SUPERFUND

PROPOSED PLAN

January 2020

Nyanza Chemical Waste Dump
Ashland, MA

U.S. EPA | HAZARDOUS WASTE PROGRAM AT EPA NEW ENGLAND

THE SUPERFUND PROGRAM protects human health and the environment by locating, investigating, and cleaning up abandoned hazardous waste sites and engaging communities throughout the process. Many of these sites are complex and need long-term cleanup actions. Those responsible for contamination are held liable for cleanup costs. EPA strives to return previously contaminated land and ground-water to productive use.

YOUR OPINION COUNTS: OPPORTUNITIES TO COMMENT ON THE PLAN

The U.S. Environmental Protection Agency (EPA) will be accepting public comments on this proposed cleanup plan from January 14-February 14, 2020. You do not have to be a technical expert to comment. If you have a concern, suggestion, or preference regarding this Proposed Plan, EPA wants to hear from you before making a final decision on how to protect your community.

EPA is also specifically soliciting public comment concerning its determination that the alternatives chosen are the least environmentally damaging practicable alternatives for protecting wetland and floodplain resources.

Comments can be sent by mail, email, or fax. The public also can offer oral or written comments at a formal public hearing (see below). If you have specific needs for the upcoming public meeting or hearing, questions about the meeting facility and its accessibility, or questions on how to comment, please contact the EPA Community Involvement Coordinator, ZaNetta Purnell.

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EPA SEEKS PUBLIC COMMENT ON PROPOSED CHANGES TO SITE CLEANUP PLAN:

Public Informational Meeting to discuss the Proposed Plan immediately followed by a Formal Public Hearing

Both meetings will be held:	Ashland High School Auditorium
Thursday • January 23, 2020	65 E. Union Street
6:30 PM to 8:00 PM	Ashland, MA 01721

30 Day Comment Period: January 14 - February 14, 2020

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CLEANUP PROPOSAL SNAPSHOT

EPA's Proposed Plan for Operable Unit 2 (OU2) Groundwater of the Nyanza Chemical Waste Dump Superfund Site (the Site) includes the following components:

- A pre-design investigation (PDI) to identify additional sources of dense non-aqueous phase liquid (DNAPL). Residual DNAPL is believed to be the source of elevated levels of volatile organic compounds (VOCs) detected within the contaminated groundwater plume.
- Additional DNAPL recovery to enhance existing extraction efforts if further DNAPL sources are encountered during the PDI.
- Treatment of groundwater within the source area to address VOC contamination in deep overburden and shallow bedrock zones using in-situ chemical oxidation (ISCO).
- Long-term monitoring in new and existing wells to evaluate remedy performance of the contaminated groundwater plume, including in both the source area and the downgradient plume areas of concern (AOCs).
- Land use restrictions (called "Institutional Controls" or ICs).

In addition to these cleanup components and institutional controls to protect the remedy, because unrestricted use standards will not be achieved, the overall remedy will continue to include periodic reviews, at a minimum, every five years to assess protectiveness of the remedy.

The remedy which EPA has proposed for OU2, including construction, O&M, and long-term monitoring, is estimated to cost approximately $20.5 million and is estimated to take approximately 5 to 10 years to design and implement. A more detailed description of this proposal is outlined in this document and in the OU2 Feasibility Study Report (FS) dated January 2020.

A CLOSER LOOK AT EPA'S PROPOSED CLEANUP APPROACH

The January 2020 OU2 Feasibility Study (FS) Report summarizes the nature and extent of contamination in OU2 groundwater at the Site and identifies the alternatives EPA considered for the proposed cleanup. The OU2 FS evaluated the efficacy of different cleanup options (also referred to as "alternatives") to protect human health and the environment by preventing risk of exposure to Site-related contaminants in groundwater. Based upon the alternatives evaluated in the OU2 FS, the long-term cleanup approach proposed by EPA for OU2 at the Nyanza Chemical Waste Dump Superfund Site includes the following components:

Groundwater

The preferred alternative proposed by EPA for the groundwater cleanup is *Alternative GW-4*. The proposed remedial approach includes enhancements to existing DNAPL recovery, additional DNAPL extraction and recovery, and in-situ treatment in the plume source area within the existing Nyacol Nano Technologies, Inc.("Nyacol") and Worcester Air Conditioning ("WAC") properties, which are northeast of the capped Megunko Hill landfill. Groundwater monitoring will be conducted in the contaminated groundwater plume, including plume source area and downgradient plume. The remedial approach is described in the January 2020 OU2 FS. For the purposes of the FS and this proposed plan, the plume has been divided into two Areas of Concern (AOCs):

1. Nyacol/WAC AOC: This includes the original manufacturing properties where historical releases resulted in soil, groundwater, and surface water impacts, including several potential zones of DNAPL impacts. The AOC is an area located immediately north and northeast of the Megunko Hill landfill; this includes portions of the WAC property located at 148 Pleasant Street, the Nyacol property located on Megunko Road, and an area immediately northeast of the Nyanza landfill. This AOC is where DNAPL has been previously discovered; and
2. Downgradient Plume AOC: This includes areas downgradient of the Nyacol/WAC AOC where a dissolved groundwater plume has migrated to and impacted both the bedrock and overburden aquifers. These downgradient plume impacts have resulted in vapor intrusion impacts to certain residential and commercial properties that are currently being addressed by vapor mitigation systems (VMS).

The AOCs are depicted in **Figure 4**.

EPA proposes to use a phased approach to implement the preferred proposed groundwater remedy (GW-4), which includes the following components:

- Pre-Design Investigation (PDI) in the Nyacol/WAC AOC to locate additional DNAPL for extraction/recovery, and to determine the layout and design of new extraction systems and subsequent in-situ treatment. The PDI would be completed within the target treatment areas depicted on **Figure 5**.
- Conduct a field-scale pilot study and install additional DNAPL extraction wells in the Nyacol/WAC AOC, if recoverable DNAPL is located during the PDI. Target DNAPL extraction zones are within the treatment areas depicted on **Figure 5.**
- 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.
- In-situ chemical oxidation (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 VOCs that are resistant to degradation. A groundwater evaluation in the Nyacol/WAC AOC would be done to design the ISCO treatment, which would commence after DNAPL extraction system installation (if additional DNAPL is located during the PDI), or following the PDI (if recoverable DNAPL is not located for extraction). Target in-situ treatment areas are depicted in **Figure 5**.
- Field-scale pilot study to determine the radius of influence (ROI) and to evaluate treatment performance of specific ISCO chemical formulations.
- ISCO treatment to be conducted 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. The number and frequency of subsequent ISCO injections will be determined by the performance monitoring results.

- Groundwater monitoring well network expansion and optimization (i.e., new monitoring wells) for long-term monitoring (LTM) of groundwater VOC concentrations in the contaminated groundwater plume, including the Nyacol/WAC AOC and downgradient plume AOC. Groundwater sampling would be on an annual basis and continue while contaminant concentrations remain above cleanup standards. Groundwater monitoring will focus on the existing vapor mitigation area, remedy performance monitoring downgradient of the treatment areas, and a portion of a potentially productive aquifer (PPA) designated by the Massachusetts Department of Environmental Protection (MassDEP). The portion of the PPA area which is near the Site is shown on **Figure 2**. In 2019, the MassDEP completed an updated groundwater use and value determination (GWU&VD), which revised and reduced the size of the original 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.

- Five-Year Reviews: Contaminants would remain in groundwater above clean-up levels for an extended period. Therefore, because hazardous substances, pollutants or contaminants will remain at the Site above levels that allow for unlimited use and unrestricted exposure, a review of Site conditions and risks would be conducted every 5 years, as required by CERCLA, to ensure remedy protectiveness.

- Institutional Controls 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).

Please refer to **Figure 6** which shows the phased approach to EPA's proposed remedy GW-4.

EPA IS REQUESTING PUBLIC COMMENTS ON THE FOLLOWING PROPOSED DETERMINATIONS

Impacts to Wetlands and Floodplains

Section 404 of the Clean Water Act, federal regulations at 44 CFR Part 9, and Executive Order 11990 (Protection of Wetlands) require a determination that there is no practical alternative to taking federal actions in waters of the United States or wetlands. Should there be no alternative, the federal actions should minimize the destruction, loss, or degradation of these resources and preserve and enhance their natural and beneficial values.

Most of the wetlands in the area of the Site are not located in the immediate vicinity of the proposed OU2 PDI and proposed treatment areas, except for some wetland areas west of the Nyacol property and east of the southern portion of WAC. Construction activities for the proposed remedy are not planned within Zone AE (the 100-year flood zone) or Zone X (the 500-year flood zone). Remedial activities in the downgradient plume AOC that may include areas on the east side of Main Street would need to take the Zone AE and Zone X flood zones into consideration. Groundwater monitoring well installation may be required at or within the designated wetland areas, however well construction can be located and planned to minimize impacts.

EPA is also required to make a determination that the clean-up alternatives that are conducted are the least damaging practicable alternatives. EPA has determined, through its analysis of the various alternatives, that the proposed clean-up alternatives which impact wetland areas are the least damaging practicable alternatives. EPA will minimize potential harm and avoid adverse impacts to wetlands by using best management practices to minimize harmful impacts on the wetlands, wildlife or habitat, and by restoring these areas consistent with federal and state wetlands protection laws. Any wetlands affected by remedial work will be restored as a wetland area and such restoration will be monitored. Mitigation measures will be used to protect wildlife and aquatic life during remediation, as necessary.

Before EPA can select a clean-up alternative, Executive Order 11988 (Floodplain Management) and federal regulations at 44 CFR Part 9 require EPA to make a determination that there is no practicable alternative to activities that affect or result in the occupancy and modification of the 100- and 500-year floodplain (or flood zone). The 100-year flood zone is equivalent to the area with a 1% chance of flooding in a year, which is denoted on Figure 3 as "Zone AE". The 500-year flood zone is equivalent to the area with a 0.2% chance of flooding in a year, which is denoted on Figure 3 as "Zone X". Through its analysis of alternatives, EPA has determined that proposed remedial activities for OU2 are not planned within Zone AE (the 100-year flood zone) located north of Pleasant Street and south of the Sudbury River and Mill Pond. Some remedial alternatives with treatment areas in the downgradient plume AOC (such as GW-8 or GW-9) may be located within Zone AE located between the Sudbury River and Main Street. Most of Zone X (the 500-year flood zone) is not located near any potential OU2 remedial areas. Remedial activities in the downgradient plume AOC would need to take the Zone AE and Zone X flood zones into consideration. For those alternatives involving actions that would result in permanent occupancy and modification of the floodplain, EPA would need to determine that no other practicable alternative is available. Remedial alternatives for the downgradient plume AOC would be developed and evaluated to take any flood zone impacts into consideration.

More detail regarding wetland and floodplain management can be found in the January 2020 OU2 FS. Please refer to Section 2.1.1 and Figure 1-3 of the January OU2 FS report for alternative-specific impacts.

Estimated Cost

The estimated total present value[1] of this proposed cleanup approach, including the pre-design investigation, capital costs including construction, operations and maintenance, and long-term monitoring, is approximately $20.5 million. Costs for all alternatives are presented in **Table 2** and discussed in the January 2020 OU2 FS in greater detail.

Potential Community Impacts

The preferred alternative (GW-4) is expected to have minimal community impacts in the downgradient plume AOC. Additional groundwater monitoring wells will be installed in the downgradient plume AOC and a portion of the PPA area, which may require property access agreements and/or temporary access to public roads. The majority of the remedial work outlined in alternative GW-4 is expected to occur in the Nyacol/WAC AOC within privately-owned industrial/commercial properties.

SITE DESCRIPTION AND HISTORY

Site Description

The Nyanza Chemical Waste Dump Superfund Site (the Site) is located in Ashland, Massachusetts, 25 miles west-southwest of Boston, Massachusetts (**Figure 1**). 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. Contamination has also been detected in the bedrock north of the former Nyanza, Inc. property and the railroad tracks, (i.e., the WAC property). A plume of groundwater contamination flows from the Nyacol property (a portion of the former Nyanza, Inc. property) and the WAC property in a north/northeasterly direction toward downtown Ashland, a dense area of residential and commercial use, to the Sudbury River. The Site is bounded to the north by the Sudbury River. **Figure 3** depicts the Federal Emergency Management Agency (FEMA) flood zones and MassDEP wetlands within the vicinity of the Site.

Site History

From 1917 to 1978, several companies occupied the Site and manufactured textile dyes and dye intermediates, inorganic colloidal solids, and acrylic polymers. Nyanza, Inc. was the most recent dye manufacturing company to occupy the Site. Chemical wastes were disposed of in various locations on the Site property, and manufacturing wastewater effluent and overflow from an underground concrete vault were discharged into adjacent wetlands and drainageways connected to the Sudbury River. An underground vault, which was removed in 1988, was taken out of service in the 1960s or 1970s but continued to be a source of contamination. Concentrations of dissolved VOCs in shallow groundwater migrating from the plume source area are resulting in vapor intrusion (VI) issues in the contaminated groundwater plume.

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[1] "Present value" cost is for the first 30 years, and is the amount of money set aside today to ensure that enough money is available over the expected life of the project, assuming certain economic conditions (e.g., inflation). The discount rate assumption used is 7%.

The Site was added to EPA's National Priorities List (NPL) on December 30, 1982. Several removal and response actions were performed at the Site between 1987 and 1992. The Site is divided into the following four Operable Units (OUs):

<u>OU1</u>: Consists of the capped landfill, the former Nyanza, Inc. property, and adjacent areas where chemical wastes contaminated with heavy metals, VOCs and SVOCs were disposed. A Record of Decision (ROD) was issued in 1985 and an Explanation of Significant Differences (ESD) was issued in 1992.

<u>OU2</u>: Consists of a groundwater plume of volatile organic contamination that extends from the Site plume source area in a north/northeasterly direction toward the Sudbury River. An interim ROD was issued in 1991, and an ESD was issued in 2006. This Proposed Plan presents a final proposed cleanup action for OU2.

<u>OU3</u>: 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.

<u>OU4</u>: 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. The river was apportioned into ten sections, or "reaches" for purposes of EPA investigations and remedial activities. EPA issued a ROD for OU4 in 2010 and an ESD in 2016.

Nyanza Chemical Waste Dump Site Timeline	
1970	Initial discovery of contamination in the Sudbury River.
September 8, 1983	Final NPL listing
September 4, 1985	OU1 ROD signed
September 4, 1985	OU1 Remedial Investigation/Feasibility Study (RI/FS) completed
April 30, 1987	Removal Action completed by Nyacol Products, Inc.
November 1987	OU1 MassDEP Operation and Maintenance (O&M) Plan finalized
December 11, 1987	OU1 Remedial Design completed
October – December 1987	EPA removal action of soils completed
June 10, 1988	EPA removal action of vault sludge completed
February 10, 1989	Removal Action of sulfuric acid tank sludge completed by a PRP.
April 21, 1989	EPA Removal Action "Megunko Road" completed
January, 1989	OU1 Remedial Action construction commenced
May 7, 1990	EPA Removal Action "Ashland Drum Removal" was completed.
April, 1991	OU2 Remedial Investigation completed
June 1991	OU2 Risk Assessment completed
September 23, 1991	OU2 Interim ROD signed
June 1992	Fish consumption advisory signs posted along Sudbury River to warn the public about mercury contamination.
September 21, 1992	OU1 ESD issued
September 25, 1992	OU1 RA report completed
March 30, 1993	OU3 ROD signed
March 30, 1993	OU3 RI/FS completed

November 10, 1993	First Five-Year Review completed
October 31, 1996	OU2 Treatability Study completed
September 28, 1998	OU3 RD completed
November 1998	Indoor Air Sampling/VI Study
March 18, 1999	OU3 RA construction commenced
August 17, 1999	Second Five-Year Review completed
August 2001	OU3 RA construction completed
May 30, 2002	OU3 RA report completed
April 2003	OU1 and OU3 O&M Plan finalized
April 12, 2004	Third Five-Year Review completed
May 2004	Indoor Air Sampling/VI Study
October 2005	Indoor Air HHRA completed
April 2006	Ashland Nyanza Health Study - Final Report - MA DPH
May 2006	OU4 Final Human Health Risk Assessment issued
September 28, 2006	OU2 Explanation of Significant Differences issued
November 2006	Indoor Air Sampling/VI study
November 1, 2006	Addendum to Third Five-Year Review issued
March 12, 2007	OU2 Final Report - Residential Indoor Air Study
April 2007	OU4 Draft Supplemental Baseline Ecological Risk Assessment issued
May 21, 2007	OU2 Commencement of construction of VMS in Ashland, MA
September 28, 2007	OU2 Final VMS installed
June 30, 2008	OU2 RA Report for VMS completed
August 2008	OU2 Monitoring and Maintenance Manual Package for VMSs issued
December 2008	MassDEP begins O&M of the VMS
December 19, 2008	OU4 Final Supplemental Baseline Ecological Risk Assessment issued
May 2009	Fourth Five-Year Review completed
September 30, 2010	OU4 ROD Signed
September 29, 2011	Addendum to. Fourth Five-Year Review issued
2012 - 2015	OU2 long-term groundwater monitoring
April 3, 2013	OU4 Remedial Action Work Plan issued
September 2013	OU2 DNAPL Extraction Wells installed
2014-2015	Indoor Air Sampling/VI study
May 2014	Fifth Five-Year Review completed
September 26, 2016	OU4 ESD Signed
November 2016	Indoor Air Sampling/VI study at Ashland Police and Fire Stations
October 2017	State O&M for OU4 Commences
2018-2019	EPA completes a Feasibility Study for OU2
January 2019	Feasibility Study Report prepared for OU2
November 2019	EPA releases the proposed cleanup plan for OU2

Prior Cleanup Actions

- OU1 remedial actions were completed between 1990 and 1992, and included:
    - Excavating sludge and contaminated soils and sediments in the former Nyanza industrial areas;
    - Capping and fencing the Megunko Hill landfill;
    - Creating an upgradient diversion trench around the landfill for surface water and groundwater;

  - Backfilling excavated areas;
  - Establishing vegetative cover in impacted wetland areas; and
  - Expanding Site groundwater monitoring.
- OU2 interim remedial actions were completed between 1991 and 2006, and included:
  - Establishing a comprehensive indoor air monitoring program;
  - Installing vapor mitigation systems (VMSs) in 41 residential and commercial buildings located above portions of the downgradient plume AOC in Ashland;
  - Installing two DNAPL extraction well systems on the WAC and Nyacol properties;
  - Conducting DNAPL step drilling investigations; and
  - Performing annual groundwater sampling.
- OU3 remedial actions were completed between 1991 and 2001, and included:
  - Excavating sediment with mercury levels above 1 mg/kg from the continuing source areas, such as the Eastern Wetland;
  - Dewatering and disposing of contaminated sediment under a section of the OU1 landfill cap;
  - Reconstructing the landfill cap disturbed during OU3 remedial work; and
  - Restoring impacted wetland areas.
- OU4 remedial actions were completed between 1992 and 2017, and included:
  - Conducting comprehensive fish tissue and sediment sampling;
  - Installing fish consumption advisory signs pertaining to mercury contamination at various locations along the Sudbury River;
  - Sampling fish tissue for mercury in five impacted Sudbury River reaches to monitor natural recovery processes; and
  - Continuing long-term monitoring in Reach 8, where mercury concentrations in fish tissue are not expected to decline to levels that would permit consumption by a recreational angler.

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; restricts residential, daycare, school, recreational or agricultural use; and restricts any activity that would interfere with the remedy.

CURRENT & FUTURE LAND USE

According to the zoning information provided by the Town of Ashland, land/parcels/properties on or near the former manufacturing areas of the Nyanza Chemical Waste Dump Site (including the Nyacol/WAC AOC) are zoned for commercial use. Future land use in this area is expected to be consistent with the current commercial/industrial land use. The downtown area of Ashland, a portion of which is located within the downgradient plume AOC, is a mix of commercial/industrial and residential properties.

WHY CLEANUP IS NEEDED

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 in the Nyacol/WAC AOC, and subsequent groundwater VOC contamination in the Nyacol/WAC AOC and downgradient plume AOC. 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 above) have been implemented for the Site. EPA is pursuing a final remedy and ROD for the OU2 groundwater contamination as outlined in this plan.

Residual DNAPL in the Nyacol/WAC AOC acts 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, in particular for indoor air (vapor intrusion) and dermal or ingestion groundwater exposure (via construction activities or private wells) in the contaminated groundwater plume, including the Nyacol/WAC AOC and downgradient plume AOC.

Properties located in the current vapor mitigation area (VMA) have been provided with, or given the opportunity to be provided with, a VMS to eliminate the short-term 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 is shown on **Figure 2**.

The objective of the proposed remedy is to use a combination of DNAPL removal and in-situ treatment in the Nyacol/WAC AOC to reduce the flux of 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 shallow groundwater exposure risk is diminished and VMSs are not required in new or existing buildings in the contaminated groundwater plume, including the Nyacol/WAC AOC and the downgradient plume AOC. Currently, no VI issues have been identified within the Nyacol/WAC AOC, where contamination primarily resides in the deep bedrock aquifer.

A full discussion of the risks posed by the Site are presented below.

Site Contaminants

The main contaminants of concern (COCs) for OU2 include:

Volatile Organic Compounds (VOCs): These include a variety of chemicals that are used in glue, paint, solvents and other products, which easily evaporate. Two categories of VOCs detected in the Nyanza Chemical Waste Dump Superfund Site 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 TCE concentration maps are included in this Plan as **Figures 7 and 8.**

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.

How is Risk to Humans Expressed?

Every person has a baseline, non-site related risk from exposure to the numerous naturally occurring and human made chemicals that are inherent in modern society. For example, the American Cancer Society estimates that 1 in 2 men, and 1 in 3 women, will develop cancer over a lifetime (Cancer Facts and Figures for 2016, American Cancer Society). While people also have baseline exposure to non-carcinogens through naturally occuring and human made chemicals that are inherent in modern society, these chemicals can result in toxic effects which are organ-specific, and therefore cannot be expressed in terms of probability.

In evaluating chemical exposure risk to humans, 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 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 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.

Exposure Pathways & Potential Risk

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 potential risk. Based on existing or reasonably anticipated future land use at a site, EPA develops different possible exposure scenarios to determine potential risk, appropriate cleanup levels for contaminants, and potential cleanup approaches; for the Nyanza Chemical Waste Dump Superfund Site, they are documented in the January 2020 OU2 FS report.

Human health and ecological risk assessments have been prepared for the Site. These conservative assessments use a number of possible contamination exposure scenarios to determine if and where there are current or potential future unacceptable risks to humans and/or the environment.
The original groundwater human health risk assessment (HHRA) 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: drinking water, showering, washing, and basement seepage.

The current exposure pathways include: the potential inhalation of contaminants in the indoor air of existing and new buildings; potential direct contact with groundwater and inhalation of vapors in trench air from construction excavation activities; and potential exposure to groundwater via direct contact from future private irrigation wells. The human health risks are described in the "Exposure Assessment" section below.

In 2005, a HHRA was completed to evaluate risks to individuals who may be exposed to VOC contaminants in indoor air at properties located above the Site groundwater plume. This updated indoor air risk assessment was included in the 2006 ESD, which supported the installation of VMSs, expanded indoor air testing, and the installation of additional shallow overburden monitoring wells to better characterize the contaminated groundwater plume. The 2006 ESD also recognized the need for long term ICs to prevent exposure to contaminated groundwater. To address this issue, EPA established a process of communication with the Town of Ashland, whereby 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 the contaminated groundwater plume. The purpose of this process is to ensure property owners and developers are aware of the groundwater contamination and potential exposure risk. The Town of Ashland does not use groundwater from within the contaminated groundwater plume for their drinking water supply. According to Town records, there are no private drinking water or irrigation wells installed in the Nyacol/WAC AOC or the downgradient plume AOC.

In 2019, a supplemental HHRA was performed for construction workers exposed to shallow groundwater and vapors during excavations (described in the Exposure Assessment section of this plan and included as Appendix B in the January 2020 OU2 FS).

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 described in the Prior Cleanup Actions section of this plan.

Human Health Risks

Humans have the potential for exposure to Site contaminants through the following exposure pathways: drinking and direct contact with groundwater, and the inhalation of vapors emanating from groundwater VOC contamination. Further discussion of the exposure pathways is presented below.

Exposure Assessment

The exposure assessment characterizes the physical setting of the Site and evaluates the exposures that may be experienced by a receptor population. To have an exposure, several factors must be present: a source of contamination, a mechanism through which a receptor can come into contact with the contaminants in that medium, and a potential or actual receptor present at the point of contact.

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. Residential use refers to use of property for the location of residential dwellings, with the assumption that young children and adults spend the majority of their time each day in the residential dwelling at their property. Residential land uses are assumed to involve exposure to groundwater as either a drinking water source and/or non-drinking water source (e.g., for watering plants).

The human health exposure pathways considered in the 1991 HHRA during the RI/FS 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 original risk assessment concluded that the contaminants present in 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 the scenarios listed has not been performed, the concentrations over time are generally consistent. Consistent levels of VOC contaminants, in particular TCE, currently detected in groundwater would result in unacceptable risks if exposed by direct contact.

The 2005 HHRA evaluated risks to individuals who may be exposed to indoor air at properties located above the Site groundwater plume. The assessment determined that incremental cancer risks exceeded the acceptable range of $1x10^{-6}$ to $1x10^{-4}$ in 2 out of 14 residences sampled using a central tendency exposure (CTE) scenario and in 7 out of 14 residences using a reasonable maximum exposure (RME) scenario. TCE was found to contribute most of the estimated cancer risk. Only one residence had a non-cancer HI above one, primarily due to benzene; petroleum products were observed in the basement that may have contributed to increased air VOC concentrations. The HHRA also modeled air concentrations based on groundwater concentrations using the Johnson-Ettinger model, and the CTE scenario concentrations were found to be like the measured air concentrations. The modeled RME scenario concentrations were higher than the measured air concentrations and were considered likely to be overestimated. This risk assessment was used as a basis for the installation of approximately forty-three (43) VMSs in buildings located above the most contaminated areas of the downgradient groundwater plume in downtown Ashland.

A 2019 supplemental HHRA was performed for construction workers potentially exposed to shallow groundwater and trench air vapors during excavations. Contaminants of concern (COCs) identified for this supplemental HHRA include TCE, 1,2,4-TCB, chlorobenzene, and 1,2-DCB. The supplemental HHRA determined there to be an unacceptable non-cancer risk (or levels of non-cancer health hazards) to construction workers for exposure to shallow groundwater (ingestion and dermal exposure routes) and trench air vapors. The non-cancer HI is greater than the EPA target of one, reflecting organ-specific HIs greater than one for effects on the developmental system, immune system, urinary system, kidney, liver, and body weight. The total cancer risk estimates were within the CERCLA acceptable cancer risk range of 10^{-6} to 10^{-4}. The full Supplemental HHRA is included in Appendix B of the January 2020 OU2 FS.

Also in 2019, the MassDEP completed an updated groundwater use and value determination, which classified most of the aquifer at and near the Site as a non-drinking water aquifer, with a small portion of the aquifer as part of a PPA. The PPA is not currently used for drinking water purposes. Based on current groundwater data and the overall hydrogeology of the Site, the PPA area has not been impacted by Site related groundwater contamination. Groundwater monitoring will be conducted at the Site to continue to demonstrate that Site contamination does not and will not impact the PPA.

Properties in the vapor mitigation area (VMA) have been provided with, or given the opportunity to be provided with, a VMS to eliminate the short-term vapor intrusion risk. However, these VMSs are voluntary for residences and businesses, do not address the source of contamination (the underlying groundwater), and do not meet a statutory preference to attain a permanent solution to the contamination. EPA's goal is to eliminate or reduce the number of VMSs needed because their use by residents or businesses is voluntary, which makes their long-term effectiveness as a protective measure questionable. Currently, there are no institutional controls on properties which have a VMS installed. The systems, which are typically located in building basements, are inspected annually by MassDEP to verify their operating status, but only where property access is granted. Some VMSs are not inspected when property access is not obtained, and thus cannot be verified as operational. Existing buildings with VMSs may be renovated or expanded, whereby the original VMS is removed or not adequate enough for the new [larger] building footprint. In addition, new buildings located in the VMA are strongly encouraged, but not required, to have some type of sub-slab depressurization system (SSDS) or vapor mitigation installed.

The objective of EPA's proposed cleanup approach is to reduce groundwater VOC concentrations in the Nyacol/WAC AOC to levels such that exposure risk is diminished, and VMSs are not required in new or existing buildings in the contaminated groundwater plume, including the Nyacol/WAC AOC and the downgradient plume AOC, where shallow groundwater is flowing toward the Sudbury River. EPA seeks to mitigate these risks by implementing the proposed remedy described in this plan, via additional or enhanced DNAPL extraction/recovery and in-situ treatment.

Information from the HHRAs, Site investigations, and information described in this exposure assessment were used to develop the groundwater cleanup alternatives presented in this plan and in the January 2020 OU2 FS.

Threats to the Environment

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. 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.

Principal Threat Waste

The National Contingency Plan (NCP), which governs EPA cleanups, at 40 CFR § 300.430(a)(1)(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. This expectation is further explained in an EPA fact sheet (OSWER #9380.3-06FS), which states that principal threat wastes are source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk 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 waste 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, air, or act as a source of direct exposure.

Although EPA has not established a threshold level of toxicity/risk to identify a principal threat waste, generally where toxicity and mobility combine to pose a carcinogenic risk of 10^{-3} or greater, the source material is considered principal threat waste. Residual DNAPL within the Nyacol/WAC AOC is acting as a continuing source of contamination to the contaminated groundwater plume, and is considered principal threat waste.

It is EPA's current judgment that the preferred alternative identified in this Proposed Plan is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances, including principal threat waste, into the environment and that treatment of the principal threat waste has been included as a component of the preferred alternative to the extent practicable.

CLEANUP ALTERNATIVES CONSIDERED

Once possible exposure pathways and potential risks have been identified at a site, cleanup alternatives are developed to reduce and/or mitigate the identified unacceptable risks and achieve the site-specific Remedial Action Objectives (RAOs), which are also known as the cleanup objectives. The RAOs for Nyanza Chemical Waste Dump Superfund Site OU2 are as follows:

- 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.

Table 1 presents the proposed groundwater contaminant cleanup levels, or Preliminary Remediation Goals (PRGs), and the basis for selection for each exposure scenario described above found to pose an unacceptable risk to human health or the environment.

Below is a summary of the cleanup alternatives considered for Nyanza Chemical Waste Dump Superfund Site OU2 which were considered for further evaluation and comparison. A more detailed description of these alternatives, and those which were not considered for further evaluation, are presented in the January 2020 OU2 FS which is available for public review. (See Page 29 of this Proposed Plan for more information on where you can find Site-related documents).

<u>Alternative GW-1: No Further Action:</u>

- 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.
- Periodic five-year reviews to assess remedy protectiveness.
- No construction would take place, and RAOs would not be achieved.

CERCLA requires that a No Action (or no further action) alternative be evaluated to establish a baseline for comparison to other remedial alternatives. Alternative GW-1 is not evaluated according to screening criteria but will be evaluated during detailed analysis.

Alternative GW-2: Continue Current Limited Action (with Enhancements):

- 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.
- PDI in the Nyacol/WAC AOC to support remedy development, address data gaps, and develop a more complete conceptual site model (CSM) including Site surveys and a groundwater evaluation.
- Investigation 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.
- Pilot Study 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).
- Installation of new DNAPL extraction wells in the Nyacol/WAC AOC (if additional DNAPL sources are located) and optimization of DNAPL extraction wells.
- No active treatment for the downgradient plume AOC (monitoring only).
- Institutional Controls 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 in new buildings constructed over the contaminated groundwater plume, including the Nyacol/WAC AOC and the downgradient plume AOC (or if an existing building with a VMS is renovated or expanded in size).
- Monitoring well network expansion and optimization (with the installation of new groundwater monitoring wells).
- Long-term monitoring of the contaminated groundwater plume, including the Nyacol/WAC AOC and the downgradient plume AOC, to determine if groundwater contaminants remain above proposed cleanup levels.
- Periodic five-year reviews to assess remedy protectiveness.

Alternative GW-4: In-Situ Treatment for Nyacol/WAC AOC; No Active Treatment for Downgradient Plume AOC *(preferred remedy in this Proposed Plan)*:

- Implementation of the remedy components outlined in Alternative GW-2.
- In-situ chemical oxidation (ISCO) treatment to be conducted within the Nyacol/WAC AOC. ISCO to target deep overburden and shallow/weathered bedrock.
- No active treatment for the downgradient plume AOC (monitoring only).
- Full-scale ISCO design, including target bedrock zones for in-situ treatment, would be determined based on results of the PDI and pilot study.
- Activated persulfate as the proposed ISCO reagent, which is capable of degrading the contaminants of concern, including the more persistent chlorinated benzenes, while achieving adequate aquifer distribution.
- ISCO performance monitoring (pre-injection and post-injection events) to evaluate the effectiveness and performance of in-situ treatment.

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

- Implementation of the remedy components outlined in Alternative GW-2.
- ISCO treatment within the Nyacol/WAC AOC immediately followed by groundwater pump and treat as a polishing step.
- Full scale ISCO design based on the results of the PDI and pilot study.
- ISCO performance monitoring (pre-injection and post-injection events) to evaluate the effectiveness and performance of in-situ treatment.
- No active treatment for the downgradient plume AOC (monitoring only).
- Installation of groundwater extraction wells in the Nyacol/WAC AOC to target residual contamination that is not addressed during in-situ treatment. A network of groundwater extraction wells would be installed to capture groundwater in target treatment areas.
- A full-scale pump and treat design to be based on results of the PDI, in-situ treatment, and a pumping and treatment pilot study
- Groundwater extracted from the Nyacol/WAC AOC would be pumped to a central treatment building and effluent would be discharged to the sewer system utilized by the Town of Ashland.

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

- Implementation of the remedy components outlined in Alternative GW-2, with exception of active treatment for downgradient plume AOC.
- ISCO treatment within the Nyacol/WAC AOC immediately followed by groundwater pump and treat as a polishing step.
- ISCO would target deep overburden and shallow/weathered bedrock.
- Groundwater extraction wells installed at the Nyacol/WAC AOC to target residual contamination that could not be addressed during in-situ treatment. A network of groundwater extraction wells would be installed to capture groundwater in target treatment areas.
- A full-scale pump and treatment design to be based on results of the PDI, in-situ treatment, and a pump and treat pilot study.
- Pumping of extracted groundwater from the Nyacol/WAC AOC to a central treatment building and discharge of effluent to the Town of Ashland sewer system.
- ISCO treatment within the downgradient plume AOC in the overburden aquifer only. Given the extensive size of the bedrock plume and the cost of investigating fractures to target in-situ treatment, bedrock injection has not been included in this alternative.
- Full scale ISCO design based on the results of the PDI and pilot study.
- ISCO performance monitoring (pre-injection and post-injection events) to evaluate the effectiveness and performance of in-situ treatments.

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

- Implementation of the remedy components outlined in Alternative GW-2.
- ISCO treatment within the Nyacol/WAC and downgradient plume AOCs.
- Activated persulfate as the proposed ISCO reagent, which is capable of degrading the more persistent chlorinated benzene COCs while achieving adequate aquifer distribution.
- ISCO treatment in the Nyacol/WAC AOC targeting deep overburden and shallow/weathered bedrock.
- ISCO treatment in the downgradient plume AOC occurring in the overburden aquifer.

- Full scale ISCO design based on the results of the PDI and a pilot study.
- ISCO performance monitoring (pre-injection and post-injection events) to evaluate the effectiveness and performance of in-situ treatments.

THE NINE CRITERIA FOR CHOOSING A CLEANUP PLAN

EPA uses nine criteria to evaluate cleanup alternatives and select a final cleanup plan. EPA has already evaluated how well each of the cleanup alternatives developed for the Nyanza Chemical Waste Dump Superfund Site meet the first seven criteria in the Feasibility Study. Once comments from the community and State are received and considered, EPA will select the final cleanup plan and document its selection in the Record of Decision (ROD) for Operable Unit 2 of the Site. The ROD will the final cleanup plan for OU2 following the 1991 interim ROD and 2006 ESD.

1. *Overall protection of human health and the environment*: Will it protect you and the plant and animal life on and near the site? EPA will not choose a cleanup plan that does meet this basic criterion.
2. *Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)*: Does the alternative meet all federal environmental and state environmental and facility siting statutes and regulations that are either applicable or relevant and appropriate to the selected cleanup plan? The cleanup plan must meet this criterion.
3. *Long-term effectiveness and permanence*: Will the effects of the cleanup plan last or could contamination cause future risk?
4. *Reduction of toxicity, mobility, or volume through treatment*: Using treatment, does the alternative reduce the harmful effects of the contaminants, the spread of contaminants, and the amount of contaminated material?
5. *Short-term effectiveness*: How soon will site risks be adequately reduced? Could the cleanup cause short-term hazards to workers, residents, or the environment?
6. *Implementability*: Is the alternative technically feasible? Are the right goods and services (i.e., treatment equipment, space at an approved disposal facility) available?
7. *Cost*: What is the total cost of an alternative over time? EPA must select a cleanup plan that provides necessary protection for a reasonable cost.
8. *State acceptance*: Do state environmental agencies agree with EPA's proposal?
9. *Community acceptance*: What support, objections, suggestions, or modifications did the public offer during the comment period?

Cleanup Alternatives Comparison

The remedial alternatives that were not initially screened out (GW-1, GW-2, GW-4, GW-5, GW-8, and GW-9) were compared to each other to identify how well each alternative meets the EPA evaluation criteria listed above. The state and community acceptance criteria will be evaluated once feedback is received during the public comment period. This comparison assists in the selection of a remedy by identifying the advantages and disadvantages of each alternative relative to the evaluation criteria.

The following discussion and Table 2 present a general and cost comparison summary of the alternatives against EPA evaluation criteria for each cleanup component. Detailed descriptions, evaluations and comparisons of alternatives are included in Sections 4.0 and 5.0 of the January 2020 OU2 FS.

Overall Protection of Human Health and the Environment

Alternative GW-1 takes no measures to treat contamination sources or plumes, control groundwater plume migration, prevent future groundwater use, or address vapor intrusion impacts. Therefore it is not considered to be protective of human health and the environment.

Alternative GW-2 includes measures for enhanced extraction and recovery of additional DNAPL in the Nyacol/WAC AOC. Alternative GW-2 is protective of human health and the environment in the short term, to prevent contact with groundwater through use of ICs, mitigate vapor intrusion by continuing the existing VMS, and extract recoverable DNAPL to the greatest extent possible. However, in the long term, this alternative would not provide a substantial decrease in the estimated time for groundwater to reach cleanup levels (PRGs), and would not substantially reduce the contamination transport towards the PPA or the Sudbury River. Therefore, in the long term, Alternative GW-2 is not protective of human health and the environment.

Alternatives GW-4, GW-5, GW-8, and GW-9 include the remedy components of GW-2, which incorporates measures for additional and/or enhanced DNAPL removal from the contaminant source area (the Nyacol/WAC AOC), by extracting recoverable DNAPL to the greatest extent possible.

Alternative GW-4 would actively treat sorbed and residual contamination in the Nyacol/WAC AOC. GW-4 does not actively treat sorbed or residual contamination that may be present within the downgradient plume AOC. Instead, it relies on contaminant attenuation/degradation from Nyacol/WAC area treatment to restore the downgradient plume AOC over time. The untreated sorbed and hot spot sources in the downgradient plume AOC extend the period of time necessary for groundwater to reach acceptable levels for vapor intrusion concerns throughout the plume. Alternative GW-4 would be protective of human health and the environment once the groundwater cleanup levels are attained.

Alternative GW-5 would actively treat sorbed, residual, and dissolved contamination in the Nyacol/WAC AOC. GW-5 also provides for plume capture via groundwater extraction in the Nyacol/WAC AOC that would reduce or eliminate the potential for plume transport . However, GW-5 does not actively treat sorbed or residual contamination that may be present within the downgradient plume AOC. This remedy relies on contaminant attenuation/degradation from Nyacol/WAC area treatment to restore the downgradient dissolved plume over time. The untreated sorbed and hot spot sources in the downgradient plume AOC extend the period of time necessary for groundwater to reach acceptable levels for vapor intrusion concerns throughout the plume. Alternative GW-5 would be protective of human health and the environment once the groundwater cleanup levels are attained.

Alternative GW-8 relies on downgradient plume control and containment in the Nyacol/WAC AOC including source removal via DNAPL extraction and in-situ treatment. It also adds a treatment component for the groundwater hotspot in the residential neighborhood in the downgradient plume AOC. Alternative GW-8 would be protective of human health and the environment once the groundwater cleanup levels are attained.

Alternative GW-9 relies on in-situ treatment in the Nyacol/WAC AOC and downgradient plume AOC, (in addition to source removal via DNAPL extraction in the Nyacol/WAC AOC). GW-9 would require a longer timeframe than GW-8 to reduce contaminant transport towards the Sudbury River. Alternative GW-9 would be protective of human health and the environment once the groundwater cleanup levels are attained.

All of the remedies would meet the criteria 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 vapor intrusion by the continued operation, monitoring, and maintenance of the existing VMSs.

Compliance with ARARs

There is no ARARs analysis for alternative GW-1 since no further action will be taken to comply with ARARs.

Chemical-Specific ARARs and TBCs

There are no chemical-specific ARARs.

Action-Specific ARARs and TBCs

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 and TBCs

Location-specific ARARs will be met for alternatives which have components that may impact wetlands and those that may extend to the floodplain of the Sudbury River. Each alternative 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. Historic features have likewise not been identified in these areas.

Long-term Effectiveness and Performance

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/inhalation, groundwater exposure) would gradually decrease over time but because of the large potential contaminant mass, it is estimated to take approximately 680 years to achieve the target Site PRG for TCE of 16 μg/L throughout the Site. TCE is the primary contaminant that 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). GW-2 does not address sorbed contaminants and dissolved phase groundwater contamination. Following the removal of additional pooled DNAPL (if located during the PDI), an estimated 30-50% of the in-situ 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 address the contaminated groundwater plume. Complete aquifer restoration would be achieved over time via contaminant attenuation/degradation after source removal in the Nyacol/WAC AOC. Due the large potential contaminant mass, it is estimated that 650 years would be required to achieve the target TCE PRG throughout the Site.

Alternative GW-4 addresses pooled and residual DNAPL and sorbed contaminants at the Nyacol/WAC. However, it does not directly address the contaminated groundwater 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 potential contaminant mass remaining in the downgradient plume, it is estimated that 275 years would be required to achieve the target PRG 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 contaminated groundwater plume, but rather relies on contaminant attenuation/degradation from source removal and treatment in the Nyacol/WAC AOC to reduce the long-term residual risk in the downgradient residential area. It is estimated that 140 years would be required to achieve the target TCE PRG throughout the Site.

Alternative GW-8 is considered to be the most aggressive active treatment alternative, as it includes both groundwater extraction and in-situ treatment in Nyacol/WAC AOC and in-situ treatment in the downgradient plume AOC. GW-8 would target all known contaminant sources. Due to the inferred presence of DNAPL and matrix-diffused contaminant mass in deep fractured bedrock, and access limitations that may restrict in-situ treatment (e.g., active railroad tracks, industrial facilities, and property access to individual residential parcels located above the downgradient plume), it is estimated that 140 years would be required to achieve the target TCE PRG 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 extraction, it is considered less aggressive than alternative GW-8. Similar to 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 target TCE PRG 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 contamination remaining in-place would require approximately 500 years to be reduced through attenuation processes at the start of the residential impacts area in the downgradient plume AOC.

Alternative GW-4 includes extraction of recoverable DNAPL (if located during the PDI) and in-situ (ISCO) treatment in the Nyacol/WAC AOC. It does not directly address the contaminated groundwater plume with active treatment. The contamination remaining in-place would require approximately 114 years to achieve the target TCE PRG through attenuation 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 extraction 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 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 target TCE PRG through attenuation at the start of the residential impacts area in the downgradient plume AOC.

Alternative GW-8 is considered to be the most aggressive active treatment alternative, as it includes both groundwater extraction and in-situ treatment in the Nyacol/WAC AOC, and in-situ treatment in the downgradient plume AOC. GW-8 would target all known contaminant sources. Although it does not reduce the toxicity of the COCs, it does serve to reduce the mobility of the associated groundwater in the Nyacol/WAC AOC. It does not reduce contaminant mobility within the downgradient plume AOC but does reduce the mass of contaminants. The contamination remaining in-place would require approximately 26 years to be reduced through attenuation processes at the start of the potential residential impacts area in the downgradient plume AOC. Due to 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 target TCE PRG through treatment at the start of the residential impacts area in the downgradient plume AOC.

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 extraction, 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 target TCE PRG through treatment at the start of the residential impacts area in the downgradient plume AOC.

Table F-2 in Appendix F of the January 2020 OU2 FS includes estimated times required to achieve the TCE PRG (Site-specific VISL) through treatment. These results indicate that it will take between 40 and 670 years for the proposed remedies to meet the PRG in groundwater at the downgradient edge of the Nyacol/WAC properties. The preferred remedy (GW-4) has a moderate projection of approximately 180 years to meet the TCE PRG of 16 µg/L at the downgradient edge of the Nyacol/WAC AOC. DNAPL removal and in-situ treatment in the Nyacol/WAC AOC is projected to remove close to 90% of the source material in a five year period. Further contaminant degradation is also projected to occur close to the source area after additional recoverable DNAPL is removed. Initial projections indicate that it would require 114 years from the assumed start of remediation for TCE concentrations to fall below 16 µg/L at the edge of the residential impact area (200 m from the source area).

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.

All of the remedies evaluated would be effective in the short term by preventing direct contact with groundwater and the inhalation of vapors through the use of ICs, and mitigating vapor intrusion 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.

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 and traffic; use of fossil fuels for construction equipment).

Alternative GW-4 (the proposed preferred remedy) involves some intrusive construction work in the Nyacol/WAC AOC (installation of extraction and injection wells) and, therefore, has some short-term community and sustainability impact (i.e., heavy equipment noise and traffic; fossil fuels for construction equipment and off-site material hauling). GW-4 also requires pressurized chemical injections, causing the potential for human (worker and community) exposure to reagents and products. However, GW-4 does not include actions within residential areas, reducing the potential risk to the community in comparison to remedies with off-site activities.

Alternative GW-5 involves intrusive construction work in the Nyacol/WAC AOC (installation of wells and piping for groundwater extraction and treatment) and, therefore, has some short-term community and sustainability impact (i.e., heavy equipment noise and traffic; fossil fuels for construction equipment and off-site material hauling). The drawdown of groundwater to achieve plume capture may also result in short-term environmental impacts to wetlands in the Nyacol/WAC AOC (and potentially outside the AOC 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. However, GW-5 does not include actions within residential areas, reducing the potential risk to the community in comparison to other remedies.

Alternative GW-8 includes DNAPL extraction and groundwater extraction in the Nyacol/WAC AOC and in-situ treatment in the Nyacol/WAC and downgradient plume AOCs. It requires pressurized chemical injections in both AOCs, including several rounds of full-scale chemical injections within off-site residential areas. These off-site actions increase the potential for community impacts in comparison with GW-2, GW-4 and GW-5. Groundwater drawdown may also result in short-term environmental impacts to wetlands in the Nyacol/WAC AOC. GW-8 is, therefore, considered to have higher environmental and community impacts than GW-5.

Alternative GW-9 includes involves DNAPL extraction in the Nyacol/WAC AOC and in-situ treatment in both the Nyacol/WAC and downgradient plume AOCs. It requires pressurized chemical injections in both AOCs, including several rounds of full-scale chemical injections within off-site residential areas. These off-site actions and their resulting potential for community impacts are considered generally equivalent to GW-8. However, because GW-9 does not result in groundwater drawdown, it results in less short-term environmental impacts than GW-8.The times to achieve PRGs in various areas of the Site are outlined in Appendix F of the January 2020 OU2 FS.

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 located during the PDI). Directional drilling may be used to reach areas that are otherwise inaccessible (such as beneath the railroad tracks and active industrial facilities) that are suspected or identified as having DNAPL below the surface. DNAPL extraction is assumed to consist of standalone stations similar to those that are already on-site but may be augmented by manual removal if those stations cannot be used because of access issues. Previous DNAPL extraction has not been successful in recovering significant contaminant mass, and engineering enhancements will be required to increase the overall DNAPL recoverability and achieve the target PRG.

Alternative GW-4 is more difficult to implement than GW-2 because it also includes in-situ chemical treatment. In-situ treatment 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 contamination is located. Angled boreholes may be used to reach 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 or GW-4 because it relies on both groundwater extraction and in-situ chemical treatment. In-situ treatment 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 contamination is located. Angled boreholes may be used to reach areas where physical access is difficult and multiple injection depths are likely needed to target the highest concentrations and prevent short-circuiting through more permeable materials. Post-injection pump and treat would rely on a steady supply of electricity and other resources. However, the system would capture any contamination that is missed by the in-situ treatment program and prevent downgradient impacts.

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. GW-8 is the most difficult of the remedies to implement because it incorporates the most remedial components, activities, and infrastructure.

The groundwater extraction 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. Therefore, those alternatives are more difficult to implement than GW-9, which does not require permanent off-site components.

Costs

Estimated costs for the alternatives are summarized in **Table 2**.

Based on cost estimates, the overall ranking of the alternatives is as follows:

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

State and Community Acceptance

Each will be evaluated once feedback is received during the public comment period.

WHY EPA RECOMMENDS THIS PROPOSED CLEANUP PLAN

Based on the results of previous investigations, previous interim OU2 remedial actions, and human health risk assessments, EPA has prepared a Feasibility Study for the Site, and recommends this proposed cleanup plan because EPA believes it achieves the best balance among EPA's required criteria used to evaluate various alternatives. The Proposed Plan meets the cleanup objectives or Remedial Action Objections (RAOs) for the Site. This Proposed Plan includes a summary in general terms of why EPA recommends the cleanup plan for the Site. For more detail, refer to the other sections of the Proposed Plan and the Feasibility Study Report.

Alternative GW-4, DNAPL extraction/recovery and in-situ treatment in the Nyacol/WAC AOC, is EPA's preferred alternative because it addresses key areas of residual contamination (areas of pooled DNAPL, residual DNAPL and sorbed contaminants), estimated to be more than 90% of the total contaminant mass. This residual contamination from the Nyacol/WAC AOC is contributing to the dissolved-phase VOC groundwater contamination in the contaminated groundwater plume, which is resulting in VI concerns, especially in areas of downtown Ashland near the Sudbury River.

Alternative GW-4 is EPA's preferred alternative for the following reasons:

- GW-4 reduction of source material and residual contamination in the Nyacol/WAC AOC which is creating a vapor intrusion and groundwater exposure risk in the contaminated groundwater plume;
- DNAPL extraction/recovery and ISCO are proven, effective technologies which require less operation and maintenance compared to groundwater pump and treatment alternatives;
- The remedy can be implemented and the progress evaluated in a phased approach;
- Existing vapor mitigation systems will continue to be monitored and maintained to prevent VI exposures in buildings; and
- Institutional Controls will be implemented to prevent exposure to contaminated groundwater in non-drinking water areas, protect construction workers from exposure to groundwater and trench vapors during excavation activities, and require a vapor intrusion evaluation or VMS installation in new buildings constructed in the contaminated groundwater plume, including the Nyacol/WAC and the downgradient plume AOCs (or if an existing building with a VMS is renovated or expanded in size).

The objective is to use a combination of DNAPL removal and groundwater treatment in the Nyacol/WAC AOC to reduce the flux of contaminants from the source area into the groundwater. This would result in a reduction of the dissolved phase VOC concentrations in the contaminated groundwater plume, including the Nyacol/WAC AOC and the downgradient plume AOC, so the existing VMSs in residential, commercial, and municipal buildings could be eliminated in the future.

EPA believes the proposed cleanup plan for the Nyanza Chemical Waste Dump Superfund Site achieves the best overall balance among EPA's nine criteria (excluding State and community acceptance, which will be considered following public comment) used to evaluate the various alternatives presented in the Feasibility Study. This cleanup approach provides both short- and long-term protection of human health and the environment, attains applicable federal environmental and state environmental and facility siting laws and regulations, reduces the toxicity, mobility, and volume of contaminants through treatment to the extent practicable, and utilizes permanent solutions.

In addition, this proposed cleanup approach uses proven cleanup technologies including DNAPL recovery and extraction and ISCO treatment of groundwater in bedrock and overburden aquifers, and is generally cost effective while achieving the site-specific cleanup objectives in a reasonable timeframe. The preferred cleanup approach also has one of the least impacts to residents.

WHAT IS A FORMAL COMMENT?

EPA will accept public comments during a 30-day formal comment period. EPA considers and uses these comments to improve its cleanup approach. During the formal comment period, EPA will accept written comments via mail, e-mail, and fax. Additionally, verbal comments may be made during the formal Public Hearing on **January 23, 2020** during which a stenographer will record all offered comments during the hearing. EPA will not respond to your comments during the formal Public Hearing.

EPA will hold a brief informational meeting prior to the start of the formal Public Hearing on **January 23, 2020.** Additionally, once the formal Public Hearing portion of the meeting is closed, EPA can informally respond to any questions from the public.

EPA will review the transcript of all formal comments received during the hearing, and all written comments received during the formal comment period, before making a final cleanup decision. EPA will then prepare a written response to all the formal written and oral comments received. Your formal comment will become part of the official public record. The transcript of comments and EPA's written responses will be issued in a document called a Responsiveness Summary when EPA releases the final cleanup plan, in a document referred to as the Record of Decision (ROD). The Responsiveness Summary and ROD will be made available to the public on-line and at the EPA Records Center (see addresses below). EPA will announce the final decision on the cleanup plan through the local media and on EPA's website.

For More Detailed Information:

The Administrative Record, which includes all documents that EPA has considered or relied upon in proposing this cleanup plan for Operable Unit 2 of the Nyanza Chemical Waste Dump Superfund Site is available for public review shortly before the start of the comment period at the following locations:

EPA Records and Information Center
5 Post Office Square, First Floor
Boston, MA 02109-3912
617-918-1440

Ashland Public Library
66 Front Street
Ashland, MA 01721

Information is also available for review on-line at www.epa.gov/superfund/nyanza

Send Us Your Comments

Provide EPA with your written comments about the Proposed Plan for Operable Unit 2 of the Nyanza Chemical Waste Dump Superfund Site.

Please email (thuot.lisa@epa.gov), fax (617-918-0129), or mail comments postmarked no later than February 14, 2020 to:

Lisa Thuot
EPA Region 1 New England
5 Post Office Square
Mail Code: 07-1
Boston, MA 02109-3912

Acronyms

AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
CSM	Conceptual Site Model
DCB	Dichlorobenzene
DCE	Dichloroethene
DNAPL	Dense Non-Aqueous Phase Liquid
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FEMA	Federal Emergency Management Agency
FR	Federal Register
FS	Feasibility Study
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IC	Institutional Control
ICF	ICF Consulting
ISCO	In-Situ Chemical Oxidation
LTM	Long-Term Monitoring
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
mg/L	Milligram per Liter
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
Nobis	Nobis Group™
NPL	National Priorities List
NRWQC	National Recommended Water Quality Criteria
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PDI	Pre-Design Investigation
PPA	Potentially Productive Aquifer
PRG	Preliminary Remediation Goal
RA	Remedial Action
RAO	Remedial Action Objective
RD	Remedial Design
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
ROI	Radius of Influence
Site	Nyanza Chemical Waste Dump Superfund Site
SSDS	Sub-Slab Depressurization System
SVOC	Semi-Volatile Organic Compound
TBC	To Be Considered
TCB	Trichlorobenzene

TCE	Trichloroethene
µg/L	Micrograms per Liter
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

Table 1 – Preliminary Remediation Goals (PRGs)

Groundwater PRGs (µg/L)		
	Selected PRG	**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]
cis-1,2-Dichloroethene	--	--
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 (carcinogenic Target Risk = $1x10^{-4}$ or Hazard Quotient = 1, 15°C groundwater temperature, modified geologic attenuation factor of 0.0005). Please refer to **Appendix H** – Attenuation Factors for Site-Specific Vapor Intrusion Screening Levels included in the January 2020 FS Report.

Table 2 – Comparative Analyses of Remedial Alternatives

	ALTERNATIVES					
	GW-1: No Further Action	**GW-2:** Continue Current Limited Action (with Enhancements)	**GW-4:** Nyacol/WAC AOC In-Situ Treatment [1] (*includes GW-2*)	**GW-5:** Nyacol/WAC AOC In-Situ Treatment, Limited Pump and Treat (P&T) (*includes GW-2*)	**GW-8:** Nyacol/WAC AOC In-Situ Treatment, Limited P&T; Downgradient Plume AOC In-Situ Treatment (*includes GW-2*)	**GW-9:** Nyacol/WAC AOC, Downgradient Plume AOC In-Situ Treatment (*includes GW-2*)
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	$0	$2,879,000	$14,940,000	$18,664,000	$43,140,000	$39,910,000
O&M Cost (Present Value) [2]	$108,000	$3,099,000	$5,547,000	$16,609,000	$13,694,000	$3,072,000
Total (Present Value)	$108,000	$5,978,000	$20,487,000	$35,273,000	$56,834,000	$42,982,000

Notes:
1. Yellow highlight = EPA's Preferred Alternative.
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.

Comparative Analyses Ratings:

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

Figure 1 – Site Location

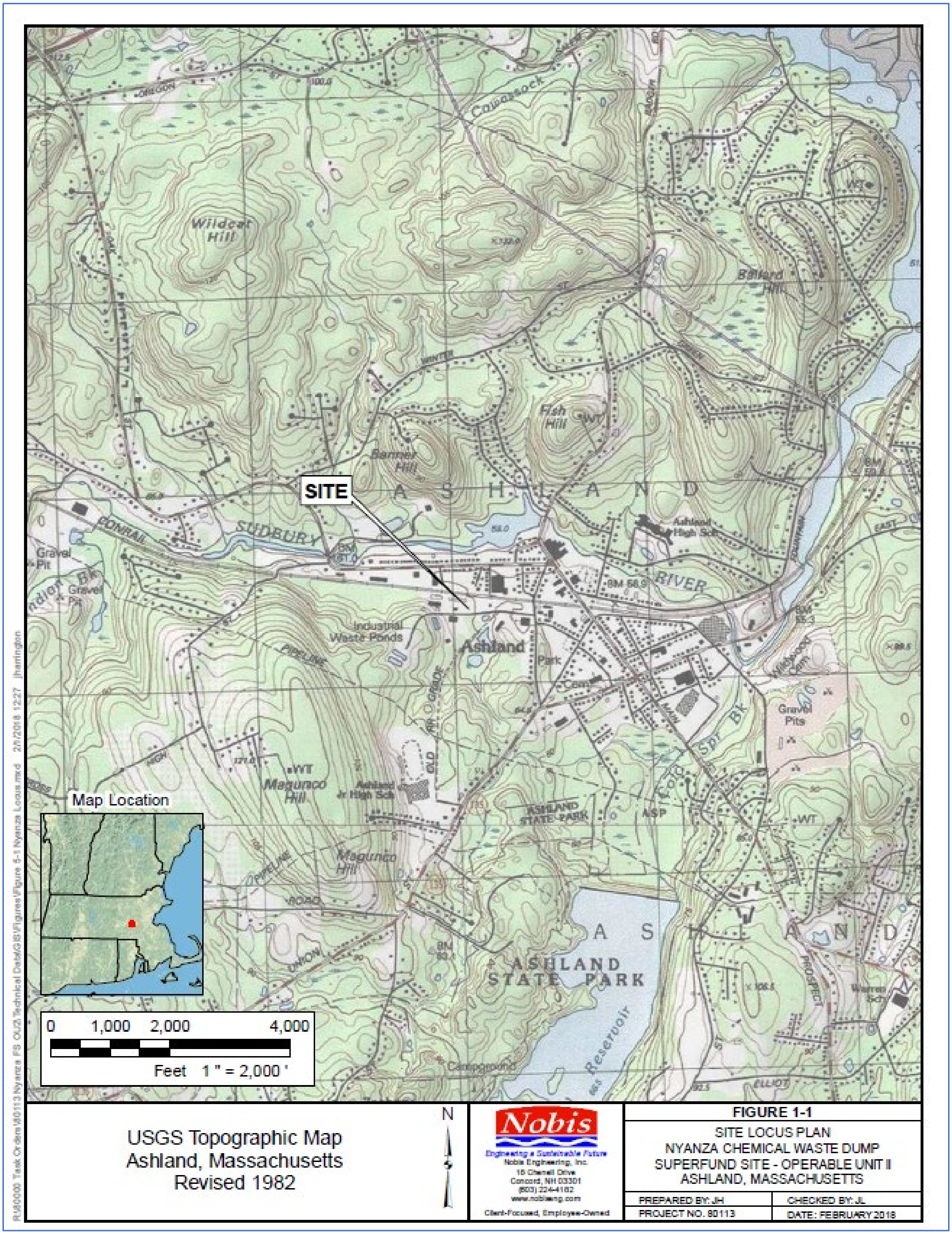


Figure 2 – Site Plan

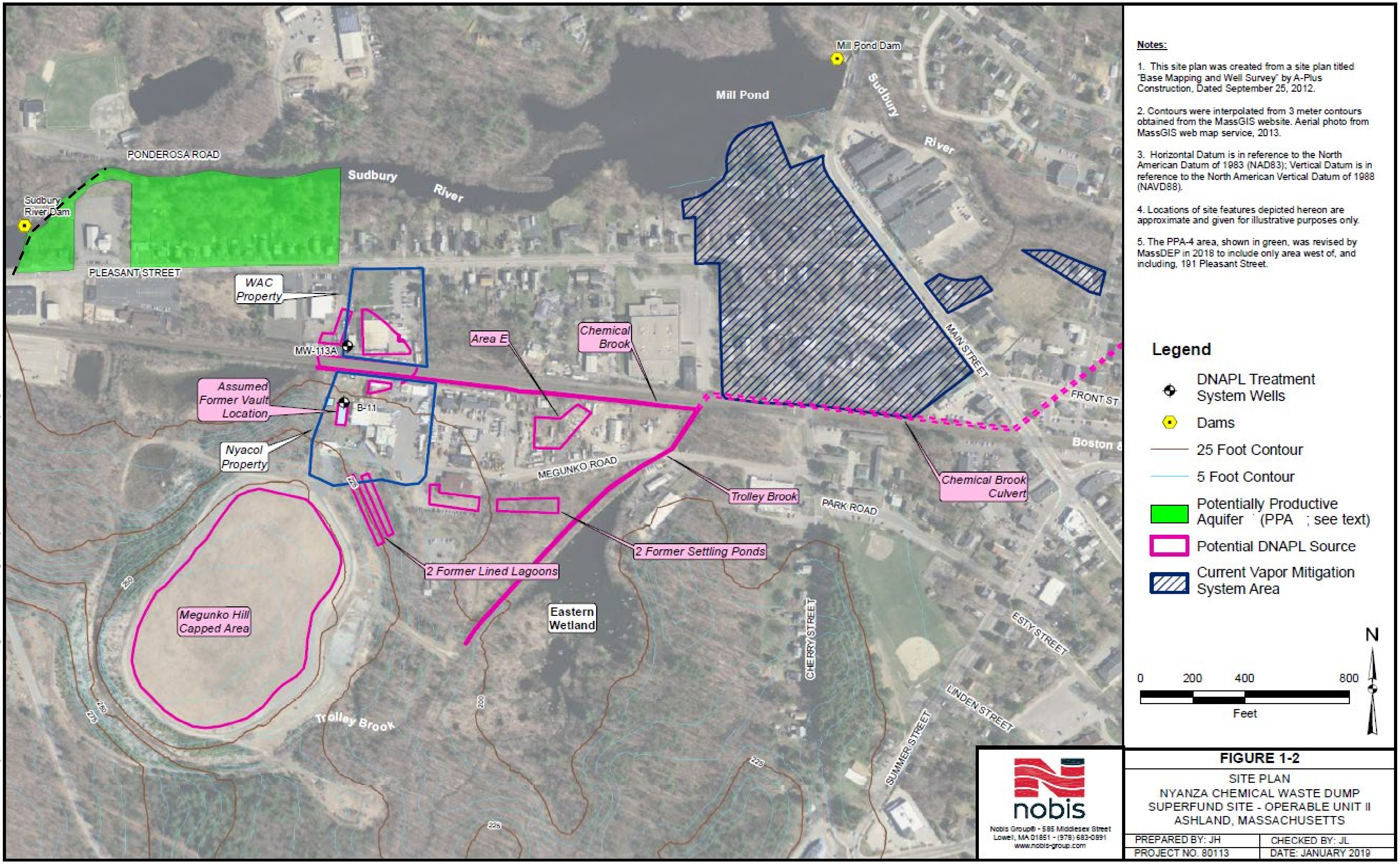


Figure 3 – Wetlands and Floodplains near the Site

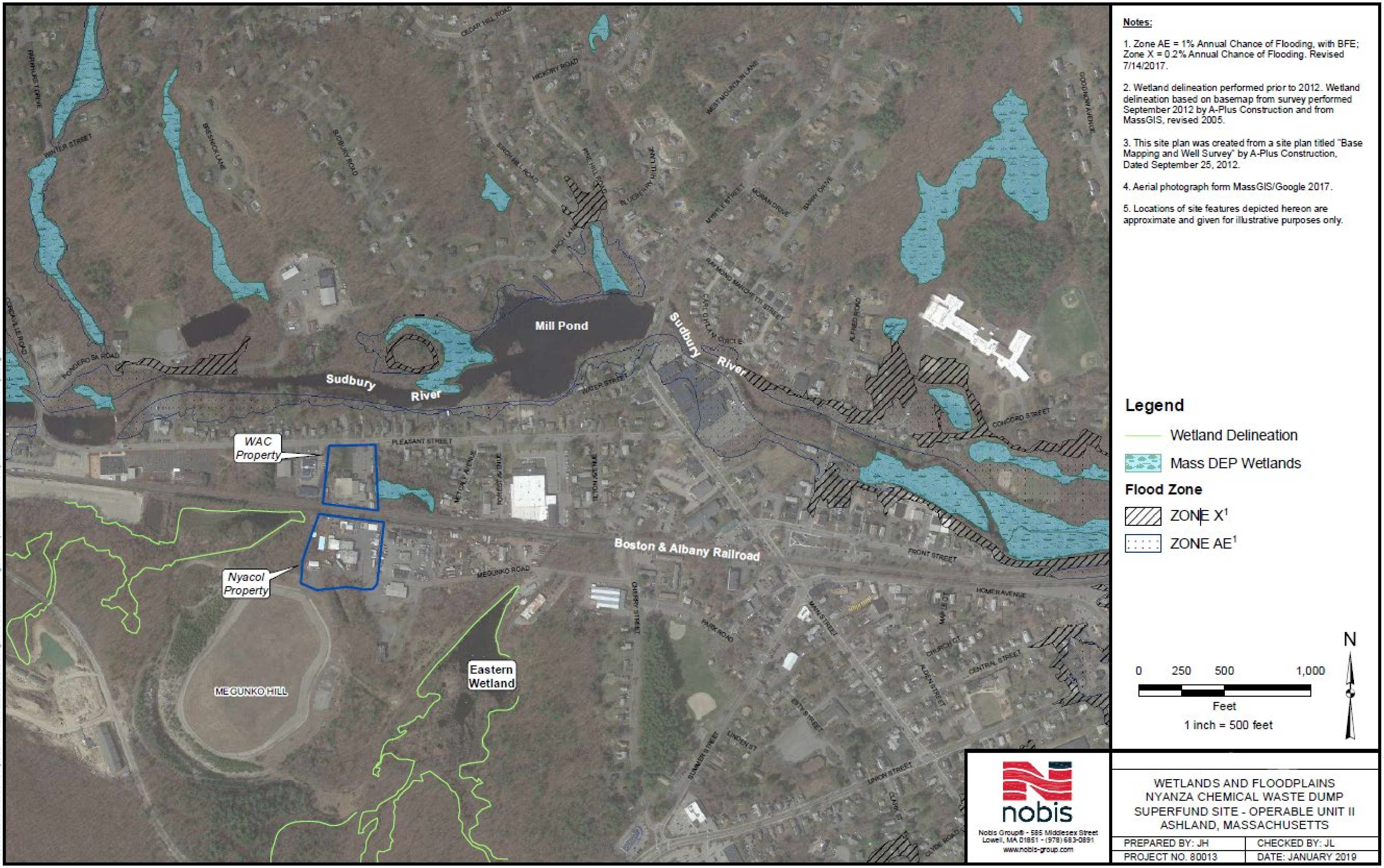


Figure 4 – Nyanza OU2 Areas of Concern

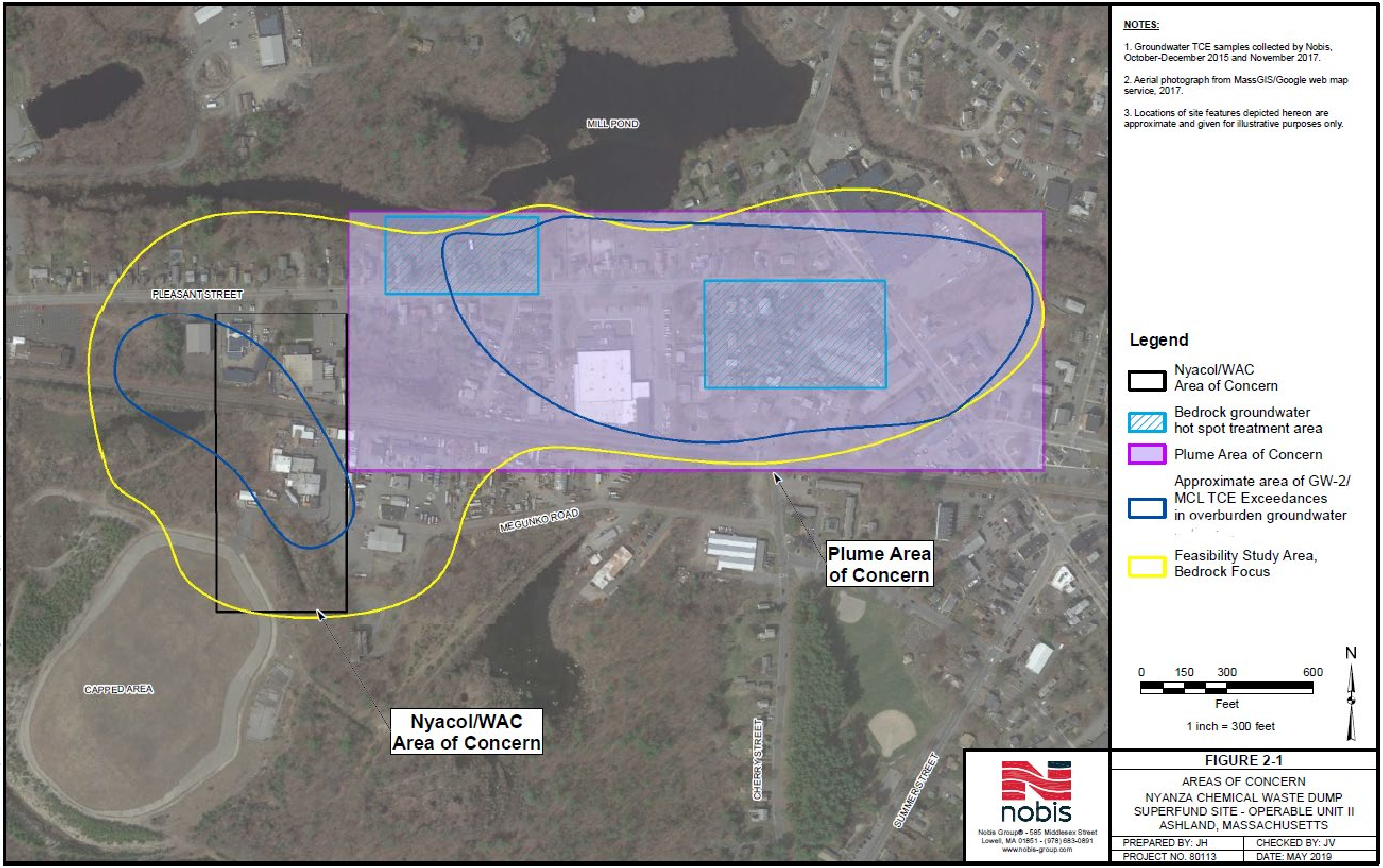
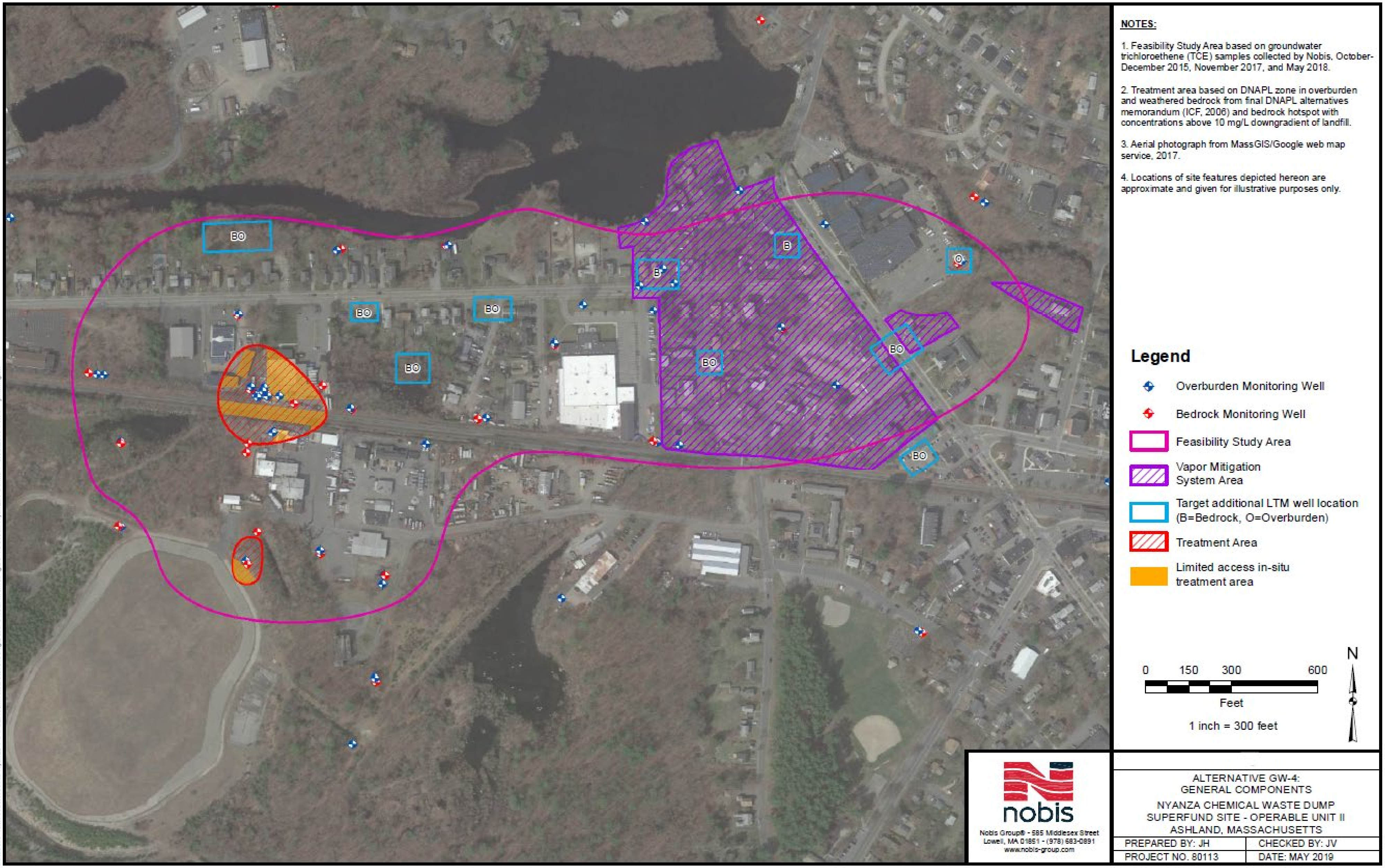


Figure 5 – Remedial Components of Proposed Alternative GW-4



Note: The scope and geographic coverage of the Remedial Action components are contingent on the results of the PDI.

Figure 6 – Proposed Alternative GW-4: Phased Implementation Approach

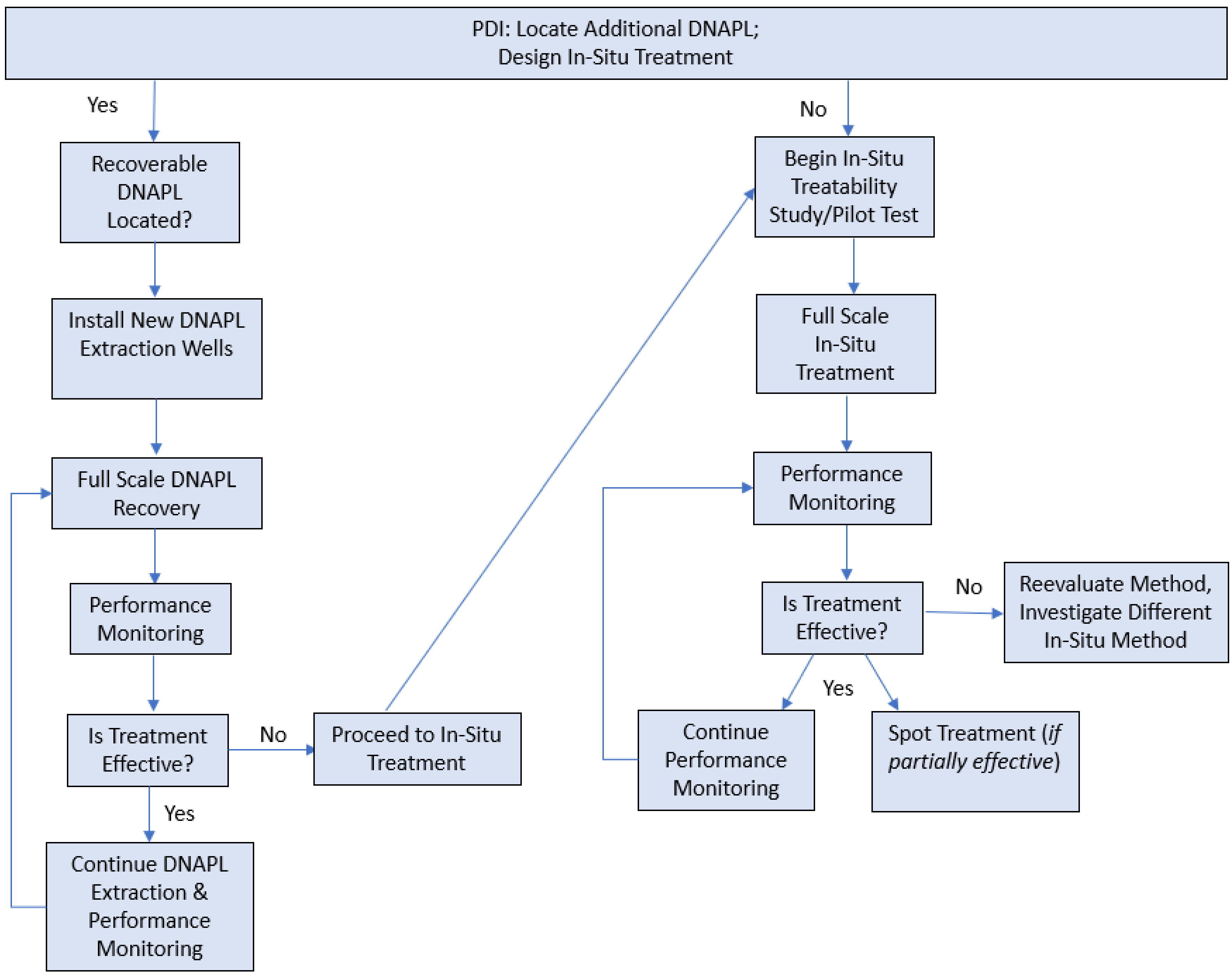


Figure 7 –Overburden Aquifer Groundwater – TCE Results

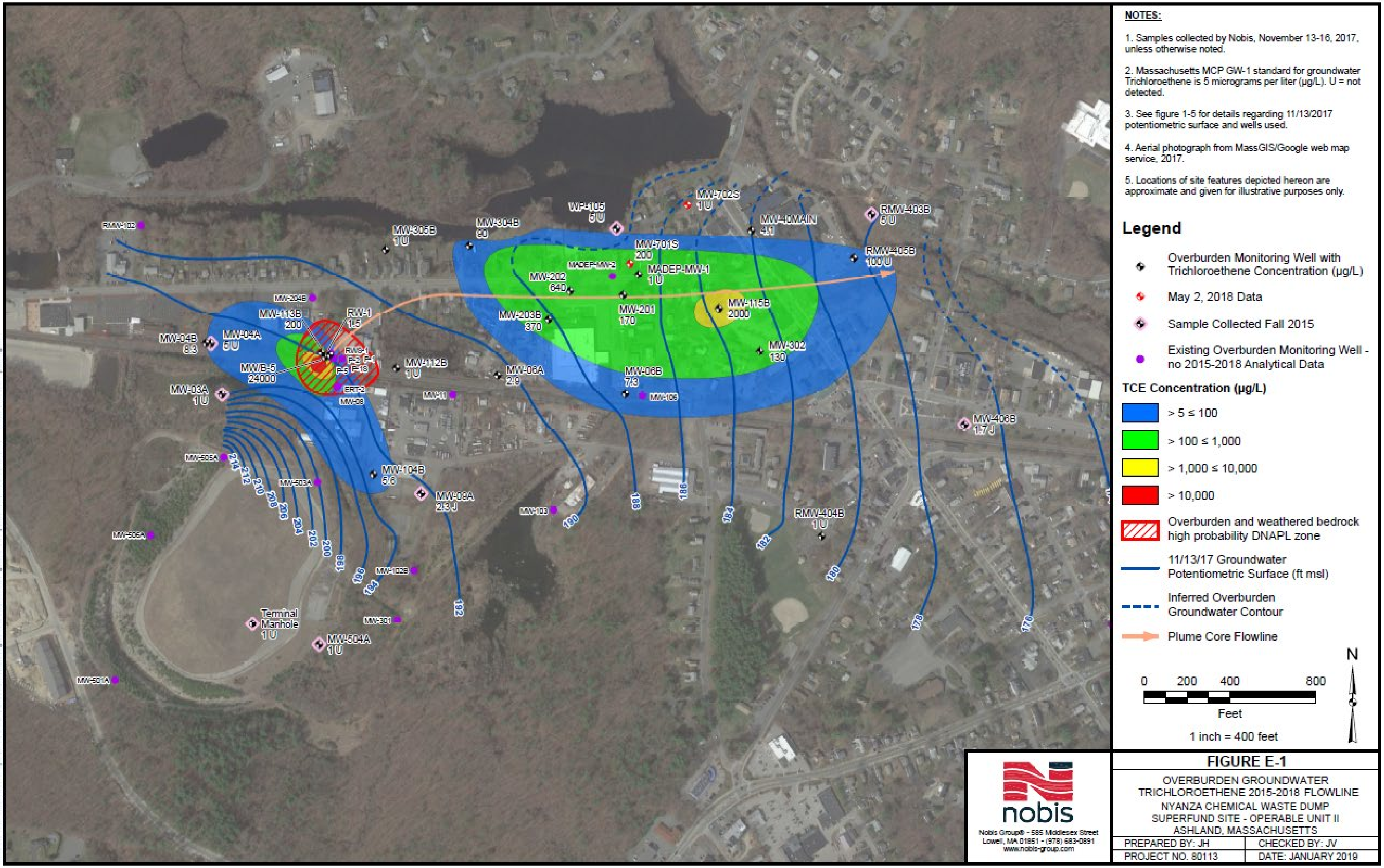
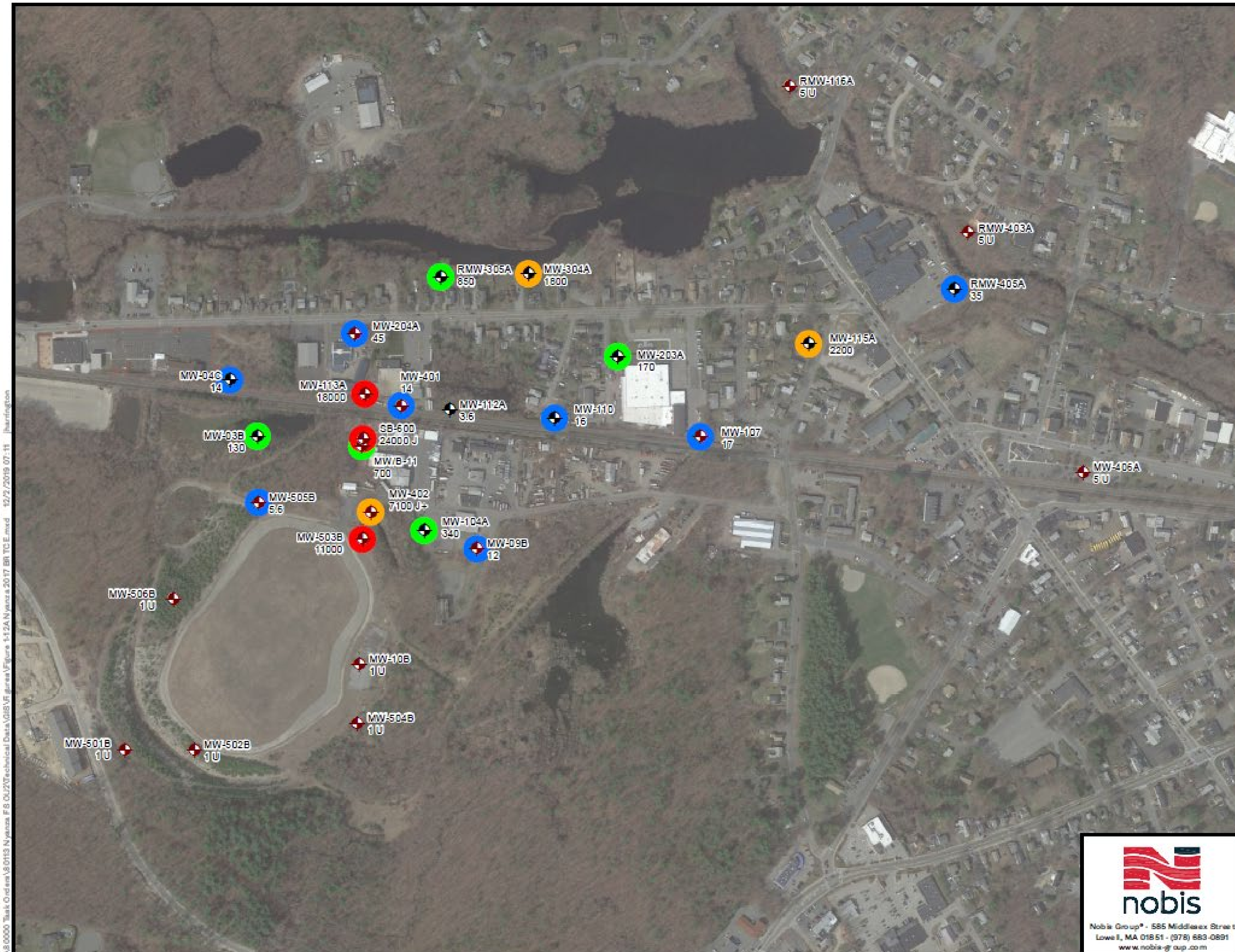


Figure 8 –Bedrock Aquifer Groundwater – TCE Results



NOTES:

1. Samples collected by Nobis, November 13-16, 2017, unless otherwise noted.
2. Massachusetts MCP GW-2 standard for groundwater Trichloroethene is 5 micrograms per liter (µg/L), selected to illustrate extent of groundwater contamination. 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

- Bedrock Monitoring Well with Trichloroethene Concentration (µg/L)
- Sample Collected Fall 2015
- > 5 ≤ 100
- > 100 ≤ 1,000
- > 1,000 ≤ 10,000
- > 10,000

0 200 400 800
Feet
1 inch = 400 feet
N

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FIGURE 1-12B
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

F:\80000 Task Orders\80113 Nyanza FS OU2\Technical Data\GIS\Figures\Figure 1-12A Nyanza 2017 BR TCE.mxd 12/2/2019 07:11 jharrington