecting benthic organisms from the effects of that substance.	These guidelines were considered during the development of cleanup goals for sediments.
State	Massachusetts Regulations for the Control of Radiation, Standards for Protection Against Radiation, Vacating Premises; 105 CMR 120.245; Standards for Protection Against Radiation	Relevant and Appropriate	These regulations specify that the annual total effective dose equivalent (TEDE) from any specific environmental source during decommissioning activities should not exceed ten millirem above background and that the annual TEDE to any individual after the Site is released for unrestricted use should not exceed ten millirem above background.	The 10 mRem above background criterion was used during the development of cleanup goals

Key:

ARAR	= Applicable or Relevant and Appropriate Requirement	RfD	= reference dose
CERCLA	= Comprehensive Environmental Response, Compensation, and Liability Act	TEDE	= total effective dose equivalent
CFR	= Code of Federal Regulations	TSCA	= Toxic Substances Control Act
CMR	= Code of Massachusetts Regulations	NUREG	= NRC Regulation
CSF	= cancer slope factor	USEPA	= United States Environmental Protection Agency
mRem	= millirem		

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Table 7 - Location-Specific ARARs

Regulatory Authority	Location Characteristic	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
Soil and Sediment (Alternative SS-4)					
Federal	Surface Waters, Endangered Species, Migratory Species	Fish and Wildlife Coordination Act [16 USC 661 et seq.] 40 CFR Part 6	Applicable	Actions that affect species/habitat require consultation with USDOI, USFWS, NMFS, and/or state agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. The effects of water-related projects on fish and wildlife resources must be considered. Action must be taken to prevent, mitigate, or compensate for project-related damages or losses to fish and wildlife resources.	To the extent necessary, actions will be taken to develop measures to prevent, mitigate, or compensate for project related impacts to habitat and wildlife. The USFWS, acting as a review agency for the USEPA, will be kept informed of proposed remedial activities.
Federal	Wetlands, Aquatic Ecosystem	Clean Water Act, Dredge or Fill Requirements Section 404 [40 CFR Part 230, 33 CFR 320-323]	Applicable	Section 404 of the CWA regulates the discharge of dredged or fill materials to U.S. waters, including wetlands. Filling wetlands would be considered a discharge of fill materials. Guidelines for Specification of Disposal Sites for Dredged or Fill material at 40 CFR Part 230, promulgated under CWA Section 404(b)(1), maintain that no discharge of dredged or fill material will be permitted if there is a practical alternative that would have less effect on the aquatic ecosystem. If adverse impacts are unavoidable, action must be taken to restore, or create alternative wetlands.	SS-4's effects on surface waters and wetlands will be evaluated and avoided and/or minimized. Compensatory wetlands mitigation will need to be performed as necessary to comply with this ARAR. The selected remedy is the least environmentally damaging practicable alternative that meets the remedial action objectives. Any wetland or surface water areas that require removal of soil/sediment will be designated for eventual restoration.
Federal	Endangered Species	Endangered Species Act [50 CFR Parts 17.11-17.12; 50 CFR 402]	Applicable, if such species are encountered	This act requires action to avoid jeopardizing the continued existence of listed endangered or threatened species or modification of their habitat.	Protection of endangered species and their habitat will be considered as part of the design and excavation activities.
State	Floodplains, Wetlands, Surface Waters	Massachusetts Wetland Protection Regulations [310 CMR 10.00]	Applicable	These regulations include standards on dredging, filling, altering, or polluting inland wetlands and protected areas (defined as areas within the 100-year floodplain). Under this requirement, available alternatives must be considered that minimize the extent of adverse impacts, and mitigation including restoration and/or replication is required.	All work to be performed within wetlands and the 100 foot buffer zone will be in accordance with the substantive requirements of these regulations. The Sphagnum Bog is within 100 feet of the Holding Basin and Cooling Water Recharge Pond.

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Table 7 - Location-Specific ARARs

Regulatory Authority	Location Characteristic	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
State	Aquatic Ecosystem	Massachusetts Clean Waters Act, 21 M.G.L. §§ 26-53 Massachusetts Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredging Material Disposal in Waters of the U.S. within the Commonwealth [314 CMR 9.00]	Applicable	For discharges of dredged or fill material, there must be no practicable alternative with less adverse impact on the aquatic ecosystem; appropriate and practicable steps must be taken to avoid and minimize potential adverse impacts to wetlands and land under water; stormwater discharges must be controlled with BMPs; and there must not be substantial adverse impacts to the physical, chemical or biological integrity of surface waters. For dredging and dredged material management, there must be no practicable alternative with less adverse impact on the aquatic ecosystem; and if avoidance is not possible, then minimize, or if neither avoidance nor minimization are possible, then mitigate potential adverse impacts.	Excavation and filling activities to be performed impacting the aquatic ecosystem will be in accordance with the substantive requirements of these regulations. The selected remedy is the least environmentally damaging practicable alternative that meets the remedial action objectives. Any wetland or surface water areas that require removal of soil/sediment will be designated for eventual restoration.
State	Endangered Species	Massachusetts Endangered Species Regulations [321 CMR 10.00]	Applicable, if such species are encountered	Actions must be conducted in a manner that minimizes the impact to Massachusetts-listed rare, threatened, or endangered species, and species listed by the Massachusetts Natural Heritage Program.	The protection of state listed endangered species will be considered during the design and implementation of remedial activities.
Groundwater (Alternative GW-4)					
Federal	Wetlands and Floodplains	Floodplain Management [44 CFR Part 9]	Relevant and Appropriate	These FEMA regulations set forth the policy, procedure and responsibilities to implement and enforce Executive Order 11988, Floodplain Management.	There is no practicable alternative to monitoring groundwater wells and installing new groundwater wells that may be within the floodplain. EPA will avoid or minimize potential harmful impacts on floodplain resources to the extent practicable.

Key:

ARAR = Applicable or Relevant and Appropriate Requirement
CFR = Code of Federal Regulations
CMR = Code of Massachusetts Regulations
CWA = Clean Water Act
NCP = National Contingency Plan
NMFS = National Marine Fisheries Service
USDOI = U.S. Department of the Interior
USEPA = U.S. Environmental Protection Agency
USFWS = U.S. Fish and Wildlife Service
USC = United States Code

Appendices