U.S. ENVIRONMENTAL PROTECTION AGENCY

EPA REGION 1 – NEW ENGLAND

RECORD OF DECISION

NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE
OPERABLE UNIT 02
ASHLAND, MASSACHUSETTS

JULY 2020

PART 3: THE RESPONSIVENESS SUMMARY

APPENDICES

PART 1: THE DECLARATION FOR THE RECORD OF DECISION

A. SITE NAME AND LOCATION

Nyanza Chemical Waste Dump Superfund Site
Ashland, Middlesex County, Massachusetts
CERLCIS ID#: MAD990685422

B. STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Nyanza Chemical Waste Dump Superfund Site, Operable Unit 02 (OU2), in Ashland, Massachusetts (the Site), which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 as amended (CERCLA, also commonly referred to as "Superfund"), 42 U.S.C. § 9601 *et seq*., and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as amended, 40 C.F.R. Part 300. The Region 1 Director of the Superfund and Emergency Management Division (SEMD) has been delegated the authority to approve this Record of Decision (ROD).

This decision was based on the Administrative Record for the Site, which has been developed in accordance with Section 113(k) of CERCLA, 42 U.S.C. § 9613(k). The Administrative Record is available for review at the Ashland Public Library, located at 66 Front Street in Ashland, Massachusetts, and at the U.S. Environmental Protection Agency (EPA) Region 1 Superfund and Emergency Management Division (SEMD) Records Center located at 5 Post Office Square, Boston, Massachusetts, and online at www.epa.gov/superfund/nyanza. The Administrative Record Index (**Appendix G** of this ROD) identifies each of the items comprising the Administrative Record upon which the selection of the remedial action is based.

The Commonwealth of Massachusetts, as the support agency, concurs with the selected remedy (see **Appendix A** of this ROD for a copy of the concurrence letter).

C. ASSESSMENT OF SITE

The response action selected in this ROD is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances, pollutants, or contaminants into the environment. The April 1991 Remedial Investigation (RI) Report (Ebasco, 1991a) for the Site summarizes the initial nature and extent of the groundwater contamination and was used as a basis for EPA's interim remedial actions, selected for Operable Unit 02 (OU2) in the 1991 ROD and performed from 1991 through the present. A Feasibility Study (FS) report (Nobis, 2020) was prepared which provided updated Site information and identified the final remedial alternatives considered for OU2.

D. DESCRIPTION OF SELECTED REMEDY

This ROD sets forth the selected remedy for the Site, which is a comprehensive cleanup approach and is based on a combination of remedial alternatives set out in a Proposed Plan issued for public comment in January 2020 that addresses the current and potential future risks caused by the groundwater contamination and the vapor intrusion pathway. The selected remedy utilizes a pre-design investigation (PDI), enhancements to existing recovery of dense non-aqueous phase liquid (DNAPL), additional DNAPL extraction and recovery, in-situ chemical oxidation (ISCO) treatment of groundwater, long-term monitoring (LTM) of groundwater, and institution controls to address unacceptable risk from exposure to groundwater from the Site.

The remedy is intended to reduce the concentration of contaminants in groundwater to levels which will be protective of human health for exposure to indoor air such that the existing vapor mitigation systems (VMSs) are no longer needed and to minimize the need for controls to protect construction workers during excavation activities.

The remedial measures selected in this ROD include the following:

Groundwater

The alternative selected by EPA for the groundwater cleanup is GW-4 (Extraction/Recovery and In-Situ Treatment in the Nyacol/WAC AOC), which includes the following components:

- PDI in the Nyacol/Worcester Air Conditioning (WAC) Area of Concern (AOC) to locate additional DNAPL for extraction and to determine the design of new DNAPL extraction systems and in-situ groundwater treatment;
- Field-scale pilot study and installation of additional DNAPL extraction wells if recoverable DNAPL is located in target study areas during the PDI. New extraction wells may also be installed in locations outside of the PDI target study areas (if additional DNAPL hot spots are detected), and may include angled or horizontal recovery wells beneath or near sensitive structures such as buildings or railroad tracks;
- Optimization of existing DNAPL extraction systems using amendments or water recirculation to enhance DNAPL recovery, or the use of pneumatic or hydraulic fracturing. This step would be implemented if the existing DNAPL extraction systems continue to be a viable option for recovering additional DNAPL in the future. Extracted DNAPL will be collected and transported off-site for disposal;
- ISCO treatment of groundwater in the Nyacol/WAC AOC using activated persulfate treatment. ISCO is accomplished by injecting a chemical oxidizer directly into the contaminated medium (i.e., groundwater) to destroy or reduce the concentration of contaminants in place, including volatile organic compounds (VOCs) that are resistant to natural degradation. A groundwater evaluation would be done to design the ISCO treatment, which would commence after installation of new DNAPL extraction systems (if additional DNAPL is located during the PDI) or following the PDI (if additional recoverable DNAPL is not located).
- Field-scale pilot study to determine the radius of influence (ROI) and to evaluate treatment performance of specific ISCO chemical formulations. ISCO treatment would be conducted within the Nyacol/WAC AOC, targeting groundwater in the deep overburden and shallow/weathered bedrock aquifers.
- Groundwater monitoring well network expansion and optimization (i.e., new monitoring wells) for LTM and remedy performance monitoring of concentrations of VOCs in the groundwater plume. This includes treatment areas, locations in the downgradient plume area of concern

(AOC) such as the vapor mitigation area, and a portion of a potentially productive aquifer (PPA) designated by the Massachusetts Department of Environmental Protection (MassDEP).

- Expanding the institutional controls to require a vapor intrusion evaluation or VMS be installed if a new building is constructed over the contaminated groundwater plume, or if an existing building with a VMS is renovated or expanded in size.
- Continued operation, maintenance and monitoring of the existing DNAPL extraction systems at two wells (MW-113A at WAC property and MW/B-11 at Nyacol property).
- Continued operation, monitoring, and maintenance of the existing VMSs until future evaluations determine they are no longer needed.
- Five-year reviews, as required by CERCLA, to ensure remedy protectiveness, and since Site contaminants would remain in groundwater above levels that would allow for unlimited use and unrestricted exposure.

E. STATUTORY DETERMINATIONS

The selected remedy (GW-4) is protective of human health and the environment, complies with federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. GW-4 also satisfies the statutory preference for treatment by addressing the principal threat (DNAPL) and the sorbed contamination within the Nyacol/WAC AOC.

Since Site contaminants would remain in groundwater above levels that would allow for unlimited use and unrestricted exposure, these additional remedial actions for Operable Unit 02 will be incorporated into the existing Five Year review cycle for the Site, to ensure all Site remedial actions provide adequate protection of human health and the environment. Five-year reviews for the Site will continue as long as waste remains at the Site above levels that would allow for unlimited use and unrestricted exposure.

F. SPECIAL FINDINGS

Issuance of this ROD embodies the following specific determinations:

Wetlands Impacts

Pursuant to Section 404 of the Clean Water Act (CWA), 44 C.F.R. Part 9, and Executive Order 11990 (Protection of Wetlands), EPA has determined that the selected remedy (GW-4) is the least environmentally damaging practicable alternative for protecting federal jurisdictional wetlands and aquatic ecosystems at and/or adjacent to the Site. EPA will minimize potential harm and avoid adverse impacts to wetlands by using best management practices during the investigation and treatment phases of the remedy. Most of the wetlands on or near the Site are not located in the remedial areas, with the exception of certain wetlands located west of the Nyacol property and southeast of the WAC property. The installation of additional groundwater monitoring wells for the remedy may be required within designated wetlands in the downgradient plume AOC. However, monitoring well construction will be planned to minimize impacts to wetlands. Any wetlands inadvertently affected by the remedial work described in this ROD will be restored or mitigated with native wetland vegetation, and any restoration efforts will be documented and monitored. Mitigation measures will be used to protect wetlands wildlife and aquatic life as necessary. As required under applicable federal wetlands regulations, EPA solicited public comment regarding the remedy's potential impacts on wetland resources and received no negative comments (see Part 3 of this ROD).

Floodplain Impacts

Pursuant to Executive Order 11988 (Floodplain Management) and federal regulations, EPA has determined that the selected remedy (GW-4) will not cause impacts to 100-year and 500-year floodplains and will not result in the occupancy and modification of floodplains. Remedial activities are not planned within the floodplain designation Zone AE (the 100-year flood zone) or Zone X (the 500-year flood zone). Best management practices will be used during remedial work phases to minimize any temporary impacts to floodplains or areas that may border floodplains. As required under applicable federal wetlands regulations, EPA solicited public comment regarding the remedy's potential impacts on floodplain resources and received no negative comments (see Part 3 of this ROD).

G. DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for this Site.

1. Chemicals of concern (COCs), also known as contaminants of concern;
2. Human health risk represented by the COCs;
3. Remediation goals established for COCs and the basis for the levels;
4. Current and future groundwater use assumptions used in human health risk assessments;
5. Current and Potential Future Site and Groundwater Uses as a result of the selected remedy;
6. Estimated capital, Operation & Maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected; and
7. Decisive factors that led to selecting the remedy.

H. AUTHORIZING SIGNATURES

This ROD documents the selected remedy for groundwater associated with the Nyanza Chemical Waste Dump Superfund Site – Operable Unit 02. This remedy was selected by EPA with concurrence of the Massachusetts Department of Environmental Protection. A copy of the State's concurrence letter is attached to this ROD (**Appendix A**).

U.S. Environmental Protection Agency

By: BRYAN OLSON Digitally signed by BRYAN OLSON Date: 2020.07.30 16:53:55 -04'00' Date: ______________________

Bryan Olson, Director
Superfund and Emergency Management Division
Region 1

PART 2: THE DECISION SUMMARY

A. SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The Nyanza Chemical Waste Dump Superfund Site (the Site) (CERCLIS ID# MAD990685422) is located on the north side of Megunko Road in the Town of Ashland, Massachusetts. The Town of Ashland is in Middlesex County and located 25 miles west of Boston and 20 miles east of Worcester (**Figure 1** in **Appendix C** of this ROD). The Site is adjacent to railroad tracks used daily by freight and commuter trains. A former landfill on Megunko Hill (now a capped Superfund landfill) is located to the southwest of the former Nyanza facility. The Site is bounded to the north by the Sudbury River. EPA is the lead agency and MassDEP is the support agency. EPA has performed and financed Remedial Investigation/Feasibility Study (RI/FS) activities for this Site. Several companies occupied the Site from 1917 to 1978, the most recent of which was the former Nyanza, Inc. facility, which manufactured textile dyes, dye intermediates, inorganic colloidal solids, and acrylic polymers. The Site includes three distinct areas: (1) the 35-acre former Nyanza, Inc. property which currently consists of wetlands, the Megunko Hill area, and an industrial park along Megunko Road; (2) drainageways between the former Nyanza, Inc. property and the Sudbury River, consisting of the Eastern Wetland, Trolley Brook, and Outfall Creak/Lower Raceway; and (3) a 26-mile stretch of the Sudbury River down to its confluence with the Assabet River in Concord, Massachusetts. A plume of groundwater with dissolved volatile organic compound (VOC) contaminants is flowing from the former manufacturing areas of the Site in a north/northeasterly direction toward the Sudbury River. The Federal Emergency Management Agency (FEMA) flood zones and MassDEP wetlands within the vicinity of the Site are shown on **Figure 3** in **Appendix C** of this ROD.

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

1. History of Site

Nyanza, Inc. was the most recent dye manufacturing company to occupy the Site. Starting in 1917, several types of chemical wastes were disposed of in various locations on the Site property with most of these wastes deposited on Megunko Hill, which was used as an unsecured landfill. Wastes included partially-treated process wastewater; chemical sludge from the wastewater treatment process; solid process wastes (e.g., chemical precipitate and filter cakes) in drums; solvent recovery distillation residue in drums; and off-specification products. Process chemicals that could not be recycled or reused (including phenol, nitrobenzene, and mercuric sulfate) were also disposed of on the Site property. Chemical wastes were also disposed in the wetland areas. The Trolley Brook and Eastern Wetland areas received waste effluent discharge from manufacturing operations in the area. The Western Wetland areas at the headwaters of Chemical Brook contained wastewater treatment sludge and possibly received overflow from an underground concrete wastewater vault that discharged into Chemical Brook. The underground concrete vault, which was taken out of service in the 1960s or 1970s, and removed in 1988, continued to be a source of contamination at the Site. Dye waste streams were discharged from the large concrete vault to Chemical Brook, Trolley Brook, underground through the Chemical Brook Culvert into Outfall Creek, and into the Lower Raceway that entered wetlands along the Sudbury River.

Residual dense non-aqueous phase liquid (DNAPL) remaining at the Site property, believed to be residing in shallow bedrock fractures, acts as an ongoing source of elevated VOC concentrations in groundwater flowing from the Site. The groundwater plume of dissolved VOCs is flowing in a north/northeasterly direction toward downtown Ashland, a dense area of residential and commercial use, to the Sudbury River. Elevated levels of chlorinated ethenes, such as trichloroethene (TCE), and chlorinated benzene compounds, such as 1,4-dichlorobenzene (1,4-DCB), have been identified in the overburden and bedrock groundwater aquifers. This residual groundwater contamination results in an unacceptable risk to human health for indoor air (via vapor intrusion) and dermal contact, inhalation, and ingestion of groundwater (via construction activities or private wells) within the contaminated groundwater plume.

Properties located in the current vapor mitigation area (VMA) have been provided with, or given the opportunity to be provided with, a vapor mitigation system (VMS) to eliminate the short-term vapor intrusion (VI) risks. However, these VMSs were voluntary for residences and businesses, did not address the source of contamination, and do not meet a statutory preference to attain a permanent solution to the contamination. The current VMA includes locations where the groundwater flow occurs at shallower depths below the ground surface and is shown on **Figure 2** in **Appendix C** (Site Plan) of this ROD.

The Site was added to EPA's National Priorities List (NPL) on December 30, 1982. The Site is divided into the following four Operable Units (OUs):

- OU1: Consists of the capped landfill, the former Nyanza, Inc. property, and adjacent areas where chemical wastes contaminated with heavy metals, VOCs and semi-volatile organic compounds (SVOCs) were disposed. A ROD was issued in 1985, and an Explanation of Significant Differences (ESD) was issued in 1992.
- OU2: Consists of a groundwater plume of volatile organic contamination that extends from the Site source area in a north/northeasterly direction toward the Sudbury River. A ROD was issued in 1991 selecting an interim remedial action, and an ESD was issued in 2006. This ROD presents a final cleanup action for OU2.
- OU3: Consists of the Eastern Wetland and various drainageways to the Sudbury River, including Trolley Brook, Chemical Brook, Outfall Creek and the Lower Raceway. These drainageways are located between the former Nyanza, Inc. property and the Sudbury River. In 1993, EPA issued a ROD for OU3.
- OU4: Consists of a 26-mile stretch of the Sudbury River which flows through five towns (Ashland, Wayland, Lincoln, Sudbury and Concord, MA) and one city (Framingham, MA) where sediment and fish tissue exhibit mercury contamination. EPA issued a ROD for OU4 in 2010 and an ESD in 2016.

The overall Site Plan is outlined in **Figure 2** in **Appendix C** of this ROD.

A more detailed description of the Site history can be found in Section 1.3 of the January 2020 FS report (Nobis, 2020).

2. History of Federal and State Investigations and Removal and Remedial Actions

Several removal actions were performed at the Site between 1987 and 1992:

- April 30, 1987: Approximately one gallon of sodium picrate was removed by a potentially responsible party (PRP), Nyacol Products, Inc.

- October to December 1987: Approximately 665 tons of soil adjacent to the underground concrete vault was removed by EPA (309 tons were incinerated, and 356 tons were shipped off-site to an approved landfill).

- June 10, 1988: Approximately 12,025 tons of sludge were removed from the underground concrete vault and placed into the on-site landfill cell by EPA. In addition, 2,512 tons of sludge from the vault were solidified on-site and disposed of at an off-site Resource Conservation and Recovery Act (RCRA) landfill facility by EPA. In addition, the vault was removed in 1988.

- February 10, 1989: Approximately 10,000 gallons of sulfuric acid sludge was removed by a PRP, Edward Camille.

- April 21, 1989: The contents of three tanks and excavated soils beneath the tanks were removed and disposed off-site by EPA as part of a Removal Action named the "Megunco Road Site. The removal site was located on a vacant unrestricted parcel (approximately 0.25 acres) which was used to dispose of old mixing tanks, pressure vessels, process tanks, and general debris.

- May 7, 1990: An estimated 50 to 100 buried drums were removed by EPA from a 0.5 acre parcel on Megunko Hill (now part of the Nyanza landfill). This removal action, referred to as "Ashland Drum Removal", was completed to eliminate the hazard presented by those drums.

- June 18, 1992: Fish consumption advisory signs were posted by EPA along the Sudbury River due to elevated levels of mercury in fish tissue from contaminated river sediment.

Several remedial actions were also performed at the Site between 1990 and 2016:

Operable Unit 01 – On-Site Landfill (1990 – 1992):

A ROD was issued for OU1 in 1985, and an ESD was issued in 1992. Remediation activities occurred between 1990 and 1992, which included: the excavation of sludge deposits and contaminated soils and sediments in the former Nyanza industrial areas; capping an area known as "the Hill" on Megunko Road (now the capped landfill); creating an groundwater and surface water diversion trench and drainage system on the upgradient side of the landfill; backfilling excavated areas to original grade; fencing the landfill site; establishing a vegetative cover in adjacent wetland areas; and expanding groundwater monitoring. More than 65,000 cubic yards of contaminated soil were excavated and placed in the landfill cell in 1990. Final construction of the landfill cap was completed in 1991.

Operable Unit 02 – Groundwater (1991 – 2006):

OU2 was originally established to address groundwater contamination. In 1991, EPA issued a ROD for OU2 for an interim remedial action. Through the completion of various studies and additional monitoring, the scope of OU2 has expanded to address DNAPL recovery and vapor mitigation. This scope expansion was documented in the 2006 Explanation of Significant Differences (ESD). The 1991 ROD and 2006 ESD did not establish cleanup levels for groundwater due to Site uncertainties at the time.

1991 ROD:

In June 1987, EPA authorized the initiation of investigative activities for OU2 to address contaminated groundwater migrating from the Site. A ROD was signed on September 23, 1991. The selected interim remedy included extraction and treatment of groundwater for a minimum of five years and conducting additional studies before adoption of a final remedy. Technical design studies for the selected remedy began in early 1992. A pilot groundwater extraction and treatment system was constructed in 1994. A DNAPL emulsion was discovered during the step test phase of the pilot system pumping test and was then observed in the recovery well and observation well. Additional pumping of the recovery well and one observation well found very slow recovery rates for the DNAPL. However, the DNAPL emulsion proved detrimental to the groundwater pump seals, causing the pumps to cease function. In 1994, the pilot test was discontinued, and the groundwater extraction and treatment remedy was postponed indefinitely.

The 1991 ROD required the development of institutional controls to limit exposure to contaminants through the installation of private wells and during excavation activities in the area of known groundwater contamination. Currently, EPA has established an informal process of communication with the Ashland Board of Health to ensure that property owners are aware of the contaminated groundwater plume and that EPA is notified if excavation is planned or private wells are proposed. The Town of Ashland does not use groundwater from the contaminated plume for their drinking water supply. The Town of Ashland also does not have any knowledge of or permits for private irrigation or production wells in the groundwater plume.

Groundwater monitoring was initiated in 1998 on a semi-annual basis until 2004. Initial data indicated that the shallow contaminated groundwater plume extends under numerous homes, businesses and municipal buildings, which prompted EPA to undertake an indoor air sampling program. Indoor air samples were collected from nine residences, the Town Hall, and the police department in late 1998 to determine if contaminants in the groundwater were volatizing and migrating into homes and businesses (through vapor intrusion) at levels that might affect public health. Results of the sampling indicated that none of the five targeted compounds (TCE, vinyl chloride, chlorobenzene, 1,4-dichlorobenzene, and benzene) exceeded screening levels established by EPA and MassDEP at that time.

Between 1999 and 2003, several studies were conducted to evaluate potential ecological risks posed by the groundwater plume discharging into the Sudbury River. Results indicated that aquatic life was affected in one of three areas studied, but any impact on aquatic life could not be tied definitively to the groundwater plume or other existing natural habitat conditions such as storm water runoff, low dissolved oxygen levels, stagnant water, or high amounts of detritus (leaf litter).

In 2004, EPA reevaluated the potential risk posed by the vapor intrusion pathway after EPA issued the Draft Guidance for Evaluating Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils in November 2002. This guidance provided suggested approaches for evaluating the VI pathway and established lower screening criteria for evaluating potential risk. Based on the TCE detections and continued elevated concentrations in groundwater, and based on new toxicity information, a second indoor air sampling program was conducted in 2004. TCE and four other contaminants were detected in several buildings sampled, with concentrations exceeding the lower end of the new screening range. Exceedances of the updated screening level range prompted EPA to make a proactive and conservative decision to perform a risk assessment in 2005 on all the available air data to determine if potentially unacceptable inhalation risks are possible using the proposed toxicity information for TCE. The risk assessment concluded that use of the new proposed TCE toxicity information resulted in a potentially unacceptable risk from continued long-term inhalation of vapors in seven of the fourteen buildings sampled, and the Ashland Town Hall.

2006 ESD:

In 2006, EPA issued an ESD for OU2. The ESD did not modify the general goals for groundwater remediation established in the 1991 ROD, but rather furthered refined the goals by creating two distinct remedial phases:

1) Installation of vapor mitigation systems in buildings located over the most contaminated portions of the groundwater plume; and
2) Installation of DNAPL extraction systems.

The ESD required that certain pre-construction activities be performed to delineate the vapor mitigation area more accurately.

In November 2006, the EPA installed 6 new shallow monitoring wells and performed an indoor air and soil gas sampling study. The goal of the air study was to determine and delineate the extent where a public health threat existed due to VOCs from the groundwater plume migrating into buildings and impacting indoor air quality. Based on the indoor air and groundwater sampling data, EPA identified 41 properties for the installation of VMSs.

The VMSs mitigate the current vapor intrusion risk identified by EPA by reducing the potential for vapors from groundwater contaminants, such as TCE, to migrate and accumulate in buildings at concentrations that may pose health risks. Sub-slab depressurization is the method of vapor mitigation. Sub-slab depressurization systems (SSDSs) work by creating a lower pressure area under a building's basement or slab relative to the interior of the building by use of a fan and a series of extraction pipes. As a result, vapors that accumulate under a building are less likely to enter the building's interior. A fan draws sub-slab soil gas from below the floor which is then vented outside through an exhaust pipe. The VMSs are similar to radon remediation systems.

The VMS installations were completed in September 2007, with a total of 43 systems installed in 41 buildings. One property owner at a 42nd location/building did not provide access to EPA to collect indoor air and soil gas data or to install a VMS. A Remedial Action Report for the Vapor Mitigation Phase of the OU2 remedy was issued on June 30, 2008. To maintain the effectiveness of the OU2 remedy, MassDEP assumed O&M responsibilities and conducts routine annual inspections of the VMSs and makes any necessary repairs where property access is granted by the owner.

A DNAPL assessment was performed in 2009 using an exploratory drilling program to identify areas likely to provide the best DNAPL recovery. In 2013, a DNAPL Extraction System Evaluation Report was prepared to evaluate different mechanisms by which DNAPL could be extracted from the bedrock from two well locations, MW/B-11 on the Nyacol property, and MW-113A on the WAC property located across the railroad tracks north of the former Nyanza, Inc. property. In September 2013, extraction systems were installed in both wells. Groundwater monitoring was reinitiated with annual sampling of approximately 30 existing monitoring wells for Site target contaminants.

The 2006 ESD also maintained the necessity for Institutional Controls to prevent the installation of new wells within, or in the vicinity of, the groundwater plume, and to prevent exposure to contaminants that could be encountered during construction or utilities excavations.

The 2006 ESD also proposed future additional indoor air monitoring in structures located above the downgradient plume, but which are outside the boundaries of the current VMA (shown on **Figure 2** in **Appendix C**). The purpose of additional indoor air sampling was to determine if any current VI inhalation risks existed outside of the currently delineated VMA that were not previously identified. Between 2014 and 2018, the EPA Region 1 OEME air technical team performed several indoor air and sub-slab soil gas sampling events at various residential, commercial, and municipal properties outside of the VMA. The sampling events included the collection of indoor air (in the basement and/or first floor of structures), sub-slab soil gas (below building slab foundations), and outdoor ambient air samples. The sampling was completed on a voluntary basis at properties where access was obtained from the property owner(s). In 2014 and 2015, indoor air and sub-slab soil gas data was collected at a large commercial property on Pleasant Street. TCE was found in the sub-slab soil gas below the building foundation but was not detected in the indoor air of the building. Results showed no exceedances of the commercial vapor intrusion screening levels (VISLs) in indoor air for the target compounds, except for benzene, which was determined to be within EPA's acceptable risk range. In 2016, indoor air was collected from the police station, and indoor air and sub-slab soil gas samples were collected from the fire station buildings, both of which are located on Main Street in Ashland. No unacceptable VI risk from TCE or other target VOC contaminants was identified in either building. In 2018, indoor air samples were collected from 10 buildings (9 residential, 1 commercial) located immediately outside the current VMA. Sub-slab soil gas samples were also collected from 7 of the 10 properties. In addition, indoor air samples were collected from 1 mixed commercial/residential building which currently has a VMS installed, per the request of MassDEP. No unacceptable VI risk was identified for TCE or the other target compounds in indoor air. TCE was detected in the sub-slab soil gas in 5 of the 7 buildings tested, but TCE was not detected in the indoor air. These findings indicate that although TCE is present in the area groundwater, and in some cases in the soil gas below slab foundations, TCE vapors are not migrating into these buildings located outside the VMA.

<u>Operable Unit 03 – Eastern Wetland and Drainageways to the Sudbury River (1993 – 2006)</u>:

A ROD was issued for OU3 in 1993, and remedial actions were completed between 1999 and 2001. The OU3 remedy was an additional source control remedy involving the cleanup of mercury-contaminated sediment in the Eastern Wetland and four key drainageways (Trolley Brook, Chemical Brook, Outfall Creek, Lower Raceway) between the former Nyanza Inc. property and the Sudbury River, which was acting as a continuing source of mercury contamination to the river. The goals were to mitigate mercury contamination in sediment in areas where accidental ingestion and dermal contact with contaminated sediments may result in unacceptable human health risks, to reduce mercury levels in the sediment and in fish in the Sudbury River, and to achieve an increased level of protection to environmental receptors equal to that found in background areas. The mercury-contaminated sediments were excavated from the wetlands and drainageways, dewatered, and placed in the existing on-site OU1 landfill. Chemical Brook, which runs parallel to the railroad tracks, was partially excavated, and the soil/remaining sediment was covered with a geotextile liner. The landfill cap area used during remedial activities was reconstructed and the impacted wetlands were restored.

Operable Unit 04 – Sudbury River (1992 – 2016):

EPA issued a ROD for OU4 in 2010 and an ESD in 2016 (which modified the 2010 ROD). Various Sudbury River investigations and remedial activities for OU4 were completed by EPA during 1992 – 2016, including implementing ICs (i.e., the posting and inspection and maintenance of fish consumption and mercury advisory signs along the Sudbury River in 6 communities), sediment sampling, fish tissue collection from the Sudbury River to monitor mercury levels, and human health risk assessments and in-depth ecological risk assessments pertaining to mercury and mercury exposure. A thin-layer sand cap that was proposed in 2010 for a more heavily mercury-contaminated area of the Sudbury River was replaced with a monitoring only remedy in 2016 based on several factors, including: updated human health risk assessments which showed a reduction in the risk of adverse health effects to recreational anglers (child and adult), natural biochemical processes (i.e., burial and dilution), and legislative measures enacted to reduce mercury emissions.

3. History of CERCLA Enforcement Activities

EPA has pursued several enforcement actions against potentially responsible parties at the Site. In 1982, EPA issued General Notice Letters to eighteen (18) potentially responsible parties. EPA issued a second round of General Notice Letters in January 1991 to twenty-one (21) potentially responsible parties. On March 25, 1994, EPA issued Special Notice Letters to sixteen (16) parties to begin formal settlement negotiations. As a result of these efforts, EPA entered into five separate Consent Decree settlements for past response costs: three settlement agreements with non-landowners and two settlement agreements with landowners.

On December 9, 1997, Rohm Tech, Inc, EPA and the Commonwealth entered into a Consent Decree in which Rohm Tech, Inc. agreed to pay a total of $4.2 million to the Natural Resource Trustees, EPA and the Commonwealth for reimbursement of past response costs.

On December 9, 1997, Scott Taylor, Estate of Roland E. Derby, Sr., Estate of Roland E. Derby, Jr., entered into a Consent Decree with EPA and the Commonwealth in which the settling defendants agreed to pay $565,000 to the Natural Resource Trustees, EPA and the Commonwealth for reimbursement of past response costs. In January 1998, Scott Taylor paid an additional $12,000 to EPA and the Commonwealth based on the Decree requiring additional insurance payments.

On June 24, 1998, PQ Corporation, Nyacol Products, Inc., Robert M. Lurie, Nancy Lurie, Thomas L. O'Connor, and Grace O'Connor entered into a Consent Decree with EPA and the Commonwealth. Pursuant to this settlement, $750,000 was paid to the Natural Resource Trustees, $5.8 million to EPA and $1.45 million was paid to the Commonwealth for past response costs.

The first landowner settlement was entered on August 1, 2000. Robert E. Gayner, MCL Development Corporation, Edward Camille and John Glynn, Jr., as Trustee of the Environmental Restoration Engineering Trust entered into a Consent Decree with EPA and the Commonwealth in which the settling defendants agreed to pay $375,000 to the EPA and the Commonwealth for reimbursement of past response costs. These landowners also agreed to file restrictive easements with respect to their parcels.

The final landowner settlement was a De Minimis Consent Decree entered on August 1, 2000 between Nelson W. Holden and Martha E. Holden, as Trustees of the Holden-Ashland Trust, William M. Leacu

(Leacu), the EPA and Commonwealth. The Holden-Ashland Trust and Leacu each agreed to file restrictive easements with respect to their properties.

As part of the two landowner Consent Decrees in August 2000, the landowners are required to file restrictive easements on their properties. These land use restrictions include the prohibition of the following activities: 1) groundwater extraction, consumption, or utilization; 2) soil excavation; 3) construction of buildings; 4) residential daycare, school, recreational, or agricultural use; and/or 5) interference with the remedy. Certain restricted activities, however, can be conducted if approved by EPA/MassDEP and if the activity does not result in an unacceptable risk to human health or the environment.

In August 2013, a Grant of Environmental Restriction and Easement (GERE) was filed in the Southern Middlesex Registry of Deeds which established certain use restrictions on properties located in four areas of the Site: the fenced landfill cap area, eastern wetland area, the western wetland area, and certain properties along Megunko Road (including the Nyacol property). In all four areas, the GERE restricts the extraction, consumption and utilization of groundwater. In all areas except for the western properties, the GERE outlines restrictions for soil excavation and construction projects; residential, daycare, school, recreational or agricultural use; and any activity that would interfere with the remedy or remedies.

C. COMMUNITY PARTICIPATION

Throughout the Site's history, community concern, interest, and involvement have been consistent. EPA has kept the community and other interested parties apprised of Site activities through informational meetings, fact sheets, press releases, and public meetings. Below is a brief chronology of the most recent public outreach efforts for Nyanza OU2:

- In April 2016, EPA held an informational Site update meeting for the Ashland Board of Health; this meeting was also open to the public.
- On March 23, 2017, EPA was invited to attend a Nyanza Advisory Committee (NAC) meeting to discuss potential groundwater ordinances, moratoriums, and restrictions for private wells in Ashland; this meeting was open to the public.
- On May 9, 2019, EPA was invited to attend a NAC meeting and provided an update with a focus on OU2 activities; this meeting was open to the public.
- On January 9, 2020, EPA published a news release which announced the start of the public comment period and upcoming public information meeting and public hearing for the Proposed Plan for OU2. EPA also produced and mailed postcards of this meeting information to nearby property owners. A public notice was completed to announce the release of a link on EPA's website to the Proposed Plan, which identified EPA's proposed remedy for OU2.
- On January 13, 2020, EPA completed the Administrative Record (AR) for the Proposed Plan, including the January 2020 Feasibility Study report, and made them available for public review at EPA's office in Boston, MA, and at the Ashland Public Library, 66 Front Street, Ashland, MA. The AR file is the primary Site information repository for residents and has been kept up to date by EPA.

- On January 23, 2020, EPA held a public information meeting, immediately followed by a Public Hearing, to describe and then discuss the Proposed Plan for OU2, and to accept any oral or written comments. A transcript of this meeting and the comments, as well as EPA's response to comments, are included in the Responsiveness Summary, which is Part 3 of this ROD.
- From January 14, 2020 through March 30, 2020, EPA held a public comment period (initially 30 days but later, in response to a request, extended to 45 days) to accept public comments on EPA's proposed remedy for the Site presented in the Proposed Plan.

D. SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

EPA has determined that there are both current and future potential threats to human health at the Site due to historic chemical and waste storage and disposal practices from the former dye manufacturing operations, the presence of DNAPL at the Site and subsequent groundwater VOC contamination. Waste disposal practices included the direct discharge of partially treated or untreated process wastewater (sourced from dye operations) from a large concrete vault into Chemical Brook and through other drainageways to the Sudbury River. Process chemicals that could not be recycled or reused were also disposed of on the former Nyanza, Inc. property, and chemical wastes and sludges were disposed in adjacent wetland areas. Prior cleanup actions (described in Section B.2 above) have been implemented for OU2 and the other three Site OUs. EPA is pursuing a final remedy for the OU2 groundwater contamination as outlined in this ROD. This final remedy and ROD expand upon the previous actions implemented for groundwater under OU2. In summary, the 1991 ROD required restoration of the groundwater and institutional controls to control exposure to the groundwater. The 2006 ESD modified the 1991 ROD for OU2 to require vapor mitigation systems to address vapor intrusion issues caused by groundwater and further expanded the institutional controls to address vapor intrusion and construction worker risks. This ROD (final remedy for OU2) expands the groundwater remedy further by providing a revised approach for restoration of the groundwater and further clarifies the institutional controls to address vapor intrusion risks.

Residual DNAPL is acting as an ongoing source of groundwater VOC contamination. Elevated levels of chlorinated ethenes such as trichloroethene (TCE) and chlorinated benzene compounds have been identified in the overburden and bedrock aquifer groundwater; this results in an unacceptable risk to human health from indoor air (vapor intrusion) and dermal exposure or ingestion of groundwater (via construction activities or private wells) from the areas of concern.

In summary, the selected remedy provides for additional investigations for locating additional DNAPL for extraction and recovery and in-situ groundwater treatment in the Nyacol/WAC AOC, expansion of the existing groundwater monitoring well network, long-term groundwater monitoring throughout the groundwater plume, periodic five-year reviews to assess remedy protectiveness, and new/additional Institutional Controls to require a vapor intrusion evaluation or a vapor mitigation system be installed if a new building is constructed over the contaminated groundwater plume, or if an existing building with a VMS is renovated or expanded, until groundwater remediation goals have been met or vapor intrusion risks have been mitigated.

Groundwater monitoring will be conducted throughout the groundwater plume, including the Nyacol/WAC AOC and the existing vapor mitigation area in downtown Ashland; additional groundwater monitoring will also be conducted to assess remedy performance in the downgradient plume and a portion of a potentially productive aquifer (PPA) designated by the MassDEP. The PPA area is shown on Figure **2** in **Appendix C** of this ROD. In 2019, the MassDEP completed an updated Groundwater Use and Value Determination (GWU&VD), which revised and reduced the size of the potential source area of the PPA (on the eastern perimeter of the PPA) defined in the 2014 GWU&VD. Based on current and historical groundwater data for overburden and bedrock aquifers, and the overall hydrogeology of the Site in this area, EPA does not anticipate Site-related groundwater contamination within the PPA. Groundwater remedy performance monitoring will allow EPA to monitor VOC concentrations, assess interim and long-term progress in attaining groundwater remediation goals, and determine the timeframe and duration for various cleanup steps described in this ROD.

E. SITE CHARACTERISTICS

The most recent significant Site findings can be found in the final January 2020 FS report and are summarized below.

1. Physical Setting

This section, summarized from the January 2020 FS report, presents information on the physical setting of the Site.

Site Geology

Site soil consists primarily of silty fine sand and silt, with some zones of fine to coarse sand and gravel to boulders. Grain size analysis from samples collected at 17 borings during the 1991 RI indicated that soil texture ranged widely both laterally and vertically. Units encountered generally consisted of fill (primarily sand and gravel mixtures) above glacio-fluvial and glacio-lacustrine units. The fluvial and lacustrine deposits were interbedded and laterally interfingered, likely because of variable meltwater and sediment volumes at the fluctuating ice margin. Glacial till covers Megunko Hill and the uplands immediately to the south. The apparent restriction of till to this area may be the result of either glacial scouring or erosion during glacial recession. Glacio-lacustrine deposits were encountered on both sides of the Sudbury River, with thicknesses ranging from 5 to 50 feet. Cobbles and boulders were also encountered resting on bedrock beneath the east end of Pleasant Street, at the deeper portions of a bedrock trough. Alluvial deposits are located along the Sudbury River channel and shoreline, and consist of sand, silt, gravel, minor amounts of clay and swamp deposits. A meandering feature visible on historical aerial photos in the center of the groundwater plume likely represents a pre-glacial riverbed and former stream channel for the Sudbury River.

The bedrock at the Site consists of Milford Granite of Lower Paleozoic to Precambrian age, which is slightly to highly fractured. The depth to bedrock at the Site ranges from approximately 3.5 feet below ground surface (bgs) to 111 feet bgs. The bedrock is generally un-foliated to very weakly foliated. The upper portions of bedrock, especially the upper two-to-eight feet, tend to be weathered and highly fractured. Rock quality designation (RQD) values are generally much lower more than 15 feet below the bedrock surface. Rock core logs from the RI indicate that most of the intersected fractures were horizontal to sub-horizontal in orientation. Borehole geophysics noted that open fractures occurred at a much higher frequency in the upper 10 feet of rock, and that fracture strike was west and northwest, with fractures dipping to the north. One borehole (near well location MW-408A) intersected a diabase dike at approximately 43 feet bgs. The bedrock surface is highest at Megunko Hill and decreases radially from the hill to a valley parallel to and south of the eastern end of Pleasant Street. Generally, the bedrock surface slopes northeastward from the capped landfill, toward the Nyacol and WAC properties, and then continues to slope downward but more gradually. An east-west, shallow trough in the bedrock surface extends, in the mid-plume area, from the MW-203 through the MW-115 well clusters, and across Main Street to the MW-405 cluster. At Mill Pond and to the north, the bedrock surface rises.

The former river channel is mapped north of the railroad tracks and includes the current DNAPL extraction well MW-113A on the WAC property. The mapped former channel also includes an oval-shaped trough in the top surface of the bedrock in the MW-113A area and a photolineament intersection. This latter feature may represent an area where bedrock fracture zones intersect and where the bedrock was more susceptible to erosion and channelization by the Sudbury River. Boring logs from the DNAPL investigation and the step drilling investigations at the WAC property indicate that overburden subsurface material encountered were interpreted (from shallow to deep) as fill, outwash, lacustrine, and till overlying bedrock. The depth to bedrock within the core of the downgradient plume, generally the area near well clusters MW-203A/B to MW-115A/B, is approximately 70 feet bgs. Overburden deposits in the downgradient plume tend to consist of a thin fill layer above interbedded glacial fluvial and glacial lacustrine materials.

The existing Site groundwater monitoring well network is depicted on **Figure 4** in **Appendix C**.

Hydrogeology

Groundwater flows to the northeast from the landfill and former Nyanza facility. Near the railroad tracks, the groundwater flows in a more easterly direction, parallel to the portion of the Sudbury River that is upstream of the dam. Measured water elevation levels from 2013 to 2015 (the most recent complete data set) were used to calculate the horizontal gradient for both overburden and bedrock aquifers. Two hydraulic gradients were calculated for each unit based on available monitoring well data: (1) a northern flow line starting from the WAC property and following approximately the northern edge of the center plume area; and (2) a southern flow line starting from the northern edge of the landfill and running along the southern edge of the center plume area. Most of the horizontal gradients were below 0.01 ft/ft. The highest horizontal gradients were in bedrock along the flow line from the landfill to the southern edge of the center plume area. Horizontal gradients tended to be slightly higher in the spring (high groundwater conditions).

Vertical hydraulic gradients were calculated for locations with a bedrock well and an overburden well in close proximity. Vertical gradients were calculated by dividing the difference in water elevations in the two wells by the difference in elevation of the saturated screen midpoints for the two wells. If multiple bedrock wells were located in the same area, the deepest bedrock well was used for the calculation. Vertical gradients tended to be low (less than 0.02 ft/ft). Well pairs with strongly negative or positive vertical gradients were located closer to the landfill. Vertical gradients were also measured for low and high groundwater conditions and were generally similar for both conditions. They tended to be mixed but generally downward northeast (downgradient) of the landfill, very low to slightly upward at the plume center, upward at the northeast end of the plume, and flat or variable southeast of the end of the plume.

Water level measurements were collected by EPA in Mill Pond and selected nearby monitoring wells approximately bi-weekly from August 2015 to March 2016. The measurements indicated that horizontal and vertical gradients between groundwater and surface water have occasionally reversed directions. While discharge of groundwater to surface water is typical, on several dates, water levels in Mill Pond were higher than those in nearby wells and piezometers, indicating downward vertical gradients. These conditions favor the flow of water from Mill Pond to groundwater. This suggests that surface water may recharge to groundwater and vice versa at different times, and that the Mill Pond dam creates an artificial condition that may divert the groundwater plume in a more easterly direction. Overburden groundwater flow direction, potentiometric surfaces and elevations, and contours for the Site are depicted on **Figure 5** in **Appendix C.**

Hydraulic conductivities were calculated during the 1991 RI using rising head tests (overburden and bedrock), packer tests (bedrock) and grain size analysis (overburden). The hydraulic conductivity in the glacio-fluvial sediment ranged from 0.04 to 48 feet/day, with the higher values from the wells downgradient of the Site to the southeast. Hydraulic conductivity values in the glaciolacustrine sediment ranged from 0.05 to 6 feet/day. Grain size analysis indicated that some stringers of clean sand had much higher conductivity (more than 100 feet per day), which were not reflected in the much larger-scale rising head tests in the same location. Hydraulic conductivity in the bedrock ranged from 0.002 to 23 feet/day; however, these values do not include the bedrock boreholes with no packer test response (approximately 30 percent of the boreholes tested), and the bedrock matrix is expected to have generally low conductivity overall.

Slug tests on wells MW-113A and MW/B-5, conducted during the 2009 step drilling investigation, yielded a hydraulic conductivity of 2.00 to 2.35 feet/day for MW-113A and 9.39 feet/day for MW/B-5. Overburden aquifer groundwater velocity was estimated to range from 0.03 to 0.07 feet/day, and bedrock aquifer groundwater velocity was estimated to range up to 0.03 feet/day, based on previous studies. It is important to note that individual bedrock fractures may have much higher groundwater velocities.

2. Conceptual Site Model

The sources of contamination, release mechanisms, exposure pathways to receptors for soil, groundwater, surface water, sediment, indoor air, as well as other site-specific factors, are considered while developing a Conceptual Site Model (CSM). The CSM is a picture of site conditions that illustrates contaminant sources, release mechanisms, exposure pathways, migration routes, and potential human and ecological receptors. It 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 all environmental media for the Site are based on this CSM. Section 1.4 of the January 2020 FS report for Nyanza OU2 contains an updated and more detailed discussion of the sources of contamination, nature and extent of contamination, and contamination fate and transport. The significant findings are summarized below.

Sources of Contamination

Nyanza, Inc. and its predecessors manufactured a wide variety of dyes and intermediates from 1917 to 1978. The 1980 Preliminary Site Assessment identified product usage, major process flow sheets, and

waste management practices. In one year (1967), Nyanza, Inc. produced 76 different dyes and 49 intermediate products, with a total production of approximately 1.6 million pounds. Only partial records were available during the Preliminary Site Assessment, but the bulk raw material was considered to be similar for previous years. Primary solvents purchased in 1970 included nitrobenzene (30,250 pounds [lbs.]), 2-nitrochlorobenzene (20,850 lbs.), 2-nitrotoluene (25,000 lbs.), and TCE (1,000 lbs.). Other major raw materials purchased included phenol (23,660 lbs.), and many salts, acids, especially hydrochloric acid (more than 1 million lbs.), and caustic bases such as soda ash (310,000 lbs.), caustic liquid (242,000 lbs.), and caustic soda flakes (266,000 lbs.).
Liquid wastes were collected in sewers and partially treated as early as 1919, but wastewaters from un-sewered buildings and an emergency bypass system were directly discharged to a ditch next to the railroad tracks (Chemical Brook; Figure 1-2). Sludge was assumed to be dewatered and then buried at various locations onsite prior to 1960, while from 1960-1978, the sludges were pumped or hauled to the top of Megunko Hill to evaporate or drain to the subsurface and then covered with fill. A 1960 process change resulted in the generation of larger volumes of sludge (an estimated 17 cubic yards [cy]/day), and the Massachusetts Department of Environmental Quality Engineering (DEQE) assumed that over 50% of the wastewater was bypassed without any treatment. In 1970 or 1971, the discharge was tied into the Metropolitan District Commission sewer and all bypass lines were removed. The system was also modified in 1974 to reduce the production of wet sludge to 0.185 cy/day. Off-spec solid material, distillation residue, and process solid wastes were placed in drums and buried on-site. The 1991 OU2 RI and the 2006 DNAPL Alternatives Memorandum identified the following potential DNAPL source areas (which are shown on **Figure 2** in **Appendix C** of this ROD):

Former Concrete Vault

This former vault located on the Nyacol property was used to collect wastewater, and was estimated to be 80 feet long, 40 feet wide, and 8 feet deep. The vault was determined to be the largest single source of contamination to groundwater. Sludges from the vault were pumped into on-site pits, and liquids were separated and discharged into Chemical Brook (described below). Samples from a 1987-1988 cleanup of the vault and surrounding soils contained high concentrations of TCE (25 mg/L), chlorobenzene (100 to 200 mg/L), 1,2- DCB (1,000 mg/L), 1,4-DCB (340 mg/L), and nitrobenzene (1,500 mg/L). A crack was observed in the north wall of the vault. From 1987-1988, the EPA and DEQE performed an emergency cleanup of the vault wastes and surrounding soils. The vault contents (2,512 tons of sludge) and adjacent soils (309 tons) were removed. The 2009 and 2012 step-drilling investigations to locate DNAPL focused on the area downgradient of the vault.

Chemical Brook

Chemical Brook, which flows parallel and adjacent to the active railroad tracks, is believed to have received overflow from the concrete vault. The upper 6 to 12 inches of soil were excavated from the channel without reaching the limit of organic contamination, but no dark staining characteristic of DNAPL was encountered. During the remedial actions for OU3 (wetlands and drainageways) in 1991-2001, additional excavation of Chemical Brook was completed, and the remaining sediment was covered with a geotextile liner and lined with crushed stone.

Former Lined Lagoons

Two lagoons located northeast of the Megunko Hill capped area (the former Megunko Hill dump, now the capped OU1 landfill), received process wastewaters which were neutralized with ammonia, lime, or sodium hydroxide. The concentrations of VOCs, semi-volatile organic compounds (SVOCs), and other chemicals in these wastewaters are not known. There are no reports of substantial quantities of DNAPL-stained soils associated with the lagoons.

Megunko Hill Dump

Investigators initially estimated that 6,000 or more drums of chemical waste were buried on the Site property, many on Megunko Hill. While the Megunko Hill dump contained organic sludges, no discrete concentrated sources of organic contamination were identified during the 1991 RI. The landfill was capped during OU1 remedial activities in 1990-1992.

Area E

Area E, located east of the Nyacol property and near the railroad tracks, was found to contain soils heavily contaminated with organic chemicals. The area was partially remediated in 1990, but excavation stopped at the water table. The concentrations of organic chemicals in the remaining soil exceeded background levels but were not reported to be characteristic of DNAPL saturation.

Nature and Extent of Contamination

Groundwater:

The main contaminants of concern (COCs) in groundwater are as follows:

- Volatile Organic Compounds (VOCs): These include a variety of chemicals that are used in glues, paints, solvents and other products which easily evaporate. Two categories of VOCs detected in the groundwater at elevated levels include:
  - Chlorinated ethenes: trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (VC).
  - Chlorinated benzenes: 1,2,4-trichlorobenzene (1,2,4-TCB), 1,2-dichlorobenzene (1,2-DCB), 1,4-dichlorobenzene (1,4-DCB), and chlorobenzene.

TCE is the primary COC for Site-related vapor intrusion issues. Overburden and bedrock aquifer TCE concentration maps are illustrated on **Figures 6 and 7** in **Appendix C** of this ROD.

- Semi-Volatile Organic Compounds (SVOCs): SVOCs are a subgroup of VOCs that tend to have a high molecular weight and high boiling point temperature. Nitrobenzene is present at elevated levels in two groundwater monitoring wells on the WAC property in the Nyacol/WAC AOC.

DNAPL Description:

DNAPL was first discovered in well MW-113A, currently an extraction and recovery well located on the WAC property. The material was a reddish to dark brown liquid with a low viscosity and a very strong almond-like chemical odor. During the 2012 step-drilling investigation, DNAPL product was also encountered in well MW/B-11. DNAPL was previously detected in wells RW-1, MW/B-5, and SB-600, but is no longer detected in these wells. DNAPL thickness up to 4.4 feet has been measured during previous investigations. The DNAPL from extraction well MW-113A was determined to have a density of 1.233, a kinematic viscosity of 0.973 centistokes at 100°F, a surface tension of 39.1 dynes/cm, and a flash point of >200°F. The 2017 DNAPL fingerprinting analysis completed by Nobis found that the most significant individual constituents were 1,2-DCB (30 percent), nitrobenzene (17 percent), chlorobenzene (3.1 percent), 1,4-DCB (7.0 percent), TCE (1.2 percent), 1,3-DCB (1.3 percent), and 1,2,4-trichlorobenzene (TCB) (1.0 percent). DNAPL was not available to sample in 2018. These concentrations are generally within 2 percent of those detected in 2015. DNAPL extraction and recovery systems have been installed in wells on the WAC (MW-113A) and Nyacol (MW/B-11) properties. Free-phase DNAPL product is often observed in MW-113A, while a DNAPL/water emulsion is typically present in MW/B-11. As of 2018, an estimated 246 gallons of DNAPL have been removed from MW-113A, and 233 gallons of a DNAPL/water emulsion have been removed from MW/B-11 since start of extraction and recovery in 2013. In 2006, a high-probability DNAPL zone was delineated in which DNAPL was likely to be present. The high probability DNAPL zone was estimated to be 400 feet in diameter, surrounding the former vault and WAC property building, depicted on **Figure 6** in **Appendix C** of this ROD. The 2006 study concluded that existing DNAPL is likely to be discontinuous, which was confirmed by the results of the 2009 and 2012 step drilling investigations. Pumping tests conducted within the study area suggest that DNAPL-bearing fractures are likely hydraulically isolated, as evidenced by a lack of water level response in adjacent bedrock wells.

Contaminant Fate and Transport

In general, the CSM outlined in the 1991 RI for fate and transport of VOCs has been supported by later studies. The highest concentrations of chlorinated ethenes, chlorinated benzenes, and nitrobenzene (including DNAPL) have historically been encountered in the bedrock immediately downgradient of the former concrete vault. The presence of DNAPL and elevated concentrations of related dissolved-phase organic chemicals indicate that the contaminants from the vault migrated downward as a DNAPL via density-driven flow. Given the timeframe of manufacturing at the Site (up to 100 years), fluids including DNAPL have likely migrated into dead-end fractures and sorbed extensively to the contaminant matrix in areas of minimal groundwater flow. Individual bedrock fractures may be hydraulically isolated from other nearby fractures, resulting in isolated accumulations of DNAPL within bedrock fractures. Available evidence does not suggest that DNAPL has migrated in fractures away from the Nyacol/WAC AOC; however, bedrock data are limited immediately north and east of these properties. Soil in the potential DNAPL area consists primarily of silty and fine sands, suggesting that residual contamination may be entrained within the finer material. Previous investigations in 1991 identified some areas of stratified sands and silts indicative of glaciolacustrine deposits within the overburden plume area. These depositional layers of alternating sand and silt, although small in scale, can provide preferential pathways for lateral DNAPL migration and may be significant reservoirs for residual DNAPL contaminant mass. Borings installed for the 1991 RI also encountered zones within the plume with significant gravel, cobbles, and boulders, which may allow for preferential flow.

Fracture trace analysis mapped two photolineaments interpreted as fracture zones intersecting areas of high concentrations: one potential fracture zone extending from the northeast edge of Megunko Hill and running north-northwest to intersect the Sudbury River, and one potential fracture zone starting north of the former vault and extending to the northeast just west of the MW-304 well cluster. The highest historical concentrations of TCE are located along the northeast-trending fracture, and relatively high concentrations of both chlorinated benzenes and ethenes extend roughly along this orientation to the MW-304 well cluster. The northwest fracture orientations run transverse to groundwater flow and may explain why the groundwater plume is relatively broad in bedrock. A former Sudbury River channel and mapped depression in the upper bedrock surface (shown on **Figure 5** in **Appendix C**) occur in the same area as high concentrations near the WAC property and the northeast-trending fracture zone. Vertical hydraulic gradients adjacent to the Sudbury River indicate potential for reversing groundwater flow to and from the river in the Mill Pond area, so contamination near the MW-304 and MW-305 well clusters may migrate downgradient (east) when conditions do not favor discharge northward to Mill Pond. Groundwater gradients appear to be consistently upward at the far northeast edge of the plume, suggesting that Sudbury River may be intercepting groundwater downstream of the Mill Pond Dam and cutting off the plume. Impacts to the Sudbury River were evaluated under OU4 investigations. The distribution of contaminants in the overburden aquifer suggest that the overburden plume is potentially disconnected, with one plume associated with the Nyacol/WAC AOC and a potential DNAPL zone/area northeast of the landfill, and the downgradient plume AOC. No groundwater monitoring wells are available in the area immediately south of Pleasant Street between these two plume areas; however, overburden monitoring wells to the north (MW-305B) and south (MW-112B) were non-detect for the primary contaminants of concern, and wells farther to the east (MW-304B and MW-06A) also had relatively low concentrations. Possible explanations for this distribution include the following:

- Migration from bedrock: The bedrock elevation decreases away from the source zone, and an apparent bedrock trough has been identified in the monitoring wells at the core of the overburden downgradient plume (MW-203A/B and MW-115A/B). If a confining unit such as till is not present, groundwater may emanate from bedrock to overburden as the bedrock slopes downward. In addition, while the hydraulic gradients are generally low at the Site, upward gradients have been observed in the downgradient plume area at wells MW-203A/B and MW-115A/B. Therefore, it is possible that groundwater in the deep overburden has been or is being contaminated by bedrock groundwater.

- Residual contaminant mass: Residual contamination may be entrained within the finer-grained units where glacial lacustrine and fluvial deposits were encountered in the downgradient plume AOC. Given the age of the potential sources of contamination starting in 1917, it is possible aquifer materials that were more coarse-grained allowed for more dilution and natural attenuation, allowing for more degradation in the area west (upgradient) of the current downgradient hotspots. The influence of the Sudbury River and Mill Pond may have also allowed for additional groundwater flow in some areas (flushing activity), which may have allowed for natural attenuation via dilution and enhanced biodegradation.

- Additional sources: While much of the area above the overburden plume is residential, some additional industrial/commercial properties are located downgradient of the Nyacol/WAC AOC. Previously unknown releases may cause a secondary plume to develop; however, this is unlikely because the primary Nyanza Site contaminants, including the chlorinated benzenes and ethenes, have similar overburden distributions, suggesting a source in common with the Nyacol/WAC AOC.

Contaminant Attenuation

The natural attenuation of chlorinated ethenes and chlorinated benzenes at individual locations was evaluated using several lines of evidence: statistically significant contaminant trends, historical contaminant trends, historical molar fraction trends, and redox conditions. Chlorinated ethenes, particularly TCE, generally degrade more readily under anaerobic conditions. Two overburden wells and one bedrock well in Nyacol/WAC AOC and three overburden wells and one bedrock well downgradient of this area have strong evidence for natural attenuation of TCE. Additional wells at the plume edge show some degree of natural attenuation by dilution in addition to other mechanisms. Thirteen wells (five in overburden and eight in bedrock) appear to be increasing in chlorinated ethene concentrations, and do not have any evidence of degradation; these locations are downgradient of the landfill, within the WAC property, and in the downgradient plume AOC. Comparison of the overburden and bedrock TCE plumes suggests that the leading edge of the plumes have decreased in concentration; however, concentrations in the Nyacol/WAC AOC and immediately downgradient of the landfill in bedrock groundwater remain elevated.

Chlorinated benzenes are generally more resistant to biodegradation than chlorinated ethenes and tend to more readily degrade under aerobic conditions. For the natural attenuation evaluation, 1,2-DCB was used as the primary parent compound because it was generally detected at higher concentrations. Overall, there is less evidence for attenuation of chlorinated benzenes at the Site, supporting the conclusion that the chlorinated benzene plumes in overburden and bedrock do not appear to be attenuating. Only two overburden and one bedrock well had strong evidence of natural attenuation. When comparing recent chlorinated benzene concentrations with 1990s data, concentrations at the outer edges of the plume have decreased; however, concentrations in the plume core have remained similar.

Routes of Exposure and Potential Receptors

<u>Human Health</u>

Exposure occurs when humans or other living organisms eat, drink, breathe or have direct skin contact with a hazardous substance or waste material. Further, if there is no exposure to a hazardous substance, there is no risk to human health. Based on existing or reasonably anticipated future land use at a site, EPA develops different exposure scenarios to determine potential human health risks, appropriate cleanup levels for contaminants, and potential cleanup approaches. The potentially contaminated media for human exposure considered under OU2 are limited to groundwater and associated vapors. COCs in shallow groundwater may be incidentally ingested and/or absorbed through the skin by exposed human receptors. In addition, volatile contaminants released from the shallow groundwater could migrate into buildings or be inhaled be workers digging construction trenches.

The following is a summary of pathways evaluated for OU2:

Receptor Population	Scenario Timeframe	Exposure Medium	Exposure Point	Exposure Route
Resident	Current and future	Indoor air	Site-wide groundwater	Inhalation via vapor intrusion
	Future	Groundwater	Irrigation wells (to fill a swimming pool)	Ingestion and dermal contact

Commercial worker	Current and future	Indoor air	Site-wide groundwater	Inhalation via vapor intrusion
Construction worker	Current and future	Shallow groundwater and/or trench air	Site-wide groundwater	Ingestion, inhalation, and dermal contact

Potential Exposure Pathways and Receptors Under Current Land Use Conditions

According to Town records, there are currently no potable wells (e.g., public water supply or private drinking water wells) within the Site groundwater plume, nor are there any records for any private irrigation wells. There are no plans to permit new private irrigation wells within the groundwater plume under current land use conditions, and the Town of Ashland is developing a groundwater ordinance to prevent the installation of private wells within the OU2 groundwater plume.

Residential and commercial buildings located within the vapor mitigation area (shown on **Figure 2** in **Appendix C** of this ROD) in the shallower downgradient groundwater plume have been impacted by vapor intrusion from Site-related VOCs. Residents or commercial building occupants may be exposed to contaminants in indoor air via inhalation as a result of a potentially complete vapor intrusion pathway. This exposure was mitigated in 2007 with the installation of VMSs in buildings located within the impacted area. The VMSs reduce the potential for vapors from groundwater contaminants, such as TCE, to migrate and accumulate in buildings at concentrations that may pose health risks. The VMSs are sub-slab depressurization systems, which are similar to radon remediation systems, which work by creating a lower pressure area under a building's basement or slab relative to the interior of the building by use of a fan and a series of extraction pipes. As a result, vapors that accumulate under a building are less likely to enter the building's interior. A fan draws sub-slab soil gas from below the floor which is then vented outside through an exhaust pipe. The VMSs are an interim remedy to protect human health from vapor intrusion risks. However, in order for the remedy to be protective of risks in the long term, additional groundwater remedies need to be implemented.

There are no known potable wells on or in the vicinity of the Site. MassDEP's 2019 updated GWU&VD revised and reduced the size of the potential source area of the PPA (on the eastern perimeter of the PPA) defined in the 2014 GWU&VD. Based on current and historical groundwater data for overburden and bedrock aquifers, and the overall hydrogeology of the Site in the vicinity of this area, EPA does not anticipate Site-related groundwater contamination within the potential source area of the PPA. Therefore, current residential exposures to groundwater used as tap water are not addressed.

Potential Exposure Pathways and Receptors Under Future Land Use Conditions

Areas around the Site property are zoned commercial, and their future use is anticipated to continue as commercial/industrial use. However, it is reasonable to assume that future construction workers may be exposed to VOC contaminants in shallow groundwater during the construction of new buildings or the renovation or expansion of existing buildings within the source area and the downgradient plume. Future construction worker exposure to shallow groundwater both on the former Site property and in off-property areas of the Site includes incidental ingestion and dermal contact with contaminated groundwater. Construction workers may also inhale volatile contaminants while doing excavation work in a construction trench.

Ecological

There are no known potential ecological exposure pathways or receptors for contaminated groundwater associated with Nyanza OU2. The contaminated groundwater plume intercepts the Sudbury River east of Main Street. However, Site VOCs have not been identified as contaminants of interest impacting the Sudbury River (which was evaluated separately under OU4). Therefore, surface water is not considered to be an exposure area of concern for OU2.
A Screening Level Ecological Risk Assessment (SLERA) provides a preliminary assessment of the potential exposure and consequent risks to ecological receptors exposed to Site-related contaminants. Between 1999 and 2003, several studies were conducted to evaluate potential ecological risks posed by the groundwater plume discharging into the Sudbury River. Results indicated that aquatic life was affected in one of three areas studied, but any impact on aquatic life could not be tied definitively to the groundwater plume or other existing natural habitat conditions such as storm water runoff, low dissolved oxygen levels, stagnant water, or high amounts of detritus (leaf litter).

3. Principal Threat Waste

The NCP at 40 C.F.R. § 300.430(a)(l)(iii) states that EPA expects to use "treatment to address the principal threats posed by a site, wherever practicable" and "engineering controls, such as containment, for waste that poses a relatively low long-term threat" to achieve protection of human health and the environment. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile, which generally cannot be contained in a reliable manner or would pose significant risks to human health or the environment should exposure occur. Low-level threat wastes are source materials that generally can be reliably contained and that would present only a low risk in the event of exposure.

The concept of principal threat and low-level threat wastes is applied on a site-specific basis when characterizing source material. Source material is defined as material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or act as a source for direct exposure. Although EPA has not established a threshold level of toxicity for identifying a principal threat waste, generally where toxicity and mobility of source material combine to pose a potential cancer risk of 10^{-3} or greater, the source material is considered to be a "principal threat waste." Low-level threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. Wastes that are generally considered to be low-level threat wastes include non-mobile contaminated source material of low to moderate toxicity, surface soil containing COCs that are relatively immobile in air or groundwater, low leachability contaminants, or low toxicity source material.

The current principal threat waste for Nyanza OU2 is the DNAPL (described in Section F.2 of this ROD and in Section 1.4.3 of the January 2020 FS report), and the elevated concentrations of chlorinated ethenes and benzenes associated with the DNAPL.

F. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

The current and reasonably anticipated future land uses of the Site form the basis for the exposure assumptions that are used for the risk assessment, are considered in the development of remedial objectives and remedial alternatives, and are considered in the selection of the appropriate remedial action.

Current Site land use is varied; property in the Nyacol/WAC AOC is zoned industrial/commercial, while the properties and buildings located within the downgradient plume AOC are a mix of residential and commercial. A portion of the former Nyanza, Inc. property, which is privately owned, is currently leased by a commercial tenant (Nyacol). The capped landfill resides immediately to the south of the industrial portion of the property and is surrounded by a perimeter fence. A solar array was installed on the landfill cap in December 2019. The former Nyanza, Inc. property is expected to remain industrial/commercial for the near future. The future use of properties which abut the Site are anticipated to remain zoned and used for commercial/industrial purposes.

Groundwater at the Site and in surrounding areas is not currently used for drinking water purposes, and the Town of Ashland provides potable drinking water to the area from their public water supply wells.

In 2014, MassDEP completed a Groundwater Use and Value Determination (GWU&VD) for the Site. The purpose of the Use and Value Determination was to identify whether the aquifer(s) impacted by the Site should be considered of “high,” “medium,” or “low” value. The evaluation was performed in accordance with criteria for groundwater classification promulgated in the MCP.[1] MassDEP determined that there were no public or private drinking water supply wells or surface water intakes within the Site review area, and that at least a portion of all property lots were within 500 feet of a public water distribution line. Four potentially productive aquifers (PPAs) were identified, all of which are classified as medium yield. Three PPAs were in areas unlikely to support potable water supplies due to existing Site uses and were considered to be consistent with non-potential drinking water source areas. A fourth PPA located north of Pleasant Street and bounded by the Sudbury River, extended east to Main Street. Although unlikely to provide a source of potable water, the PPA was identified as a potential future drinking water supply source area. In an updated GWU&VD document dated February 2019, MassDEP re-evaluated land uses and reclassified the eastern portion of this PPA (eastward from 42°15’ 43”N, -71°28’27.7”W to the intersection with Main Street) as a non-potential drinking water source area. The updated GWU&VD located the eastern end of the potential source area of this PPA at 42°15’ 43”N, -71°28’27.7”W (see **Figure 2** in **Appendix C** of this ROD). Based on current and historical groundwater data for overburden and bedrock aquifers, and the overall hydrogeology of the Site in the vicinity of the PPA, EPA does not anticipate Site-related groundwater contamination within the potential source area of the PPA. In addition, the 2019 updated GWU&VD classified the use and value of the Site impacted groundwater elsewhere as “low.” Accordingly, groundwater at the Site does not need to be restored to its beneficial use as a potential drinking water source. Groundwater monitoring will be conducted to monitor the eastern portion of the potential source areas of the PPA to confirm that Site contamination does not migrate to or impact the PPA.

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[1] The Groundwater Use and Value Determination is consistent with an EPA-endorsed Massachusetts Comprehensive State Groundwater Protection Program (CSGWPP).

G. SUMMARY OF SITE RISKS

Human health and ecological risk assessments have been performed for OU2, which evaluated different exposure scenarios to determine if there are current or future unacceptable risks to humans and/or the environment.

Exposure occurs when humans or other living organisms eat, drink, breathe or have direct skin contact with a hazardous substance or waste material. Based on existing or reasonably anticipated future land use at a site, EPA develops different exposure scenarios to determine potential risk, appropriate cleanup levels for contaminants, and potential cleanup approaches. For Nyanza OU2, the alternatives are documented in the January 2020 OU2 FS report.

In evaluating risk to human health, estimates for risk from carcinogens and non-carcinogens (chemicals that may cause adverse effects other than cancer) are expressed differently. EPA also considers the cumulative carcinogenic and non-carcinogenic effects when multiple chemical exposures with similar target endpoints are present.

For carcinogens, a chemical-specific daily intake level is first estimated and then multiplied with a cancer slope factor (CSF) or an inhalation unit risk (IUR) to estimate excess lifetime cancer risk. CSF and IUR values are toxicity values developed by EPA scientists based on epidemiological (human studies) and/or animal studies to measure a chemical's ability to cause cancer. Cancer risk estimates are expressed in terms of probability. For example, exposure to a particular site-related carcinogenic chemical may present a 1 in 1,000,000 increased chance of causing cancer over an estimated lifetime of 70 years. This can also be expressed as one-in-a-million or 10^{-6} excess lifetime cancer risk. The EPA acceptable risk range for carcinogens is 10^{-6} (1 in 1,000,000) to 10^{-4} (1 in 10,000) in a 70-year lifetime. In general, site-related cancer risks in excess of this range are considered unacceptable and would require being addressed by the Superfund cleanup.

For non-carcinogens, exposures are first estimated and then compared to a reference dose (RfD) or a reference concentration (RfC) for inhalation. RfD and RfC values are toxicity values developed by EPA scientists based on epidemiological (human studies) and/or animal studies as estimates of a daily exposure to a person, including the most sensitive person, that is likely to be without an appreciable risk of an adverse health effect when exposure occurs over the duration of a lifetime. The exposure dose or concentration is divided by the RfD or RfC value to calculate the ratio known as a hazard index (HI) for measuring whether non-cancer adverse health effects would likely occur or not. In general, HI values based on site-related exposure in excess of 1.0 is considered unacceptable and would require being addressed by the Superfund cleanup.

Summaries of the risk assessments which support the need for remedial action are discussed below.

1. Human Health Risk Assessment

The baseline human health risk assessment (HHRA) for OU2 was completed in 1991 and evaluated total carcinogenic and non-carcinogenic risk for the most probable scenario and the realistic worst-case scenario using two years (1988 and 1990) of groundwater data (Ebasco, 1991b). The human health exposure pathways considered in the 1991 HHRA included potential future ingestion of groundwater as drinking water; dermal contact with groundwater during washing; inhalation of groundwater VOCs while showering; inhalation of VOCs and dermal contact with groundwater in basements; dermal contact and ingestion of surface water; and dermal contact and ingestion of sediment. The baseline HHRA concluded that contaminants present in the groundwater were determined to pose potential unacceptable risks (exceeding the cancer risk of $1x10^{-4}$ or HI of 1). While an updated risk assessment for these scenarios has not been performed, the concentrations of contaminants have generally remained consistent over time. The levels of VOC contaminants, and in particular TCE, currently detected in groundwater would result in unacceptable human health risks.

In 2004, a second indoor air monitoring program was conducted to assess vapor intrusion risk. The target VOCs (TCE, vinyl chloride, chlorobenzene, benzene, and 1,4-dichlorobenzene) were detected in five of the seven homes sampled. TCE was detected in indoor air at concentrations ranging from 1.3 to 2.9 micrograms per meter cubed ($\mu g/m^3$), and were all below the screening level of 134 $\mu g/m^3$ applicable at that time. In 2001, EPA proposed a range of new screening levels ranging from 2 to 43 $\mu g/m^3$ based on a target cancer risk level of 1×10^{-4}. Concentrations of TCE in three of the residences exceeded the lower end of the new screening level range, and this prompted EPA to perform a risk assessment on the available air testing data to determine if there were potentially unacceptable inhalation risks.

In 2005, a supplemental HHRA for OU2 to evaluate risks to individuals who may be exposed to indoor air at properties located above the groundwater plume was completed (ICF, 2005). This risk assessment concluded that when comparing the proposed TCE toxicity standard to the TCE indoor air results, there was a potentially unacceptable risk from continued long-term inhalation of TCE vapors in the Ashland Town Hall and in seven of the fourteen residences sampled. The results of the supplemental HHRA prompted the installation of the VMSs in buildings within a specific area designated by EPA as the vapor mitigation area (VMA). The 2005 supplemental HHRA supported remedial actions outlined in the 2006 ESD including the installation of VMSs and expanded indoor air testing.

2. Supplemental Human Health Risk Assessment

In 2020, a supplemental HHRA was performed for construction workers potentially exposed to shallow groundwater and trench air vapors during excavations (see Appendix B-1 of the January 2020 FS report (Supplemental Human Risk Assessment Technical Memorandum)). The supplemental HHRA consists of hazard identification, exposure assessment, toxicity assessment, and risk characterization for the construction worker exposure scenario. Relevant validated laboratory data from shallow groundwater sampling were selected, evaluated, and summarized specifically for HHRA purposes. This effort included preparing summary statistics, identifying the exposure point concentrations (EPCs) to be used for the exposure scenario, and developing Risk Assessment Guidance for Superfund (RAGS) D standardized risk assessment tables.

Groundwater data used for the supplemental HHRA were derived from monitoring wells with depths of 15 feet or less below ground surface (bgs) that were recently sampled within the TCE overburden plume.

Hazard Identification

Based on the previous investigations, an analysis of data gaps, and the current and reasonably anticipated future uses, shallow groundwater and associated vapors are the sole media of potential concern to construction workers in the supplemental HHRA for OU2.

Contaminant of Potential Concern (COPC) selection was based on chemical substances found at the Site including chemical-specific concentrations, occurrence, distribution, and toxicity. COPCs include only those chemicals with positive detections and are limited to those chemicals that exceed the selection criteria. COPCs identified for this supplemental HHRA include TCE, 1,2,4-TCB, chlorobenzene, and 1,2-DCB. Screening levels based on residential exposure assumptions were used for this HHRA as a conservative screening tool to be protective of all potential current and future site uses and local groundwater uses. Screening levels based on residential exposure assumptions are very conservative for screening shallow groundwater for protection of construction worker exposures.

Exposure Assessment

The potentially contaminated media for human exposure considered under OU2 are limited to groundwater and associated vapors located downgradient from the 35-acre Nyanza Chemical Waste Dump Superfund Site. (Other groundwater exposure scenarios have been previously evaluated in previous HHRAs described above). COPCs in shallow groundwater may be incidentally ingested and/or absorbed through the skin by exposed human receptors. In addition, volatiles released from the shallow groundwater into the air could be inhaled. A Conceptual Site Model (CSM) for the supplemental HHRA is depicted on **Figure 8** in **Appendix C** of this ROD.

Potentially exposed populations include construction worker exposures to shallow groundwater and associated vapors during excavation work in the plume of approximately 75-acre area of groundwater contamination which underlies properties located to the east and northeast of the original Nyanza, Inc. property. The shallow groundwater and associated vapors exposure pathways represent a threat to human health by exposure to hazardous substances in groundwater via incidental ingestion and dermal contact and inhalation of associated vapors. Concentrations of volatile organic compounds (VOCs) greater than Regional Screening Levels (RSLs) were found in groundwater at the Site, and there is the potential for the Site to be visited by the human receptors identified above. Given the presence of VOCs at concentrations greater than RSLs and the potential use of the Site by human receptors, the shallow groundwater and associated vapors exposure pathways are considered complete.

EPCs are the COPC concentrations that a receptor is assumed to encounter during exposure to Site groundwater and/or vapors in trench air. Shallow groundwater and trench air EPCs used in the supplemental HHRA are presented in Tables A 3.1 and A.3.2 of the supplemental HHRA report (Appendix B-1 of the January 2020 FS report) and are also included in Appendix B of this ROD.

Groundwater EPCs: The maximum detections were used as EPCs because of the limited number of samples, percent detected, and other data-set specific variables.
EPCs for Trench Air: To estimate the EPC for air in a construction trench, the supplemental HHRA used an approach suggested by the Virginia Department of Environmental Quality (VDEQ) within the Virginia Unified Risk Assessment Model – VURAM 2.0 User's Guide (VDEQ, 2018), which is based on a

combination of a vadose zone model (to estimate volatilization of gases from contaminated groundwater into a trench) and a box model (to estimate dispersion of the contaminants from the air inside the trench into the above-ground atmosphere). The VDEQ methodology is described in the following paragraphs. The airborne concentration of a contaminant in a trench can be estimated based on maximum shallow groundwater concentrations using the following equation:

Cair = CGW x VF x CF
Where:

Cair = air concentration of contaminant in the trench (mg/m^3)
CGW = concentration of contaminant in groundwater μg/L)
VF = volatilization factor (L/m^3)
CF = Conversion factor 0.001 mg/μg).

It is assumed that a construction project could result in an excavation of 15 feet bgs or less. If the depth to groundwater at a site is less than 15 feet, as it is at this Site, the VDEQ model assumes that a worker would encounter groundwater when digging an excavation or a trench. The worker would then have direct exposure to the groundwater. The worker would also be exposed to contaminants in the air inside the trench that would result from volatilization from the groundwater pooling at the bottom of the trench. The following equation is used to calculate the volatilization factor (VF) for a trench less than 15 feet deep, assuming a 3-feet wide, 8-feet deep, and 8-feet long trench:

VF = (Ki x A x F x 10-3 x 104 x 3,600) / (ACH x V)
Where:

Ki = overall mass transfer coefficient of contaminant (cm/second)
A = area of the trench (m^2) (2.23 m^2)
F = fraction of floor through which contaminant can enter (unitless)
ACH = air changes per hour (hr) = 2 hr-1
V = volume of trench (m^3) (5.44 m^3)
10-3 = conversion factor (L/cm^3)
104 = conversion factor (cm^2/m^2)
3,600 = conversion factor (seconds/hr).

Exposure doses are dependent upon the magnitude, frequency, and duration of exposure. They are estimated by combining the COPC concentration (i.e., the EPC) and the exposure parameters. The exposure doses are expressed as intakes in milligrams of COPC per kilogram of body weight per day (mg/kg-day). Two types of doses were calculated in this supplemental HHRA. The first, the lifetime average daily dose (LADD), which is averaged over a 70-year lifetime, was used to estimate cancer risk. The second, the average daily dose (ADD), which is averaged over the actual exposure duration for each receptor, was used to estimate non-cancer health effects. Table A-4.1 of the supplemental HHRA report (in Appendix B-1 of the January 2020 FS report) presents the values used for daily intake calculations that were used to estimate construction worker exposure to the potentially affected shallow groundwater and associated vapors.

Toxicity Assessment

Cancer Effects
For cancer effects, the toxicity values are expressed as oral cancer slope factors (CSFs) in units of per milligrams of COPC per kilogram of body weight per day $(mg/kg\text{-}day)^{-1}$ or as inhalation unit risk (IUR) factors in units of per micrograms of COPC per cubic meter $(\mu g/m^3)^{-1}$. EPA has assigned each contaminant a "weight-of-evidence" category that represents the likelihood of it being a human carcinogen. Oral and inhalation carcinogenic toxicity values are presented Tables A-6.1 and A-6.2 of the supplemental HHRA report (in Appendix B-1 of the January 2020 FS report) and are also included in Appendix B of this ROD. EPA's Cancer Guidelines and Supplemental Guidance (March 2005) have been used as the basis for analysis of carcinogenicity risk assessment.

Non-Carcinogenic Effects
Non-carcinogens refer to contaminants that cause toxic effects other than cancer. Non-cancer effects can include, for example, central nervous system damage, reproductive effects, and other systemic effects. For addressing non-carcinogenic effects, it is EPA's policy to assume that a safe exposure level exists, which is described by the reference dose (RfD) in units of mg/kg-day and reference concentration (RfC) in units of mg/m^3. The premise of non-cancer toxicity values is that there is an exposure level below which deleterious non-cancer effects are not expected to occur. Tables A-5.1 and A-5.2 of the supplemental HHRA report (in Appendix B-1 of the January 2020 FS report) present oral and inhalation non-carcinogenic toxicity values.

Toxicity values have not been developed for the dermal contact and absorption pathway. Dermal toxicity values were derived from the oral toxicity values as described in the EPA dermal risk assessment guidance.

Risk Characterization

The risk characterization integrates the information developed in the exposure assessment and the toxicity assessment into an evaluation of the potential risks associated with exposure to COPCs. Carcinogenic risks were calculated for those COPCs with evidence of carcinogenicity and for which cancer toxicity values are available. Non-cancer health effects were evaluated for all COPCs (i.e., including carcinogens) for which non-cancer toxicity values are available.

Cancer Health Effects
Potential cancer risk from the ingestion and dermal contact pathways was calculated by multiplying the estimated LADD that is calculated for a COPC through an exposure route by the exposure route-specific CSF. The LADD (or lifetime average daily dose) is expressed as intake averaged over a 70-year lifetime as mg COPC/kg-body weight per day. The CSF is the COPC- and route-specific cancer slope factor $(mg/kg\text{-}day)^{-1}$.

Potential cancer risk from the inhalation pathway was calculated by multiplying the modeled air concentration, or CA $(\mu g/m^3)$ by the IUR (COPC-specific inhalation unit risk factor $(\mu g/m^3)^{-1}$. Carcinogenic risks associated with exposure to individual chemicals are estimated by multiplying the chemical intake for each carcinogen by its CSF. This value represents an upper bound of the probability of an individual developing cancer over a lifetime as the result of exposure to a chemical. The results from the carcinogenic risk assessment are compared to acceptable risk ranges established by EPA. EPA's guidelines, established in the NCP, identify acceptable exposure levels as those concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} to 10^{-6} using information on the relationship between dose and response. Typically, the resulting cancer risk estimates are expressed in scientific notation as a probability (e.g., 1 x 10^{-6} or 1E-06 for 1/1,000,000) and in this example, indicates that an average individual is not likely to have greater that a one in a million chance of developing cancer over 70 years as a result of site-related exposure to the compound at the stated concentration.

Estimated risks represent an incremental risk of cancer from exposures to contamination originating from the Site. These are risks above and beyond that which we face from other causes such as from cigarettes or ultra-violet radiation from the sun. The chance of an individual developing cancer from all other (unrelated to the Site) causes has been estimated to be as high as one in three. EPA generally views site related cancer risks in excess of 10^{-4} as unacceptable. Current EPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances.

Non-Cancer Health Effects

Potential non-cancer health effects were evaluated by the calculation of hazard quotients (HQs) and hazard indices (HIs). For the ingestion and dermal contact pathways, the HQ is the ratio of the exposure duration-averaged estimated daily intake (ADD) through a given exposure route to the COPC and route-specific RfD (or HQ = ADD/RfD). The ADD is the estimated daily intake averaged over the exposure duration (in mg/kg-day), and the RfD is the Reference dose (in mg/kg-day). For inhalation exposure, the HQ is the ratio of the air concentration and the COPC-specific RfC [or HQ = CA / (RfC x CF)], where CA is the air concentration (in µg/m^3), RfC is the COPC-specific reference concentration (in mg/m^3), and CF is the conversion factor (in 1,000 µg/mg .

A HQ $\leq$ 1 indicates that a receptor's exposure to a single contaminant is less than the safe value and that adverse effects are unlikely. Conversely, a HQ > 1 indicates that adverse effects as a result of exposure to the contaminant are possible. To account for additive effects resulting from exposure to more than one compound, a Hazard Index (HI) is generated by adding the HQs for all chemicals of concern that have the same or a similar mechanism or mode of action. As a conservative measure and a common practice, HQs are often added for all compounds of concern that affect the same organ or system (i.e., liver, nervous system) since the mechanism or mode of action is not always known. HIs were calculated for each exposure route, and a total HI was calculated based on exposure to the COPCs from exposure routes for each receptor. A HI < 1 indicates that adverse effects are unlikely whereas a HI > 1 indicates adverse effects are possible.

Details of risk calculations are presented in Tables A-7.1 and A-9.1 of the supplemental HHRA report (in Appendix B-1 of the January 2020 FS report). A Risk Summary for an Adult Construction Worker is presented on Table A-10.1 of the supplemental HHRA report (in Appendix B-1 of the January 2020 FS report) and is also included in Appendix B of this ROD.

The construction worker shallow groundwater-contact scenario specific risks and health hazards are summarized below:

- The total cancer risk of 3 x10^{-5} is within the EPA targeted cancer risk range (10^{-4} to 10^{-6}).
- The non-cancer HI is greater than one (172), reflecting organ-specific HIs greater than one for effects on the developmental system (104), immune system (105), urinary system (57), kidney (7), liver (8), and body weight (2).

The exposure scenario evaluated resulted in unacceptable levels of non-cancer health hazards greater than one for future construction workers exposed to shallow groundwater and trench air. Chemicals of concern (COCs) are defined as those COPCs whose individual cancer risk exceeds $1x10^{-6}$ in a scenario with total risk greater than $1x10^{-4}$ OR whose individual HQ exceeds 1. TCE, 1,2,4-trichlorobenzene, chlorobenzene, and 1,2-dichlorobenzene were identified as COCs for shallow groundwater and trench air.

Carcinogenic Risks
Cancer Risks developed for construction workers are as follows:

Receptor (Timeframe)	RME Cancer Risk
Construction Worker – shallow groundwater (Future)	$1x10^{-6}$
Construction Worker – trench air vapors (Future)	$3x10^{-5}$

Cancer risk estimates for construction workers exposed to shallow groundwater and VOCs in trench air are within the EPA targeted cancer risk range (10^{-4} to 10^{-6}).

Non-Carcinogenic Risks
Hazard indices developed for future construction workers are as follows:

Receptor (Timeframe)	RME HI
Construction Worker – shallow groundwater (Future)	2
Construction Worker – trench air vapors (Future)	169

The HIs are greater than 1.0, with at least one organ-specific HI exceeding the EPA target of 1.0, for construction workers exposed to shallow groundwater and VOCs in trench air. For construction workers exposed to shallow groundwater and VOCs in trench air, under the RME scenario, organ-specific HIs exceed 1.0 for the developmental system (HI = 104), immune system (HI = 105), urinary system (HI = 57), kidney (HI = 7), liver (HI = 8), and body weight (HI = 2). Individual contaminant HQs exceed one for TCE (HQ = 103 with impacts to the developmental system and immune system), 1,2,4-trichlorobenzene (HQ = 57 with impacts to the urinary system), chlorobenzene (HQ= 7 with impacts to the kidney and liver), and 1,2-dichlorobenzene (HQ = 2 with impacts to total body weight), as VOCs in trench air. No individual contaminant HQs exceed one for incidental ingestion and dermal contact exposures to shallow groundwater. TCE is the only individual COPC with a hazard quotient above 1.0 (HQ = 103 for TCE in trench air and HQ=0.9 for incidental ingestion and dermal contact exposures to shallow groundwater) for the immune system; however, benzene in trench air also contributes slightly (HQ = 0.4) to the target organ-specific HI exceeding 1.0 for the immune system.

Uncertainties

Some of the uncertainties applicable to the supplemental HHRA include the following:

- Selection of exposure scenarios: The possibility that the scenario evaluated in the HHRA overstated realistic exposures, and thus overestimated the actual Site risks. This HHRA considered a construction worker scenario, assuming year-long direct contact (incidental ingestion and dermal) with groundwater and inhalation of vapors in construction trenches. This scenario is unrealistic in that construction workers should not be in trenches with standing water. See further discussion below of exposure area, sampling depth, contamination depth, and selection of exposure assumptions, which each contribute to the uncertainties within the selected scenario.

- Selection of data: This HHRA used shallow groundwater data collected between 2015 and 2018 from wells located within the overburden plume as defined by a 5 ug/L contour for TCE. The overburden plume map (Figure 2-1) appears as two distinct segments, the center points of which are approximately 1800 feet apart. Construction workers are unlikely to contact groundwater over this large expanse; however, because the groundwater wells are in the same aquifer and the contamination is presumably derived from the same source, wells from both segments were included in a single dataset. This HHRA used data collected from top of screen depths of 15 ft bgs or shallower. This includes samples with bottom screens of 20 ft bgs or shallower. Construction workers are unlikely to contact groundwater deeper than 8-10 feet bgs; however, data from slightly deeper wells were used to represent groundwater at the top of the water table. As the greatest contamination has been found in deeper wells, this approach likely overestimates concentrations to which an excavation worker is likely to contact.
- Use of MDCs for EPCs: The dataset had insufficient number of samples to calculate a 95%UCL. Therefore, the MDCs were assumed as the EPCs. Use of MDCs as EPCs can result in overestimating risks. It should also be noted that one of the primary risk drivers, nitrobenzene, was detected in only one of three samples. These data issues can result in overestimating risks.
- Selection of exposure assumptions: The exposure assumptions directly influence the calculated doses and ultimately the calculation of risk. The RME concept was used to estimate the exposure potential for each of the receptors that were evaluated in the HHRA. The RME is defined as the "maximum exposure that is reasonably expected to occur at the site". In most cases, these assumptions are upper-bound estimates of potential real-life exposures, and possibly result in an overestimation of risk.
- Lack of toxicity values for dermal exposure: Toxicity values for dermal exposures have not been developed by EPA. Oral RfDs and oral CSFs were adjusted and used to assess toxicity from dermal exposures following guidelines provided by EPA. The dermal route of exposure can result in different patterns of distribution, metabolism, and excretion than occur from the oral route. When oral toxicity values for systemic effects are applied to dermal exposures, uncertainty in the risk assessment is introduced because these differences are not considered. Since any toxicity differences between oral and dermal exposure would depend on the specific COPC, use of oral toxicity factors can result in the overestimation or underestimation of risk. It is not possible to make a general statement about the direction or magnitude of this uncertainty.

3. Supplemental Evaluation Following Risk Assessment

Residential Irrigation Well Evaluation

The use of an irrigation well to fill a swimming pool was the exposure scenario assessed in this risk evaluation. This irrigation well scenario included the evaluation of incidental ingestion and dermal contact pathways. The following exposure assumptions were used during the irrigation well evaluation:

- Exposure duration – 20 years (adult) and 6 years (child);

- Exposure frequency – 52 days/year (adult) and 65 days/year (child);
- Exposure time – 1 hour/event (adult) and 2 hours/event (child);
- Event frequency – 1 event/day (adult and child);
- Skin surface area – 19,652 cm^2 (adult) and 6,365 cm^2 (child); and
- Water ingestion rate – 0.05 L/hr (adult) and 0.1 L/hr (child).

These parameters were utilized in the EPA Regional Screening Level (RSL) online calculator to develop screening levels at a cancer risk level of 10^{-6} and a non-cancer hazard index of 0.1. The recreator surface water scenario in the RSL online calculator was used to calculate screening levels applicable to the irrigation water (swimming pool) scenario. In order to simplify calculations, the screening evaluation was performed on the Contaminants of Potential Concern (COPCs) from the Human Health Risk Assessment (HHRA), including 12 analytes.

EPA's guidelines, established in the NCP, identify acceptable exposure levels as those concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} to 10^{-6} using information on the relationship between dose and response. Additionally, an HQ of one or less indicates that adverse non-cancer health effects associated with the exposure scenario are unlikely to occur. The total cancer risk was determined to be 3.17×10^{-5} and the non-cancer hazard index is shown to be 4.9. The total cancer risk is within the EPA acceptable risk range; however, the non-cancer hazard exceeds the EPA target risk goal. The main non-cancer risk contributor (where the HI > 1) is TCE, with an HQ=2.45.

The irrigation well to fill a swimming pool risk exposure is addressed through ICs documented in the 2006 ESD, to prohibit the installation of private wells, (which would include irrigation wells), in the contaminated groundwater plume.

4. Ecological Risk Assessment

A preliminary ecological assessment of groundwater impacts to surface water was included in the 1991 RI/FS. In 1999, a Supplemental Baseline Ecological Risk Assessment was completed. These assessments supported various remedial actions for other operable units described in Site History in Part 2.B of this ROD. There are no known potential ecological exposure pathways or receptors for contaminated groundwater associated with Nyanza OU2. Between 1999 and 2003, several studies were conducted to evaluate potential ecological risks posed by the groundwater plume discharging into the Sudbury River. No impacts on aquatic life could not be tied definitively to the groundwater plume.

5. Basis for Remedial Action

The Supplemental HHRA for the Construction Worker, Supplemental Irrigation Well Evaluation, and previous HHRAs conducted for Nyanza OU2 have identified unacceptable human health risks for current and future residents, future construction workers potentially exposed to COCs in groundwater via direct contact, ingestion, or inhalation. The current vapor intrusion risk for building occupants was mitigated with the VMS remedy outlined in the 2006 ESD. The ESD documented the need for ICs to prevent exposure to contaminated groundwater, by preventing the installation of new private wells (which would include irrigation wells), within, or in the vicinity of, the contaminated groundwater plume. The current and potential future releases of hazardous substances from the Site, (in this case VOCs dissolving into groundwater from residual pooled DNAPL), if not addressed by implementing the remedial action selected in this ROD, may present an endangerment to public health from the Site groundwater.

Given that DNAPL remains in the Nyacol/WAC area and acts as an ongoing source of contamination, changes in subsurface conditions or to configuration of structures may result in future vapor intrusion risks. Therefore, the elevated chlorinated ethene and chlorinated benzene concentrations in groundwater (which are two or more orders of magnitude above the VISLs) establish basis for action.

H. REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) are media-specific cleanup goals that define the objective of remedial actions to protect human health and the environment. Based on preliminary information relating to types of contaminants, environmental media of concern, and potential exposure pathways, RAOs were developed to aid in the development and screening of alternatives. These RAOs were developed to mitigate, restore, and/or prevent existing and future potential threats to human health and the environment and to attain ARARs. The COCs and the groundwater remediation goals are presented in **Table 2** (in **Appendix B** of this ROD). The RAOs for the selected remedy of the Site are:

- Prevent or minimize further migration of groundwater containing Site contaminants to the downgradient plume AOC which is resulting in a long term vapor intrusion risk.
- Prevent future exposure of construction workers to groundwater containing Site contaminants that would result in a total excess lifetime cancer risk greater than the target risk range of 10^{-6} to 10^{-4}, and/or a non-cancer Hazard Index greater than 1.
- Prevent exposure of future building occupants to indoor air vapors, via a vapor intrusion pathway, containing Site contaminants that would result in a total excess lifetime cancer risk greater than the target risk range of 10^{-6} to 10^{-4}, and/or a non-cancer Hazard Index greater than 1.

I. DEVELOPMENT AND SCREENING OF ALTERNATIVES

A. Statutory Requirements/Response Objectives

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. The goal of the Superfund program as stated in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) at 40 C.F.R. § 300.430(a)(1)(i) is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including: a requirement that EPA's remedial action, when complete, must comply with all federal environmental and more stringent state environmental and facility siting standards, requirements, criteria, or limitations, unless a waiver is invoked; a requirement that EPA select a remedial action that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a preference for remedies in which treatment permanently and significantly reduces the toxicity, mobility, or volume of the hazardous substances is a principal element over remedies not involving such treatment. Response alternatives were developed to be consistent with these Congressional mandates.

B. Technology and Alternative Development and Screening

CERCLA and the NCP set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements, a range of remedial alternatives were developed for the Site. Technologies considered for the remedial alternatives included the following: containment to inhibit the migration of contaminants as well as prevent direct contact between contaminated groundwater and potential receptors; groundwater collection via pumps, drainage trenches or other means, and extraction, and ex-situ treatment and discharge of groundwater; and in-situ treatment technologies such as biological, physical, chemical, and/or thermal processes that could be applied to treat groundwater in-place. In-situ treatment aims to reduce the overall toxicity, mobility, and/or volume of the impacted groundwater media.

With respect to source control and groundwater, the FS developed a range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances is a principal element. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that cannot be reliably contained or that would present a significant risk to human health or the environment should exposure occur. The current principal threat waste for the Nyanza Site is the residual DNAPL described in Section 1.4.3 of the January 2020 FS report, and the elevated concentrations of chlorinated ethenes and benzenes associated with the DNAPL that are in groundwater flowing from the Site.

This range of alternatives included alternatives that physically remove/extract hazardous substances (in this case, DNAPL) to the maximum extent feasible; alternatives to treat groundwater contamination in-situ in sources area(s) and downgradient plume area; alternatives to pump and treat groundwater in source area(s) and/or downgradient plume area; an alternative that involves continuity of existing remedies with enhancements and protection through additional institutional controls; and a no further action alternative.

As discussed in Section 2.0 of the January 2020 FS report, groundwater treatment technology options were identified, assessed, and screened based on implementability, effectiveness, and cost. Section 3.0 of the January 2020 FS report presents the remedial alternatives developed by combining the technologies identified in the previous screening process in the categories identified in Section 300.430(e)(3) of the NCP. The purpose of the initial screening was to narrow the number of potential remedial actions for further detailed analysis while preserving a range of options. Each alternative was then evaluated in detail in Section 4.0 of the January 2020 FS report.

In summary, of the nine (9) remedial alternatives screened in Section 3.0 of the January 2020 FS report for groundwater, six (6) alternatives were selected for detailed and comparative analyses.

J. DESCRIPTION OF ALTERNATIVES

This section provides a narrative summary of each remedial alternative retained following screening and evaluated in the detailed analyses (Section 4.0) of the January 2020 FS report. These alternatives were developed by combining response actions and technologies to address the estimated exposure risks to human health and the environment. The alternatives were also developed, to the extent practicable, to represent a range of effectiveness, duration of time required to achieve the RAOs, and cost to implement.

The descriptions of each remedial alternative are conceptual and are used for costing purposes. The specific design details and costs for the selected remedy will be re-evaluated during the remedial design. The costs are intended to be within the target accuracy of -30 to +50% of the actual cost. All present worth costs associated with O&M and periodic expenditures are based on a 7% discount rate over 30 years. Refer to Section J and Section L.3 of this ROD for a breakdown of costs (including capital and O&M), as well as discussion on the time to construct and meet RAOs, for each alternative and the selected remedy.

Groundwater Alternatives Analyzed

Groundwater alternatives included source area plume treatment only, a combination of source area plume treatment and downgradient plume treatment, limited action, and no further action. For purposes of the alternatives, the Site groundwater plume has been divided into two primary Areas of Concern (AOCs):

1. Nyacol/WAC AOC: This includes the original manufacturing property where historical releases resulted in soil/sediment, surface water, and groundwater impacts. This AOC is generally located directly north/northeast of the (now capped) Megunko Hill landfill, and includes: sections of the WAC property located at 148 Pleasant Street, the Nyacol property located on Megunko Road, and an area immediately northeast of the landfill. This AOC is also where DNAPL has been previously discovered and extracted/recovered, and where additional zones of residual DNAPL may reside in subsurface bedrock fractures.

2. Downgradient Plume AOC: This includes locations downgradient of the Nyacol/WAC AOC where a groundwater plume with dissolved VOCs has migrated and impacted the bedrock and overburden aquifers. The downgradient plume has resulted in vapor intrusion impacts to certain residential and commercial properties in an area currently being addressed by the installation of VMSs.

The AOCs described above are depicted in **Figure 9** in **Appendix C** of this ROD.

The groundwater alternatives analyzed for the Site include:
- GW-1: No Further Action
- GW-2: Continued Current Limited Action (with Enhanced DNAPL Extraction)
- GW-4: Nyacol/WAC AOC In-Situ Treatment*
- GW-5: Nyacol/WAC AOC In-Situ Treatment and Limited Pump and Treat*
- GW-8: Nyacol/WAC AOC In-Situ Treatment and Limited Pump and Treat; Downgradient Plume AOC In-Situ Treatment*
- GW-9: Nyacol/WAC AOC and Downgradient Plume AOC In-Situ Treatment*

Note: Alternatives denoted with ‘*’ also incorporate the components of Alternative GW-2.

Each of these groundwater alternatives is summarized below. More complete, detailed presentations of each alternative are found in Section 4.0 of the January 2020 FS report.

Alternative GW-1: No Further Action

Alternative GW-1 was developed as a baseline to compare against other alternatives. No further action would be taken to reduce, control, or eliminate potential risks from exposure to contaminants in groundwater, and does not include environmental monitoring to assess long-term changes in contaminant concentrations in groundwater. No construction would take place, and RAOs would not be achieved. Periodic five-year reviews would be done to assess remedy protectiveness. The estimated capital cost for this alternative is $0, and the estimated net present value is $108,000 (O&M costs for five-year reviews).

Alternative GW-2: Continued Current Limited Action (with Enhanced DNAPL Extraction)

The Limited Action Alternative GW-2 continues the operation, maintenance and monitoring of the two existing DNAPL extraction and recovery well systems (MW-113A at the WAC property, and MW/B-11 at the Nyacol property) and the existing VMSs. A pre-design investigation in the Nyacol/WAC AOC would be completed to support remedy development, address data gaps, and develop a more complete conceptual site model including Site surveys and a groundwater evaluation. Investigations would be completed in overburden and fractured bedrock to locate additional DNAPL sources, determine DNAPL characteristics and migration pathways, determine layout and design of additional extraction well locations, and evaluate other system enhancements to improve future DNAPL recovery. A pilot study would be done to optimize DNAPL extraction well design, evaluate capture zones, establish extraction rates, and evaluate fracture zones to enhance recovery. If additional DNAPL sources are located in the Nyacol/WAC AOC, new DNAPL extraction/recovery wells would be installed. The existing well network would be expanded and optimized with the installation of new groundwater monitoring wells. Alternative GW-2 does not have active treatment for the downgradient plume AOC; however, performance monitoring would be completed to monitor groundwater VOC concentrations in this area. Long-term monitoring of groundwater in the overall plume would be done to determine if contaminant concentrations remain above remediation goals. Institutional controls would be expanded to require a vapor intrusion evaluation or VMS be installed if a new building is constructed over the contaminated groundwater plume or if an existing building with a VMS is renovated or expanded in size and to require additional protective measures for construction workers during excavation. Periodic five-year reviews will also be done to assess remedy protectiveness. The estimated capital cost for this alternative is $2,879,000, and the estimated net present value is $5,978,000.

Alternative GW-4: In-Situ Treatment for the Nyacol/WAC AOC; No Active Treatment for the Downgradient Plume AOC (*This is EPA's Selected Alternative*)

Alternative GW-4 includes the components described above in the GW-2 alternative, with the addition of the following components: In-situ chemical oxidation (ISCO) treatment would be conducted within the Nyacol/WAC AOC to target deep overburden and shallow/weathered bedrock. Activated persulfate is the proposed ISCO reagent, which is capable of degrading the contaminants of concern, including the more persistent chlorinated benzenes, while achieving adequate aquifer distribution. Full-scale ISCO design, including target bedrock zones for in-situ treatment, would be determined based on results of the pre-design investigation (PDI) and a pilot study. ISCO performance monitoring (pre-injection and post-injection events) would be done to evaluate the effectiveness and performance of in-situ treatment. No active treatment for the downgradient plume AOC would be done (performance and long-term groundwater monitoring only). The estimated capital cost for this alternative is $14,940,000, and the estimated net present value is $20,487,000.

Alternative GW-5: In-Situ Treatment and Limited Groundwater Pump and Treat for the Nyacol/WAC AOC; No Active Treatment for Downgradient Plume AOC

Alternative GW-5 includes the components described above in the GW-2 alternative, with the addition of the following components: ISCO treatment would be conducted within the Nyacol/WAC AOC to target deep overburden and shallow/weathered bedrock, using activated persulfate as the proposed reagent. Full-scale ISCO design would be determined based on results of the PDI and a pilot study. ISCO performance monitoring (pre-injection and post-injection events) would be done to evaluate the effectiveness and performance of in-situ treatment. ISCO would be followed by groundwater pump and treat as a polishing step. No active treatment for the downgradient plume AOC would be done (performance and long-term groundwater monitoring only). Groundwater pump and treat would be conducted in the Nyacol/WAC AOC to target residual contamination that is not addressed during in-situ treatment or DNAPL extraction. A network of groundwater extraction wells would be installed to capture groundwater in target areas. A full-scale groundwater pump and treat design would be done based on results of the PDI, in-situ treatment, and a pump and treat pilot study. Extracted groundwater would be pumped to a central treatment building, and the effluent would be discharged to the sewer system utilized by the Town of Ashland. The estimated capital cost for this alternative is $18,664,000, and the estimated net present value is $35,273,000.

Alternative GW-8: In-Situ Treatment and Limited Groundwater Pump and Treat for the Nyacol/WAC AOC; In-Situ Treatment for Downgradient Plume AOC

Alternative GW-8 includes the components described above in the GW-2 alternative, with the addition of the following components: ISCO treatment would be conducted within the Nyacol/WAC AOC to target deep overburden and shallow/weathered bedrock, using activated persulfate as the proposed reagent. Full-scale ISCO design would be determined based on results of the PDI and a pilot study. ISCO performance monitoring (pre-injection and post-injection events) would be done to evaluate the effectiveness and performance of in-situ treatment. ISCO would be followed by groundwater pump and treat as a polishing step. Groundwater pump and treat would be conducted in the Nyacol/WAC AOC to target residual contamination that is not addressed during in-situ treatment or DNAPL extraction. A network of groundwater extraction wells would be installed to capture groundwater in target areas. A full-scale groundwater pump and treat design would be done based on results of the PDI, in-situ treatment, and a pump and treat pilot study. Extracted groundwater would be pumped to a central treatment building, and the effluent would be discharged to the sewer system utilized by the Town of Ashland. ISCO treatment would also be conducted within the downgradient plume AOC in the overburden aquifer only; given the extensive size of the bedrock plume and cost of investigating fractures to target in-situ treatment, a bedrock injection has not been included in this alternative. The estimated capital cost for this alternative is $43,140,000, and the estimated net present value is $56,834,000.

Alternative GW-9: In-Situ Treatment for the Nyacol/WAC AOC and Downgradient Plume AOC:

Alternative GW-9 includes the components described above in the GW-2 alternative, with the addition of the following components: ISCO treatment would be conducted within the Nyacol/WAC and downgradient plume AOCs, using activated persulfate as the proposed ISCO reagent. ISCO treatment in the Nyacol/WAC AOC would target deep overburden and shallow/weathered bedrock. ISCO treatment in the downgradient plume AOC would target the overburden aquifer only; given the extensive size of the bedrock plume and cost of investigating fractures to target in-situ treatment, a bedrock injection has not been included in this alternative. Full scale ISCO design based on the results of the PDI and a pilot study. ISCO performance monitoring (pre-injection and post-injection events) would be done to evaluate the effectiveness and performance of in-situ treatments. The estimated capital cost for this alternative is $39,910,000, and the estimated net present value is $42,982,000.

K. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 121(b)(1) of CERCLA presents several factors that, at a minimum, EPA is required to consider in its assessment of remedial alternatives. Building upon these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives.

A detailed analysis was performed on groundwater alternatives using the nine evaluation criteria in order to select a Site remedy. The comparative analysis of alternatives was presented in Section 5.0 of the January 2020 FS report. The following is a summary of the comparison of each alternative's strength and weakness with respect to the nine evaluation criteria. These criteria are summarized as follows:

Threshold Criteria

The two threshold criteria described below must be met for the alternatives to be eligible for selection in accordance with the NCP.

1. **Overall protection of human health and the environment** addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.
2. **Compliance with applicable or relevant and appropriate requirements (ARARs)** addresses whether a remedy will meet all Federal environmental and more stringent State environmental and facility siting standards, requirements, criteria, or limitations, unless a waiver is invoked.

Primary Balancing Criteria

The following five criteria are utilized to compare and evaluate the elements of one alternative to another that meet the threshold criteria:

3. **Long-term effectiveness and permanence** address the criteria that are utilized to assess alternatives for the long-term effectiveness and permanence they afford, along with the degree of certainty that they will prove successful.

4. **Reduction of toxicity, mobility, or volume through treatment** addresses the degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the site.

5. **Short term effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

6. **Implementability** addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. **Cost** includes estimated capital and O&M costs, as well as present value costs.

Modifying Criteria

The modifying criteria are used as the final evaluation of remedial alternatives, generally after EPA has received public comments on the Proposed Plan:

8. **State acceptance** addresses the State's position and key concerns related to the preferred alternative and the other alternatives described in the Proposed Plan and FS, and the State's comments on ARARs or the proposed use of waivers.

9. **Community acceptance** addresses the public's general response to the alternatives described in the Proposed Plan and FS.

Following the detailed analysis of each individual alternative, a comparative analysis was conducted focusing on the relative performance of each alternative against the nine criteria. This comparative analysis can be found in Table 5-1 of the January 2020 FS report, and attached to this ROD as **Table 1** in **Appendix B** of this ROD.

This section below presents the nine criteria, the alternatives, and the strengths and weaknesses from the comparative analysis.

Comparative Analysis for Groundwater Alternatives

Overall Protection of Human Health and the Environment

The No Further Action Alternative (GW-1) is not protective of human health or the environment because it takes no further measures to treat contamination sources or the plume, control groundwater plume migration, prevent future groundwater use, reduce risks to construction workers, or address vapor intrusion impacts.
The Limited Action Alternative (GW-2) is protective of human health and the environment in the short term because it includes measures for enhanced extraction and recovery of additional DNAPL in the Nyacol/WAC AOC. GW-2 will help prevent contact with groundwater through use of ICs, extract recoverable DNAPL to the greatest extent possible, and mitigate current vapor intrusion risk in the VMA

by continuing the operation and maintenance of the existing VMSs. GW-2 is not protective of human health and the environment in the long term, because it would not provide a substantial decrease in the estimated time for groundwater to reach remediation goals.

Alternative GW-4, which is EPA's selected remedy, would be protective of human health and the environment when groundwater remediation goals are attained. GW-4 would actively treat sorbed and residual contamination in the Nyacol/WAC AOC at the former Site property and in former manufacturing areas, where they have the highest concentrations of VOCs in groundwater. GW-4 does not actively or directly treat sorbed or residual contamination within the downgradient plume AOC, but rather relies on contaminant attenuation/degradation from Nyacol/WAC AOC treatment to restore the downgradient plume AOC over time.

Alternative GW-5 would be protective of human health and the environment once the groundwater remediation goals are attained, because it would actively treat sorbed, residual, and dissolved contamination in the Nyacol/WAC AOC. GW-5 also includes groundwater pump and treat to further address the plume. GW-5 does not actively or directly treat sorbed or residual contamination within the downgradient plume AOC, but rather relies on contaminant attenuation/degradation from Nyacol/WAC area treatment to restore the downgradient plume AOC over time.

Alternative GW-8 would be protective of human health and the environment once groundwater remediation goals are attained. GW-8 uses downgradient plume control and containment via in-situ treatment, limited groundwater pump and treat, and DNAPL removal in the Nyacol/WAC AOC. It also adds a treatment component for groundwater hotspots in the downgradient plume AOC.

Similarly, Alternative GW-9 also focuses on in-situ treatment in both the Nyacol/WAC AOC and downgradient plume AOC. GW-9 would also be protective of human health and the environment once groundwater remediation goals are attained.

Alternatives GW-2, GW-4, GW-5, GW-8, and GW-9 would meet the criterion of being protective of human health in the short term by preventing direct contact with groundwater and the inhalation of vapors through the use of ICs, and mitigating the current vapor intrusion risk by the continued operation, monitoring, and maintenance of the existing VMSs. ICs will be expanded to address future vapor intrusion risk by requiring vapor intrusion evaluations and vapor mitigation systems in new or expanded buildings over the contaminated groundwater plume until groundwater remediation goals are achieved or vapor intrusion risk has been mitigated. The remedy would also protect construction workers from inhalation exposure risks during excavation trench activities.

Compliance with ARARs

All alternatives except for No Action Alternative (GW-1) were developed to comply with ARARs. There is no ARARs analysis for GW-1 since no further action will be taken under this alternative. With proper implementation, it is anticipated that Alternatives GW-2, GW-4, GW-5, GW-8, and GW-9 will meet chemical-specific, action-specific, and location-specific ARARs._All of the active treatment alternatives will generate wastes. Investigation-derived waste (IDW) from well installation and sampling will be determined if it is hazardous; if so, appropriate hazardous waste regulations will be followed. In addition, all of the active remedies include the potential extraction of recoverable DNAPL, which will be disposed of as hazardous waste. All the active remedies will comply with traffic controls, air emission limitations, noise limitations, and best management practices. Alternatives with a groundwater treatment component (GW-5 and GW-8) will also comply with action-specific ARARs relating to off-site disposal of hazardous waste (residuals), discharge limitations, monitoring/reporting requirements, systems operations, and best management practices. Location-specific ARARs will be met for alternatives (i.e., GW-8 and GW-9) that have treatment in the downgradient plume AOC which could have remedy components that may impact wetlands and those that may extend to the floodplain of the Sudbury River. Each alternative also includes a PDI incorporating an updated wetland delineation to better locate and identify potential mitigation strategies. Endangered, threatened, and/or listed species or habitats have not been identified at or in the vicinity of the Site. Historic features have likewise not been identified in these areas. The ARARs and TBCs for the selected remedy are outlined in **Appendix D** of this ROD.

Long-term Effectiveness and Permanence

Alternative GW-1 leaves the most residual mass of contamination in place and provides the least effective controls on contaminant concentrations or migration, as no further action would be conducted. Risk (i.e., from vapor intrusion and groundwater exposure) would gradually decrease over time. Due to the large potential contaminant mass, it is estimated to take approximately 680 years to achieve the groundwater remediation goal for TCE of 16 µg/L throughout the Site. As discussed in Section E.2 (Site Characteristics, Conceptual Site Model, Nature and Extent of Contamination), above, TCE is the primary VOC contaminant which contributes to Site-related vapor intrusion issues.

Alternative GW-2 would leave a large amount of residual mass contamination in place because it would only target recoverable pooled DNAPL (if located during the PDI). Following the removal of additional pooled DNAPL (if located during the PDI), an estimated 30-50% of the contaminant mass would likely remain in place as residual DNAPL located within soil pore spaces and dead-end bedrock fractures, matrix-diffused contamination, and contaminants sorbed to soil and bedrock minerals. GW-2 would also not directly or actively treat the dissolved phase contamination in the downgradient plume AOC. Complete aquifer restoration would be achieved over time via contaminant attenuation/degradation after source removal in the Nyacol/WAC AOC. Due the large potential residual contaminant mass, it is estimated that 650 years would be required to achieve the TCE groundwater remediation goal throughout the Site.

Alternative GW-4, which is EPA's selected remedy, addresses pooled and residual DNAPL and sorbed contaminants at the Nyacol/WAC AOC. However, it does not directly address the contaminated downgradient plume AOC. GW-4 relies on contaminant attenuation/degradation after source removal and treatment in the Nyacol/WAC AOC to reduce the long-term human health risks in the downgradient plume AOC. Because of the potential residual contaminant mass remaining in the downgradient plume, it is estimated that 275 years would be required to achieve the TCE groundwater remediation goal throughout the Site.

Alternative GW-5 addresses pooled DNAPL, residual DNAPL, sorbed contaminants, and dissolved contaminants at Nyacol/WAC (estimated to be more than 90% of the total contaminant mass). However, it does not directly address the downgradient plume AOC, but rather relies on contaminant attenuation and degradation from source removal and treatment in the Nyacol/WAC AOC to reduce the long-term residual risk. It is estimated that 140 years would be required to achieve the TCE groundwater remediation goal throughout the Site.

Alternative GW-8 is the most aggressive active treatment alternative, as it includes both in-situ treatment and groundwater extraction in the Nyacol/WAC AOC and in-situ treatment in the downgradient plume AOC. GW-8 would target all known contaminant sources. Limitations (from DNAPL and matrix-diffused bedrock contaminants, active railroad tracks, industrial buildings, and property access to individual residential parcels located above the downgradient plume) may leave untreated contaminants in place following treatment. An estimated 140 years would be required to achieve the TCE groundwater remediation goal throughout the Site.

Alternative GW-9 includes in-situ treatment in both the Nyacol/WAC and downgradient plume AOCs and targets all known contaminant sources. Since it does not include groundwater pump and treat, it is considered less aggressive than Alternative GW-8. Like GW-8, limitations (from DNAPL and matrix-diffused bedrock contaminants, active railroad tracks, industrial buildings, and property access to individual residential parcels located above the downgradient plume) may leave untreated contaminants in place following treatment. An estimated 275 years would be required to achieve the TCE groundwater remediation goal throughout the Site.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

Alternative GW-1 involves no further action or treatment.

Alternative GW-2 includes extraction of recoverable DNAPL (if located during the PDI) but does not reduce the toxicity of the COCs or reduce the mobility of the associated contaminated groundwater plume. The TCE contamination remaining in-place would require approximately 500 years to be reduced at the start of the residential impacts area in the downgradient plume AOC.

Alternative GW-4, EPA's selected remedy, includes extraction of recoverable DNAPL (if located during the PDI) and in-situ (ISCO) treatment in the Nyacol/WAC AOC to reduce the mass of contaminants. It does not directly treat the dissolved phase contamination in the downgradient plume AOC, but rather. relies on contaminant attenuation and degradation after source removal and treatment to reduce the long-term residual risk in the downgradient plume AOC. The contamination remaining in-place would require approximately 114 years to achieve the TCE remediation goal at the start of the residential impacts area in the downgradient plume AOC.

Alternative GW-5 includes extraction of recoverable DNAPL as well as in-situ treatment and groundwater pump and treat in the Nyacol/WAC AOC. Although it does not reduce the toxicity of the COCs, it does serve to reduce the mobility of the associated groundwater and reduces the mass of contaminants in the Nyacol/WAC AOC. It does not reduce contaminant mobility within the downgradient plume AOC. The contamination remaining in-place would require approximately 26 years to achieve the TCE remediation goal at the start of the residential impacts area in the downgradient plume AOC.

Alternative GW-8 is considered the most aggressive active treatment alternative, as it includes both in-situ treatment and groundwater pump and treat in the Nyacol/WAC AOC, and in-situ treatment in the downgradient plume AOC. Although it does not reduce the toxicity of the COCs, it does serve to reduce the mobility of the dissolved VOCs in groundwater in the Nyacol/WAC AOC and reduces the mass of contaminants. Due to the contamination remaining in place, the inferred presence of DNAPL and matrix-diffused contaminant mass in deep fractured bedrock, and access limitations that may restrict in-situ treatment, full restoration would require approximately 26 years to achieve the TCE groundwater remediation goal at the start of the residential impacts area in the downgradient plume AOC.

Like GW-8, Alternative GW-9 includes DNAPL extraction at Nyacol/WAC AOC and in-situ treatment in both Nyacol/WAC and downgradient plume AOCs, targeting all known contaminant sources. Since it does not include groundwater pump and treat, it is somewhat less aggressive than GW-8 and does not serve to directly limit plume mobility. Due to the inferred presence of DNAPL and matrix-diffused contaminant mass in deep fractured bedrock as well as access limitations that may restrict in-situ treatment, full restoration would require approximately 114 years to achieve the TCE groundwater remediation goal at the start of the residential impacts area in the downgradient plume AOC.

Short-term Effectiveness

The short-term effectiveness of the remedial alternatives has been evaluated from three perspectives: risks to the community and on-site workers during implementation, short term environmental impacts, and sustainability. The remedial alternatives' time until RAOs are achieved were also evaluated under this criterion (see discussions in Long-term Effectiveness and Permanence, and Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment, above, for the estimated timeframes). All the remedies evaluated would be effective in the short term by mitigating the future vapor intrusion risk through the use of expanded ICs, and mitigating the current vapor intrusion risk by the continued operation, monitoring, and maintenance of the existing VMSs.

Alternative GW-1 has the lowest risks to the community and to workers during implementation but would take the longest time to achieve RAOs.

Alternative GW-2 has the least amount of material handling and intrusive work. However, it involves some intrusive construction work (installation of DNAPL extraction wells) in the Nyacol/WAC AOC and is considered to have some short-term community and sustainability impacts (i.e., heavy equipment noise traffic, and use of fossil fuels for construction equipment). GW-2 would take almost as long time as GW-1 to achieve RAOs.

Alternative GW-4, EPA's selected remedy, involves some intrusive construction work in the Nyacol/WAC AOC (for the installation of DNAPL extraction and ISCO injection wells) and, therefore, has some short-term community and sustainability impact (i.e., heavy equipment noise and traffic, fossil fuels for construction equipment, off-site material hauling, and potential minor disruption of commercial businesses where remedy work is being conducted). GW-4 also requires pressurized chemical injections, causing the potential for human (worker and community) exposure to reagents and products. Since GW-4 does not include remedial actions and treatment within residential areas, this reduces the potential risk to the overall public and community.GW-4, like GW-9, would not take as long time as GW-2 to achieve RAOs but would take longer than GW-5 and GW-8.
Alternative GW-5 involves intrusive construction work in the Nyacol/WAC AOC (the installation of DNAPL extraction and ISCO injection wells, and the installation of wells and piping for groundwater

pump and treat). Therefore, GW-5 has some short-term community and sustainability impact (i.e., heavy equipment noise and traffic, fossil fuels for construction equipment, off-site material hauling, and potential minor disruption of commercial businesses where remedy work would be conducted). The drawdown of groundwater to achieve plume capture during pump and treat may also result in short-term environmental impacts to adjacent wetlands in the Nyacol/WAC AOC (and potentially beyond depending on the extent of groundwater drawdown). GW-5 also requires pressurized chemical injections, causing the potential for human (worker and community) exposure to reagents and products. Since GW-5 does not include remedial actions and treatment within residential areas, this reduces the potential risk to the overall public and community. GW-5, like GW-8, would take the shortest time to achieve RAOs.

Alternative GW-8 includes DNAPL extraction, in-situ treatment, and groundwater pump and treat in the Nyacol/WAC AOC, and in-situ treatment in the downgradient plume AOC. It requires pressurized chemical injections, including several rounds of full-scale chemical injections within residential areas. These actions within residential areas increase the potential for community impacts compared to Alternatives GW-2, GW-4 and GW-5. Groundwater drawdown during pump and treat may also result in short-term environmental impacts to wetlands in the Nyacol/WAC AOC or beyond. GW-8 is, therefore, considered to have greater environmental and community impacts than Alternatives GW-4 and GW-5. GW-8, like GW-5, would take the shortest time to achieve RAOs.

Alternative GW-9 includes DNAPL extraction in the Nyacol/WAC AOC and in-situ treatment in both the Nyacol/WAC and downgradient plume AOCs. Like GW-8, it requires pressurized chemical injections including several rounds of full-scale chemical injections within residential areas. These actions within residential areas and their resulting potential for community impacts are considered generally equivalent to GW-8. However, because GW-9 does not have groundwater pump and treat, it has fewer short-term environmental impacts than GW-8. GW-9, like GW-4, would not take as long time as GW-2 to achieve RAOs but would take longer than GW-5 and GW-8.

Implementability

Alternative GW-1 is readily implementable, as it would not include any further remedial actions.

Alternative GW-2 is the most implementable of the action alternatives, as it involves a PDI and actions to extract and optimize the removal of any further recoverable DNAPL (if additional sources area located during the PDI). Directional drilling may be used to reach closer to, or beneath, areas that are otherwise inaccessible (such as beneath the railroad tracks and industrial buildings) that may have potential DNAPL sources in subsurface. Previous DNAPL extraction, while it has been successful in recovering DNAPL, has not recovered a significant contaminant mass; thus, additional engineering enhancements will be required to increase the overall DNAPL recoverability and achieve groundwater remediation goals.

Alternative GW-4 is more difficult to implement than GW-2 because it also includes in-situ (ISCO) chemical treatment. ISCO will require direct contact to destroy contamination, which may be difficult to reach in the weathered and shallow competent bedrock, where a significant portion of the residual contamination is located. Angled boreholes may be used to reach potential contaminant source areas where physical access is difficult (such as beneath the railroad tracks or under building foundations). Multiple injection depths are likely needed to target the highest concentrations and prevent short-circuiting through more permeable materials.

Alternative GW-5 is more difficult to implement than GW-2 and GW-4 because it also relies on both groundwater pump and treat, which would rely on a steady supply of electricity and other resources. The location and construction of a central treatment building for the groundwater pump and treat building may be challenging or difficult on private and/or commercial property in the Nyacol/WAC AOC (i.e., due to space considerations, existing buildings and commercial operations, etc.). Alternatives GW-8 and GW-9 are more difficult to implement than GW-5 because they involve treatment within the downgradient plume AOC. This area is heavily developed and contains more than 40 residential and commercial properties, and access to properties to conduct treatment activities is expected to be limited. Contamination appears to extend to a significant depth in this area, creating a large potential treatment volume and area. GW-8 and GW-9 are more difficult to implement due to potential property and land access limitations (e.g., active railroad tracks, existing industrial buildings, and potential denial of property access to residential or commercial parcels) that may restrict or prohibit treatment within targeted areas of the downgradient plume AOC. GW-8 is the most difficult of the remedies to implement because it incorporates the most remedial components, activities, and infrastructure.

The groundwater pump and treat included in GW-5 and GW-8 would involve the construction of permanent wells, pipelines, and treatment buildings either across property boundaries or with long piping runs along utility corridors. In addition, the effluent that would be discharged from the central treatment building to the sewer system utilized by the Town of Ashland would also require approval and a discharge permit. Therefore, those alternatives are more difficult to implement than GW-2, GW-4 and GW-9, which do not require permanent off-site components.

Costs

The costs for the alternatives are presented in **Table 1** in **Appendix B** of this ROD.

There are no capital costs for the No Further Action Alternative GW-1; costs included are for operations and maintenance (for five-year reviews).

Alternatives GW-8 and GW-9 have the highest capital construction costs, while GW-5 and GW-8 have the highest O&M costs. GW-1 has the lowest total costs, followed by GW-2, GW-4, GW-5, and GW-9. Alternative GW-8 has the highest total costs.

<u>Modifying Criteria for Alternative GW-4</u>

State Acceptance

The Commonwealth of Massachusetts, through its lead agency, MassDEP, has expressed its support for EPA's preferred alternative presented in the January 2020 Proposed Plan, and concurs with the selected remedy outlined in this ROD (see **Appendix A** of this ROD for the State concurrence letter).

Community Acceptance

EPA's extensive community engagement efforts at the Site included the publication of a Proposed Plan in January 2020, and the occurrence of public meetings described in further detail above in Section C of this ROD. A public informational meeting was held at the Ashland High School in Ashland, MA, on January

23, 2020, and was immediately followed with a Public Hearing. A transcript was created for this hearing and has been made part of the Administrative Record for this ROD. In addition to the oral comments received at the hearing, 11 written comments were also provided. A summary of the comments specific to the proposed alternatives for Nyanza OU2, and EPA's responses to these comments are included in the Responsiveness Summary, Part 3 of this ROD.

L. THE SELECTED REMEDY

1. Summary of the Rationale for the Selected Remedy

The selected remedy for OU2, Alternative GW-4, utilizes source control via DNAPL extraction/recovery and in-situ treatment in the Nyacol/WAC AOC. The remedy was selected because it addresses key areas of residual contamination (areas of pooled DNAPL, residual DNAPL in bedrock fractures, and sorbed contaminants), estimated to be more than 90% of the total contaminant mass. This residual source area contamination in the Nyacol/WAC AOC is contributing to the dissolved-phase VOC groundwater contamination in the downgradient plume, which is resulting in vapor intrusion and groundwater exposure risks. Additional source control measures are necessary to address groundwater that presents unacceptable risks to human health.

EPA believes the selected remedy for OU2 achieves the best overall balance among the nine criteria used to evaluate the various alternatives presented in the January 2020 FS report. This cleanup approach provides both short-term and long-term protection of human health and the environment, attains applicable federal environmental and state environmental laws and regulations, reduces the toxicity, mobility, and volume of contaminants through treatment to the extent practicable, and utilizes permanent solutions. In addition, the selected remedy uses proven cleanup technologies including DNAPL extraction/recovery and ISCO treatment of groundwater in bedrock and overburden aquifers. The selected remedy is also generally cost effective while achieving the site-specific cleanup objectives in a reasonable timeframe and has fewer impacts to the community.

The major components of the remedy are as follows:

- Pre-Design Investigation (PDI) in the Nyacol/WAC AOC to locate additional DNAPL for extraction and recovery, and to determine the layout and design of new extraction systems and subsequent in-situ treatment.
- Field-scale pilot study and install additional DNAPL extraction wells in the Nyacol/WAC AOC, if recoverable DNAPL is located during the PDI.
- Installation of additional DNAPL extraction wells (if additional DNAPL hots spots are located outside of the target PDI area), including angled or horizontal recovery wells to investigate beneath sensitive structures such as buildings or railroad tracks.
- Optimization of existing DNAPL extraction systems using amendments or water recirculation to enhance DNAPL recovery, or the use of pneumatic or hydraulic fracturing. This step would be implemented if the existing DNAPL extraction systems continue to be a viable option for recovering additional DNAPL in the future. Extracted DNAPL will be collected and transported off-site for disposal.

- ISCO treatment of groundwater in the Nyacol/WAC AOC by injecting a chemical oxidizer directly into the contaminated medium (i.e., groundwater) to destroy or reduce the concentration of contaminants in place, including VOCs that are resistant to degradation.
- Groundwater evaluation to design the ISCO treatment which would commence after the installation of any new DNAPL extraction well systems.
- Field-scale pilot study to determine the radius of influence (ROI) and to evaluate treatment performance of specific ISCO chemical formulations.
- ISCO treatment (i.e., chemical injections) within the Nyacol/WAC AOC, targeting deep overburden and shallow/weathered bedrock.
- Performance monitoring (i.e., groundwater sampling) after ISCO injection events to track progress and determine the number and frequency of subsequent injections.
- Groundwater monitoring well network expansion and optimization (i.e., new monitoring wells) for both performance monitoring and long-term monitoring of groundwater VOC concentrations throughout the contaminated groundwater plume.
- Periodic Five-Year Reviews will be conducted every 5 years, as required by CERCLA, to ensure remedy protectiveness while contaminants remain at the Site above levels that would allow for unlimited use and unrestricted exposure.
- Operation and Maintenance of existing OU2 remedy components including the VMSs and two DNAPL extraction systems.
- Expanding the institutional controls to require a vapor intrusion evaluation or VMS be installed if a new building is constructed over the contaminated groundwater plume, or if an existing building with a VMS is renovated or expanded in size.

Please refer to **Figure 14** in **Appendix C** of this ROD which shows the phased approach to EPA's selected remedy GW-4.

2. Description of Remedial Components

The final selected remedy for OU2 (GW-4) is consistent with EPA's preferred alternatives outlined in the January 2020 Proposed Plan. The selected remedy GW-4 includes the components of remedy GW-2, in addition to in-situ treatment in the areas where DNAPL and/or residual contamination is expected to be located (the Nyacol and WAC properties and immediately northeast of the capped landfill, referred to as the Nyacol/WAC AOC). No active treatment will be performed for the downgradient plume AOC; performance and long-term monitoring only of groundwater will be done. **Figures 10 - 13** in **Appendix C** of this ROD depict the general components and target treatment areas of the remedy.

The following is a detailed description of the components of the selected remedy (GW-4):

a) Pre-Design Investigation:

A PDI will be performed in the Nyacol/WAC AOC to support remedy development. It may include the following work to address data gaps and develop a more complete CSM that accurately identifies appropriate DNAPL sources targeted for extraction and recovery, and to determine the target overburden and bedrock zones for in-situ (ISCO) treatment. The full scope of the PDI will be determined once EPA embarks on the Remedial Design effort. However, the PDI is expected to include the following components:

- Surveys and wetland delineations;
- Evaluation of groundwater in the Nyacol and WAC AOC;
- DNAPL investigations and pilot studies; and,
- Other investigations needed to properly design and implement the Selected Remedy.

<u>DNAPL Pilot Study (Enhanced DNAPL Extraction Option)</u>
Following the Phase II DNAPL, a field-scale pilot study will be conducted to support the enhanced DNAPL extraction option. The objectives of the pilot study will be to:

- Optimize DNAPL extraction well construction design,
- Evaluate DNAPL extraction well capture zone;
- Establish realistic DNAPL extraction rates and recovery volume estimates;
- Evaluate pneumatic or hydraulic fracturing of discrete zones within the overburden and/or shallow bedrock and/or other enhancements to enhance the DNAPL recovery radius of influence (ROI) and recovery rates; and
- Provide other information that may be necessary to resolve RD data gaps.

b) DNAPL Extraction
As part of the enhanced DNAPL extraction option, recoverable DNAPL will be removed from the Nyacol/WAC AOC to the extent possible to reduce contaminant mass and accelerate aquifer restoration. The wells installed as part of the DNAPL PDI may be used for the full-scale DNAPL extraction if recoverable DNAPL is encountered. If the PDI results indicate that a groundwater hotspot with concentrations indicative of potential DNAPL may be located outside the PDI well network, additional recovery wells will be installed in a step-out drilling program (or “step drilling”) to target potentially recoverable DNAPL. Angled recovery wells may be used to reach beneath sensitive structures (i.e., buildings, railroad tracks). GW-4 also includes a provision to optimize DNAPL extraction in existing or new DNAPL extraction wells, which may include addition of amendments or water recirculation to enhance DNAPL recovery, or the use of pneumatic or hydraulic fracturing.

The most appropriate method of remedy implementation will be determined during the Remedial Design.

c) In-Situ Treatment
An in-situ treatment method (assumed to be in-situ chemical oxidation, or ISCO) will be performed in target treatment areas within the Nyacol/WAC AOC with TCE concentrations above 10 mg/L (shown on **Figure 13** in **Appendix C** of this ROD). Some target treatment areas may have potentially limited access. It is anticipated that the treatment will be implemented using activated persulfate as the primary reagent, which was selected because it is the only ISCO reagent with an oxidation energy capable of breaking down the chlorinated benzene COCs while achieving adequate aquifer distribution.

The full-scale ISCO will be designed and performed based on the results of the PDI. It will commence when pooled DNAPL can no longer be recovered from new extraction wells. ISCO will target deep overburden and shallow/weathered bedrock in areas where DNAPL has been recovered and/or in other areas where groundwater VOC concentrations are elevated. Some injection locations may include shallow hot spots or multiple targets at different depth intervals (such as the hot spot immediately downgradient of the landfill). The wells installed during PDI and DNAPL remedial action may be used for ISCO. Additional ISCO well installations may be required to ensure that the inferred 30-foot injection spacing (estimated 18-foot ROI) provides coverage over the entire source area, including sorbed contamination zones. Additional wells may also be required if PDI findings indicate the presence of previously unidentified contaminant hotspots outside the PDI and DNAPL well network. Soil and/or bedrock samples will be collected during the well installation to evaluate geology, lithology, contaminant characteristics, and additional parameters to support remedy design (oxidant demand, permeability, etc.). It is estimated that two full rounds of ISCO will be conducted, and two partial rounds will be conducted, to target areas of remaining contamination to achieve significant reductions in chemical mass and address sorbed contamination. Some ISCO injection points are assumed to be installed at an angle (e.g., directional drilling). Any deep bedrock well installations will include the performance of borehole geophysics, multiple-interval packer sampling, and hydraulic testing. Injection point density will be reduced to half in limited access areas, such as below building foundations. The remedial design will also consider methods to prevent contaminant migration during remedy implementation. The most appropriate method of remedy implementation will be determined during the Remedial Design phase.

d) Monitoring Well Network Optimization

Additional groundwater monitoring wells will be installed to address data gaps, determine if any changes are needed to the current VMS network, optimize the monitoring well network for long-term monitoring and remedy performance monitoring. The optimized well network will monitor both the potential DNAPL area in the Nyacol/WAC AOC and the downgradient plume AOC to evaluate the potential for plume expansion, and to evaluate the impact of DNAPL removal and in-situ treatment on groundwater VOC concentrations throughout the plume. Proposed locations of additional monitoring wells are shown in **Figures 11 and 12** in **Appendix C** of this ROD. However, final monitoring well locations will be determined during the design phase based on results of the PDI.

e) Institutional Controls

Institutional Controls, including limitations on land and groundwater uses and activities, are necessary to protect human health by controlling potential exposures to contaminated groundwater, indoor air, and trench air vapors. Institutional Controls are also necessary for the protection of remedy components, including limitations on uses and activities that interfere with or disturb components of the remedy.

The 1991 ROD and the 2006 ESD for Nyanza OU2 previously documented the necessity for institutional controls pertaining to groundwater exposure through the installation of private wells and through construction activities. The 1991 ROD required institutional controls for groundwater to prevent landowners from installing new wells in the areas of known groundwater contamination, and suggested that local permit restrictions implemented through the Town is one example of how such controls may be implemented. The 2006 ESD maintained the need for ICs to prevent the installation of new private wells within, or in the vicinity of, the contaminated groundwater plume. The 2006 ESD expanded the need for institutional controls to prevent incidental ingestion of contaminants in shallow groundwater that could be encountered during excavations, such as for construction or utility installations or repairs. The 2006 ESD also expanded the need for institutional controls to address the vapor intrusion risks associated with the Site and suggested that local restrictions may be needed to restrict new construction in the area of potential vapor intrusion risk, unless they include measures to mitigate the possible vapor intrusion risk.

Following the 2006 ESD, further risk exposure scenarios were evaluated, and it was determined that the use of irrigation wells to fill a swimming pool and construction worker exposure to trench air vapors may present an unacceptable risk. This new information further supports the need to prevent the installation of new private wells (for either potable or irrigation purposes) within the contaminated groundwater plume as originally required by both the 1991 ROD and 2006 ESD and the need for institutional controls for construction workers.

Since this ROD includes measure to reduce contamination such that vapor mitigation systems may no longer be needed, this ROD also clarifies that the institutional controls to address potential vapor intrusion risks are still needed until remediation goals are achieved and expands the area where the controls are needed. Specifically, this ROD requires, over the entire groundwater plume, a vapor intrusion evaluation or vapor mitigation system be installed if a new building is constructed, or if an existing building with a VMS is expanded, until groundwater remedial goals are achieved.

Currently, EPA continues with work with the Town according to an informal set of procedures whereby the Town notifies EPA and requests input on construction activities that may cause exposures that pose an unacceptable risk. EPA will continue to work with the Town in this manner until ICs, such as an ordinance or regulations, to address these issues are implemented.

f) Long Term Monitoring

LTM will be required to evaluate concentrations in both the Nyacol/WAC and downgradient plume AOCs. LTM will continue for as long as groundwater contaminant concentrations remain above remediation goals. However, the number of wells sampled may be reduced if the extent of the plume decreases consistently over time. Groundwater sampling trends from LTM will be evaluated to determine the extent of any natural attenuation as part of the five-year review process. Selected monitoring wells will be sampled periodically using low-flow methods and analyzed for VOCs, SVOCs, and general geochemistry to evaluate contaminant trends, and contaminant degradation or attenuation. Long term groundwater sampling will be completed on a routine basis and continue while VOC contaminant concentrations remain above groundwater remediation goals. Groundwater monitoring will focus on the existing vapor mitigation area, remedy performance monitoring downgradient of the treatment areas, and a portion of a PPA designated by MassDEP. The portion of the potential source area of the PPA which is near the Site is shown on **Figure 2** in **Appendix C** of this ROD. In 2019, the MassDEP completed an updated Groundwater Use and Value Determination (GWU&VD), which revised and reduced the size of the potential source area of the PPA (on the eastern perimeter of the PPA) defined in the 2014 GWU&VD. Based on current and historical groundwater data for overburden and bedrock aquifers, and the overall hydrogeology of the Site in the vicinity of this area, EPA does not anticipate Site-related groundwater contamination within the potential source area of the PPA.

g) Five-Year Reviews

At the conclusion of remedy construction, hazardous substances, pollutants, or contaminants associated with OU2 will remain in place. Therefore, as required by law, EPA will review the OU2 remedy/remedies to ensure that the remedial action(s) are protective of human health and the environment at least once every five years. These five-year reviews will evaluate the components of the remedy for as long as contaminated media remain in place above levels that would allow for unlimited use and unrestricted exposure. The purpose of the five-year review is to evaluate the implementation and performance of a Site remedy or remedies to determine if the remedy is, or the remedies are, protective of human health and the environment. The five-year review will document recommendations and follow-up actions as necessary to ensure long-term protectiveness of a remedy, or to bring about protectiveness of a remedy that is not protective. These recommendations could include providing additional response actions, improving O&M activities, optimizing the remedy, enforcing access controls and Institutional Controls, and/or conducting additional studies and investigations.

Remedy Modifications

The selected remedy may change somewhat as a result of the remedial design, results of the PDI, additional groundwater monitoring, and/or construction processes. More specifically, pre-design investigations will include new groundwater wells and additional groundwater sampling to better refine the horizontal extent of groundwater contamination, and to assess impacts (if any) on the portion of the PPA designated by MassDEP (described above) which is located near the Site. Any changes to the remedy described in this ROD would be documented using a technical memorandum in the Administrative Record, an Explanation of Significant Differences (ESD), or ROD amendment, as appropriate.

3. **Summary of the Estimated Remedy Costs**

The estimated total cost of the selected remedy is approximately $20.5 million. A summary table of the major capital construction and annual O&M cost elements for the selected remedy is shown below. The discount rate used for calculating total present worth costs was 7%. The timeframe estimated in the January 2020 FS report over which cost expenditures are calculated is 30 years.

Remedy	Capital Cost	O&M – Present Value (30 years)	Total Cost – Present Value[2]
GW-4	$ 14,940,000	$ 5,547,000	$ 20,487,000

Changes in the cost elements may occur as a result of new information and data collected during the remedial design or pre-design investigation. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

4. **Expected Outcomes of the Selected Remedy**

The objective of the selected remedy is to use a combination of DNAPL removal and in-situ treatment in the Nyacol/WAC AOC to reduce the flux of VOC contaminants from the source area into the groundwater plume migrating toward the Sudbury River. The goal is to reduce dissolved-phase VOC concentrations to levels such that existing VMSs in residential, commercial, and municipal buildings

[2] Total Cost – Present Value presented is the sum of capital cost, net present value of periodic cost (separate from O&M) for 30 years, and net present value of annual O&M for 30 years.

could be eliminated in the future and no new VMSs or other SSDSs are required in new or existing buildings.

The effectiveness of the remedy will be determined based upon attainment of the groundwater remediation goals (performance standards) outlined in **Table 2** in **Appendix B** of this ROD. A groundwater monitoring program will be implemented in order to evaluate remedy performance and progress towards attainment of cleanup levels. The details of the monitoring program will be established during the remedial design phase and will include preparation of a long-term monitoring plan. Monitoring scope and frequency could change over time based on technical analysis of the remedy, optimization studies, revised conceptual site model, or other information, as determined by EPA.

Remediation Goals

Groundwater remediation goals (RGs) were developed for the COCs identified for OU2 from human health risk assessments and groundwater monitoring data. COCs are the chemicals found at the Site that, based on the results of the risk assessment, were determined to pose an ILCR greater than 1 in 1 million or an HI greater than 1. The groundwater preliminary remedial goals (PRGs) provided in the January 2020 FS report are site-specific Vapor Intrusion Screening Levels (VISLs), which were adopted as the final remedial goals (RGs) identified in this ROD. The RGs were calculated using the EPA VISL calculator based on a target cancer risk of 1×10^{-4} and a target non cancer HQ of 1.

The RGs were adjusted for site-specific attenuation factors of groundwater temperature and Site geology. The standard temperature assumed in the EPA VISL calculator is 25°C; this was modified to 15°C based upon review of available groundwater temperature sampling data from shallow overburden groundwater wells.

The attenuation factor used to calculate the RGs was also modified based on site-specific information. This site-specific geology reduced the recommended attenuation factor from 0.001 to 0.0005, which doubles the resulting calculated VISL value. This value is still considered to be conservative, as it uses the 95th percentile value.

The selected groundwater RGs are shown in **Table 2** of **Appendix B** of this ROD. These groundwater remediation goals serve as a target for reducing VOC concentrations in groundwater to a level that is protective of indoor air. Because these remediation goals are based on screening level calculations, EPA will not use these groundwater remediation goals as the sole factor in determining if the vapor mitigation systems can be terminated. Instead, EPA will use multiple lines of evidence to determine whether a vapor intrusion pathway may be present, which is consistent with EPA's "OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air," OSWER 9200.2-154, June 2015. For example, EPA has calculated indoor air screening levels (SLs) (see **Table 2** in **Appendix B** of this ROD). which can be used to confirm whether residual groundwater contamination is causing an unacceptable risk in indoor air. As progress is made in reducing groundwater concentrations to the remediation goals in the ROD, EPA will conduct periodic evaluations, using multiple lines of evidence, such as both groundwater and indoor air data, to determine if the vapor mitigation systems are needed.

Consistent with EPA's 1996 Final Ground Water Use and Value Determination Guidance, and EPA's endorsement of the Commonwealth of Massachusetts' Comprehensive State Groundwater Protection Program, MassDEP developed a GWU&VD of the groundwater impacted by the Site in 2014 and 2019. Aside from a portion of a PPA located north of the Site, MassDEP determined that there is a "low" use and value for groundwater within the Site. In addition, based on current and historical groundwater data for overburden and bedrock aquifers, and the overall hydrogeology of the Site in the vicinity of the PPA, EPA does not anticipate Site-related groundwater contamination within the PPA. Therefore, EPA has selected groundwater remediation goals based on unacceptable risk to human health for exposure to indoor air via vapor intrusion, because Site groundwater is not considered a future potential drinking water source.

M. STATUTORY DETERMINATIONS

The remedial action selected for implementation at the Nyanza Chemical Waste Dump Superfund Site – OU2 is consistent with CERCLA and, to the extent practicable, the NCP. The selected remedy is protective of human health and the environment, will comply will ARARs, and is cost-effective. In addition, the selected remedy utilizes permanent solutions and proven treatment technologies intended to permanently and significantly reduce the mobility, toxicity, or volume of hazardous substances to the maximum extent practicable. The selected remedy also achieves the best overall balance among EPA's nine criteria used to evaluate the various alternatives presented in the Feasibility Study.

1. The Selected Remedy is Protective of Human Health and the Environment

The selected remedy for OU2 will adequately protect human health and the environment by eliminating, reducing, or controlling exposures to human receptors through extraction, treatment, engineering controls, long-term monitoring, and institutional controls. This cleanup approach provides both short- and long-term protection of human health, and reduces the toxicity, mobility, and volume of contaminants through extraction and treatment to the extent practicable. The selected remedy will reduce potential human health risk levels such that they do not exceed EPA's target risk range of a total excess lifetime cancer risk of 10^{-6} to 10^{-4} and/or a non-cancer Hazard Index greater than 1.0. The selected remedy also uses land use restrictions to prevent unacceptable exposures in the future to the contaminants that will remain at the Site in the near term.

More specifically, the remedy focuses on source control in the Nyacol/WAC AOC with further expanded investigations and recovery of residual pooled DNAPL, and in-situ treatment for areas of groundwater contamination with elevated chlorinated VOC concentrations (e.g., chlorinated ethenes and chlorinated benzenes). Long-term monitoring of groundwater and the vapor intrusion pathway will ensure the remedy remains protective until remediation goals are met. Expanded ICs will provide further protection from future exposures to contaminated groundwater emanating from the Site until groundwater remediation goals are achieved.

2. The Selected Remedy Complies with ARARs

The selected remedy will comply with federal and state ARARs identified for OU2. The selected remedy will also incorporate procedures and processes identified by policies, advisories, criteria, and guidance documents (TBCs). A detailed list of ARARs/TBCs for the selected remedy is included in **Appendix D** of this ROD.

The only chemical-specific ARARs/TBCs for the OU2 alternatives or the selected remedy are TBCs, notably those pertaining to vapor intrusion, which were used to develop PRGs and remediation goals for groundwater. The selected remedy will comply with action-specific ARARs and TBCs for the selected remedy, in particular the disposal of investigation-derived waste (IDW) from well installation and extraction of recoverable DNAPL, which will be disposed of as hazardous waste. Location-specific ARARs will be met for any components that may impact wetlands and those that may extend to the floodplain of the Sudbury River. The selected remedy also includes a PDI incorporating a wetland delineation to better locate and identify potential mitigation strategies. Endangered, threatened, and/or listed species or habitats have not been identified at or in the vicinity of the Site. In addition, historic features have not been identified in these areas.

3. The Selected Remedy is Cost-Effective

In EPA's judgment, the selected remedy is cost-effective because the remedy costs are proportional to its overall effectiveness (see 40 C.F.R. § 300.430(f)(1)(ii)(D)). This determination was made by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria (i.e., that are protective of human health and the environment and comply with all federal and any more stringent state ARARs, or as appropriate, waive ARARs). Overall effectiveness was evaluated by assessing three of the five balancing criteria—long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; and short-term effectiveness; in combination. The overall effectiveness of each alternative then was compared to the alternative's cost to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence represents a reasonable value for the money to be spent. The estimated present worth cost of the selected remedy is approximately $20.5 million.

4. The Selected Remedy Utilizes Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

Once the Agency identified those alternatives that attain or, as appropriate, waive ARARs and that are protective of human health and the environment, EPA identified which alternative utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. This determination was made by deciding which one of the identified alternatives provides the best balance of trade-offs among alternatives in terms of: 1) long-term effectiveness and permanence; 2) reduction of toxicity, mobility, or volume through treatment; 3) short-term effectiveness; 4) implementability; and 5) cost. The balancing test emphasized long-term effectiveness and permanence and the reduction of toxicity, mobility, or volume through treatment, and considered the preference for source area treatment as a principal element, and balanced community and state acceptance. The selected remedy provides the best balance of trade-offs among the alternatives.

The selected remedy is protective of human health and the environment, uses proven cleanup technologies such as contaminant extraction/recovery, in-situ treatment, and institutional controls; the remedy is also cost-effective in achieving the site-specific cleanup objectives in a reasonable timeframe.

5. The Selected Remedy Partially Satisfies the Preference for Treatment Which Permanently and Significantly Reduces the Toxicity, Mobility, or Volume of the Hazardous Substances as a Principal Element

The NCP indicates that, in addition to complying with ARARs and providing protection for human health and the environment, both the short- and long-term aspects of effectiveness should be considered when evaluating alternatives. Short term is considered to be the construction and implementation period, while long-term begins once the remedial action is complete and RAOs have been met. Short-term effectiveness considerations include the effects of the alternatives during the construction and implementation period, the alternative's ability to meet RAOs, and the relative time frame required to achieve RAOs. Long-term effectiveness considers the magnitude of the remaining residual risk because of residual contaminant sources and the adequacy and reliability of specific technical components and control measures to maintain compliance with RAOs over the life of the remediation.

The selected remedy (GW-4) addresses pooled and residual DNAPL and sorbed contaminants at the Nyacol/WAC AOC. While it does not directly address the downgradient plume, GW-4 relies on contaminant attenuation/degradation after source removal and treatment in the Nyacol/WAC AOC to reduce the long-term residual risk in the downgradient plume AOC. Because of the large potential contaminant mass in the source area, it is estimated that 275 years would be required to achieve the TCE target RG throughout the Site. EPA will conduct periodic evaluations of groundwater contaminant concentrations and other information to determine if and when the need for VMSs may be eliminated.

6. Five-Year Reviews of the Selected Remedy are Required

At the conclusion of the OU2 Site remedy implementation and construction, hazardous contaminants will remain at the Site in the near term. Therefore, as required by law, EPA will review the Site remedies to ensure that the remedial action(s) continue to protect human health and the environment at least once every five years, as part of the EPA's five-year reviews for the entire Nyanza Site as long as waste remain above levels that would allow for unlimited use and unrestricted exposure. These five-year reviews will evaluate the components of the OU2 Site remedy for as long as contaminated media (i.e., groundwater) remain in place above groundwater remediation goals.

N. DOCUMENTATION OF NO SIGNIFICANT CHANGES

EPA presented the Nyanza OU2 Proposed Plan for remediation of the Site to the public for review and comment on January 14, 2020. The Proposed Plan described the alternatives considered and EPA's preferred alternative for the selected remedy.

The preferred alternative included:

- A pre-design investigation;
- Pilot testing of remedy treatment and groundwater evaluations; additional DNAPL extraction/recovery and in-situ groundwater treatment at the Nyacol/WAC AOC;
- Performance monitoring of groundwater to assess remedy effectiveness over time;
- Long-term monitoring of groundwater;

- Operation and maintenance of the 41 existing VMSs;
- Operation and maintenance of the two existing DNAPL recovery systems (if they continue to be productive in the future);
- Institutional Controls to require a vapor intrusion evaluation or VMS be installed if a new building is constructed over the contaminated groundwater plume or if an existing building with a VMS is renovated or expanded in size; and
- Five-year reviews to ensure the remedy remains protective of human health and the environment.

The Proposed Plan listed the following ICs to:

1. Prevent construction worker exposure to contaminated groundwater until groundwater clean-up levels are achieved;
2. Prevent contact with contaminated groundwater by restricting the installation of private non-drinking water wells (e.g., irrigation wells) where non-drinking water cleanup levels are exceeded, until groundwater cleanup levels are achieved; and
3. Require a vapor intrusion evaluation or VMS be installed if a new building is constructed over the contaminated groundwater plume, including the Nyacol/WAC AOC and the downgradient plume AOC (or if an existing building with a VMS installed is renovated or expanded in size).

However, EPA determined that the first two ICs were already addressed in previous OU2 decision documents (i.e., the 1991 ROD and the 2006 ESD), including the construction worker exposure to contaminated groundwater and restricting the installation of private wells. Accordingly, these ICs were removed from the remedy in this ROD to avoid repetitiveness and confusion.

The 2006 ESD also suggested that ICs may also be needed to restrict new construction in the area of potential vapor intrusion risk unless they include measures to mitigate this risk. Since this ROD includes measures to reduce groundwater contamination to levels that eliminate the need for the vapor intrusion systems, this ROD clarifies that institutional controls are needed to require, over the entire groundwater plume, a vapor intrusion evaluation or vapor mitigation system be installed if a new building is constructed, or if an existing building with a VMS is expanded, until groundwater remedial goals are achieved.

EPA reviewed all written and verbal comments submitted during the public comment period, which began on January 14, 2020, and ended on March 30, 2020. Based upon a review of the submitted comments, EPA determined that no significant changes to the selected remedy, as originally identified in the January 2020 Proposed Plan, were necessary.

O. STATE ROLE

The Commonwealth of Massachusetts, through MassDEP, concurs with the selected remedy for the Site. A copy of the declaration of MassDEP's concurrence is attached as **Appendix A** of this ROD.

PART 3 – THE RESPONSIVENESS SUMMARY

A. PUBLIC COMMENTS AND EPA RESPONSES

EPA published the notice of availability of the Proposed Plan and Administrative Record through a news release on January 9, 2020, and released the Proposed Plan to the public on January 14, 2020 by posting a publicly accessible link on EPA's website. In addition, postcard notifications were mailed to residents and businesses located within a one-mile radius of the Site. EPA also provided the Proposed Plan to the Ashland Public Library located at 66 Front Street, Ashland, MA.

From January 14, 2020 through February 14, 2020, EPA held a thirty-day public comment period to accept public comments on the alternatives presented in the Feasibility Study and Proposed Plan, and on any other documents previously released to the public. An extension to the public comment period was requested, and, as a result, the comment period was extended to March 30, 2020.

On January 23, 2020, EPA held a public informational meeting, immediately followed by a Public Hearing, to describe EPA's Proposed Plan and to accept any oral or written comments. The meeting was held at the Ashland High School Auditorium, 65 East Union Street, Ashland, MA. A transcript of this meeting and the comments received at the meeting are included in the Responsiveness Summary.
Nine public comments were received during the Public Hearing, and ten were received in writing during the public comment period. Comments have been condensed, combined and categorized to facilitate responses. The full text of the written and oral comments received during the comment period has been included in the ROD Administrative Record.

<u>Comments on the Proposed Remedy Timeframe:</u>

Several comments were received which expressed concerns about the estimated timeframe for the design and implementation of the proposed groundwater remedy, and/or whether EPA could expedite the groundwater cleanup process for the Site. One commenter was concerned that the remedy timeframe would create further health issues for persons affected by the Site and noted that those issues could be prevented if the remedy could be completed sooner. Another commenter asked specifically what help they or others could provide to prevent the contamination at the site from harming other persons.

> **EPA Response**:
>
> EPA acknowledges the concerns over the time needed to implement the design and remedial action at the site. It is important to note that the timeframes provided in the Proposed Plan are estimates and are governed by both technical factors and the availability of funding. For the implementation of the design phase, the timeframes are highly dependent on the complexities of the site and the cleanup technology chosen. Although there have been several rounds of investigation conducted at the site, a robust pre-design investigation (PDI) is necessary to gather important information about the site including the location of additional sources of DNAPL for extraction/removal, and the most appropriate areas to target for groundwater treatment via in-situ chemical oxidation (ISCO). There are also many technical factors that impact the timeframe for implementing the ISCO technology and those factors need to be fully assessed in a field scale

pilot study. For example, factors such as the size of the contaminant source area, whether contaminants are trapped in hard-to-reach areas like bedrock fractures or clay, the nature of the soil or rock formations and whether they allow the oxidant to spread quickly and evenly, the groundwater flow velocity, and the lifespan of the oxidant when injected into the subsurface all have varying impacts on the implementation timeframes. A field-scale pilot study and post-injection performance monitoring are necessary steps to gather additional data to evaluate these factors prior to completing the design. Once the design is completed, the next phase is to conduct full scale implementation. Full scale implementation is an iterative approach where oxidants are injected, and monitoring is conducted to evaluate the success of each injection before additional injections are conducted. Therefore, the ISCO technology is inherently a technology that involves a prolonged implementation process.

As noted above, one additional factor that will affect the overall time to complete the design and implement the remedy is the availability of funding. The cleanup at the Nyanza site is classified as a "fund-financed" cleanup meaning that it is paid for by dollars appropriated to the Superfund program by the United States Congress. These funds go toward the cleanup of sites where potentially responsible parties are either non-existent (orphan sites) or are incapable of paying for cleanup (e.g., bankrupt). The vast majority of these funds come from General Revenues. Therefore, each year the federal budget and available funds affect the pace, scope and duration of fund-financed cleanups. In a given fiscal year, the Superfund construction budget is typically insufficient to pay for both ongoing cleanup projects and all the new shovel-ready projects. Over the last five years, EPA was unable to fund many of the new fund-financed construction projects ready to start work. EPA's decision-making process for allocating limited Superfund construction resources utilizes a risk-based process for prioritizing new construction work in balance with maintaining projects already underway.

At the Nyanza Site, the most imminent, direct threats from the Site have been mitigated by previous remedial actions conducted by EPA at the Site. Remedial actions have occurred at the Site to remove, contain, and/or control Site-related contamination, and mitigate risks since the 1980s. The OU2 selected remedy is the final stage of addressing residual contamination from the Site which is impacting groundwater.

EPA has determined the interim remedies implemented for OU2 are currently protective of human health and the environment in the short term. In particular, the vapor mitigation systems (VMSs) installed in buildings within the downgradient plume area are functioning and inspected annually by MassDEP to mitigate the vapor intrusion risk. There are also no known private or irrigation wells installed within the plume which could result in exposure to groundwater. These factors will be considered when future funding is allocated to sites for cleanup and that may impact when the Nyanza site receives the funding needed to complete the design and implementation of the remedy. However, EPA will continue to keep all interested parties informed of the project status and will continue to evaluate site conditions to insure they site remains protective until all remedial activities are completed.

<u>Comments on Monitoring During the Remedy Implementation</u>:

Several comments were received that requested EPA include provisions for robust and ongoing monitoring of groundwater and Site conditions during the implementation of the proposed remedy, so that EPA can evaluate remedy progress. One commenter noted that given the changing nature of technology and best practices, that EPA have mechanisms in place to revisit, evaluate and potentially make changes to the remedy based on the effectiveness.

Commenters also cited concerns about potential changes in plume mobility, instability, and the potential for people to come into contact with contaminants in their own back yards. One commenter requested that the groundwater monitoring well network be expanded to monitor contaminant movement that could reach surface water resources, particularly the various drainageways discharging to the Sudbury River. Another commenter asked about how far and wide the new monitoring wells will be located.

EPA Response:

The Monitoring Well Network Optimization phase of the selected remedy will include the installation of additional monitoring wells to address data gaps, conduct long-term groundwater monitoring, and conduct remedy performance monitoring. The optimized well network would monitor groundwater VOC concentrations in the Nyacol/WAC and downgradient plume AOCs to evaluate the impact and effectiveness of additional DNAPL removal and/or ISCO treatment. The monitoring program will also specifically target treatment areas, locations in the downgradient plume area of concern (AOC) such as the vapor mitigation area, and a portion of a potentially productive aquifer (PPA) designated by MassDEP. The existing groundwater monitoring well network at the Site is depicted on Figure 4 in Appendix C of this ROD. The additional monitoring locations are outlined in Figures 11 and 12 in Appendix C of this ROD. ISCO performance monitoring (pre-injection and post-injection events) would also be done to evaluate the effectiveness and performance of in-situ treatment. Remedy performance monitoring and long-term monitoring are critical steps which will allow EPA to monitor groundwater VOC concentrations, determine interim and long-term progress in attaining groundwater cleanup levels, evaluate the timeframe and duration for various cleanup steps described in this ROD, and to make any amendments, adjustments, or enhancements to the remedy as necessary.

<u>Comments on ISCO Treatment:</u>

Two comments were received with questions related to the ISCO treatment component under Alternative GW-4; specifically, how EPA would ensure that the potential benefits will outweigh the potential risks, what potential by-products may result from different ISCO chemical formulations and their mobility. One commenter inquired on how the following potential disadvantages would be addressed or mitigated:

- Potential need for large amounts of chemical.
- Resistance of some contaminants to oxidation.
- Limited ability to penetrate low permeability soil and groundwater zones.
- Potential for ISCO-induced effects (e.g., gas evolution, permeability reduction, secondary water quality effects).
- Potential for rebound of target contaminants.

- Inability to treat contaminant source zones to the most stringent goal levels (e.g., MCLs).

EPA Response:

ISCO is an aggressive remediation technology that has been applied to a wide range of volatile and semivolatile hazardous contaminants, is often considered for DNAPL source zone (or contaminant mass) removal at sites where groundwater and/or porous media have contaminants of concern, such as TCE, which are amenable to common oxidants. This also includes the dissolved-phase chemicals (i.e. in groundwater) emanating from these source zones. ISCO has been selected as a remedy at numerous Superfund sites, both throughout New England and across the United States. Chemical oxidation involves reduction/oxidation ("redox") reactions that convert hazardous compounds to nonhazardous or less toxic compounds that are more stable, less mobile, or inert. ISCO typically requires multiple iterations of oxidant application and performance monitoring due to variability in contaminant distribution, subsurface heterogeneity, and mass transport mechanisms.

Remediation technology selection is typically guided by factors such as geology, media, contaminant, treatment timeframe, remedial goals, and cost. The oxidant recommended for the Site is activated persulfate, which can have a persistence ranging from weeks to months after application. Robust site characterization, design analysis, oxidant application and delivery approach, and treatability and pilot testing prior to full-scale application can optimize the ISCO process and potentially reduce the amount or frequency of the oxidant needed for treatment. The pre-design investigation and bedrock hydrogeology analyses for the Site will be critical to target ISCO treatment zones in the subsurface bedrock to ensure reagents reach contaminated zones.

ISCO technology poses a low risk to the surrounding community during implementation, as the treatment reactions occur in the subsurface. Remediation will be focused in the Nyacol/WAC AOC, which is a commercial/industrial zoned area. Proper training, use of personal protective equipment (PPE), and engineering and administration controls will reduce risks to workers who handle and distribute the ISCO chemicals and to ensure safety to humans and the environment. Site-specific ARARs have also been evaluated to ensure regulatory compliance for environmental factors including underground injection control, air quality, and water quality. ISCO can work relatively quickly to remediate a contaminant source area when compared to other groundwater treatment technologies (such as pump and treat).

Performance evaluation metrics such as process monitoring (concentration, volumes, flow rates and distribution of the oxidant) and a robust groundwater monitoring program are necessary to evaluate the effectiveness of the ISCO treatment. Monitoring will be accomplished through new and existing monitoring wells in the source area and in the downgradient plume. Data collected during and after ISCO treatment will be compared to remediation goals and historical data (to identify changes or trends in groundwater VOC concentrations, plume characteristics, ISCO reaction byproducts, and contaminant reduction, degradation and/or rebound). Modifications to the treatment techniques may be required or necessary during the remedial design or remedial action phases based on testing, performance, and monitoring results. For more information on ISCO technology, please visit EPA's Contaminated Site Clean-Up information website: https://clu-in.org/techfocus/default.focus/sec/In_Situ_Oxidation/cat/Overview/

Comments on EPA Alternative GW-5:

Two comments were received whereby the commenters favored alternative GW-5 over EPA's proposed alternative GW-4, because the GW-5 plan was more aggressive than GW-4 and would achieve faster results with the additional step of groundwater pump and treat after ISCO treatment. Commenters also noted that GW-5 and GW-4 did not contain direct treatment measures to address contamination in the downgradient plume AOC, which have some hot-spot locations with elevated TCE concentrations.

EPA Response:

Although alternative GW-5 was evaluated and considered, EPA ultimately decided the disadvantages of constructing and operating a groundwater pump and treat system outweighed the advantages. GW-5 requires the construction of a central treatment plant building on the Nyacol property to process the extracted groundwater. Space considerations for this central treatment building footprint were a concern and would require occupation of a section of private property with heavy industrial activity. The ongoing operation and maintenance of a groundwater treatment plant requires significant quantities of electricity, treatment media, and contractor oversite. Alternative GW-5 is also almost twice the cost of GW-4 and would have a high O&M cost burden for the State in the long term. The treatment system would also require an oil-water separator to remove residual DNAPL, a holding tank with a chemical inhibitor for iron and manganese precipitation, an air stripper with carbon to remove VOC vapors to meet state air regulations, and a heat exchanger. Residual contamination from the oil-water separator and carbon filters require off-site disposal and/or reclamation. Extracted groundwater needs to be discharged off-site either by an indirect discharge to a publicly owned treatment works (POTW), or a direct discharge to a waterway (such as the Sudbury River), and effluent would need to be treated and sampled for compliance with discharge limitations under a National Pollution Discharge Elimination System (NPDES) permit to meet state and national standards. The 1991 interim ROD for Nyanza OU2 selected a groundwater pump and treat system, but it was not successful during field testing due to the discovery and presence of DNAPL that interfered with the pilot pump and treat system at that time.

Although the estimated times to achieve remediation goals for alternative GW-5 were calculated to be less than GW-4, the overall attenuation of the downgradient plume (i.e. reduction of contaminant concentrations) from the source area treatment would still be a slower process under both alternatives based on the geology and distribution of contamination. EPA believes the selected remedy GW-4 achieves the best overall balance among the nine criteria used to evaluate the various alternatives. This cleanup approach provides short-term and long-term protection of human health and the environment, attains applicable federal environmental and state environmental laws and regulations, reduces the toxicity, mobility, and volume of contaminants through treatment to the extent practicable. The selected remedy uses also proven cleanup technologies and is generally cost effective while achieving the Site-specific cleanup objectives in a reasonable timeframe, with lesser impacts to the surrounding community.

In the downgradient plume AOC, EPA ultimately decided that direct treatment was not feasible and would be difficult to implement. The downgradient plume area, primarily located within downtown Ashland, is heavily developed and contains more than 40 residential and commercial properties. ISCO treatment requires pressurized chemical injections, including multiple rounds of full-scale chemical applications which would have resulted in a greater impact to the community within off-Site residential areas. Obtaining access to multiple properties to conduct treatment activities was expected to be challenging and limited. Other land availability, limitations, and potential impediments (e.g., active railroad tracks, existing buildings, density of homes, major utilities) could restrict or prohibit treatment within the targeted areas of the downgradient plume. The selected remedy GW-4 targets source removal and treatment of residual contamination in the Nyacol/WAC AOC, which is directly contributing to the dissolved contamination in groundwater within the downgradient areas.

Comments on Communications with the Public During Remedy Implementation:

Comments were received requesting that EPA keep the public and local organizations continuously informed about ongoing Site remedial work, including the timing and location of remedial activities such as ISCO treatment. The comments included questions about how citizens can learn about and be updated on the Site work and whether there would be a live feed of ongoing remediation work. One commenter noted concerns about how and when citizens would be notified if the Site had been compromised or if an emergency or potential release occurred during remediation work or due to an extreme weather event such as a flood.

EPA Response:

EPA considers community involvement to be an important component of the Superfund cleanup process, and Site-specific community involvement plans are developed and implemented for each site, including the Nyanza Site. EPA typically tailors the scope of the community involvement plans to the level of community interest in the site and at each the stage of the cleanup process. EPA will take into consideration the requests for enhanced communication by providing timely and periodic updates as part of the community involvement plan (CIP) for the Site. These updates may occur in various ways, including fact sheets, press releases, website notifications, social media, and working directly with Town officials to assist with information dissemination.

A formal communication plan can be developed as part of the implementation of the remedy to ensure that the public and businesses are kept updated and informed of Site activities. Although EPA is not anticipating live feeds from remedial activities, visual aids such as photographs and videos may be shared as part of the communication plan. In the event of any emergency, EPA and their contractors working at the Site would immediately coordinate with the Town's response authorities, and corrective actions would be documented.

Comments on Proposed Institutional Controls:

A comment was received which explained that the Nyanza Advisory Subcommittee has been working on ways to implement ICs pertaining to the use of the groundwater and vapor mitigation systems, while noting the methods and possible ways of implementing the ICs were somewhat limited.

EPA Response:

EPA thanks the Nyanza Advisory Subcommittee for their efforts to implement ICs. EPA will work in coordination with the Town of Ashland, the Nyanza Advisory Subcommittee, and MassDEP regarding details of implementing future ICs related to the Site.

Comment on the Comparative Analyses Table:

A comment was received regarding Table 2 (Comparative Analyses of Remedial Alternatives) in the Proposed Plan. Specifically, was there any type of scoring matrix that EPA could create for comparing remedies to help assess what would achieve a quicker Site cleanup without factoring in or including the remedy cost.

EPA Response:

EPA is required to utilize nine criteria to evaluate cleanup alternatives and select a final cleanup plan for Superfund Sites: overall protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short-term effectiveness, implementability, costs, state acceptance and community acceptance. EPA prepared a table summarizing the results of the Comparative Analyses for all the remedial alternatives considered for OU2 for the first seven of these evaluation criteria and presented that summary in Table 2 of the Proposed Plan. The two final evaluation criteria are state and community acceptance and these criteria are considered after receiving comments during the public comment period. The time to achieve target remediation goals as well as the cost to achieve those goals are important factors considered by EPA when selecting a final remedy. However, under the Superfund laws and regulations neither criteria can form the sole basis for selecting a final cleanup plan. The Superfund laws and regulations require EPA to consider all nine criteria and select a final remedy that represents the best balance among all criteria.

Comment on Ecological and Human Health Risks of VOC Contamination in Riverine Areas:

One commenter had questions about how residual VOC contamination in groundwater baseflow entering riverine areas (the Sudbury River and the surrounding floodplains and wetlands) would impact: (a) ecological exposure risk for sensitive wildlife, and (b) human health exposure risk for recreational users of the Sudbury River. They also noted that restoring natural healthy wetland and riverine habitat in contaminated areas may provide the best means of slowing and removing contaminants and protecting the health of humans and wildlife, including aquatic wildlife. The commenter also noted that the selected remedy should take into consideration the potential for riverine flooding, at levels that reflect current models of climate change-induced riverine flooding and changing precipitation patterns.

EPA Response:

Under Nyanza Operable Unit 04 (OU4), EPA investigated a 26-mile stretch of the Sudbury River which was impacted by site contamination. Various remedial activities for OU4 were completed by EPA during 1992 to 2017, including implementing ICs (i.e. the posting and inspection and maintenance of fish consumption and mercury advisory signs along the Sudbury River in 6 communities), sediment sampling, fish tissue collection from the Sudbury River to monitor mercury levels, and human health risk and ecological risk assessments pertaining to mercury and mercury exposure. A preliminary ecological assessment of groundwater impacts to surface water was included in the 1991 RI/FS. In 1999, a Supplemental Baseline Ecological Risk Assessment was completed which revealed no known potential ecological exposure pathways or receptors for contaminated groundwater associated with Nyanza OU2. Between 1999 and 2003, several studies were conducted to evaluate potential ecological risks posed by the groundwater VOC plume that is slowly discharging into the Sudbury River. Results indicated that aquatic life was affected in one of three areas studied, but any impact could not be definitively tied to the groundwater plume over other existing habitat conditions such as storm water runoff into the river, low dissolved oxygen levels, stagnant water, and/or high amounts of detritus (leaf litter). Human health risk for recreational users in the Sudbury River is focused on the consumption of fish with mercury contamination. VOC contaminants in groundwater have not been identified as a human health risk in fish tissue or surface water.

EPA has determined the selected remedy is not anticipated to cause impacts to floodplains and will not result in the occupancy or modification of floodplains adjacent to the Site. The remedial components (PDI, direct treatment) are not planned within the floodplain designation Zone AE (the 100-year flood zone) or Zone X (the 500-year flood zone). EPA has determined that the selected remedy is the least environmentally damaging practicable alternative for protecting federal jurisdictional wetlands and aquatic ecosystems at and/or adjacent to the Site. Most of the wetlands on or near the Site are not located in the remedial areas, with the exception of certain wetlands located west of the Nyacol property and southeast of the WAC property. EPA will minimize potential harm and avoid adverse impacts to wetlands by using best management practices during the investigation and treatment phases of the remedy. The installation of additional groundwater monitoring wells for the remedy may be required within designated wetlands or floodplain areas in the downgradient plume. However, the well installation is a temporary action and best management practices will be employed to minimize any temporary impacts to floodplains, wetlands, or areas that may border floodplains. Any wetlands that are inadvertently affected by the remedial work described in this ROD will be restored or mitigated with native wetland vegetation, and any restoration efforts will be documented and monitored.

<u>Comments on Cleanup versus Containment of Site Contamination:</u>

EPA received one comment that supports active clean-up rather than the containment of remaining contamination from the Site. Another commenter noted concerns that contamination contained in place at the Site capped landfill is not being adequately monitored.

EPA Response:

EPA's selected remedy intends to physically remove residual DNAPL contamination from the Site that resides in the Nyacol/WAC AOC by the installation of additional DNAPL extraction systems; the remedy will also employ methods to treat contamination "in-situ", or treating in-place, by the injection of ISCO oxidants into the subsurface. The capped landfill is a remedy component that was implemented as part of OU1, and later modified under OU3. To ensure the effectiveness of the OU1 and OU3 remedies, MassDEP conducts routine inspections and makes necessary repairs to the components of the landfill including the cap, the toe, side slopes, drains and the landfill gas vents. MassDEP also conducts inspections and routine maintenance on the landfill stormwater drainage system, the interceptor trench, underdrain system (terminal manhole), sedimentation basin, and landfill site perimeter fence. Finally, MassDEP monitors groundwater from 15 monitoring wells and conducts air monitoring around the landfill to evaluate whether the remedy is functioning properly. To date, these inspections and monitoring results have demonstrated that the landfill continues to effectively contain the waste.

Comments on Construction of a Recreational Path Near the Site:

Two comments were submitted regarding the risk and safety of a proposed future multi-use, paved recreational path in Ashland that would run adjacent to the Site and in the vicinity of Trolley Brook. A commenter also noted a concern that the landfill cap has reached the end of its lifecycle.

EPA Response:

EPA has not identified a human health risk from the Site for recreational activities such as walking or biking on a recreational trail in the vicinity of Trolley Brook or adjacent wetlands. Trolley Brook and the adjacent Eastern Wetland were remediated by EPA between 1999 and 2001 under OU3 in accordance with a March 1993 EPA Record of Decision. These wetlands and drainageways originally received wastewater discharges contaminated with mercury from the textile dye manufacturing processes that occurred at the Site. The cleanup plan for OU3 included excavation of sediment with mercury levels above 1 mg/Kg; dewatering of excavated contaminated sediment and placement under the landfill cap; restoration of impacted wetlands; and institutional controls to increase public knowledge about mercury contamination in the Sudbury River sediment and fish tissue. To ensure the protectiveness of these remedies, MassDEP performs O&M activities in this area including inspections of Trolley Brook.

The selected remedy in this Record of Decision for (OU2) is focused on addressing the groundwater contamination that is flowing underground from the former Site manufacturing area, toward the Sudbury River.

The Nyanza landfill cap does not have a 30-year life span; this is a misconception based on the 30-year timeframe used by the Superfund program for monitoring and cost estimation purposes. Literature and research on other similar landfill caps indicate that these caps can last well over hundreds of years. The Nyanza landfill cap consists of a 60 mil membrane located more than 35 inches below the surface which sits above a solid engineered bentonite layer. Also included in the landfill design is a water collection and diversion trench used to divert clean groundwater and surface water around the landfill. The Nyanza cap is inspected annually by MassDEP as part of their O&M activities and is still in good condition. After in-depth structural engineering and plan reviews, the cap was approved for a solar array by EPA and MassDEP. The solar array was completed and activated in December 2019. EPA and MassDEP have no plans to terminate the Nyanza landfill monitoring program. Any future repairs to the landfill that may be required would be performed by the appropriate party.

Comment on Excavation Work for Utilities Projects:

A comment was received about a proposed 5-year gas pipeline utilities project, and whether there would be any risk of exposure to Site contaminants or health concerns for residents located near the project.

EPA Response:

At this time, EPA does not have information on the design or construction plans for the proposed 5-year pipeline project. However, EPA has established a process of communication with the Town of Ashland, whereby various Town departments (i.e., Board of Health, Conservation Commission, and Planning Department) seek input from EPA and MassDEP on construction projects with excavation activities planned within or near the Site groundwater plume. The purpose of this process is to ensure property owners, developers, and construction managers are aware of the groundwater contamination and potential exposure risk and can implement the appropriate measures for health and safety and materials handling.

Comment on Residential Gardening and Minor Residential Digging Activities:

A comment was received with a question about the safety of residents performing flower gardening and minor excavation work such as post-hole digging for a fence installation, [i.e. at properties located within the downgradient groundwater plume].

EPA Response:

EPA has not identified a risk from the Nyanza Superfund Site groundwater for shallow residential digging activities such as gardening or fence post-hole digging, based on available soil and groundwater data. Although depth to groundwater varies by location throughout the plume, water level measurements collected in 2018 from monitoring wells in the center of the existing vapor mitigation area indicate groundwater depths of 6.5 feet or greater below the ground surface. EPA contends that encountering groundwater several feet below the surface during light residential digging activities is highly unlikely. EPA has mitigated risk to Site-related surface contaminants (i.e. sediment and soil) during prior remedial actions under Nyanza Operable Units 01 and 03.

Comment on the Government Purchase of Homes in Ashland:

A comment was received which requested that the federal and state government consider giving anyone who has purchased a home [near the Site] and have not been given adequate disclosure over the past 10-20 years the ability to sell their homes to the government.

EPA Response:

It is EPA's policy to implement Superfund remedies in such a way as to protect public health without the need for relocation. EPA's preference is to address the risks posed by Superfund Site contamination by using well-designed methods of cleanup which allow people to remain safely in their homes and businesses. The overwhelming majority of Superfund sites located in residential areas are being cleaned up without the need for EPA to permanently relocate residents and businesses. Permanent relocation may be considered in situations where EPA has determined that structures must be destroyed because they physically block or otherwise interfere with a cleanup and methods for lifting or moving the structures safely, or conducting cleanup around the structures are not implementable from an engineering perspective. Permanent relocation may also be considered in situations where EPA has determined that structures cannot be decontaminated to levels that are protective of human health for their intended use, or when potential treatment or other response options would require the imposition of unreasonable restrictions to maintain protectiveness (e.g. where property owners' use of their yards would be prohibited or severely restricted). Permanent relocation may also be considered when an alternative under evaluation includes a temporary relocation expected to last longer than one year, and/or if temporary relocation remedy may not be practicable or there is a shortage of available long-term rentals within the immediate area making it difficult to implement temporary relocation.

EPA has not identified the need for relocation of any business or residences related to the Nyanza site. In 2007, EPA installed a total of 43 vapor mitigation systems (VMSs) in 41 buildings based on indoor air studies and groundwater sampling data. Criteria for determining properties that required a VMS included: location of where test results exceed EPA's proposed target risk for the inhalation of vapors; concentrations of target VOC contaminants in groundwater, particularly TCE; and use of modeling to identify structures that may be susceptible to inhalation risks from vapor intrusion. VMSs are similar in design to radon remediation systems and reduce the potential for vapors from groundwater contaminants such as TCE to migrate and accumulate in buildings at concentrations that may pose health risks. These systems were installed at no cost to the property owners on a voluntary basis, with access and approval from the property owners.

Comment on the 2015 Groundwater Monitoring Data Summary (Nobis, 2016):

A comment was received on the 2015 Groundwater Monitoring Data Summary report for the Nyanza Chemical Waste Dump Superfund Site, Operable Unit 2, which was prepared for EPA by Nobis Engineering, Inc. in December 2016. The commenter noted that he had detected a calculation error on report Table 5-4: "Historical Data Comparison – MCP Exceedances and Maximum Concentrations", in the column '2015 – 2014 Differences'.

EPA Response:

EPA reviewed this report table, and determined that the data displayed under the column of "2015 – 2014 differences, Maximum Concentration (µg/L)" was inadvertently calculated as the difference between the 2014 and 2013 maximum concentrations, rather than the difference in the 2015 and 2014 maximum concentrations. This information will be corrected in the report, however this discrepancy does not affect the remedy selected by EPA.

Comments from Environmental Companies:

EPA received comments from two independent environmental companies describing their interest in the proposed Site remedial actions, and/or technologies that could be employed during Site remediation activities.

EPA Response:

EPA appreciates the expressed interest in the Site and the technological information provided. EPA contracts are awarded under the Remedial Acquisition Framework (RAF) to provide national support through multiple award contracts to the EPA remedial program and its responsibilities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). More information can be found at: https://www.epa.gov/contracts.

Comment Pertaining to Groundwater PRGs:

EPA received a comment from MassDEP regarding the preliminary remediation goals (PRGs) for groundwater. MassDEP questioned if EPA evaluated cumulative risk across multiple chemicals. MassDEP noted that if the PRGs for individual chemicals were based on EPA's upper limit for risk ($1x10^{-4}$ for carcinogenic risk and HI = 1 for non-carcinogenic risk), then the sum of risks from multiple chemicals could exceed EPA's upper limit of acceptable risks.

EPA Response:

During the risk assessments completed in 1991 and 2005, EPA evaluated the cumulative human health risk from exposure to multiple contaminants in groundwater and indoor air as required by EPA Risk Assessment Guidance for Superfund (RAGS). These evaluations led to the development of remedial action objectives that addressed the unacceptable risks and the installation of vapor mitigation systems (VMSs) in several residences and buildings. The goal of the remedy in this ROD is to reduce the concentration of contaminants in groundwater to levels such that VMSs are no longer needed. EPA calculated groundwater remediation goals based on site-specific vapor intrusion screening levels using a cancer risk target of $1x10^{-4}$ (1-in-10,000). These groundwater remediation goals serve as a target for reducing VOC concentrations in groundwater to a level that is protective of human health for exposure to indoor air. EPA believes these remediation goals are conservative because there are many other factors that will affect how contaminants migrate from groundwater to indoor air that are not accounted for in the calculation of these screening levels. Because these remediation goals are based on screening level calculations, EPA will not use these groundwater remediation goals as the sole factor in determining if the vapor mitigation systems can be terminated. Instead, EPA will use multiple lines of evidence, (i.e. groundwater concentrations, indoor air, sub-slab soil gas concentrations, etc.) to determine whether a vapor intrusion pathway may be present, which is consistent with EPA's "OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air," OSWER 9200.2-154, June 2015. EPA has calculated indoor air screening levels (SLs) (see Table 2 of Appendix B) which can be used to confirm whether residual groundwater contamination is causing an unacceptable risk in indoor air.

Appendices

Appendix A

Massachusetts Department of Environmental Protection

Letter of Concurrence

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

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

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

July 30, 2020

Mr. Brian Olson, Director
Office of Site Remediation and Restoration
U.S. Environmental Protection Agency Region 1
5 Post Office Square, Suite 100
Mail Code: OSRR07-03
Boston, MA 02114-2023

Re: State Concurrence Determination
Record of Decision
Nyanza Chemical Waste Dump Superfund Site - Operable Unit #2
Ashland, MA

Dear Mr. Olson:

The Department of Environmental Protection (MassDEP) has reviewed the Record of Decision (ROD) and selected remedy recommended by the U.S. Environmental Protection Agency (EPA) for cleanup of Operable Unit #2 (OU2) of the Nyanza Chemical Waste Dump Superfund site (Site) in Ashland, MA. This letter provides MassDEP's concurrence with EPA's selected remedy for OU2 of the Site, as discussed below.

The selected remedy addresses threats from exposure to Site-related groundwater contamination and associated trench and indoor air vapors. The main components of the selected remedy include:

- A pre-design investigation (PDI) to locate additional DNAPL within the source area;
- If recoverable DNAPL is located, field scale pilot testing, installation and operation of additional DNAPL recovery wells;
- Optimization of the two existing DNAPL recovery systems (if still viable)to increase DNAPL recovery;
- Groundwater evaluations and field-scale pilot testing of in-situ chemical oxidation (ISCO) groundwater treatment;

- ISCO treatment targeting groundwater within the deep overburden and shallow bedrock in the source area;
- Expansion of the groundwater monitoring well network and long-term groundwater monitoring;
- Supplemental institutional controls to require vapor intrusion evaluations and/or installation of vapor mitigation systems at new, renovated, or expanded buildings within the VOC plume; and
- Continued operation, maintenance, monitoring and repair of 43 existing VMS in the VMA until future risk evaluations determine that the VMS are no longer needed.

The selected remedy, along with remedy components already in place from the 1991 Interim ROD and the 2006 ESD, is a comprehensive approach that is protective of human health and the environment; uses proven cleanup technologies such as contaminant extraction/recovery, in-situ treatment, and institutional controls; and the remedy is also cost effective in achieving the site-specific cleanup objectives in a reasonable timeframe.

MassDEP agrees with the conclusions in the ROD and therefore agrees with the Selected Remedy for OU2 of the Site.

If you have any questions regarding this letter please contact the MassDEP project manager, Jennifer McWeeney, at 617-654-6560, or Diane Baxter, Division Director of Federal Grant Programs, at 617-292-5697.

Sincerely,

Paul W. Locke
Assistant Commissioner
MassDEP BWSC

Cc: Lisa Thuot, USEPA project manager

Appendix B

Tables

Table 1 – Comparative Analyses of Remedial Alternatives

GROUNDWATER WALTERNATIVES	Overall Protection of Human Health & The Environment	Compliance with ARARs	Long-Term Effectiveness & Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Implementability	COSTS		
							Capital Cost	O&M Cost	Total Present Value [2]
GW-1: No Further Action	□	□	♦	♦	♦	♦♦♦♦	$0	$108,000	$108,000
GW-2: Continue Current Limited Action (with Enhanced DNAPL Extraction)	□	■	♦	♦♦	♦	♦♦♦♦	$2,879,000	$3,099,000	$5,978,000
GW-4: Nyacol/WAC AOC In-Situ Treatment [1]	■	■	♦♦	♦♦♦	♦♦♦♦	♦♦♦	$14,490,000	$5,547,000	$20,487,000
GW-5: Nyacol/WAC AOC In-Situ Treatment, Limited Pump & Treatment [1]	■	■	♦♦♦	♦♦♦	♦♦♦	♦♦♦	$18,664,000	$16,609,000	$35,273,000
GW-8: Nyacol/WAC AOC In-Situ Treatment & Limited P&T; Downgradient Plume AOC In-Situ Treatment [1]	■	■	♦♦♦♦	♦♦♦♦	♦♦	♦♦	$43,140,000	$13,694,000	$56,834,000
GW-9: Nyacol/WAC and Downgradient Plume AOC In-Situ Treatment [1]	■	■	♦♦♦	♦♦♦	♦♦	♦♦	$39,910,000	$3,072,000	$42,982,000

<u>Notes</u>:
1. Alternatives GW-4, GW-5, GW-8, and GW-9 include the remedial components of GW-2.
2. Total present value O&M cost is for 30 years, including costs for Five-Year Reviews and discount rate of 7% per EPA 540-R-00-002, OSWER 9355.0-75, July 2000.

<u>Comparative Analyses Ratings</u>:

♦ = Poor □ = Fail
♦♦ = Fair ■ = Pass
♦♦♦ = Good
♦♦♦♦ = Very Good

Table 2 – Remediation Goals (RGs)

Site-Wide Groundwater		
Chemical of Concern	**Selected RG (µg/L) [2]**	**Basis**
1,2,4-Trichlorobenzene	150	Site-Specific VISL[1]
1,2-Dichlorobenzene	9,990	Site-Specific VISL[1]
1,4-Dichlorobenzene	975	Site-Specific VISL[1]
Benzene	428	Site-Specific VISL[1]
Chlorobenzene	1,400	Site-Specific VISL[1]
Nitrobenzene	30,200	Site-Specific VISL[1]
Trichloroethene	16	Site-Specific VISL[1]
Vinyl chloride	38	Site-Specific VISL[1]

Notes:

1. Site-specific VISL = May 2018 Vapor Intrusion Screening Level target groundwater concentration. Please refer to **Appendix H** – Attenuation Factors for Site-Specific Vapor Intrusion Screening Levels included in the January 2020 FS Report.
2. Micrograms per liter.

Indoor Air Screening Levels (SLs)				
Chemical of Concern	**Non-cancer SL (HQ=0.1) µg/m^3**	**Cancer SL (10^{-6}) µg/m^3**	**Cancer SL (10^{-5}) µg/m^3**	**Cancer SL (10^{-4}) µg/m^3**
1,2,4-Trichlorobenzene	0.2	N/A[1]	N/A[1]	N/A[1]
1,2-Dichlorobenzene	20.9	N/A[1]	N/A[1]	N/A[1]
1,4-Dichlorobenzene	83.4	0.255	2.55	25.5
Benzene	3.13	0.36	3.6	36
Chlorobenzene	5.21	N/A[1]	N/A[1]	N/A[1]
Nitrobenzene	0.939	0.0702	0.702	7.02
Trichloroethene	0.2	0.478	4.78	47.8
Vinyl chloride	10.4	0.168	1.68	16.8

Notes:

1. N/A = A cancer SL is not available for this chemical of concern.

TABLE A-2.1
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CONTAMINANTS OF POTENTIAL CONCERN - GROUNDWATER
OPERABLE UNIT II - NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE
ASHLAND, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Point	CAS Number	Contaminant	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (N/C) (2)		COPC Flag (Y/N)	Rationale for Selection or Deletion
Site	95501	1,2-Dichlorobenzene	1.1	450	µg/L	MW-201-120215A	8/9	5.0 - 5.0	450	30	n	YES	ASL
	87616	1,2,3-Trichlorobenzene	19	37	µg/L	MW-201-120215A	3/9	1.0 - 5.0	37	0.70	n	YES	ASL
	120821	1,2,4-Trichlorobenzene	6.0	160	µg/L	MW-201-120215A	5/9	1.0 - 5.0	160	0.40	n	YES	ASL
	541731	1,3-Dichlorobenzene	8.2	12	µg/L	MW-201-120215A	2/9	1.0 - 10	12	NBA		YES	NBA
	106467	1,4-Dichlorobenzene	1.4	98	µg/L	MW-201-120215A	6/9	1.0 - 5.0	98	0.48	c	YES	ASL
	78933	2-Butanone	35	35	µg/L	MW-DEP-1-113015A	1/9	1.0 - 10	35	560	n	NO	BSL
	120832	2,4-Dichlorophenol	0.70	0.70	µg/L	MW-201-120215A	1/3	4.8 - 4.8	0.70	4.6	n	NO	BSL
	67641	Acetone	3.4	170	µg/L	MW-DEP-1-113015A	2/9	1.0 - 10	170	1400	n	NO	BSL
	71432	Benzene	6.1	12	µg/L	MW-06B-111417A	3/9	1.0 - 10	12	0.46	c	YES	ASL
	108907	Chlorobenzene	7.7	380	µg/L	MW-201-120215A	5/9	1.0 - 5.0	380	7.8	n	YES	ASL
	156592	cis-1,2-Dichloroethene	6.2	180	µg/L	MW-201-120215A	7/9	1.0 - 5.0	180	3.6	n	YES	ASL
	1634044	Methyl tert-butyl ether	5.5	5.5	µg/L	MW-06B-111417A	1/9	1.0 - 10	5.5	14	c	NO	BSL
	98953	Nitrobenzene	1.0	1.0	µg/L	MW-04A-120115A	1/3	4.8 - 4.8	1.0	0.14	c	YES	ASL
	86306	N-Nitrosodiphenylamine	0.42	0.42	µg/L	MW-201-120215A	1/3	4.8 - 4.8	0.42	12	c	NO	BSL
	95476	o-Xylene	6.1	6.1	µg/L	MW-06B-111417A	1/9	1.0 - 10	6.1	19	n	NO	BSL
	108952	Phenol	0.46	0.83	µg/L	MW-201-120215A	2/3	9.5 - 10	0.83	580	n	NO	BSL
	156605	trans-1,2-Dichloroethene	1.5	2	µg/L	MW-201-120215A	1/9	1.0 - 10	1.5	36	n	NO	BSL
	79016	Trichloroethene	2.4	240	µg/L	MW-201-120215A	7/9	1.0 - 5.0	240	0.28	n	YES	ASL
	7440702	Calcium	130000	130000	µg/L	MW-104B-111317A	1/1	NA	130000	NUT		NO	See text
	7439896	Iron	18000	18000	µg/L	MW-104B-111317A	1/1	NA	18000	1400	n	YES	ASL
	7439954	Magnesium	2300	2300	µg/L	MW-104B-111317A	1/1	NA	2300	NUT		NO	See text
	7439965	Manganese	720	720	µg/L	MW-104B-111317A	1/1	NA	720	43	n	YES	ASL

Notes/sources:

(1) Maximum detected concentration used for screening.

(2) Risk-based tapwater concentrations obtained from the Regional Screening Level (RSL) Table (November, 2019).

NBA = no benchmark available.

ASL = above screening level.

BSL = below screening level.

c = cancer based screening value set at a target risk of 1E-06.

µg/L = micrograms per liter.

NA = not available.

n = noncancer based screening value set at a target hazard quotient of 0.1.

NUT = essential nutrient.

TABLE A-2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CONTAMINANTS OF POTENTIAL CONCERN - VAPOR INTRUSION EXPOSURE PATHWAY - GROUNDWATER

OPERABLE UNIT II - NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE

ASHLAND, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Indoor Air

Exposure Point	CAS Number	Contaminant	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (N/C) (2)	COPC Flag (Y/N)	Rationale for Selection or Deletion
Site	95501	1,2-Dichlorobenzene	1.1	450	µg/L	MW-201-120215A	8/9	5.0 - 5.0	450	266 n	YES	ASL
	87616	1,2,3-Trichlorobenzene	19	37	µg/L	MW-201-120215A	3/9	1.0 - 5.0	37	NBA	YES	NBA
	120821	1,2,4-Trichlorobenzene	6.0	160	µg/L	MW-201-120215A	5/9	1.0 - 5.0	160	3.6 n	YES	ASL
	541731	1,3-Dichlorobenzene	8.2	12	µg/L	MW-201-120215A	2/9	1.0 - 10	12	NBA	YES	NBA
	106467	1,4-Dichlorobenzene	1.4	98	µg/L	MW-201-120215A	6/9	1.0 - 5.0	98	2.6 c	YES	ASL
	78933	2-Butanone	35	35	µg/L	MW-DEP-1-113015A	1/9	1.0 - 10	35	224,000 n	NO	BSL
	67641	Acetone	3.4	170	µg/L	MW-DEP-1-113015A	2/9	1.0 - 10	170	2,250,000 n	NO	BSL
	71432	Benzene	6.1	12	µg/L	MW-06B-111417A	3/9	1.0 - 10	12	1.6 c	YES	ASL
	108907	Chlorobenzene	7.7	380	µg/L	MW-201-120215A	5/9	1.0 - 5.0	380	41 n	YES	ASL
	156592	cis-1,2-Dichloroethene	6.2	180	µg/L	MW-201-120215A	7/9	1.0 - 5.0	180	NBA	YES	NBA
	1634044	Methyl tert-butyl ether	5.5	5.5	µg/L	MW-06B-111417A	1/9	1.0 - 10	5.5	450 c	NO	BSL
	98953	Nitrobenzene	1.0	1.0	µg/L	MW-04A-120115A	1/3	4.8 - 4.8	1.0	72 c	NO	BSL
	95476	o-Xylene	6.1	6.1	µg/L	MW-06B-111417A	1/9	1.0 - 10	6.1	49 n	NO	BSL
	156605	trans-1,2-Dichloroethene	1.5	1.5	µg/L	MW-201-120215A	1/9	1.0 - 10	1.5	NBA	YES	NBA
	79016	Trichloroethene	2.4	240	µg/L	MW-201-120215A	7/9	1.0 - 5.0	240	0.52 n	YES	ASL

Notes/sources:

(1) Maximum detected concentration used for screening.

(2) Screening toxicity value derived from the EPA Vapor Intrusion Screening Level (VISL) calculator based on the residential target groundwater concentration (December, 2019).

NBA = no benchmark available.
ASL = above screening level.
BSL = below screening level.
c = cancer based screening value set at a target risk of 1E-06.
µg/L = micrograms per liter.
NA = not available.
n = noncancer based screening value set at a target hazard quotient of 0.1.

TABLE A-3.1
EXPOSURE POINT CONCENTRATION SUMMARY - GROUNDWATER
OPERABLE UNIT II - NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE
ASHLAND, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Point	Contaminant of Potential Concern	Units	Arithmetic Mean	95% UCL	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Site	1,2-Dichlorobenzene	µg/L	189	NC	450	450	µg/L	Maximum	See footnote
	1,2,3-Trichlorobenzene	µg/L	11	NC	37	37	µg/L	Maximum	See footnote
	1,2,4-Trichlorobenzene	µg/L	45	NC	160	160	µg/L	Maximum	See footnote
	1,3-Dichlorobenzene	µg/L	5.8	NC	12	12	µg/L	Maximum	See footnote
	1,4-Dichlorobenzene	µg/L	35	NC	98	98	µg/L	Maximum	See footnote
	Benzene	µg/L	6.0	NC	12	12	µg/L	Maximum	See footnote
	Chlorobenzene	µg/L	144	NC	380	380	µg/L	Maximum	See footnote
	cis-1,2-Dichloroethene	µg/L	85	NC	180	180	µg/L	Maximum	See footnote
	Nitrobenzene	µg/L	3.5	NC	1.0	1.0	µg/L	Maximum	See footnote
	Trichloroethene	µg/L	73	NC	240	240	µg/L	Maximum	See footnote
	Iron	µg/L	18000	NC	18000	18000	µg/L	Maximum	See footnote
	Manganese	µg/L	720	NC	720	720	µg/L	Maximum	See footnote

NC = Not calculated.

Note: Maximum detected concentration used as the EPC because total samples were less than or equal to 10.

TABLE A-3.2
EXPOSURE POINT CONCENTRATION SUMMARY - SHALLOW GROUNDWATER - VAPORS IN CONSTRUCTION TRENCH
OPERABLE UNIT II - NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE
ASHLAND, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater/Trench Air

Exposure Point	Contaminant of Potential Concern	Units	Maximum Concentration	Exposure Point Concentration (Cair)		
				Trench Air		
				Value	Units	Rationale[1]
Shallow Groundwater	1,2-Dichlorobenzene	µg/L	450	3.0	mg/m^3	Modeled from VDEQ gw VRP Table
	1,2,3-Trichlorobenzene	µg/L	37	0.22	mg/m^3	Modeled from VDEQ gw VRP Table
	1,2,4-Trichlorobenzene	µg/L	160	1.0	mg/m^3	Modeled from VDEQ gw VRP Table
	1,3-Dichlorobenzene	µg/L	12	NA	mg/m^3	Modeled from VDEQ gw VRP Table
	1,4-Dichlorobenzene	µg/L	98	0.66	mg/m^3	Modeled from VDEQ gw VRP Table
	Benzene	µg/L	12	0.11	mg/m^3	Modeled from VDEQ gw VRP Table
	Chlorobenzene	µg/L	380	2.9	mg/m^3	Modeled from VDEQ gw VRP Table
	cis-1,2-Dichloroethene	µg/L	180	1.5	mg/m^3	Modeled from VDEQ gw VRP Table
	Nitrobenzene	µg/L	1.0	0.0022	mg/m^3	Modeled from VDEQ gw VRP Table
	Trichloroethene	µg/L	240	1.7	mg/m^3	Modeled from VDEQ gw VRP Table

[1]Cair calculated from the Virginia Department of Environmental Quality (VDEQ) 2013 groundwater Voluntary Remediation Program (VRP) model.

TABLE A-5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
OPERABLE UNIT II - NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE
ASHLAND, MASSACHUSETTS

Contaminant of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal (1)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD: Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Dates (2)
1,2-Dichlorobenzene	Chronic	9.00E-02	mg/kg-day	1.0	9.00E-02	mg/kg-day	No adverse effects	1,000	IRIS	12/14/2018
1,2,3-Trichlorobenzene	Chronic	8.00E-04	mg/kg-day	1.0	8.00E-04	mg/kg-day	Hepatic, Body Weight, Thyroid	10,000	PPRTV	9/11/2009
1,2,4-Trichlorobenzene	Chronic	1.00E-02	mg/kg-day	1.0	1.00E-02	mg/kg-day	Endocrine	1,000	IRIS	12/14/2018
1,3-Dichlorobenzene	---	NA	---	---	NA	---	---	---	---	---
1,4-Dichlorobenzene	Chronic	7.00E-02	mg/kg-day	1.0	7.00E-02	mg/kg-day	Hepatic	100	ATSDR	6/4/2019
4-Chloroaniline	Chronic	4.00E-03	mg/kg-day	1.0	4.00E-03	mg/kg-day	Immune System	3,000	IRIS	12/14/2018
Aniline	Chronic	7.00E-03	mg/kg-day	1.0	7.00E-03	mg/kg-day	Hematologic	1,000	PPRTV	5/23/2007
Benzene	Chronic	4.00E-03	mg/kg-day	1.0	4.00E-03	mg/kg-day	Immune System	300	IRIS	12/14/2018
Chlorobenzene	Chronic	2.00E-02	mg/kg-day	1.0	2.00E-02	mg/kg-day	Hepatic	1,000	IRIS	12/14/2018
cis-1,2-Dichloroethene	Chronic	2.00E-03	mg/kg-day	1.0	2.00E-03	mg/kg-day	Urinary	3,000	IRIS	12/14/2018
Naphthalene	Chronic	2.00E-02	mg/kg-day	1.0	2.00E-02	mg/kg-day	Body Weight	3,000	IRIS	12/14/2018
Nitrobenzene	Chronic	2.00E-03	mg/kg-day	1.0	2.00E-03	mg/kg-day	Hematologic	1,000	IRIS	12/14/2018
Pentachlorophenol	Chronic	5.00E-03	mg/kg-day	1.0	5.00E-03	mg/kg-day	Hepatic	300	IRIS	12/14/2018
Pyridine	Chronic	1.00E-03	mg/kg-day	1.0	1.00E-03	mg/kg-day	Hepatic	1,000	IRIS	12/14/2018
Trichloroethene	Chronic	5.00E-04	mg/kg-day	1.0	5.00E-04	mg/kg-day	Developmental, Immune System	Multiple	IRIS	12/14/2018
Vinyl chloride	Chronic	3.00E-03	mg/kg-day	1.0	3.00E-03	mg/kg-day	Hepatic	30	IRIS	12/14/2018
Iron	Chronic	7.00E-01	mg/kg-day	1.0	7.00E-01	mg/kg-day	Gastrointestional Tract	1.5	PPRTV	9/11/2006
Manganese	Chronic	2.40E-02	mg/kg-day	0.040	9.60E-04	mg/kg-day	Nervous System	3.0	IRIS	12/14/2018

(1) Source: RAGS Part E Guidance.

(2) Represents date source was searched.

Definitions: ATSDR = Agency for Toxic Substances and Disease Registry.

IRIS = Integrated Risk Information System.

NA = Not available.

PPRTV = Provisional Peer-Reviewed Toxicity Value (EPA, various dates).

RSL = Regional Screening Level.

TABLE A-5.2
NON-CANCER TOXICITY DATA -- INHALATION
OPERABLE UNIT II - NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE
ASHLAND, MASSACHUSETTS

Contaminant of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC: Target Organ(s)	
		Value	Units			Source(s)	Dates (1)
1,2-Dichlorobenzene	Chronic	2.00E-01	mg/m^3	Body Weight	1,000	HEAST	1997
1,2,3-Trichlorobenzene	---	NA	---	---	---	---	---
1,2,4-Trichlorobenzene	Chronic	2.00E-03	mg/m^3	Urinary	3,000	PPRTV	6/16/2009
1,3-Dichlorobenzene	---	NA	---	---	---	---	---
1,4-Dichlorobenzene	Chronic	8.00E-01	mg/m^3	Hepatic	100	IRIS	12/14/2018
Benzene	Chronic	3.00E-02	mg/m^3	Immune System	300	IRIS	12/14/2018
Chlorobenzene	Chronic	5.00E-02	mg/m^3	Hepatic, Kidney	1,000	PPRTV	10/12/2006
cis-1,2-Dichloroethene	---	NA	---	---	---	---	---
Naphthalene	Chronic	3.00E-03	mg/m^3	Nervous System, Respiratory System	3,000	IRIS	12/14/2018
Nitrobenzene	Chronic	9.00E-03	mg/m^3	Nervous System, Respiratory System	30	IRIS	12/14/2018
Pyridine	---	NA	---	---	---	---	---
Trichloroethene	Chronic	2.00E-03	mg/m^3	Developmental, Immune System	Multiple	IRIS	12/14/2018
Vinyl chloride	Chronic	1.00E-01	mg/m^3	Hepatic	30	IRIS	12/14/2018

(1) Represents date source was searched.

Definitions: HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System.
NA = Not available.
PPRTV = Provisional Peer-Reviewed Toxicity Value (EPA, various dates)
RSL = Regional Screening Level.

TABLE A-6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
OPERABLE UNIT II - NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE
ASHLAND, MASSACHUSETTS

Contaminant of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (1)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Dates (2)
1,2-Dichlorobenzene	NA	---	---	NA	---	---	---	---
1,2,3-Trichlorobenzene	NA	---	---	NA	---	---	---	---
1,2,4-Trichlorobenzene	2.90E-02	(mg/kg-day)^-1	1.0	2.90E-02	(mg/kg-day)^-1	D	PPRTV	6/16/2009
1,3-Dichlorobenzene	NA	---	---	NA	---	---	---	---
1,4-Dichlorobenzene	5.40E-03	(mg/kg-day)^-1	1.0	5.40E-03	(mg/kg-day)^-1	Not assessed under IRIS	CalEPA	6/4/2019
4-Chloroaniline	2.00E-01	(mg/kg-day)^-1	1.0	2.00E-01	(mg/kg-day)^-1	Not assessed under IRIS	PPRTV	9/30/2008
Aniline	5.70E-03	(mg/kg-day)^-1	1.0	5.70E-03	(mg/kg-day)^-1	B2	IRIS	12/14/2018
Benzene	5.50E-02	(mg/kg-day)^-1	1.0	5.50E-02	(mg/kg-day)^-1	A	IRIS	12/14/2018
Chlorobenzene	NA	---	---	NA	---	---	---	---
cis-1,2-Dichloroethene	NA	---	---	NA	---	---	---	---
Naphthalene	NA	---	---	NA	---	---	---	---
Nitrobenzene	NA	---	---	NA	---	---	---	---
Pentachlorophenol	4.00E-01	(mg/kg-day)^-1	1.0	4.00E-01	(mg/kg-day)^-1	B1	IRIS	12/14/2018
Pyridine	NA	---	---	NA	---	---	---	---
Trichloroethene	4.60E-02	(mg/kg-day)^-1	1.0	4.60E-02	(mg/kg-day)^-1	A	IRIS	12/14/2018
Vinyl chloride	7.20E-01	(mg/kg-day)^-1	1.0	7.20E-01	(mg/kg-day)^-1	A	IRIS	12/14/2018
Iron	NA	---	---	NA	---	---	---	---
Manganese	NA	---	---	NA	---	---	---	---

(1) Source: RAGS Part E Guidance.

(2) Represents date source was searched.

Definitions: CalEPA = California Environmental Protection Agency.
IRIS = Integrated Risk Information System.
NA = Not available.
PPRTV = Provisional Peer-Reviewed Toxicity Value (EPA, various dates).
RSL = Regional Screening Level.
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.
D - Not classifiable as a human carcinogen.

TABLE A-6.2
CANCER TOXICITY DATA -- INHALATION
OPERABLE UNIT II - NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE
ASHLAND, MASSACHUSETTS

Contaminant of Potential Concern	Unit Risk		Weight of Evidence/ Cancer Guideline Description	Unit Risk: Inhalation CSF	
	Value	Units		Source(s)	Dates (1)
1,2-Dichlorobenzene	NA	---	---	---	---
1,2,3-Trichlorobenzene	NA	---	---	---	---
1,2,4-Trichlorobenzene	NA	---	---	---	---
1,3-Dichlorobenzene	NA	---	---	---	---
1,4-Dichlorobenzene	1.10E-05	$(\mu g/m^3)^{-1}$	Not assessed under IRIS	CalEPA	6/4/2019
4-Chloroaniline	NA	---	---	---	---
Benzene	7.80E-06	$(\mu g/m^3)^{-1}$	A	IRIS	12/14/2018
Chlorobenzene	NA	---	---	---	---
cis-1,2-Dichloroethene	NA	---	---	---	---
Naphthalene	3.40E-05	$(\mu g/m^3)^{-1}$	Cancer Guideline	CalEPA	6/4/2019
Nitrobenzene	4.00E-05	$(\mu g/m^3)^{-1}$	B1	IRIS	12/14/2018
Pyridine	NA	---	---	---	---
Trichloroethene	4.10E-06	$(\mu g/m^3)^{-1}$	A	IRIS	12/14/2018
Vinyl chloride	4.40E-06	$(\mu g/m^3)^{-1}$	A	IRIS	12/14/2018

(1) Represents date source was searched.

Definitions: CalEPA = California Environmental Protection Agency.

IRIS = Integrated Risk Information System.

NA = Not available.

RSL = Regional Screening Level.

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.

TABLE A-10.1
RISK SUMMARY - SHALLOW GROUNDWATER - CONSTRUCTION WORKER
OPERABLE UNIT II - NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE
ASHLAND, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Groundwater in construction trenches	1,2-Dichlorobenzene	---	---	---	---	No adverse effects	0.0011	---	0.034	0.035
			1,2,4-Trichlorobenzene	---	---	---	---	Endocrine	0.0036	---	0.20	0.20
			1,4-Dichlorobenzene	1.7E-09	---	5.2E-08	5.4E-08	---	---	---	---	---
			Benzene	2.1E-09	---	1.9E-08	2.1E-08	---	---	---	---	---
			Chlorobenzene	---	---	---	---	Hepatic	0.0042	---	0.075	0.080
			Nitrobenzene	---	---	---	---	---	---	---	---	---
			Trichloroethene	3.5E-08	---	2.6E-07	3.0E-07	Developmental, Immune System	0.11	---	0.80	0.90
			Chemical Total	3.9E-08	---	3.3E-07	3.7E-07		0.12	---	1.1	1.2
		Total Trench Groundwater					3.7E-07					1.2
		Vapors in construction trenches	1,2-Dichlorobenzene	---	---	---	---	Body Weight	---	1.8	---	1.8
			1,2,4-Trichlorobenzene	---	---	---	---	Urinary	---	57	---	57
			1,4-Dichlorobenzene	---	1.2E-05	---	1.2E-05	---	---	---	---	---
			Benzene	---	1.5E-06	---	1.5E-06	---	---	---	---	---
			Chlorobenzene	---	---	---	---	Hepatic, Kidney	---	7.0	---	7.0
			Nitrobenzene	---	---	---	---	---	---	---	---	---
			Trichloroethene	---	1.2E-05	---	1.2E-05	Developmental, Immune System	---	103	---	103
			Chemical Total	---	2.6E-05	---	2.6E-05		---	169	---	169
		Total Trench Vapor					2.6E-05					169
Site Shallow Groundwater Total							2.6E-05					170
						Total Risk Across All Media	2.6E-05				Total Hazard Across All Media	170

Appendix C

Figures

USGS Topographic Map
Ashland, Massachusetts
Revised 1982

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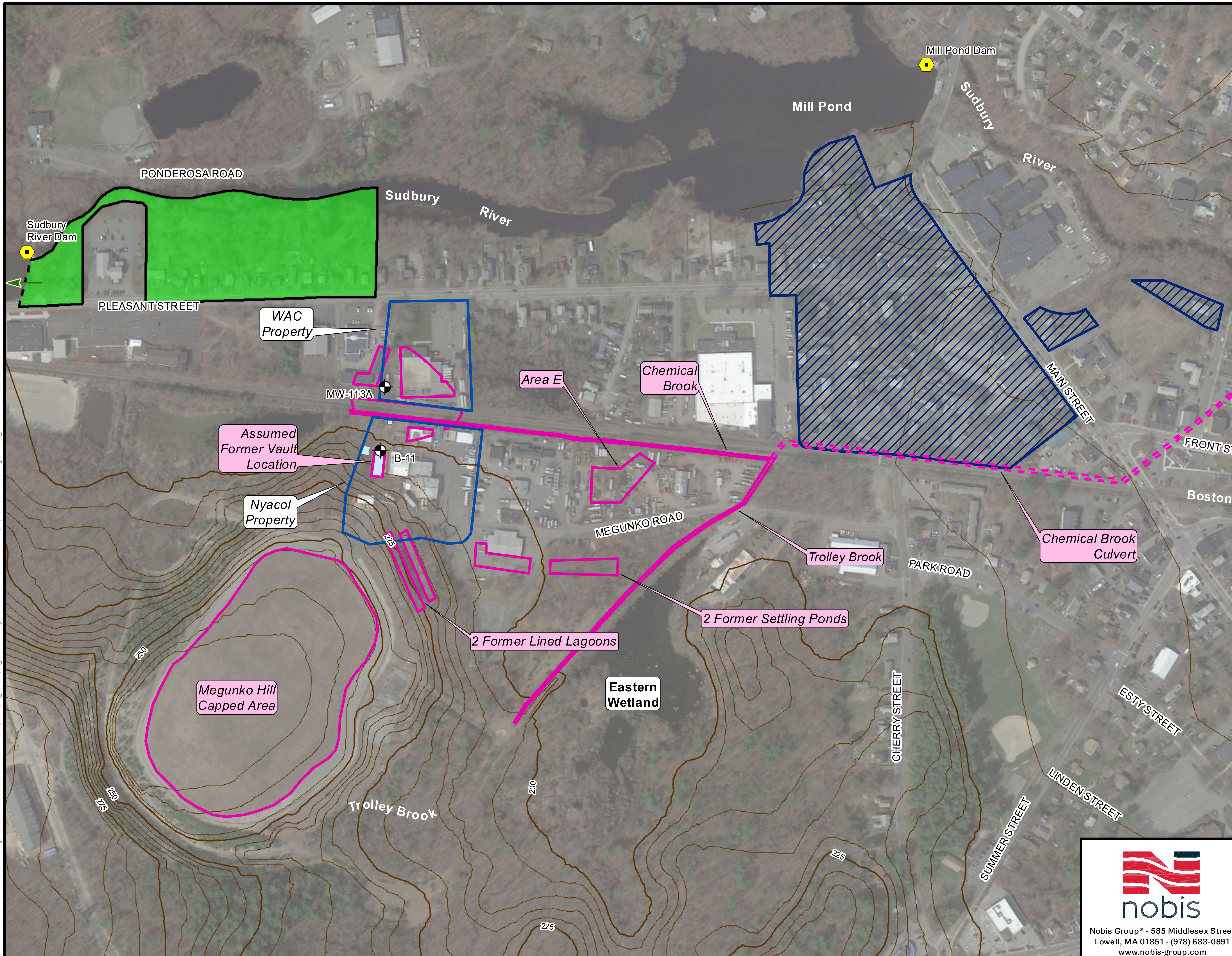
FIGURE 1

SITE LOCUS PLAN
NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JL
PROJECT NO. 80113	DATE: OCTOBER 2018

R:\80000 Task Orders\80113 Nyanza FS OU2\Technical Data\GIS\Figures\2018 remedial alternatives memo\Figure 1-1 Nyanza RAM Locus.mxd 10/16/2018 13:53 jharrington



Notes:

1. This site plan was created from a site plan titled "Base Mapping and Well Survey" by A-Plus Construction, Dated September 25, 2012.

2. The PPA area, shown in green, was revised by MassDEP in 2019 to include only area west of, and including, 191 Pleasant Street. The full extent of PPA extends approximately 1.5 miles west of the dashed boundary

3. Contours were interpolated from 3 meter contours obtained from the MassGIS website. Aerial photograph form MassGIS/Google 2017.

4. Horizontal Datum is in reference to the North American Datum of 1983 (NAD83); Vertical Datum is in reference to the North American Vertical Datum of 1988 (NAVD88).

5. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- DNAPL Treatment System Wells
- Dams
- 25 Foot Contour
- 5 Foot Contour
- Potentially Productive Aquifer (see text)
- Potential DNAPL Source
- Current Vapor Mitigation System Area

0 200 400 800
Feet
N

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FIGURE 2
SITE PLAN
NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 80113	DATE: JANUARY 2020

<u>**Notes:**</u>

1. Zone AE = 1% Annual Chance of Flooding, with BFE; Zone X = 0.2% Annual Chance of Flooding. Revised 7/14/2017.

2. Wetland delineation performed prior to 2012. Wetland delineation based on basemap from survey performed September 2012 by A-Plus Construction and from MassGIS, revised 2005.

3. This site plan was created from a site plan titled "Base Mapping and Well Survey" by A-Plus Construction, Dated September 25, 2012.

4. Aerial photograph form MassGIS/Google 2017.

5. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Wetland Delineation

Mass DEP Wetlands

Flood Zone

ZONE X[1]

ZONE AE[1]

0 250 500 1,000

Feet

1 inch = 500 feet

N

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FIGURE 3

WETLANDS AND FLOODPLAINS
NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JL
PROJECT NO. 80013	DATE: JANUARY 2019

F:\80000 Task Orders\80113 Nyanza FS OU2\Technical Data\GIS\Figures\FS Tech Memo\Figure 1-3 Nyanza Wetlands Floodplains.mxd 8/22/2019 jharrington

Notes:

1. Cross sections for the locations shown are found on Figures 1-13 and 1-14.

2. This site plan was created from a site plan titled "Base Mapping and Well Survey" by A-Plus Construction, Dated September 25, 2012.

3. Aerial photograph form MassGIS/Google 2017.

4. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Overburden Monitoring Well
- Bedrock Monitoring Well
- Staff Gauge
- Cross-Section Location

0 250 500 1,000

Feet

1 inch = 500 feet

N

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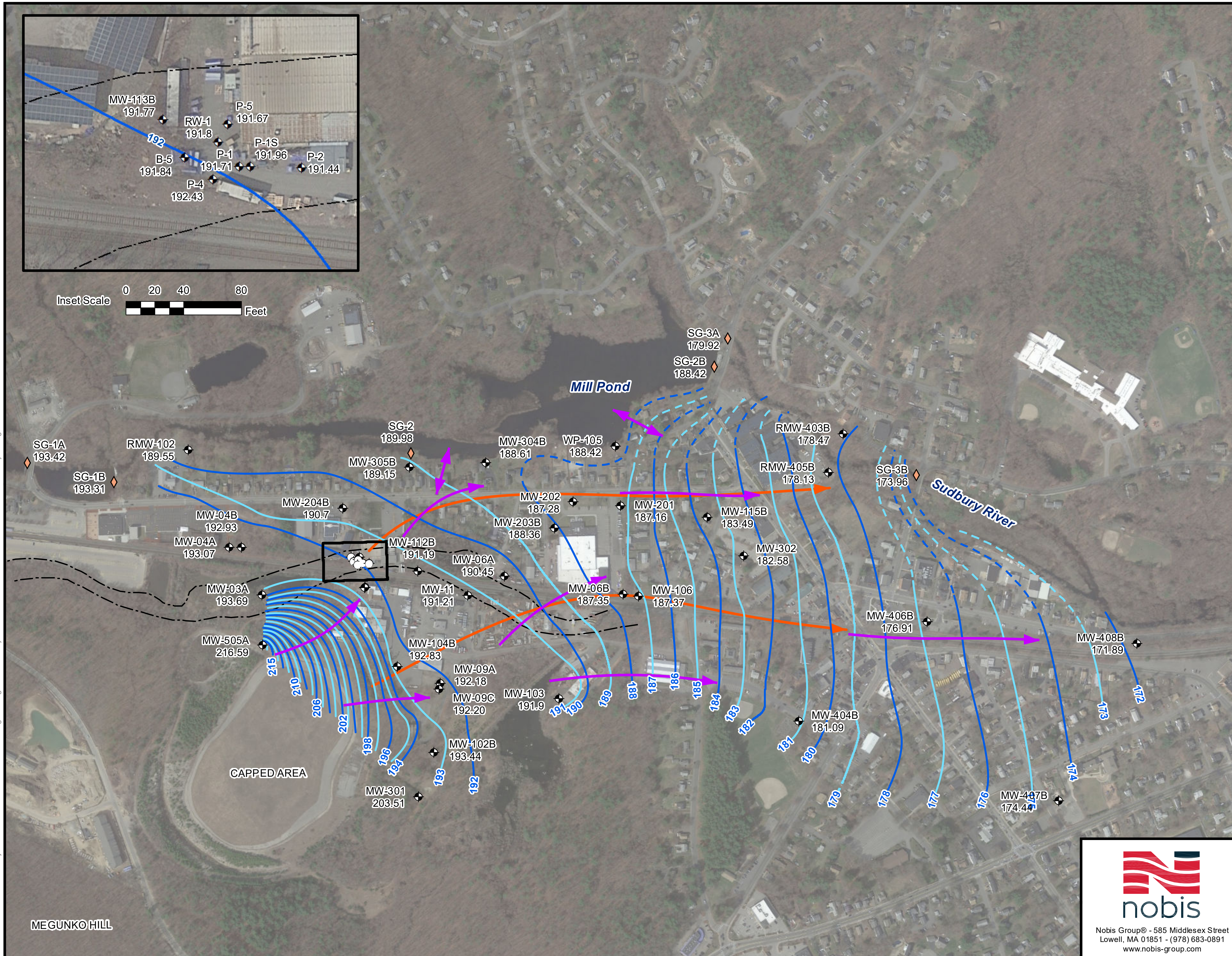
FIGURE 4

SITE MONITORING WELLS
NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 80013	DATE: JANUARY 2019

F:\80000 Task Orders\80113 Nyanza FS OU2\Technical Data\GIS\Figures\FS Tech Memo\Figure 1-6 Nyanza Site MWs.mxd 8/21/2019 jharrington



NOTES:

1. Potentiometric surface generated from ESRI Spatial Analyst version 10.6 using the natural neighbor method. Other interpretations are possible.

2. Double headed arrows indicate that conditions favor flow between surface water and groundwater at some times, and the opposite at other times.

3. Former Sudbury River stream channel from EPA, 1989, Photogeologic Analysis Nyanza Chemical Company, Ashland, Massachusetts.

4. Anomalous data from MW-301 not included for contouring.

5. Aerial photograph from MassGIS/Google, 2017.

6. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Overburden Monitoring Well with Groundwater Elevation 11/13/17 (ft msl)
- Staff Gauge with Surface Water Elevation 11/13/17 (ft msl)
- Overburden Potentiometric Surface with Groundwater Elevation 11/13/17 (ft msl)
- Inferred Overburden Groundwater Contour
- Groundwater Flow Direction
- Generalized Groundwater Flow
- Former Stream Channel (See text)

0 250 500 1,000
Feet
1 inch = 500 feet
N

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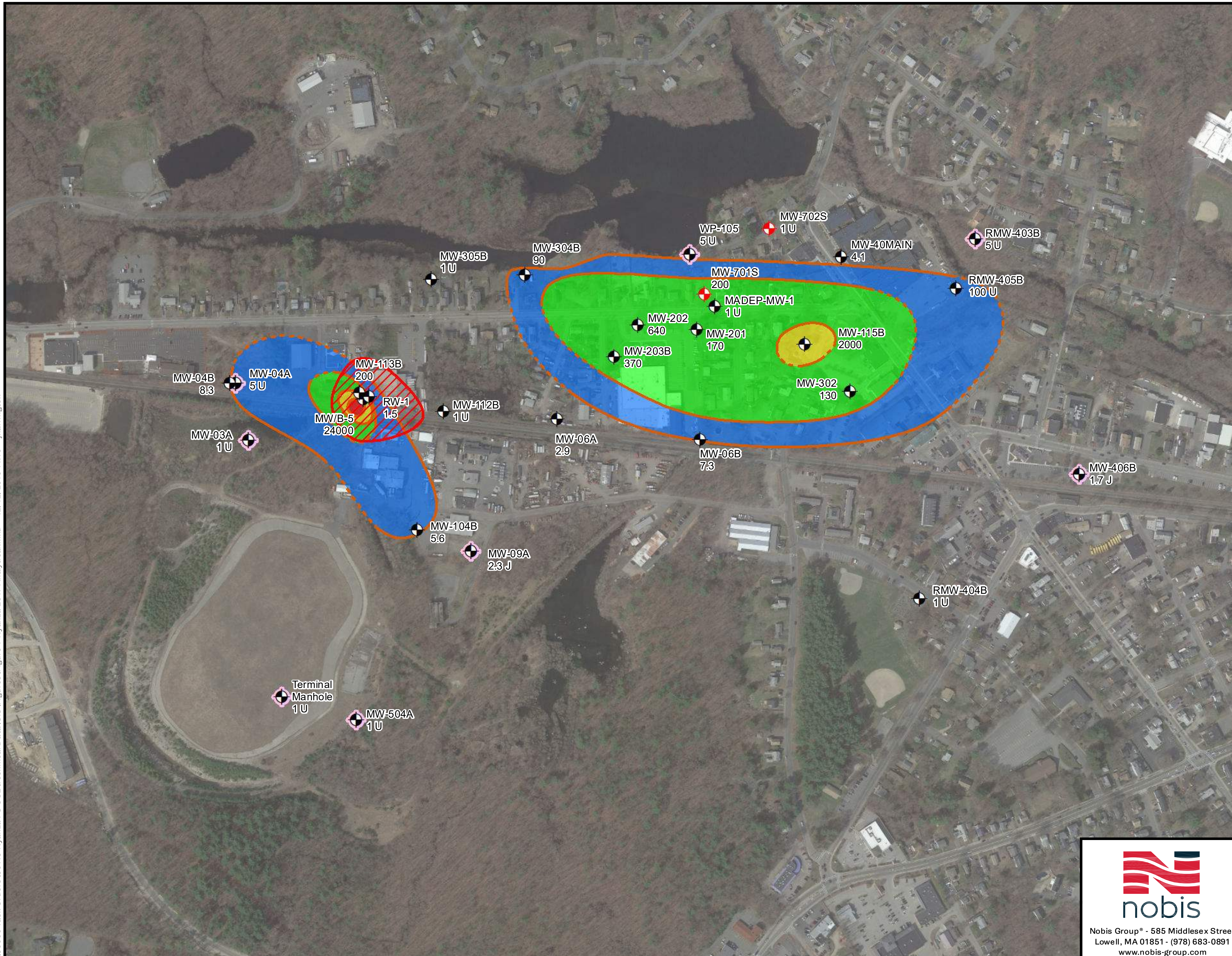
FIGURE 5

OVERBURDEN GROUNDWATER ELEVATIONS AND POTENTIOMETRIC SURFACE - FALL 2017

NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 80113	DATE: JANUARY 2019

F:\80000 Task Orders\80113 Nyanza FS OU2\Technical Data\GIS\Figures\Figure 2-1 2 3 Nyanza GW Elev 2017-18.mxd 12/6/2019 14:04 jharrington



NOTES:

1. Samples collected by Nobis, November 13-16, 2017, unless otherwise noted.
2. Maximum Contaminant Level for groundwater Trichloroethene is 5 micrograms per liter (µg/L). U = not detected.
3. High probability DNAPL zone shown was delineated by ICF (2006); see text.
4. Aerial photograph from MassGIS/Google web map service, 2017.
5. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Overburden Monitoring Well with Trichloroethene Concentration (µg/L)
- May 2, 2018 Data
- Sample Collected Fall 2015

TCE Concentration (µg/L)
(Dashed where inferred)

- > 5 ≤ 100
- > 100 ≤ 1,000
- > 1,000 ≤ 10,000
- > 10,000
- Overburden and weathered bedrock high probability DNAPL zone

0 200 400 800
Feet
1 inch = 400 feet

N

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FIGURE 6

OVERBURDEN GROUNDWATER TRICHLOROETHENE RESULTS - FALL 2017

NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 80113	DATE: DECEMBER 2019

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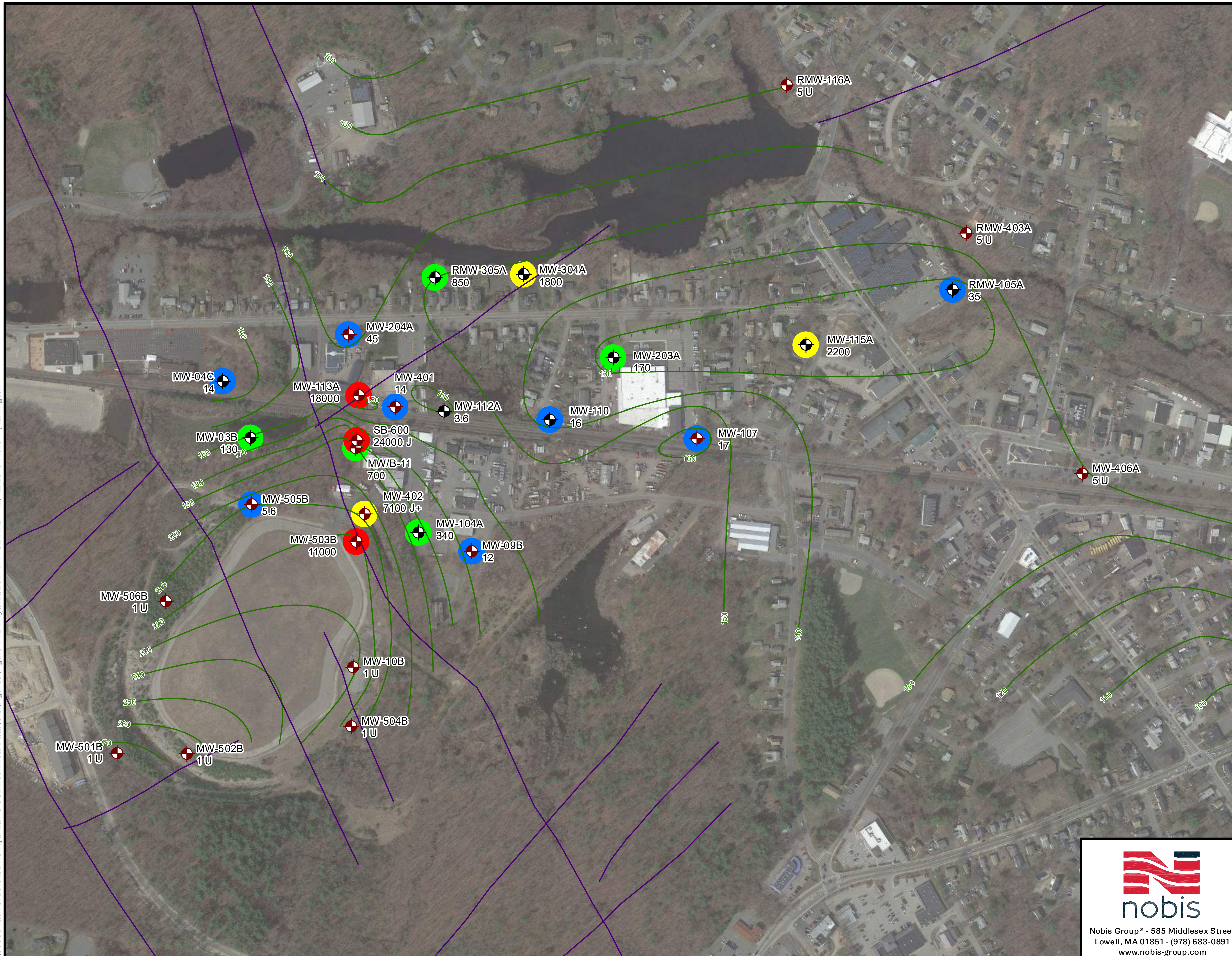

NOTES:

1. Samples collected by Nobis, November 13-16, 2017, unless otherwise noted.

2. Maximum Contaminant Level for groundwater Trichloroethene is 5 micrograms per liter (µg/L), selected to illustrate extent of groundwater contamination. U = not detected.

3. Bedrock surface contours from Nobis (2016), Figure 3-2.

4. Photolineaments from EPA, 1989, Photogeologic Analysis Nyanza Chemical Company, Ashland, Massachusetts.

5. Aerial photograph from MassGIS/Google web map service, 2017.

Legend

- Bedrock Monitoring Well with Trichloroethene Concentration (µg/L)
- Sample Collected Fall 2015

Trichloroethene Concentration (µg/L)

- > 5 ≤ 100
- > 100 ≤ 1,000
- > 1,000 ≤ 10,000
- > 10,000

- Top of Bedrock Elevation Contour (ft NAVD88)
- Depression Bedrock Contour
- Photolineaments

N

0 200 400 800

Feet

1 inch = 400 feet

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FIGURE 7

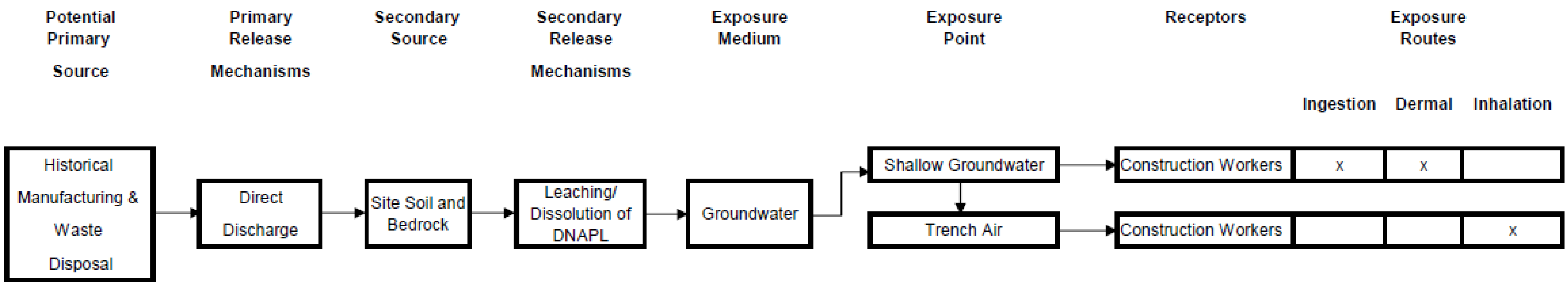
BEDROCK GROUNDWATER TRICHLOROETHENE RESULTS - FALL 2017

NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

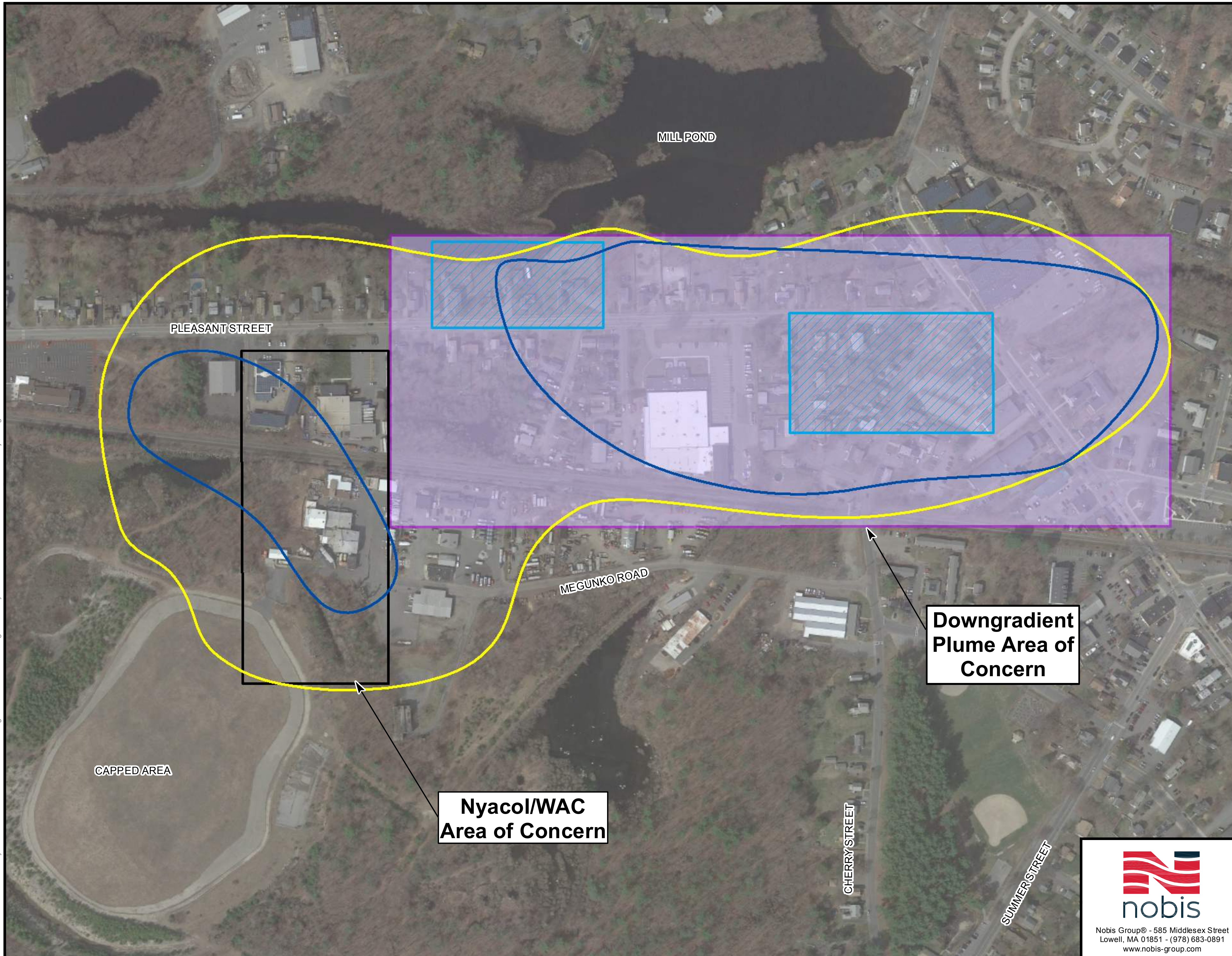
PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 80113	DATE: NOVEMBER 2019

Figure 8 – CSM: Supplemental HHRA (Construction Worker)

CONCEPTUAL SITE MODEL
OPERABLE UNIT II - NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE
SUPPLEMENTAL HUMAN HEALTH RISK ASSESSMENT TECHNICAL MEMORANDUM
ASHLAND, MASSACHUSETTS



Note:
x = Quantitative analysis.



NOTES:

1. Groundwater TCE samples collected by Nobis, October-December 2015 and November 2017.

2. Aerial photograph from MassGIS/Google web map service, 2017.

3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Nyacol/WAC Area of Concern
- Bedrock groundwater hot spot treatment area
- Downgradient Plume Area of Concern
- Approximate area of MCL TCE Exceedances in overburden groundwater (≥ 5 µg/L)
- Feasibility Study Area, Bedrock Focus

0 150 300 600
Feet
1 inch = 300 feet

N

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FIGURE 9

AREAS OF CONCERN
NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 80113	DATE: MAY 2019

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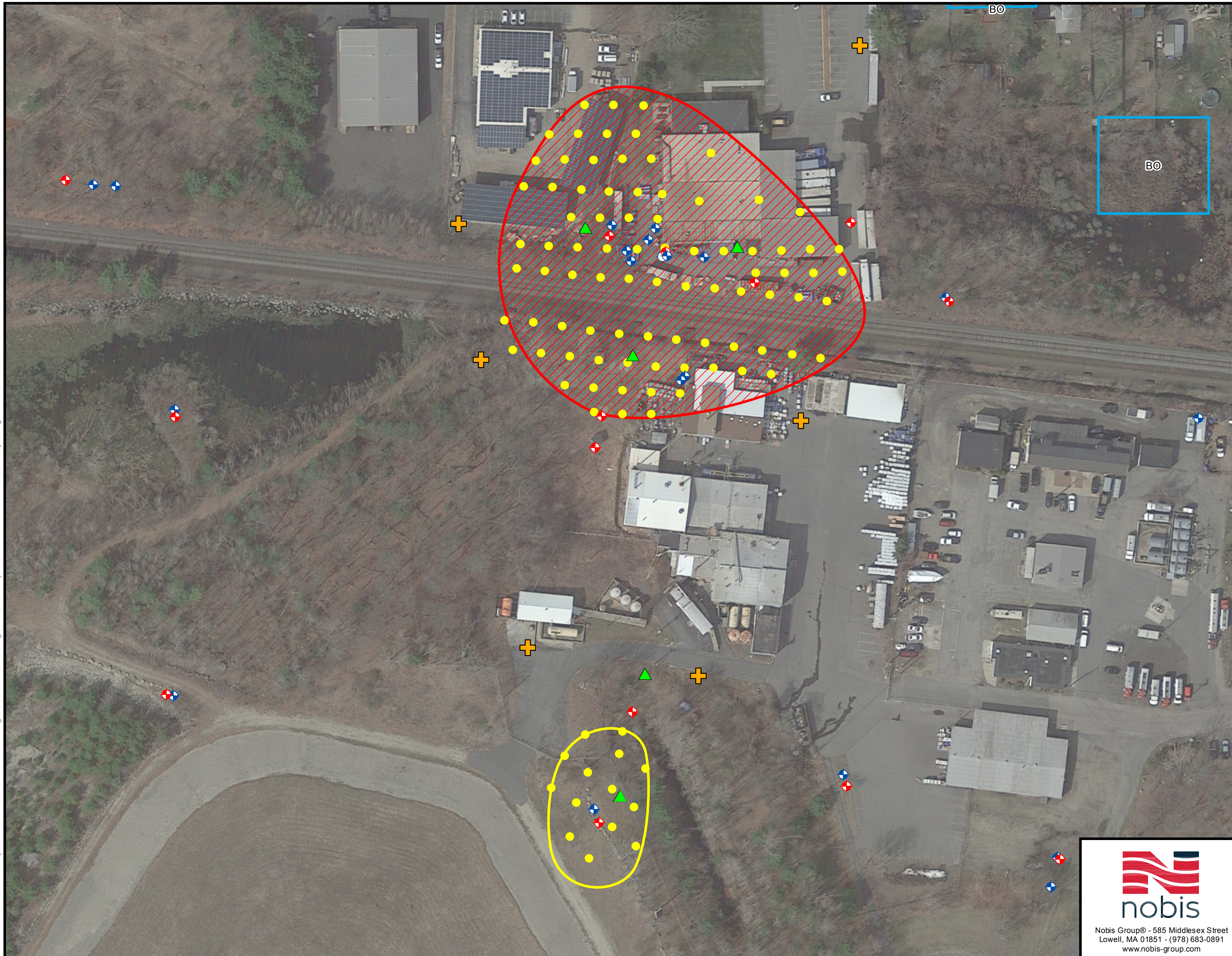

NOTES:

1. DNAPL zone in overburden and weathered bedrock from final DNAPL alternatives memorandum (ICF, 2006) and bedrock hotspot with concentrations above 10 mg/L downgradient of landfill.

2. Bedrock hotspot based on exceedance of 10,000 ug/L TCE at MW-503B (11,000 ug/L in Fall 2015). Hotspot edge delineated based on MW-402 TCE concentration less than 10,000 ug/L (7,100 ug/L in Fall 2015)

3. Aerial photograph from MassGIS/Google web map service, 2017.

4. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Existing Overburden Monitoring Well
- Existing Bedrock Monitoring Well
- Proposed initial PDI well cluster locations
- Proposed rock core location
- Proposed Phase I DNAPL PDI screening locations
- Target alternative LTM well location (B=Bedrock, O=Overburden)
- DNAPL zone in overburden and weathered bedrock
- Bedrock hotspot downgradient of landfill

0 50 100 200
Feet
1 inch = 100 feet
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FIGURE 10

ALTERNATIVE GW-4:
NYACOL/WAC INVESTIGATION COMPONENTS

NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 80113	DATE: MAY 2019

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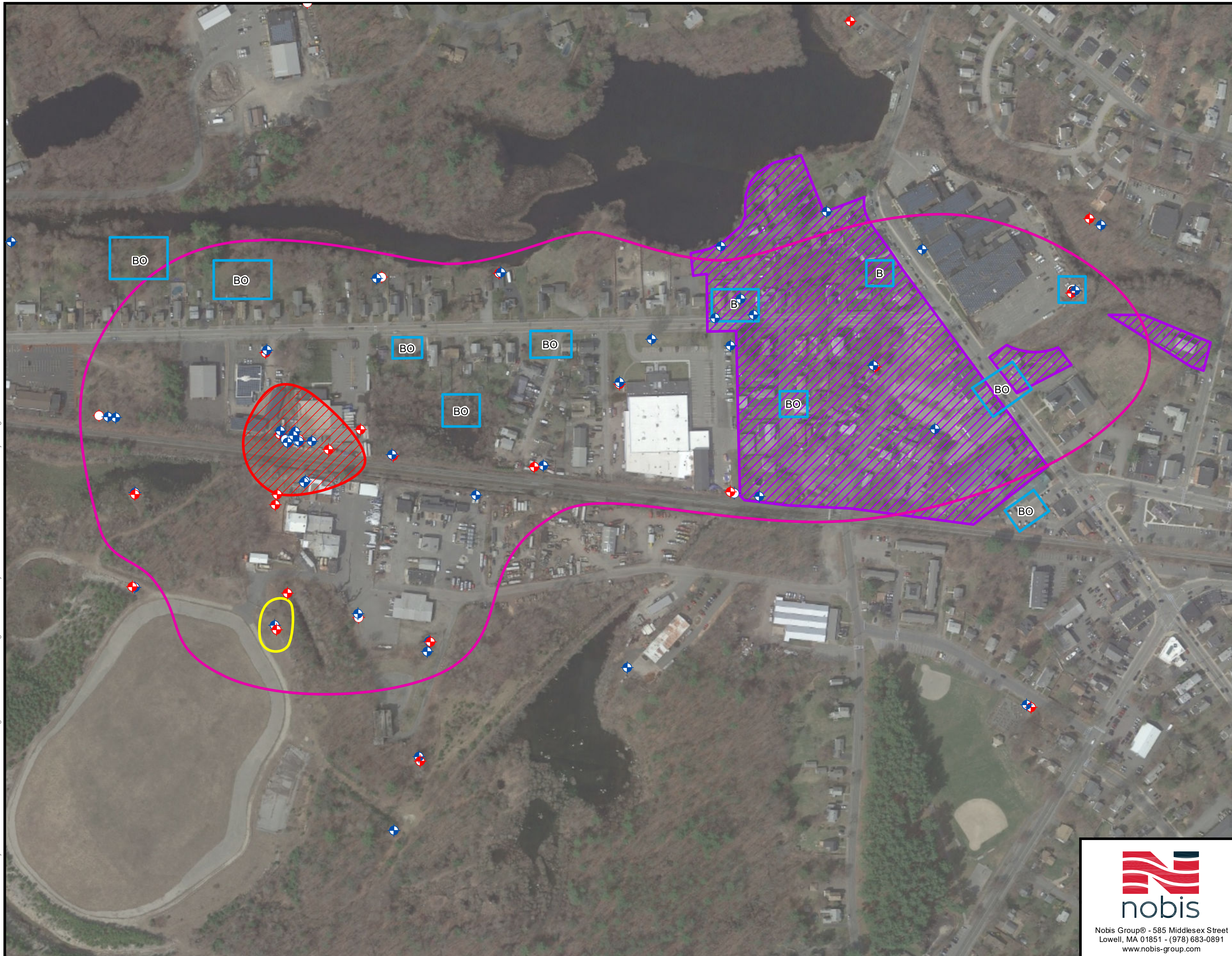

NOTES:

1. Feasibility Study Area based on groundwater trichloroethene (TCE) samples collected by Nobis, October-December 2015, November 2017, and May 2018.

2. Treatment area based on DNAPL zone in overburden and weathered bedrock from final DNAPL alternatives memorandum (ICF, 2006) and bedrock hotspot with concentrations above 10 mg/L downgradient of landfill.

3. Bedrock hotspot based on 10,000 ug/L TCE contour associated with MW-503B (Fall 2015 data).

4. Aerial photograph from MassGIS/Google web map service, 2017.

5. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Overburden Monitoring Well
- Bedrock Monitoring Well
- Feasibility Study Area
- DNAPL zone in overburden and weathered bedrock
- Bedrock hotspot downgradient of landfill
- Vapor Mitigation System Area
- Target additional LTM well location (B=Bedrock, O=Overburden)

0 150 300 600

Feet

1 inch = 300 feet

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FIGURE 11

ALTERNATIVE GW-4:
GENERAL COMPONENTS

NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 80113	DATE: DECEMBER 2019

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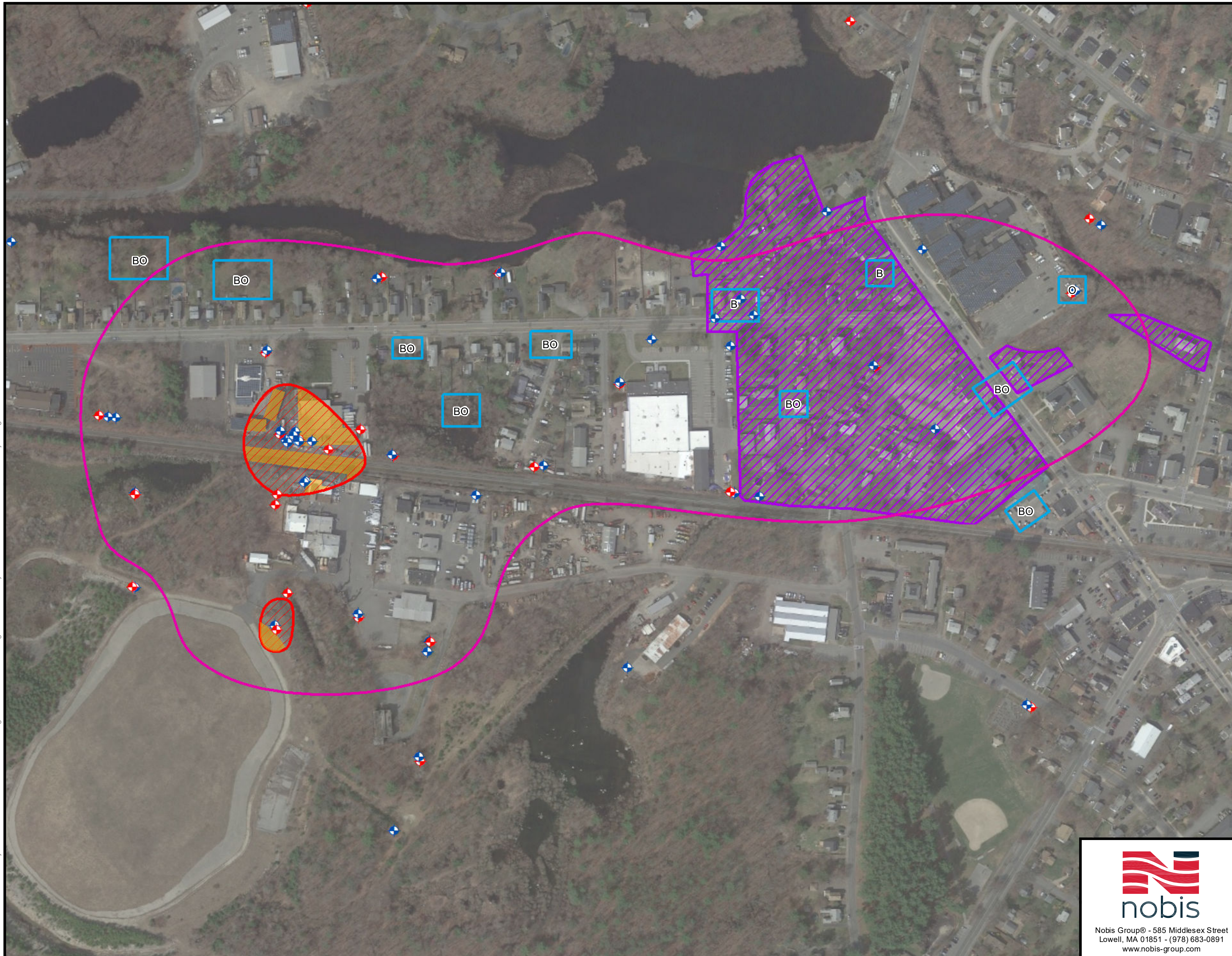

NOTES:

1. Feasibility Study Area based on groundwater trichloroethene (TCE) samples collected by Nobis, October-December 2015, November 2017, and May 2018.

2. Treatment area based on DNAPL zone in overburden and weathered bedrock from final DNAPL alternatives memorandum (ICF, 2006) and bedrock hotspot with concentrations above 10 mg/L downgradient of landfill.

3. Bedrock hotspot based on 10,000 ug/L TCE contour associated with MW-503B (Fall 2015 data).

4. Aerial photograph from MassGIS/Google web map service, 2017.

5. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Overburden Monitoring Well
- Bedrock Monitoring Well
- Feasibility Study Area
- Vapor Mitigation System Area
- Target additional LTM well location (B=Bedrock, O=Overburden)
- Treatment Area
- Limited access in-situ treatment area

0 150 300 600

Feet

1 inch = 300 feet

N

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FIGURE 12

ALTERNATIVE GW-4:
GENERAL COMPONENTS

NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 80113	DATE: DECEMBER 2019

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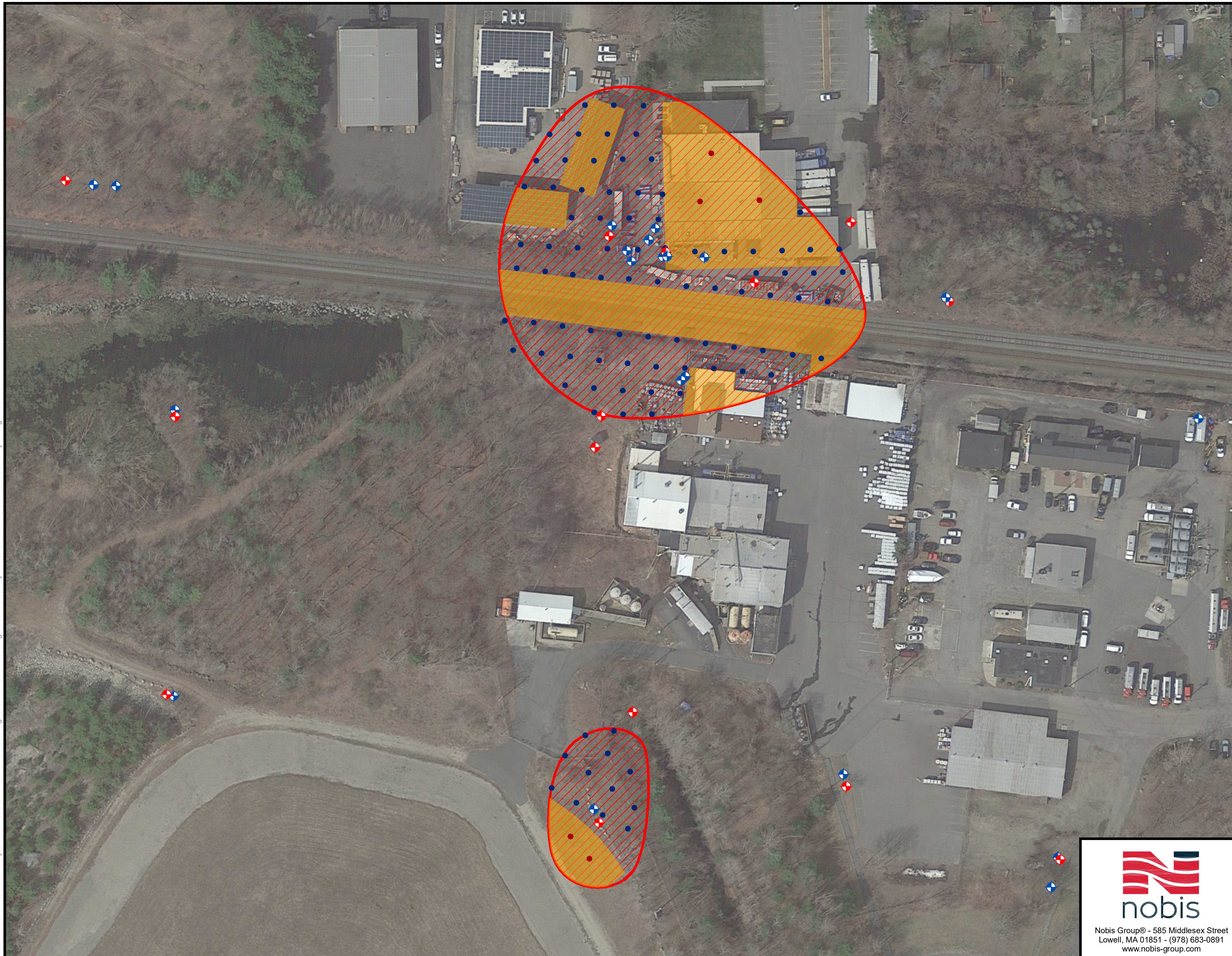

NOTES:

1. Treatment area based on DNAPL zone in overburden and weathered bedrock from final DNAPL alternatives memorandum (ICF, 2006) and bedrock hotspot with concentrations above 10 mg/L downgradient of landfill.

2. Injection locations shown include a combination of bedrock, overburden, and directional-drilling wells. Final vertical and horizontal configuration will be determined based on results of pre-design investigation.

3. Aerial photograph from MassGIS/Google web map service, 2017.

4. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Existing Overburden Monitoring Well
- Existing Bedrock Monitoring Well
- Injection Location
- Limited Access Injection Location
- Limited access in-situ treatment area
- Treatment Area

0 50 100 200
Feet
1 inch = 100 feet
N

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FIGURE 13

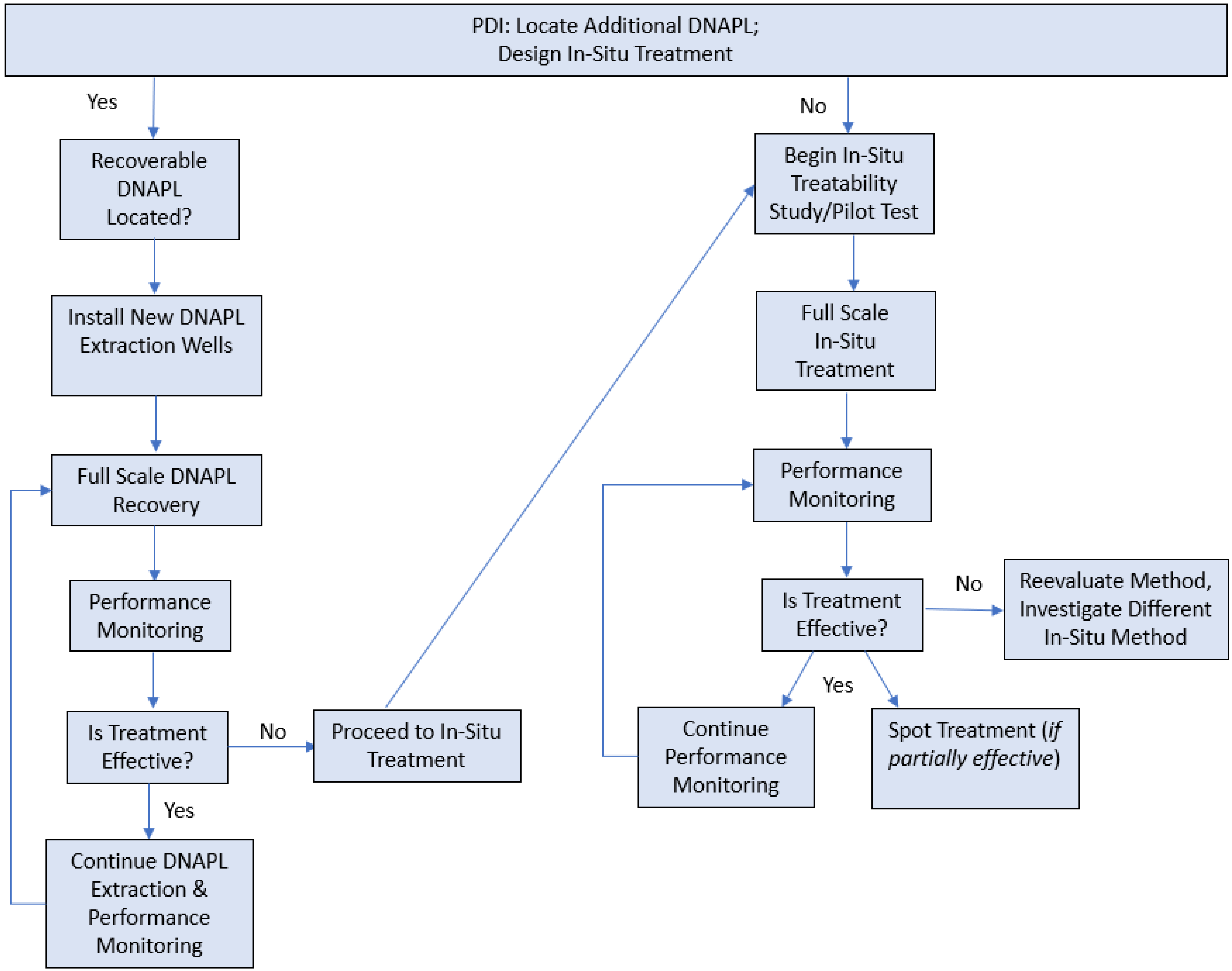
ALTERNATIVE GW-4:
NYACOL/WAC TREATMENT COMPONENTS

NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE - OPERABLE UNIT II
ASHLAND, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 80113	DATE: AUGUST 2019

F:\80000 Task Orders\80113 Nyanza FS OU2\Technical Data\GIS\Figures\FS Tech Memo\Figure 4 Section Nyanza FS.mxd 8/15/2019 13:32 jharrington

Figure 14 – Proposed Alternative GW-4: Phased Implementation Approach



Appendix D

ARARs Tables

Table D-1
Summary of Chemical-Specific ARARs

Federal Criteria, Advisories, and Guidance			
Requirement	**Requirement Synopsis**	**Status**	**Action to Attain ARAR**
Regional Screening Levels for Chemical Contaminants at Superfund Sites (https://www.epa.gov/risk/regional-screening-levels-rsls-whats-new)	Provides risk-based screening levels for various environmental media, for residential and industrial exposure scenarios, and for leaching of contaminants to groundwater.	To Be Considered	Regional Screening Levels for were considered in the human health risk assessment.
EPA Risk Reference Doses (RfDs) and EPA Carcinogen Assessment Group Cancer Potency Factors (CPFs)	RfDs are considered to be levels unlikely to cause significant adverse non-cancer health effects associated with lifetime exposure. RfDs are used to develop risk-based cleanup standards by computing human health hazards from exposure to non-carcinogens at the Site. CPFs are used as qualitative weight-of-evidence judgment as to the likelihood of a chemical being a carcinogen.	To Be Considered	RfDs and CPFs were considered in the human health risk assessment .
EPA Human Health Assessment Cancer Slope Factors (CSFs)	Cancer slope factors estimate the upper-bound probability of increased cancer risk from lifetime exposure to contaminants. Used to develop risk-based cleanup standards by computing the incremental cancer risk from exposure to carcinogens at the Site.	To Be Considered	CSFs were considered in the human health risk assessment.
Guidelines for Carcinogenic Risk Assessment, EPA/630/P-03/001F, March 2005	Guidance values used to evaluate the potential carcinogenic hazard caused by Site contaminant exposure.	To Be Considered	These values were considered in the human health risk assessment.
EPA Carcinogenic Assessment Group Potency Factors	These factors are used to evaluate an acceptable risk from a carcinogen.	To Be Considered	These factors were considered in the human health risk assessment.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens, EPA/630/R/03/003F, March 2005	Guidance values used to evaluate the potential carcinogenic hazard to children caused by Site contaminant exposure.	To Be Considered	This guidance was considered in the human health risk assessment.

Table D-2
Summary of Action-Specific ARARs

Federal Criteria, Advisories, and Guidance			
Requirement	**Requirement Synopsis**	**Status**	**Action to Attain ARAR**
OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air (OSWER Publication 9200.2-154). June 2015.	This EPA guidance establishes a methodology for assessing potential indoor air risks to human health that may result from volatilization of contaminants from groundwater and soil vapor into an overlying building, using multiple lines of evidence.	To Be Considered	The methodology from the guidance was considered in developing remediation goals. As progress is made in reducing groundwater concentrations to the remediation goals, EPA will use multiple lines of evidence to determine whether a vapor intrusion pathway may be present, consistent with this guidance.
EPA Vapor Intrusion Screening Level (VISL) Calculator	EPA developed the VISLs as numerical screening levels to identify areas or buildings that may warrant further investigation of the vapor intrusion pathway.	To Be Considered	VISLs were used to develop remediation goals for groundwater. As progress is made in reducing groundwater concentrations to the remediation goals, EPA will use multiple lines of evidence to determine whether a vapor intrusion pathway may be present.
Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 C.F.R. Part 61)	Regulates VOC emissions from specific source categories. Establishes allowable numerical limits for specific stationary source categories. Provides requirements for monitoring, testing, reporting, and repairs.	Applicable	Emissions from well drilling activities will be addressed under this ARAR if threshold limit is exceeded.
Clean Water Act, National Pollution Discharge Elimination System (NPDES) 40 C.F.R. Parts 122 and 125	Stormwater standards for activities disturbing more than one acre.	Applicable	Best management practices will be used during construction activities to meet stormwater standards if there is over one acre of construction.

Table D-2
Summary of Action-Specific ARARs

Federal Criteria, Advisories, and Guidance (con't.)			
Requirement	**Requirement Synopsis**	**Status**	**Action to Attain ARAR**
Resource Conservation and Recovery Act (RCRA), Subtitle C, 40 C.F.R. Parts 260-262 and 264	Standards used to identify, manage, and dispose of hazardous waste. Massachusetts has been delegated the authority to administer these standards through its hazardous waste management regulations. Includes hazardous waste identification; generator and handler requirements; tracking requirements; storage, treatment, and disposal requirements; groundwater monitoring requirements; closure and post-closure requirements; and land disposal restrictions.	Applicable	DNAPL from extraction systems and any investigation-derived waste (IDW) determined to be hazardous will be properly stored, tested, and sent for off-site disposal in accordance with these regulations.
Resource Conservation and Recovery Act (RCRA), Tank Systems, 40 C.F.R. Part 264 Subpart J	Tanks or tank systems that are to be used to temporarily store hazardous liquids or as part of a treatment system for hazardous liquids must be designed, installed, and operated in accordance with the RCRA standards.	Applicable	The requirements in these regulations will be followed for the design of storage tanks for the DNAPL extraction system and temporary tanks used for chemical storage for in-situ treatment.
Safe Drinking Water Act and Resource Conservation and Recovery Act, Underground Injection Control Program, 40 C.F.R. §§ 144, 146, 147	These standards regulate disposal systems or any bored, drilled, or driven shaft, dug hole, or any other opening in the ground that is used to discharge waste (where "waste" is defined as "any substance or material that flows or moves whether in a semi-solid, liquid or other state), either under pressure or gravity, to the soil or groundwater.	Relevant and Appropriate	The substantive requirements for this regulation will be followed for any injections for in-situ treatment and DNAPL optimization.
Safe Drinking Water Act (SDWA) National Primary Drinking Water Regulations, Maximum Contaminant Levels (MCLs), 42 U.S.C. § 300f *et seq.*; 40 C.F.R. Part 141, Subparts B and G	Establishes MCLs for common organic and inorganic contaminants applicable to public drinking water supplies.	Relevant and Appropriate	MCLs will be used in the groundwater monitoring to determine the impacts (if any) on the potential source area portion of the potentially productive aquifer designated by MassDEP that is near the Site.
Guide to Management of Investigation-Derived Wastes (IDW); OSWER 9345.3-03FS (1992)	Guidance on managing IDW in a manner that ensures protection of human health and the environment.	To Be Considered	IDW will be managed as recommended in this guidance.

Table D-2
Summary of Action-Specific ARARs

Federal Criteria, Advisories, and Guidance (con't.)			
Requirement	**Requirement Synopsis**	**Status**	**Action to Attain ARAR**
Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action and Underground Storage Tank Sites. OSWER 9200.4-17P (1999)	Guidance regarding use of monitored natural attenuation for cleanup of contaminated groundwater.	To Be Considered	The groundwater monitoring program in the downgradient plume (and the Nyacol/WAC AOC, once available DNAPL is removed) will be designed and conducted in accordance with this guidance.
State Criteria, Advisories, and Guidance			
Requirement	**Requirement Synopsis**	**Status**	**Action to Attain ARAR**
MassDEP Vapor Intrusion Guidance: Site Assessment, Mitigation and Closure, Policy #WSC-16-435 (October 14, 2016), Indoor Air Threshold Values	This guidance provides guidance on investigating, assessing, understanding, and mitigating vapor intrusion at disposal sites.	To Be Considered	As progress is made in reducing groundwater concentrations to the remediation goals, EPA will use multiple lines of evidence to determine whether a vapor intrusion pathway may be present, consistent with this guidance.
Massachusetts Hazardous Waste Regulations (310 CMR 30.000/MGL c. 21C), including 30.100 (identification and listing of hazardous waste), 30.300 (requirements for hazardous waste generators), and 30.680 (hazardous waste rules for containers)	Massachusetts is authorized to administer RCRA through its state regulations. These regulations address the generation, storage, collection, treatment, disposal, use, reuse, and recycling of hazardous waste.	Applicable	Recovered DNAPL and IDW that are determined to be hazardous will be managed in accordance with these regulations, including staging, storage, stockpiling, and disposal requirements.
Massachusetts Ambient Air Quality Standards (310 CMR 6.00)	These regulations set primary and secondary standards for emissions of sulfur dioxide, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead.	Applicable	DNAPL extraction systems will be designed and constructed to comply with these regulations.

Table D-2
Summary of Action-Specific ARARs

State Criteria, Advisories, and Guidance (con't)			
Requirement	**Requirement Synopsis**	**Status**	**Action to Attain ARAR**
Massachusetts Air Pollution Control Regulations (310 CMR 7.00)	These regulations set emission limits necessary to attain ambient air quality standards, including emission limits 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).	Applicable	DNAPL extraction systems will be designed and constructed to comply with these regulations.
Erosion and Sediment Control Guidelines for Urban and Suburban Areas, Massachusetts Executive Office of Environmental Affairs (2003)	Guidance on preventing erosion and sedimentation.	To Be Considered	Best management practices suggested by this guidance will be used during drilling and construction activities.
Division of Air Quality Control (DAQC) Policy 90-001, Noise Regulation, February 1990	Establishes guideline where sources of new noise should not emit more than 10 decibels above the existing (background) level at the property boundary or closest residence.	To Be Considered	Construction, in-situ treatment and DNAPL system activities will comply with this policy.
Monitoring Well Guidance (WSC-310-91)	Guidance on locating, drilling, installing, sampling, and decommissioning monitoring wells.	To Be Considered	Monitoring well installation and decommissioning will comply with this guidance.

Table D-3
Summary of Location-Specific ARARs

Federal Criteria, Advisories, and Guidance			
Requirement	**Requirement Synopsis**	**Status**	**Action to Attain ARAR**
Floodplains Management and Protection of Wetlands (Executive Order 11988 and 11990); FEMA Regulations (44 C.F.R. Part 9)	These Federal Emergency Management Agency (FEMA) regulations set forth the policy, procedure and responsibilities to implement and enforce Executive Order 11988 (Floodplain Management) and Executive Order 11990 (Protection of Wetlands). These regulations require the avoidance of impacts associated with the occupancy and modification of federally-designated 100-year and 500-year floodplain and the avoidance of development within the floodplain wherever there is a practicable alternative. An assessment of impacts to the 500-year floodplain is required for critical actions, which include siting waste facilities in a floodplain. The regulations prohibit activities that adversely affect a federally-regulated wetland unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use. Requires public notice when proposing any action in or affecting a floodplain or wetlands.	Applicable	Downgradient monitoring wells may be located within the special flood hazard area for the Sudbury River. No other construction is anticipated in the floodplain. Well installation would not appear to modify or occupy floodway or result in the loss of flood storage capacity during remediation. Installation of groundwater monitoring wells will be planned and performed to minimize adverse impacts on wetlands. Mitigation measures will be used to protect wetlands wildlife and aquatic life as necessary. Public comments were solicited regarding the selected remedial alternative's potential impacts on floodplain and wetland resources in the Proposed Plan, and no negative comments were received.
Clean Water Act (CWA), Dredge or Fill Requirements Section 404 (40 C.F.R Parts 230 and 231, and 33 C.F.R. Parts 320-323)	Section 404 of the CWA regulates the discharge of dredged or fill materials to waters of the U.S., 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 C.F.R. Part 230, promulgated under CWA § 404(b)(1), maintain that no discharge of dredged or fill material will be permitted if there is a practicable 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. EPA must determine which alternative is the least environmentally damaging practicable alternative to protect wetland and aquatic resources.	Applicable	Installation of groundwater monitoring wells will be planned and performed to minimize adverse impacts on wetlands. Mitigation measures will be used to protect wetlands wildlife and aquatic life as necessary. EPA has determined that the selected remedial alternative is the least environmentally damaging practicable alternative because (a) there is no practicable alternative method that will achieve cleanup objectives with less adverse impact and (b) all practicable measures would be taken to minimize and mitigate any adverse impacts from the work. Public comments were solicited on this determination in the Proposed Plan, and no negative comments were received.

Table D-3
Summary of Location-Specific ARARs

Federal Criteria, Advisories, and Guidance (con't)			
Requirement	**Requirement Synopsis**	**Status**	**Action to Attain ARAR**
Fish and Wildlife Coordination Act (16 U.S.C. § 661 *et seq.*; 40 C.F.R. Part 6)	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.	Applicable	Groundwater monitoring wells may be located in wetland areas, but potential adverse effects are expected to be minimal. EPA will mitigate adverse project related impacts to fish and wildlife resources, if necessary, in consultation with the U.S Fish and Wildlife Service.
Migratory Bird Treaty Act (16 U.S.C. § 703 *et seq.*)	If migratory birds are identified at the Site, this Act makes it unlawful to take, capture, kill, or otherwise impact a migratory bird or any nest or egg of a migratory bird.	Applicable	During PDI, injection, and O&M activities, if migratory bird protected areas are identified in the site area, measures to avoid, minimize and or mitigate any impacts to protected resource areas will be implemented in consultation with appropriate USFWS officials.
National Historic Preservation Act (NHPA), 54 U.S.C. §§ 306108 and 306107, 36 C.F.R. Part 800	Sections 106 and 110(f) of the National Historic Preservation Act of 1966, as amended, require EPA to take into account the effects of CERCLA response actions on any historic property included or eligible for inclusion on the National Registry of Historic Places.	Applicable	Identification of significant historic features or artifacts is not anticipated during remedial actions within the Site, which is heavily developed. However, if such artifacts are identified during well drilling, actions will be taken to comply with this ARAR, including consultation with federal and state historic preservation officials, as necessary.
"Policy on Floodplains and Wetland Assessments for CERCLA Actions," OSWER Directive 9280.0-02 (August 6, 1985)	Guidance which discusses situations that require preparation of floodplains or wetlands assessments and factors to consider in preparing assessments for response actions taken under Section 104 or 106 of CERCLA, including avoiding adverse impacts to wetlands and floodplains unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm that may result from such actions.	To Be Considered	This guidance will be considered when planning and implementing actions within protected resources.

Table D-3
Summary of Location-Specific ARARs

State Criteria, Advisories, and Guidance			
Requirement	**Requirement Synopsis**	**Status**	**Action to Attain ARAR**
Massachusetts Antiquities Act (MGL c. 9, §§26-27C); Massachusetts Historical Commission Regulations, 950 CMR 70.00; Protection of Properties Included in the State Register of Historic Places, 950 CMR 71.00	These regulations require the adoption of prudent and feasible means to eliminate, minimize or mitigate adverse effects to historic and archeological properties. These regulations establish procedures for coordination with the National Historic Preservation Act. These regulations may be applicable if significant historic features or artifacts are identified during intrusive work.	Applicable	Identification of significant historic features or artifacts is not anticipated during remedial actions within the heavily developed Site. However, if such artifacts are identified during well drilling, actions will be taken to comply with this ARAR.
Wetlands Protection Act and Regulations: 310 CMR 10.00/MGL c. 131	Regulations restrict dredging, filling, altering, or polluting inland wetland resource areas and impose performance standards for work in such areas. Protected resource areas include banks (10.54), bordering vegetated wetlands (10.55), land under water (10.56), bordering land subject to flooding (10.57) and riverfront areas (10.58).	Relevant and Appropriate	Monitoring wells and chemical injection wells may be installed within the wetland area located west of the Nyacol property. Potential adverse impacts to the wetland is expected to be minimal.

Appendix E

References

References

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Ebasco, 1991b. Draft Final Risk Assessment Report, Nyanza Chemical Waste Dump Site, Operable Unit II – Groundwater Study, Ashland, Massachusetts. June.

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Nobis, 2012. Technical Memorandum for Step Drilling Program, Nyanza Chemical Waste Dump Superfund Site – Operable Unit 2, Ashland, Massachusetts. December.

Nobis, 2020. Feasibility Study, Nyanza Chemical Waste Dump Superfund Site, Operable Unit 2, Ashland, Massachusetts. Prepared for EPA Region 1, Boston, Massachusetts, Contract EP-S1-06-03. January.

Appendix F

Acronyms and Abbreviations

Acronyms and Abbreviations

AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
C.F.R.	Code of Federal Regulations
cm	Centimeter
COC	Contaminant of Concern or Chemical of Concern
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
CSF	Cancer Slope Factor
CTE	Central tendency exposure
CWA	Clean Water Act
cy	Cubic yards
DCB	Dichlorobenzene
DCE	Dichloroethene
DEQE	Massachusetts Department of Environmental Quality Engineering
DNAPL	Dissolved non-aqueous phase liquid
DPT	Direct-push technology
Ebasco	Ebasco Services, Inc.
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentration
ESD	Explanation of Significant Differences
FEMA	Federal Emergency Management Agency
FS	Feasibility Study
GERE	Grant of Environmental Restriction and Easement
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
ICs	Institutional Controls
ICF	ICF Consulting
ILCR	Incremental Lifetime Cancer Risk
IUR	Inhalation Unit Risk
IDW	Investigation-derived waste
ISCO	In-situ chemical oxidation
lbs.	Pounds
LTM	Long-term monitoring
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MCP	Massachusetts Contingency Plan
MiHPT	Membrane Interface Hydraulic Profiling Tool
mg/L	Milligram per Liter
NAPL	Non-aqueous phase liquid

NAUL	Notice of Activity and Use Limitation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
Nobis	Nobis Group™
NPL	National Priorities List
OEME	Office of Environmental Measurement and Evaluation
O&M	Operations and Maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PDI	Pre-Design Investigation
PPA	Potentially Productive Aquifer
ppb	Part Per Billion
ppm	Part Per Million
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
RA	Remedial Action
RG	Remediation Goal
RAMP	Remedial Action Master Plan
RAO	Remedial Action Objective
RD	Remedial Design
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable maximum exposure
ROD	Record of Decision
ROI	Radius of influence
RQD	Rock quality designation
SHPO	State Historic Preservation Office
Site	Nyanza Chemical Waste Dump Superfund Site
SI	Site Investigation
SSDS	Sub-Slab Depressurization System
TBC	To-Be-Considered
TCB	Trichlorobenzene
TCE	Trichloroethene
UCL	Upper Concentration Limit
U.S.C.	United States Code
VC	Vinyl chloride
VI	Vapor Intrusion
VISL	Vapor Intrusion Screening Level
VMA	Vapor mitigation area
VMS	Vapor mitigation system
VOC	Volatile organic compound
WAC	Worcester Air Conditioning

Appendix G

Administrative Record Index and Guidance Documents

Nyanza Chemical Waste Dump
Operable Unit (OU) 2
NPL Site Administrative Record
Record of Decision (ROD)

Index

ROD Dated: July 2020
Released: August 2020

Prepared by
EPA New England
Superfund & Emergency Management Division

Introduction to the Collection

This is the administrative record for the Nyanza Chemical Waste Dump Superfund Site, Ashland, Massachusetts, Operable Unit 2 (OU2) Record of Decision (ROD), dated July 2020. The file contains site-specific documents and a list of guidance documents used by EPA staff in selecting a response action at the site.

This record replaces the administrative record file for the Nyanza Chemical Waste Dump Superfund Site, Ashland, Massachusetts, Operable Unit 2 (OU2) Record of Decision (ROD) Proposed Plan, dated January 2020. This record includes, by reference, administrative records for the OU1 ROD, issued September 1985; the Removal Action, issued April 1991; the OU2 interim ROD, issued September 1991; the Removal Action, dated July 1992; the OU1 Explanation of Significant Differences (ESD), issued September 1992; the OU3 ROD, issued March 1993; the OU2 ESD, issued September 2006; the OU4 ROD, issued September 2010; and the OU4 ESD, issued September 2016. Documents listed as bibliographic sources in individual reports might not be listed separately in the index.

The administrative record file is available for review at:

Online: https://go.usa.gov/xd38m

Additional information about the site is also available at www.epa.gov/superfund/nyanza.

EPA New England
SEMS Records and Information Center
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617-918-0440 (fax)

Ashland Public Library
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Ashland, MA 01721
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508-881-0162 (fax)
https://www.ashlandmass.com/184/Ashland-Public-Library

Framingham Public Library
49 Lexington Street
Framingham, MA 01702
508-352-5570 (phone)
https://framinghamlibrary.org

An administrative record is required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA).

Questions about this administrative record should be directed to the EPA New England site manager, Lisa Thuot (617) 918-1129, Thuot.Lisa@epa.gov.

AR 66244 Record of Decision Proposed Plan August 2020

Document ID	Title	Document Date	Page Count	Author	Addressee	Resource Type	Program Information	Access Control	Region	URL
647852	RECORD OF DECISION (ROD)	7/30/2020	124	R01: (US EPA REGION 1)		RPT / Report	053-REMEDIAL/0531-Remedy Characterization/05.04-RECORD OF DECISION (ROD)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/647852
647297	RESPONSIVENESS SUMMARY	7/30/2020	13	R01: (US EPA REGION 1)		RPT / Report	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/647297
647299	LETTER REGARDING STATE CONCURRENCE WITH RECORD OF DECISION (ROD)	7/30/2020	2	R01: Locke, Paul (MA DEPT OF ENVIRONMENTAL PROTECTION)	R01: Olson, Bryan (US EPA REGION 1)	LTR / Letter	053-REMEDIAL/0531-Remedy Characterization/05.04-RECORD OF DECISION (ROD)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/647299
100014207	LETTER REGARDING COMMENT ON PROPOSED PLAN	3/30/2020	1	R01: Mcweeney, Jennifer (MA DEPT OF ENVIRONMENTAL PROTECTION)	R01: Thuot, Lisa (US EPA REGION 1)	LTR / Letter	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100014207
641853	EMAIL REGARDING PUBLIC COMMENT ON CLEANUP PROPOSAL	3/10/2020	1	R01: Schiller, Meredith (ASHLAND (MA) RESIDENT)	R01: Thuot, Lisa (US EPA REGION 1), R01: Purnell, Zanetta (US EPA REGION 1)	EML / Email	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/641853
641855	EMAIL REGARDING PUBLIC COMMENT ON CLEANUP PROPOSAL	2/27/2020	1	R01: Wang, Monica (ENVIROCON)	R01: Thuot, Lisa (US EPA REGION 1)	EML / Email	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/641855
100013821	EMAIL REGARDING PUBLIC COMMENT ON CLEANUP PROPOSAL	2/16/2020	1	R01: Subramanian, Vijay (ASHLAND (MA) RESIDENT)	R01: Thuot, Lisa (US EPA REGION 1)	EML / Email	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100013821
644002	NEWS RELEASE: EPA EXTENDS COMMENT PERIOD ON PROPOSED CLEANUP PLAN FOR THE NYANZA CHEMICAL WASTE DUMPSITE IN ASHLAND, MA, PUBLIC COMMENT PERIOD ENDS 03/30/2020	2/14/2020	2	R01: (US EPA REGION 1)		PUB / Publication	051-COMMUNITY INVOLVEMENT/0511-Community Involvement Activities/13.03-NEWS CLIPPINGS/PRESS RELEASES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/644002
641856	EMAIL REGARDING PUBLIC COMMENT ON CLEANUP PROPOSAL	2/14/2020	2	R01: Field-juma, Alison (ORGANIZATION FOR THE ASSABET RIVER (OAR))	R01: Thuot, Lisa (US EPA REGION 1)	EML / Email	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/641856
641852	EMAIL REGARDING PUBLIC COMMENT ON CLEANUP PROPOSAL	2/11/2020	1	R01: Green, Andrea (ASHLAND (MA) RESIDENT)	R01: Thuot, Lisa (US EPA REGION 1)	EML / Email	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/641852
100013823	EMAIL REGARDING PUBLIC COMMENT ON CLEANUP PROPOSAL	2/8/2020	1	R01: Bosinoff, Philip (ASHLAND (MA) RESIDENT)	R01: Thuot, Lisa (US EPA REGION 1)	EML / Email	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100013823
647290	EMAIL REGARDING PUBLIC COMMENT ON CLEANUP PROPOSAL, QUESTION ABUT ACCURACY OF DATA LISTED ON WEBSITE (SCREEN CAPTURE OF TABLE 5-4, HISTORICAL DATA COMPARISON - MCP EXCEEDANCES AND MAXIMUM CONCENTRATIONS ATTACHED)	1/28/2020	2	R01: Narayana, K G	R01: Thuot, Lisa (US EPA REGION 1)	EML / Email	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/647290
100013822	EMAIL REGARDING PUBLIC COMMENT ON CLEANUP PROPOSAL	1/27/2020	3	R01: Karenski, Darya & Leonid (ASHLAND (MA) RESIDENT)	R01: Thuot, Lisa (US EPA REGION 1), R01: Purnell, Zanetta (US EPA REGION 1)	EML / Email	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100013822
100013824	EMAIL REGARDING PUBLIC COMMENT ON CLEANUP PROPOSAL	1/24/2020	1	R01: Flood, Catherine (ASHLAND (MA) RESIDENT)	R01: Thuot, Lisa (US EPA REGION 1), R01: Purnell, Zanetta (US EPA REGION 1)	EML / Email	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100013824
641851	EMAIL REGARDING PUBLIC COMMENT ON CLEANUP PROPOSAL	1/24/2020	1	R01: Ring, Diane Brooks (ASHLAND (MA) RESIDENT)	R01: Thuot, Lisa (US EPA REGION 1)	EML / Email	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/641851
641854	EMAIL REGARDING PUBLIC COMMENT ON CLEANUP PROPOSAL	1/24/2020	1	R01: Ednie, Matthew (CASCADE ENVIRONMENTAL)	R01: Thuot, Lisa (US EPA REGION 1)	EML / Email	053-REMEDIAL/0531-Remedy Characterization/05.03-RESPONSIVENESS SUMMARIES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/641854
100012956	PUBLIC MEETING / HEARING PRESENTATION - 01/23/2020	1/23/2020	26	R01: (US EPA REGION 1)		MTG / Meeting Document	051-COMMUNITY INVOLVEMENT/0511-Community Involvement Activities/13.04-PUBLIC MEETINGS/HEARINGS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012956
100013806	TRANSCRIPT OF PUBLIC HEARING - PROPOSED CLEAN-UP PLAN	1/23/2020	22	R01: (APEX REPORTING)	R01: (US EPA REGION 1)	MTG / Meeting Document	051-COMMUNITY INVOLVEMENT/0511-Community Involvement Activities/13.04-PUBLIC MEETINGS/HEARINGS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100013806
643139	NEWS RELEASE: EPA PROPOSES GROUNDWATER CLEANUP PLAN FOR THE NYANZA WASTE DUMP SUPERFUND SITE IN ASHLAND, MA	1/9/2020	4	R01: (US EPA REGION 1)		PUB / Publication	051-COMMUNITY INVOLVEMENT/0511-Community Involvement Activities/13.03-NEWS CLIPPINGS/PRESS RELEASES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/643139
100012881	SAVE THE DATE POSTCARD ANNOUNCEMENT OF MEETING AND HEARING 01/23/2020	1/7/2020	2	R01: (US EPA REGION 1)		MTG / Meeting Document	051-COMMUNITY INVOLVEMENT/0511-Community Involvement Activities/13.04-PUBLIC MEETINGS/HEARINGS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012881
100012890	PROPOSED PLAN	1/1/2020	39	R01: (US EPA REGION 1)		RPT / Report	053-REMEDIAL/0531-Remedy Characterization/04.09-PROPOSED PLANS FOR SELECTED REMEDIAL ACTION	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012890
100012904	DRAFT FINAL FEASIBILITY STUDY (FS) (01/13/2020 TRANSMITTAL LETTER ATTACHED)	1/1/2020	977	R01: (NOBIS GROUP)	R01: (US EPA REGION 1)	RPT / Report	053-REMEDIAL/0531-Remedy Characterization/04.06-FEASIBILITY STUDY REPORTS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012904
100012882	UPDATED GROUNDWATER USE AND VALUE DETERMINATION	2/1/2019	6	R01: (MA DEPT OF ENVIRONMENTAL PROTECTION)		RPT / Report	053-REMEDIAL/0531-Remedy Characterization/16.01-CORRESPONDENCE (NATURAL RESOURCE TRUSTEE)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012882
100012899	AMENDMENT TO GRANT OF ENVIRONMENTAL RESTRICTION AND EASEMENT (GERE) (TRANSMITTAL LETTER ATTACHED)	1/15/2019	22	R01: (US DISTRICT COURT/DISTRICT OF MA)		LGL / Legal Instrument	053-REMEDIAL/0534-Post Construction/08.07 - INSTITUTIONAL CONTROLS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012899
100012896	PUBLIC NOTICE FOR 30-DAY COMMENT PERIOD PROPOSED PLAN	1/10/2019	1	R01: (US EPA REGION 1)		PUB / Publication	051-COMMUNITY INVOLVEMENT/0511-Community Involvement Activities/13.03-NEWS CLIPPINGS/PRESS RELEASES	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012896

100012898	DRAFT DENSE NON-AQUEOUS PHASE LIQUID (DNAPL) EXTRACTION SYSTEM OPERATIONS AND MAINTENANCE (O&M) REPORT #4 (09/17/2018 TRANSMITTAL LETTER ATTACHED)	9/1/2018	97	R01: (NOBIS GROUP)	R01: (US EPA REGION 1)	RPT / Report	053-REMEDIAL/0534-Post Construction/08.03-LONG-TERM RESPONSE REPORTS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012898
100012878	LETTER REGARDING PRELIMINARY IDENTIFICATION OF STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARAR)	8/2/2018	3	R01: Mcweeney, Jennifer (MA DEPT OF ENVIRONMENTAL PROTECTION)	R01: Thuot, Lisa (US EPA REGION 1)	LTR / Letter	053-REMEDIAL/0531-Remedy Characterization/04.05-ARARS (FS)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012878
100012889	2017-2018 DATA SUMMARY TECHNICAL MEMORANDUM (07.25/2018 TRANSMITTAL LETTER ATTACHED)	7/1/2018	423	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	RPT / Report	053-REMEDIAL/0531-Remedy Characterization/04.02-SAMPLING & ANALYSIS DATA (FS)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012889
100012879	QUALITY ASSURANCE PROJECT PLAN (QAPP) (12/21/2017 TRANSMITTAL LETTER ATTACHED)	12/1/2017	432	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	WP / Work Plan	053-REMEDIAL/0531-Remedy Characterization/04.02-SAMPLING & ANALYSIS DATA (FS)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012879
100012897	DENSE NON-AQUEOUS PHASE LIQUID (DNAPL) EXTRACTION SYSTEM OPERATIONS AND MAINTENANCE (O&M) REPORT #3 (09/20/2017 TRANSMITTAL LETTER ATTACHED)	9/1/2017	100	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	RPT / Report	053-REMEDIAL/0534-Post Construction/08.03-LONG-TERM RESPONSE REPORTS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012897
595049	FINAL 2015 GROUNDWATER MONITORING REPORT (12/14/2016 TRANSMITTAL LETTER ATTACHED)	12/1/2016	696	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	RPT / Report	053-REMEDIAL/0533-Remedial Action/07.02-SAMPLING & ANALYSIS DATA (RA)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/595049
583496	DENSE NON-AQUEOUS PHASE LIQUID (DNAPL) EXTRACTION SYSTEM OPERATIONS AND MAINTENANCE (O&M) REPORT (TRANSMITTAL DATED 12/22/2015 ATTACHED)	12/1/2015	77	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	RPT / Report	053-REMEDIAL/0534-Post Construction/08.03-LONG-TERM RESPONSE REPORTS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/583496
190145	OSWER TECHNICAL GUIDE FOR ASSESSING AND MITIGATING THE VAPOR INTRUSION PATHWAY FROM SUBSURFACE VAPOR SOURCES TO INDOOR AIR	6/1/2015	267	R01: (US EPA)		LAWS / Laws/Regulations/Guidance	058-PROGRAM SUPPORT/0583-Regulatory Development/B8.1-Regulations, Standards & Guidelines	UCTL(Uncontrolled)	11	https://semspub.epa.gov/src/document/11/190145
558707	2013 GROUNDWATER MONITORING DATA SUMMARY (05/23/2014 TRANSMITTAL LETTER ATTACHED)	5/1/2014	424	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	RPT / Report	053-REMEDIAL/0533-Remedial Action/07.02-SAMPLING & ANALYSIS DATA (RA)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/558707
555308	FINAL DENSE NON-AQUEOUS PHASE LIQUID (DNAPL) EXTRACTION CONSTRUCTION SUMMARY, OPERABLE UNIT (OU) 2 (04/23/2014 TRANSMITTAL AND OPERATION AND MAITNENANCE (O AND M) MANUAL ATTACHED)	4/1/2014	485	R01: (NOBIS ENGINEERING INC)		RPT / Report	053-REMEDIAL/0533-Remedial Action/07.05-REMEDIAL ACTION DOCUMENTS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/555308
100012891	GROUNDWATER USE AND VALUE DETERMINATION (02/25/2014 TRANSMITTAL LETTER ATTACHED)	2/1/2014	11	R01: (MA DEPT OF ENVIRONMENTAL PROTECTION)		RPT / Report	053-REMEDIAL/0531-Remedy Characterization/16.01-CORRESPONDENCE (NATURAL RESOURCE TRUSTEE)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/100012891
549054	GRANT OF ENVIRONMENTAL RESTRICTION AND EASEMENT (GERE) AND SUBORDINATIONS (09/17/2013 TRANSMITTAL LETTER AND PLAN BOOK 2013 PAGES 589 AND 590 ATTACHED)	8/6/2013	53	R01: (US DISTRICT COURT/DISTRICT OF MA)		LGL / Legal Instrument	053-REMEDIAL/0534-Post Construction/08.07 - INSTITUTIONAL CONTROLS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/549054
535576	FINAL GROUNDWATER MONITORING DATA SUMMARY REPORT (05/10/2013 TRANSMITTAL LETTER ATTACHED)	5/1/2013	432	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	RPT / Report	053-REMEDIAL/0533-Remedial Action/07.02-SAMPLING & ANALYSIS DATA (RA)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/535576
554625	DRAFT FINAL DENSE NON-AQUEOUS PHASE LIQUID (DNAPL) EXTRACTION SYSTEM EVALUATION REPORT (04/05/2013 TRANSMITTAL LETTER ATTACHED)	4/1/2013	42	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	RPT / Report	053-REMEDIAL/0533-Remedial Action/07.06-WORK PLANS & PROGRESS REPORTS (RA)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/554625
524090	TECHNICAL MEMORANDUM FOR STEP DRILLING PROGRAM (INCLUDES TRANSMITTAL LETTER DATED 12/21/2012)	12/1/2012	62	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	RPT / Report	053-REMEDIAL/0533-Remedial Action/07.06-WORK PLANS & PROGRESS REPORTS (RA)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/524090
521711	GROUNDWATER MONITORING DATA SUMMARY, REVISION 1 (08/10/2012 TRANSMITTAL LETTER ATTACHED)	8/1/2012	185	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	ADD / Analytical Data Document	053-REMEDIAL/0533-Remedial Action/07.02-SAMPLING & ANALYSIS DATA (RA)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/521711
494731	FINAL GROUNDWATER MONITORING DATA SUMMARY (10/11/2011 TRANSMITTAL LETTER ATTACHED)	10/1/2011	151	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	RPT / Report	053-REMEDIAL/0533-Remedial Action/07.02-SAMPLING & ANALYSIS DATA (RA)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/494731
506030	FINAL QUALITY ASSURANCE PROJECT PLAN (QAPP), OPERABLE UNIT (OU) 2, AMENDMENT NO. 1 (11/11/2010 TRANSMITTAL LETTER ATTACHED)	11/1/2010	962	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	WP / Work Plan	053-REMEDIAL/0533-Remedial Action/07.05-REMEDIAL ACTION DOCUMENTS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/506030
554626	DRAFT TECHNICAL MEMORANDUM (TM) FOR STEP DRILLING PROGRAM (01/12/2009 TRANSMITTAL LETTER ATTACHED)	1/1/2010	41	R01: (NOBIS ENGINEERING INC)	R01: (US EPA REGION 1)	MEMO / Memorandum	053-REMEDIAL/0533-Remedial Action/07.06-WORK PLANS & PROGRESS REPORTS (RA)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/554626
286717	INTERIM REMEDIAL ACTION (RA) REPORT VAPOR MITIGATION PHASE (CONCURRENCES AND ROUTING SLIP ATTACHED)	6/30/2008	23	R01: (US EPA REGION 1)		RPT / Report	053-REMEDIAL/0533-Remedial Action/07.05-REMEDIAL ACTION DOCUMENTS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/286717
278853	FINAL WORK PLAN FOR VAPOR MITIGATION SYSTEMS, REMEDIAL ACTION (RA)	2/12/2007	68	R01: Adams, Amy (NOBIS ENGINEERING INC)	R01: (US ARMY COPRS OF ENGINEERS), R01: (US EPA REGION 1)	WP / Work Plan	053-REMEDIAL/0533-Remedial Action/07.06-WORK PLANS & PROGRESS REPORTS (RA)	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/278853
278851	FINAL CONCEPTUAL DESIGN FOR VAPOR MITIGATION SYSTEMS	12/22/2006	69	R01: (ICF INTERNATIONAL)	R01: (US ARMY COPRS OF ENGINEERS - NEW ENGLAND DIVISION)	RPT / Report	053-REMEDIAL/0532-Remedial Design/06.04-REMEDIAL DESIGN REPORTS	UCTL(Uncontrolled)	1	https://semspub.epa.gov/src/document/01/278851