U. S. EPA Superfund Program

Proposed Plan for Record of Decision, Operable Unit 3 (OU-3)

Hidden Lane Landfill Superfund Site
Sterling, Loudoun County, Virginia

EPA ANNOUNCES PROPOSED PLAN **April 2021**

A. INTRODUCTION

The United States Environmental Protection Agency (EPA) is issuing this Proposed Remedial Action Plan (Proposed Plan) to present the Agency's Preferred Alternative for a remedial action at the Hidden Lane Landfill Superfund Site in Sterling, Loudoun County, Virginia (Site). For administrative purposes, the Site has been separated into three Operable Units (OUs). OU-1 addresses the Site-wide groundwater contamination, OU-2 addresses the exposure of the public to Site-related contaminants in groundwater in residential drinking water wells and OU-3 addresses the landfill cap and the source of Site groundwater contamination. This Proposed Plan presents the rationale for proposing the Preferred Alternative and includes a summary of alternatives evaluated to address OU-3. In 2019, EPA selected a remedial action in a Record of Decision (ROD) for OU-2. The restoration of Site-wide contaminated groundwater will be addressed in a future ROD for OU-1, which EPA expects to be the final remedial action for the Site.

Dates to Remember

April 12 – May 12, 2021 Public Comment Period on EPA's Proposed Plan

Pre-recorded meeting available: April 12, 2021 here: https://www.epa.gov/superfund/hiddenlane

Question & Answer Session:
Wednesday April 21, 2021 from 6:00-7:00pm
Call 484-352-3221
Conference ID: 722-199-998#

EPA is the lead agency for Site activities, and the Virginia Department of Environmental Quality (VDEQ) is the support agency. EPA, in consultation with VDEQ, will select a remedial action for OU-3 after reviewing and considering all information submitted during the 30-day public comment period held between April 12, 2021 and May 12, 2021.
The public is encouraged to review the Proposed Plan and submit comments to EPA from April 12, 2021 and May 12, 2021. Comments may be submitted any one of three ways. All comments received will be treated equally.

- **Mail (postmarked no later than 05/12/2021):** U.S. EPA Region 3 Attn: Chris Vallone 1650 Arch Street (Mail code: 3SD23) Philadelphia, PA 19103

- **E-mail:** vallone.christopher@epa.gov

- **Voicemail:** Call 215-814-2007 to leave a message. Please speak slowly and clearly and include your name and phone number.

For the purposes of this Proposed Plan, the landfill at the Site is designated as a Waste Management Area (WMA). The contaminated source material located in overburden soils, bedrock and groundwater at the southern entrance of the landfill and under the landfill has been designated by EPA as a principal threat because the source material would pose a significant risk to human health or the environment should exposure occur. Various cleanup technologies were evaluated by EPA to treat the principal threat source material, located in overburden soils, bedrock and groundwater. The most promising technologies to treat the principal threat source material are summarized in Table 1, below.

Table 1: Remedial Technologies to Treat Principal Threat Source Material

Name of Technology	Brief Explanation	Applicability
Excavation and Disposal	Excavation of contaminated soil with onsite or offsite disposal.	Permanently removes principal threat source material.
Groundwater Extraction and Treatment with Cosolvent/Surfactant Flushing and Recirculation	Pumps groundwater and treats it using conventional technology and discharges it back to groundwater upgradient of the source area.	Permanently removes and treats all contaminants of concern in groundwater at the Site.
In Situ Bioremediation and Chemical Reduction	Injection of amendments, such as zero valent iron, and carbon into the subsurface, to promote *in situ* anaerobic biotic/abiotic treatment and chemical reduction of contaminants.	Passively treats the contaminants of concern in place.
In Situ Chemical Oxidation (ISCO)	Strong chemical oxidizers are injected or mixed into soil and/or groundwater to destroy contaminants in place.	Treats contaminants of concern in place. Multiple injections may be required because oxidizers are consumed relatively quickly during treatment.
In Situ Thermal Treatment	Heats subsurface to boiling points of volatile contaminants and extracts the vapors.	Rapidly and permanently remove and treat all contaminants of concern at the Site.

Ten (10) different remedial alternatives were developed to treat the principal threat source material in the overburden and/or bedrock and address the WMA. These alternatives were evaluated in the Site 2020 Feasibility Study (FS); a summary of the evaluation is presented in this Proposed Plan. EPA, in consultation with VDEQ, evaluated the following alternatives to address the WMA and the principal threat source material in overburden and/or bedrock at the Site:

- Alternative 1 – No Action.
- Alternative 2 – Landfill Cap Repair and Maintenance with Land Use Controls (LUCS).
- Alternative 3A – Principal Threat Source Area Overburden Excavation and Offsite Disposal.
- Alternative 3B – Principal Threat Source Area Overburden Excavation and Soil Treatment with Onsite Disposal.
- Alternative 4 – Principal Threat Source Area Bedrock Groundwater Extraction and Treatment with Cosolvent/Surfactant Flushing and Recirculation.
- Alternative 5A – *In Situ* Bioremediation and Chemical Reduction of Principal Threat Source Area Material in Overburden and Bedrock.
- Alternative 5B – *In Situ* Bioremediation and Chemical Reduction of Principal Threat Source Material in Bedrock.
- Alternative 6A - *In Situ* Chemical Oxidation of Principal Threat Source Material in Overburden and Bedrock.
- Alternative 6B - *In Situ* Chemical Oxidation of Principal Threat Source Material in Bedrock.
- Alternative 7 - *In Situ* Thermal Treatment/*Ex Situ* Treatment of Extracted Vapor for Principal Threat Source Material in Overburden and Bedrock.

Based on the available information, the Preferred Alternative proposed for public comment is a combination of three alternatives above (2, 3A & 5B) to address the WMA, principal threat source material in overburden and principal threat source material in bedrock.

EPA, in consultation with VDEQ, may modify the Preferred Alternatives presented in this Proposed Plan or select another remedial action based on new information and/or public comments. Therefore, the public is encouraged to review and comment on all alternatives presented in this Proposed Plan for the remedial action at OU-3. The public comment period will run from April 12, 2021 and May 12, 2021. After the close of the public comment period and consideration of any comments received, EPA will document selection of the remedial action in a ROD for OU-3. The public's comments and EPA's responses will be documented in the Responsiveness Summary section of the ROD.

EPA is issuing this Proposed Plan as part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), 42 U.S.C. § 9617(a), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) at 40 C.F.R. § 300.430(f)(3).

This Proposed Plan highlights key information that can be found in greater detail in the 2020 FS for OU-3 and other documents contained in the Administrative Record file. The Administrative Record contains all the documents considered or relied upon in the selection of the Preferred Alternatives for this remedial action. EPA and VDEQ encourage the public to review these documents to gain a more comprehensive understanding of the Site and the Superfund activities that have been conducted at the Site.

The administrative record file for this action can be accessed via the internet at www.epa.gov/superfund/hiddenlane or at the following locations:

Cascades Library
21030 Whitefield Place
Potomac Falls, VA 20165
Hours: Call (703) 444-3228
http://library.loudoun.gov

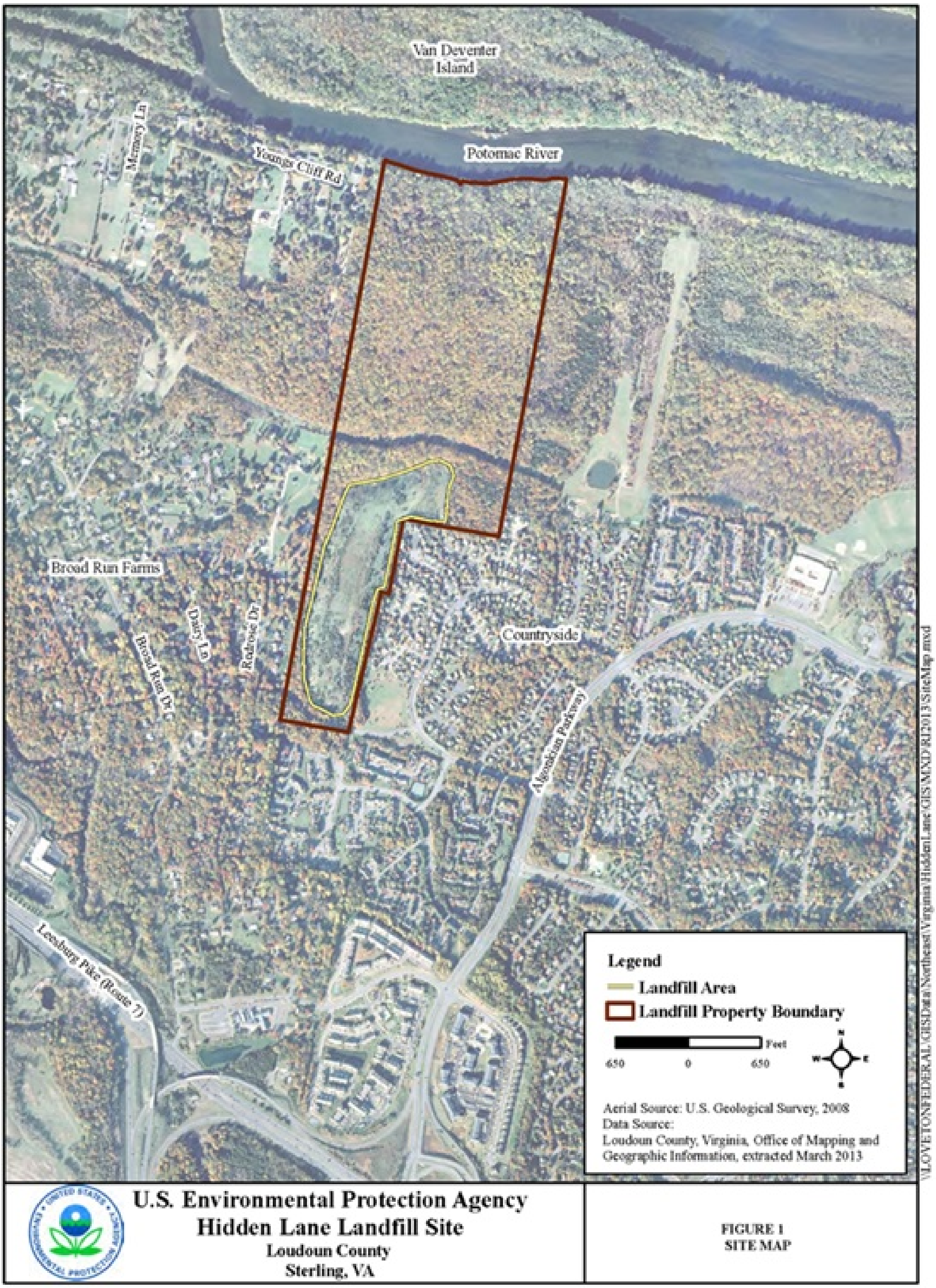
EPA Administrative Records Room
Attn: Administrative Records Coordinator
1650 Arch Street
Philadelphia, PA 19103
Phone: (215) 814-3157
Hours: Monday-Friday 8:30 am to 4:30 pm
By appointment only

B. SITE BACKGROUND

Site Location and Description

The Site was a privately owned and operated landfill situated north of Virginia Route 7 between the communities of Broad Run Farms, to the west, and Countryside, to the east, in Sterling, Loudoun County, Virginia (See Figure 1 below). The landfill is approximately 40 acres in size and is adjacent to the flood plain of the Potomac River. Starting in 1971, the facility accepted a variety of solid wastes including construction and demolition wastes. The landfill was closed in 1986 by order of the Commonwealth of Virginia, pursuant to a 1983 Loudoun Circuit Court Order. As part of the close-out procedures, the landfill was covered with a two-foot clay cap. The Site is currently not in use and the landfill is covered in grass and trees. Access to the Site is unrestricted, except for a locked gate at the Site's road entrance.

Figure 1: Site Map



Previous Environmental Investigations and Actions

EPA conducted a Preliminary Assessment of the landfill from 1988 to 1989. Trichloroethene (TCE) contamination was detected in two drinking water wells in the Broad Run Farms community, west of the landfill. No TCE was detected in the three landfill monitoring wells located downgradient of the landfill, landfill seeps, soils or surface water. Based on the information available at the time and the limited scientific understanding of bedrock aquifers, the TCE in drinking water wells was not attributed to the landfill at that time. No further action under CERCLA was recommended.

Over the next 16 years, TCE was found in five new wells installed in the Broad Run Farms community. In March 2005, 67 drinking water wells in the Broad Run Farms community were sampled for TCE by the Loudoun County Health Department. Based on the sampling results, VDEQ installed Point-of-Entry Treatment Systems (POETS) in 22 affected residences to remove the TCE before the well water was distributed in the home plumbing. Three additional residences were provided POETS during the VDEQ period of system maintenance.

EPA reopened its evaluation of the Site in October 2005. A Site Assessment was completed in 2007, which resulted in the Site being proposed to EPA's National Priorities List of contaminated sites (NPL) on September 19, 2007. The Site was listed on the NPL on March 19, 2008. Maintenance of the 25 residential POETS was transferred from VDEQ to EPA in June 2008. EPA installed additional POETS at residences where Site contaminants were found to pose a risk or potential risk to human health during the remedial investigation (RI). Currently, EPA maintains 37 residential POETS.

RI activities began in early 2009. The investigation included sampling and analysis of groundwater, surface water, and sediments, as well as landfill gases including methane associated with the landfill. An evaluation of the potential for the migration of Site-related vapors into private homes was also conducted. The RI concluded that only human exposure to contaminated groundwater posed any unacceptable risk.

In 2016, EPA began work on a FS at the Site to identify alternatives for a remedial action to address the drinking water well contamination and groundwater contamination. Due to uncertainties concerning the potential source of groundwater contamination and the need for further investigation, EPA and VDEQ in the summer of 2017 decided to propose a permanent remedy for the domestic drinking water wells affected by TCE in groundwater as a separate interim remedial action. In 2019, EPA developed a ROD for OU-2 which addresses exposure to TCE in residential drinking water wells at concentrations exceeding or potentially exceeding the Federal Safe Drinking Water Act Maximum Contaminant Level (MCL) of 5 micrograms per liter (µg/L). The OU-2 remedy consists of extending an existing public waterline into the area of the Broad Run Farms development affected or potentially affected by the Site. Figure 2, below, from the 2019 ROD, shows TCE concentrations in groundwater at the Site.

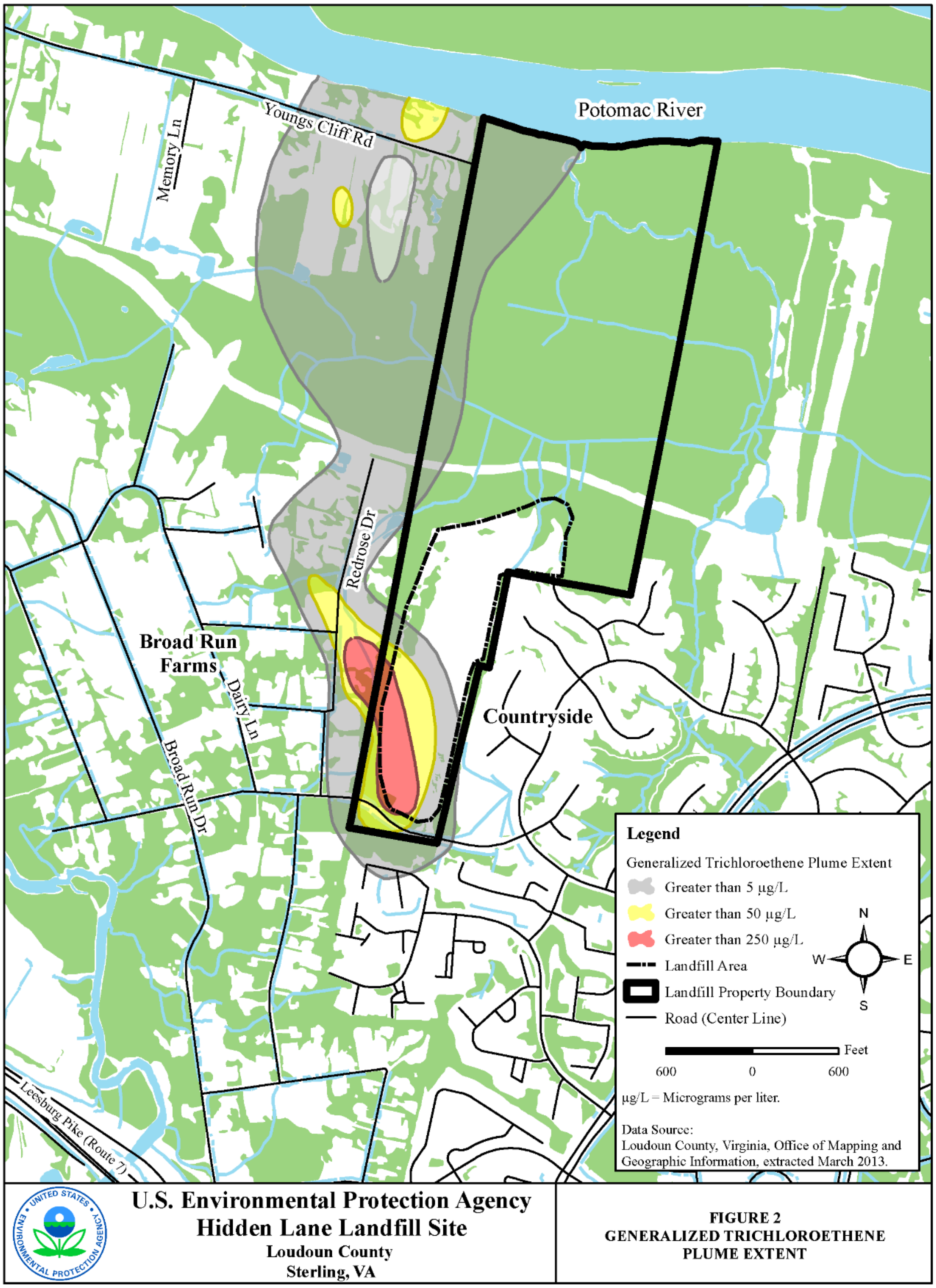
Also in 2019, EPA finalized a Supplemental RI with the objectives of locating the TCE source area within the landfill footprint, characterizing the magnitude and extent of the source area contamination, and generating data to identify transport mechanisms associated with the migration of TCE from the source area into the bedrock aquifer. In 2020, EPA developed a FS to identify and evaluate potential actions to address the WMA and the principal threat source material in overburden soils and groundwater and bedrock.

Cultural Investigations and National Historic Preservation Act Consultation

In 2020 EPA began consultation under the National Historic Preservation Act of 1966 (NHPA), 54 U.S.C. § 300101 *et seq*., with a number of interested parties, including several Federally Recognized Tribes. In addition, also in 2020, EPA undertook government-to-government consultation with the Federally Recognized Tribes, consistent with EPA policy [1]. Currently, EPA is performing investigations at the Site to determine the archeological significance at OU-2. After EPA selects a remedy for OU-3 in a ROD, a supplemental investigation will be conducted at the Site to determine the archeological significance at OU-3.

[1] Government-to-government consultation provides the opportunity for Federally Recognized Tribes associated with the Site to provide meaningful input in the selection of a remedy. This consultation is described in "EPA Policy on Consultation and Coordination with Indian Tribes" (May 4, 2011) (https://www.epa.gov/sites/production/files/2013-08/documents/cons-and-coord-with-indian-tribes-policy.pdf).

Figure 2: Generalized TCE Plume Extent



C. SITE CHARACTERISTICS

The Site is located in a residential area of Sterling, Loudoun County, Virginia. Residential developments are present to the immediate east, west, and south of the Site. The Site occupies approximately 40 acres of 150 acres of undeveloped property. The property extends from the Potomac River south approximately 5,000 feet to Persimmon Road and separates the Broad Run Farms development from the Countryside development. The landfill is approximately 50 feet high, 400 feet wide, and 2,000 feet long. The area north of the landfill is undeveloped woodland bounded by the Potomac River.

Topographically, the Site lies within the Triassic Lowlands, a subdivision of the Piedmont Physiographic Province. Apart from the landfill itself, the topography of the Site consists of a series of fluvial terraces and the 100-year floodplain of the Potomac River. The floodplain of the Potomac River extends from the river southward approximately 2,000 feet to near the northern extent of the landfill. Most of this area is designated wooded wetland. The elevation of the Site changes from approximately 240 feet (ft.) above mean sea level (MSL) in the southern portion of the Site to approximately 200 ft. MSL near the Potomac River. The top of the landfill itself is approximately 276 ft. MSL.

Geology

The Site lies within the Culpeper Basin, the largest of the Mesozoic age rift basins in Virginia. These early Mesozoic basins were formed during downfaulting associated with the continental breakup of Pangaea and are filled with mostly sedimentary rocks. The Culpeper Basin is bound to the west by east-dipping normal faults. The basin shallows to the east, unconformably overlying rocks of the Potomac Terrane, and is bounded locally by an antithetic west-dipping normal fault.

Two major geologic units are found at the Site: unconsolidated alluvium and terrace deposits, and bedrock. Based on the Geologic Map of Loudoun County, Virginia, overburden on the southern portion of the Site consists of terrace deposits while overburden in the northern portion consists of alluvium. Observations made during the RI field activities determined that the alluvium and terrace deposits near the Site are approximately 7 to 37 ft. thick. Weathered bedrock (saprolite), ranging from 3 to 5 ft. in thickness, separate the alluvium deposits from the underlying bedrock. The bedrock encountered beneath the Site consists of the ancient river (fluvial) and lake (lacustrine) deposits of the Balls Bluff Siltstone. Depth to bedrock ranges from approximately 16 ft. to 37 ft. below ground surface (bgs). The Balls Bluff Siltstone is estimated to be approximately 4,000 ft. thick near the Site. The fluvial member is a red-brown silty sandstone interbedded with clay and sandy siltstone layers. In contrast, the lacustrine member consists of thin-bedded silty and sandy shale interbedded with clay and sandy siltstone. Siltstone is the predominant rock type encountered near the Site.

Landfill

The landfill at the Site is mounded (50 ft. in height) relative to surrounding grades, is steeply sloping, and has a relatively flat, but irregular topographic top surface. The landfill boundaries were surveyed as part of the 2020 FS. The landfill is designated as a WMA. A WMA is defined in the NCP for the purpose of addressing contamination to the groundwater point of compliance. The area of attainment of compliance for groundwater cleanup levels is generally expected to be throughout the plume at the edge of the WMA.

In 1986, the landfill was closed by the Commonwealth of Virginia pursuant to a 1983 Loudoun Circuit Court Order. As part of the close-out procedures, the landfill was covered with a two-foot clay cap. Virginia Department of Health (VDH) Bureau of Solid Waste provided oversight of the implementation of the order utilizing the Commonwealth of Virginia's regulations that were applicable at the time. The VDH Site Inspection report noted that the landfill cap appeared to be well constructed with no erosion or leachate problems. During the RI, the landfill cap was inspected and found the cap consisted primarily of clay and/or silt.

The landfill cap limits infiltration of rainwater into the landfill and isolates any unknown contaminant sources in the landfill, preventing additional groundwater contamination. The cap has not been maintained since 1997. There are currently no maintenance plans or LUCs in place to protect the landfill cap or limit exposure to potential contaminants in the landfill.

Groundwater

Groundwater elevation data collected from overburden and bedrock monitoring wells at the Site indicate the presence of a multi-aquifer system. The two-aquifer units are the overburden and bedrock aquifers. The overburden aquifer consists of the soil and saprolite overlying the bedrock. Near the landfill, shallow groundwater is present in the overburden and appears to be temporary during times of precipitation. Closer to the Potomac River, groundwater in the overburden is more widespread and persistent. This is evidenced by the presence of a wooded wetland north of the landfill. The direction of groundwater flow within the overburden aquifer is from areas of higher upland elevation north toward lowland elevation near the Potomac River.

The bedrock aquifer is separated from the overburden aquifer by a clay layer at the base of the overburden. The upper 20 ft. of bedrock near the landfill is not saturated with groundwater. The thickness of unsaturated bedrock decreases north toward the Potomac River. Groundwater flow within the bedrock is restricted to secondary openings, known as joints and fractures. Like the overburden aquifer, the preferred direction of groundwater flow in the bedrock aquifer is north toward the river. However, the specific pathway is controlled by the orientation and degree of connection of bedrock fractures. This results in a north/northwest direction of groundwater flow in the bedrock aquifer. Residences in the Broad Run Farms development obtain their drinking water from the bedrock aquifer.

Source Area Overburden

The 2019 Supplemental RI located a TCE source area on the southern end of the landfill where source material is present in the unsaturated and saturated overburden (approximately 8-35 ft. bgs) and bedrock aquifer matrix. See Figure 3 below for detailed view of the TCE plume and approximate source area extent. The sampling results from the 2019 Supplemental RI suggest overburden soil beneath the landfill and at the landfill-bedrock interface are impacted with TCE and TCE degradation products, 1,1-dichloroethene (1,1-DCE), *cis*-1,2-dichloroethene (DCE) and vinyl chloride.

The dimensions of overburden source area are approximately 100 ft. by 50 ft. TCE concentrations exceeding EPA's Soil Screening Levels (SSL) of 0.0012 milligrams per kilogram (mg/kg) were detected in the source area soils in the following overburden layers:

- 8 – 20 ft. bgs - layer of wood debris,
- 20 – 30 ft. bgs – layer of saturated clay, and
- 30 – 35 ft. bgs – saprolite to bedrock interface.

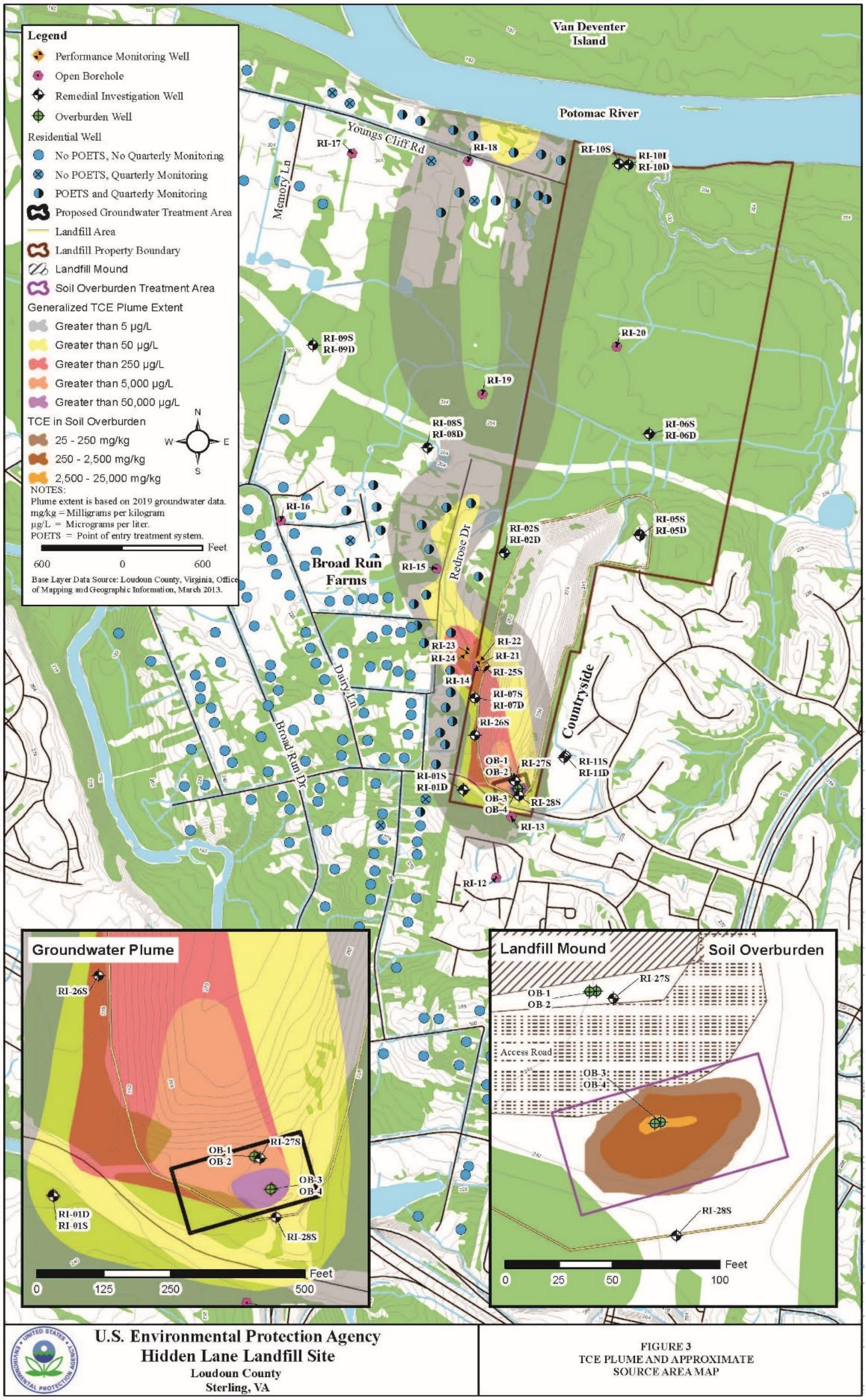
Waste characterization soil sample results in the overburden source area indicate that TCE and its breakdown products are present at concentrations greater than EPA's SSL. Overall, most of the contaminant mass in the overburden is located within the clay layer and TCE concentrations generally increase with depth down to the bedrock surface. The highest TCE concentration detected in soil was reported at approximately 25,000 mg/kg in the clay layer near the bedrock interface.

The source area material located within the footprint of the landfill WMA is considered a principal threat. Principal threat material includes saturated and unsaturated overburden and bedrock material because TCE is being released from the overburden source material into groundwater, where it creates a dissolved-phase plume that flows through the bedrock fractures. The high concentrations present within the overburden clay represent a long-term source of groundwater contamination. This source of contamination is expected to persist in groundwater until the source material is addressed.

WHAT IS A "PRINCIPAL THREAT"?

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300 430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air or acts as a source for direct exposure. Contaminated groundwater generally is not considered to be a source material, however, Non-Aqueous Phase Liquids (NAPLs) in groundwater may be viewed as source material. Principal threat wastes are those 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. The decision to treat these wastes is made on a site-specific basis through a detailed analysis of the alternatives using the nine remedy selection criteria. This analysis provides a basis for making a statutory finding that the remedy employs treatment as a principal element.

Figure 3: TCE Plume and Approximate Source Area Map



Source Area Bedrock

Sampling from the 2019 Supplemental RI detected TCE in bedrock groundwater at concentrations up to 120,000 µg/L, which exceeds EPA's MCL of 5 µg/L. See Table 2 below for a summary of groundwater concentrations in the source area. The highest concentrations detected were at depths between 25 and 71 ft. bgs. TCE contamination appears to extend vertically to the depth of bedrock and may spread out laterally on the bedrock surface. Findings also indicate that a preferential pathway exists in this region for groundwater impacts between the saprolite and fractured bedrock. See Figure 4 and Figure 4A below for a cross-section depiction of the TCE plume in groundwater at the Site.

It can be inferred that pure TCE product may have originally been present as a dense non-aqueous phase liquid (DNAPL) in the source area. This DNAPL would have been present both near and below the overburden-bedrock interface, where TCE concentrations exceed 100,000 µg/L. Given the time since the landfill operations have occurred, it is likely that released TCE has dissolved and diffused into the low permeability, high porosity clays and into the bedrock matrix through the process of matrix diffusion. No pure TCE product has been detected during the investigations.

Dissolved-phase groundwater contaminant migration from the source area is controlled by a network of secondary geologic features such as fractures and bedding planes. Dissolved-phase TCE has migrated from the source area downward into the fractures of the Balls Bluff Siltstone to depths of approximately 460 ft. bgs. The dissolved-phase TCE plume extends approximately 4,000 ft downgradient of the landfill (to the Potomac River). Based on the monitoring well and residential well data, the TCE plume appears to be in a steady-state condition. Vertical flow paths with downward gradients along fractures intersect the zone of highest concentrations detected at the Site, while upward gradients are more prevalent in wells located nearer to the Potomac River. The data collected indicates no evidence that contaminated groundwater is adversely impacting surface water or sediment quality in nearby water bodies.

Table 2: Groundwater Concentrations in Source Area Contamination – Supplemental RI

Analyte	MCL (µg/L)	Minimum Detect (µg/L)	Maximum Detect (µg/L)	Number of Detects [a]	Number of Exceedances
1,1,1-trichloroethane	200	0.4	24,000	14	7
1,1,2-trichloroethane	5	0.27	170	5	4
1,1-dichloroethene	7	0.64	6,700	13	8
1,2-dichloroethane	5	86	230	3	3
Benzene	5	110	110	1	1
cis-1,2-dichloroethene	70	0.63	33,000	14	7
Methylene chloride	5	0.18	23,000	13	7
TCE	5	6.5	120,000	14	14
Vinyl chloride	2	0.43	4,900	5	4

a. Out of a total of 14 samples, 12 samples and 2 duplicates.

Figure 4: Cross-Section of TCE Concentrations in Groundwater

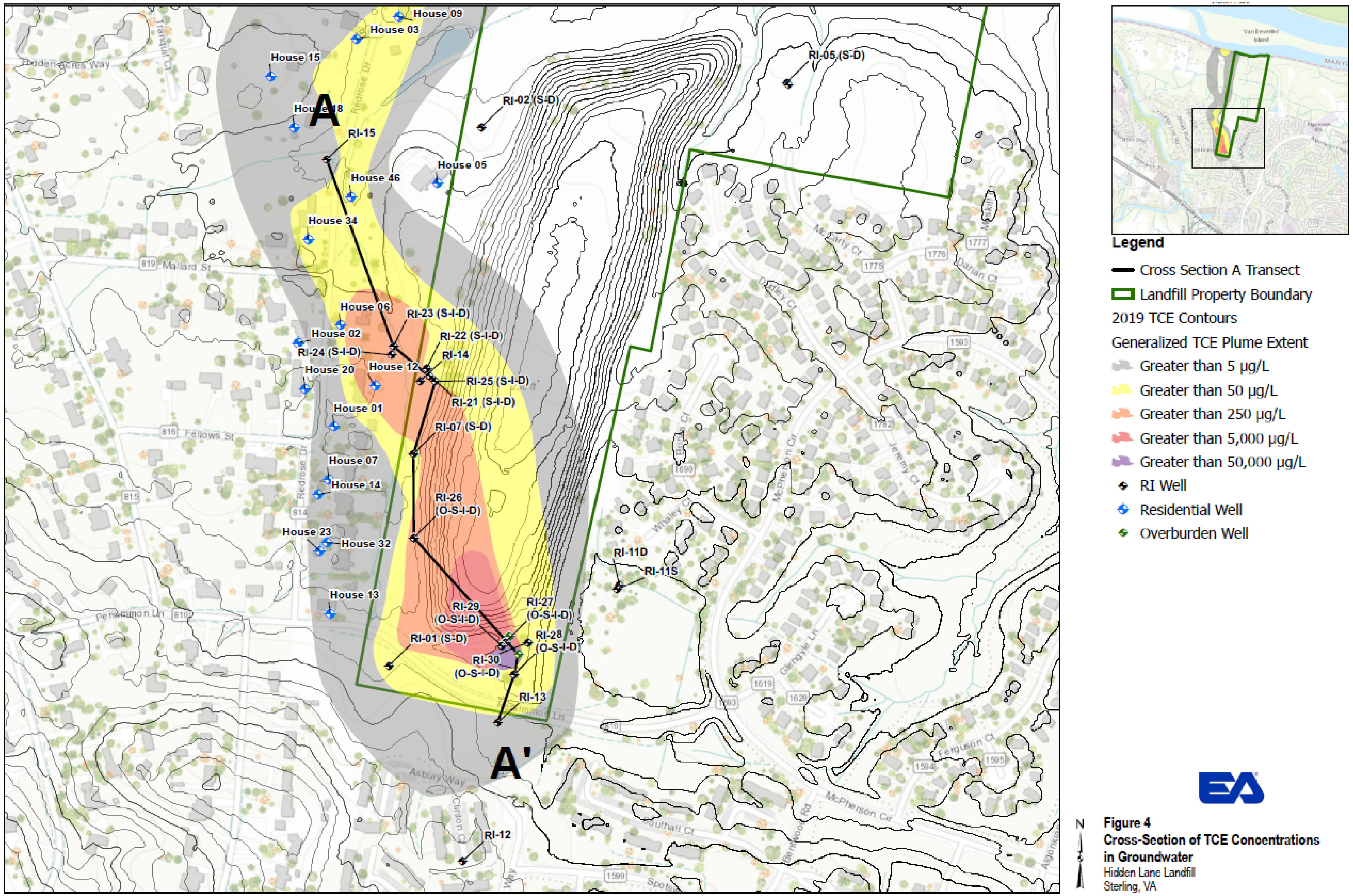
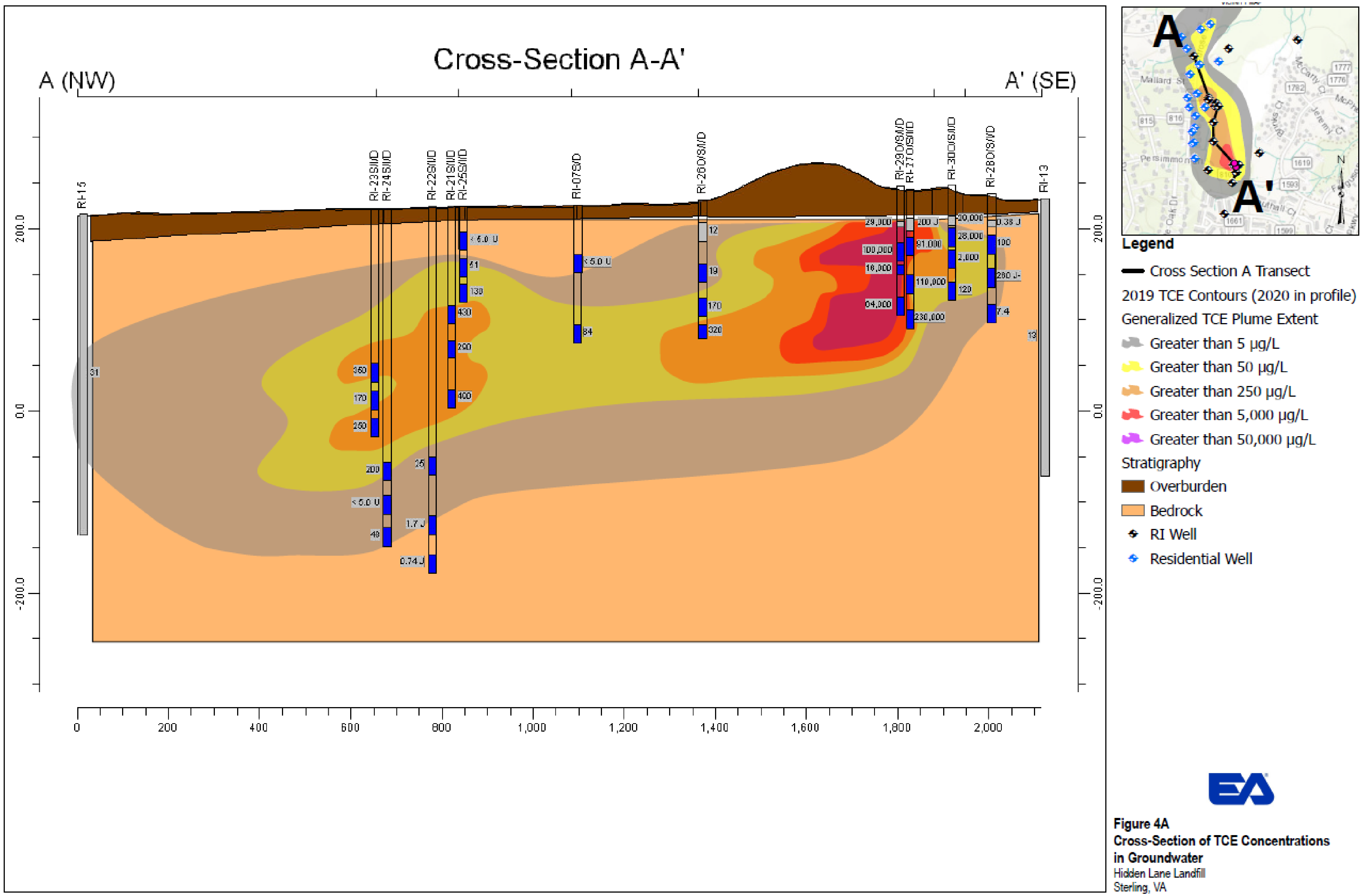


Figure 4A: Cross-Section of TCE Concentrations in Groundwater



D. SCOPE AND ROLE OF RESPONSE ACTION

OU-3, the focus of this Proposed Plan, is the second of three planned OUs for the Site and addresses the landfill cap and source of Site groundwater contamination. In 2019, EPA signed a ROD and is currently conducting remedial action activities at OU-2 to address exposure to TCE and its breakdown products in residential drinking water wells at concentrations exceeding or potentially exceeding MCLs via installation of and connections to a waterline. EPA expects the future ROD for OU-1 will address the final remedial action for the Site and will focus on Site-wide groundwater contamination.

The landfill cap has not been maintained since 1997. There are currently no maintenance plans in place to protect the cap or limit exposure to potential contaminants in the landfill. The Preferred Alternatives presented in this Proposed Plan would provide long-term stewardship of the landfill cap and would address the source of groundwater contamination found at the Site. The Preferred Alternatives would address the principal threat source material in the overburden and bedrock by removal and treatment. It is expected the actions will result in a substantial decrease in TCE concentrations in groundwater under and downgradient of the WMA.

All alternatives were developed to achieve the Remedial Action Objectives (RAOs) at OU-3 of the Site.

E. SUMMARY OF SITE RISKS

WHAT IS HUMAN HEALTH RISK AND HOW IS IT CALCULATED?

A Superfund human health **risk assessment** estimates the "baseline risk." This is an estimate of the likelihood of developing cancer or non-cancer health effects if no cleanup action were taken at a site. To estimate baseline risk at a Superfund site, EPA undertakes a four-step process:

1. Analyze Contamination
2. Estimate Exposure
3. Assess Potential Health Dangers
4. Characterize Site Risk

In Step 1, EPA looks at the concentrations of contaminants found at a site as well as past scientific studies on the effects these contaminants have had on people (or animals, when human studies are unavailable). A comparison between site-specific concentrations and concentrations reported in past studies helps EPA to determine which concentrations are most likely to pose the greatest threat to human health.

In Step 2, EPA considers the different ways that people might be exposed to the contaminants identified in Step 1, the concentrations that people might be exposed to, and the potential frequency and duration of exposure. Using this information, EPA calculates a "reasonable maximum exposure" (RME) scenario, which portrays the highest level of exposure that could reasonably be expected to occur.

In Step 3, EPA uses the information from Step 2 combined with information on the toxicity of each chemical to assess potential health risks. EPA considers two types of risk: cancer and non-cancer risk. The likelihood of any kind of cancer resulting from a Superfund site is generally expressed as an upper bound probability; for example, a "1 in 10,000 chance." In other words, for every 10,000 people that could be exposed, one extra cancer may occur as a result of exposure to site contaminants. An extra cancer case means that one more person could get cancer than would normally be expected to from all other causes. For non-cancer health effects, EPA calculates a "hazard index." The key concept here is that a "threshold level" (measured usually as a hazard index (HI) of less than 1 exists below which non-cancer health effects are no longer predicted.

In Step 4, EPA determines whether site risks are great enough to cause health problems for people at or near the Superfund site. The results of the three previous steps are combined, evaluated and summarized. EPA adds up the potential risks from the individual contaminants and exposure pathways and calculates a total site risk.

Human Health and Ecological Risk Assessments

The environmental data collected from the RI and the Supplemental RI indicate that TCE and TCE degradation products, 1,1-DCE, DCE and vinyl chloride are the primary contaminants of concern (COCs) that pose the greatest potential unacceptable risk to human health at the Site.

The 2015 RI included a Site-wide Human Health Risk Assessment (HHRA) that evaluated risk posed by resident ingestion of and dermal contact with groundwater, surface water, seep water, and sediment, and inhalation of Volatile Organic Compounds (VOCs) while showering. TCE in groundwater was identified as the Site's main COC.

Data used in the HHRA were divided into two exposure areas for evaluation. The Landfill and Adjacent Wells Exposure Area and The Potomac River Exposure Area. Potential concerns for human health exposure to groundwater near the Site in the short-term is being addressed as part of OU-2.

- The Landfill and Adjacent Wells Exposure Area – The HHRA evaluated groundwater data from wells located immediately to the west of the landfill, data from surface water and sediment samples collected adjacent to the landfill, and data from seep water samples. The cumulative carcinogenic risk posed by exposure to groundwater for the resident adult and child was $2x10^{-4}$, which is above the EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

  Both the resident adult and child had exceedances of non-carcinogenic thresholds for groundwater exposure in this area. Exceedance of non-carcinogenic thresholds was due to TCE, cobalt, and manganese. While cobalt and manganese were identified as posing potential non-carcinogenic risks to receptors in the Landfill and Adjacent Wells Exposure Area, the HHRA identified uncertainties with the oral reference doses (RfDs) for both metals that would result in an overestimation of the potential for risks from them. Therefore, the HHRA reached a final conclusion that potential concerns for human health from exposure to groundwater near the Site is due to TCE.

- The Potomac River Exposure Area – The HHRA evaluated groundwater data from wells northwest of the landfill near the Potomac River and data from surface water and sediment samples collected from the Potomac River and a pond east of the landfill. The cumulative carcinogenic risks for the resident adult and child was $1x10^{-4}$ which is equal to the upper end of the EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

  Both the resident adult and child had exceedances of non-carcinogenic thresholds for groundwater exposure in this area. Exceedance of non-carcinogenic thresholds was due to TCE only.

The results of the HHRA indicated that there are no human health concerns for exposure to surface water, sediment, and seep water, regardless of exposure area evaluated. Groundwater was identified as the only medium of concern for human health. Concerns for human health exposure to groundwater near the Site in the short-term is currently being addressed as part of OU-2.

The Supplemental RI included an HHRA that evaluated the risk and hazard to potential construction workers from exposure to subsurface soil and groundwater in the TCE source area in the event that the source area was excavated. The cumulative carcinogenic risk results were $1x10^{-3}$ which is above the EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$. This risk was primarily due to volatilization of TCE into the air from groundwater. Non-carcinogenic thresholds for construction workers were exceeded for exposure to groundwater and soil, also primarily due to volatilization of TCE into the air.

The Ecological Risk Assessment (ERA) conducted as part of the RI evaluated data generated from surface water and sediment samples collected from ponds and drainages in the vicinity of the landfill, and from the Potomac River. The ERA concluded that COCs in sediment and surface water are unlikely to pose risks to ecological receptors. In addition, the landfill cap evaluation completed in 2013 included visual examinations of the landfill cap and the advancement of shallow soil borings to observe the depth of the cap. The landfill cap is intact and does not allow for potential landfill contents/contaminants to affect ecological receptors. Furthermore, the TCE source area is in subsurface soil to which ecological receptors are not exposed.

WHAT ARE THE PRIMARY "CONTAMINANTS OF CONCERN"?

In the OU2 ROD, EPA identified trichloroethene (TCE) and its potential breakdown products, 1,1-dichloroethene (1,1-DCE), *cis*-1,2 dichloroethene (DCE) and vinyl chloride, as the primary COCs at the Site. These contaminants pose the greatest potential risk to human health at the Site.

Trichloroethene (TCE): TCE has been detected in source area groundwater at concentrations up to 120,000 µg/L. TCE has been detected in source area soils at concentrations up to 25,000 mg/kg. TCE is a halogenated organic compound historically used as an industrial solvent and a degreaser. Exposure to this compound has been associated with deleterious health effects in humans, including anemia, skin rashes, diabetes, liver conditions and urinary tract disorders. Other health effects for TCE include specific cancers, mutagenicity, immunotoxicity and probable fetal heater malformations. TCE is carcinogenic to humans by all routes of exposure.

1,1-Dichloroethene (1,1-DCE): 1,1-DCE has been detected in source area groundwater at concentrations up to 36 µg/L. 1,1-DCE has been detected in source area soils at concentrations up to 580 mg/kg.

***cis*-1,2-Dichloroethene (*cis*-1,2-DCE):** *cis*-1,2-DCE has been detected in source area groundwaters at concentrations up to 180 µg/L. *cis*-1,2-DCE has been detected in source area soils at concentrations up to 61 mg/kg.

Vinyl chloride (VC): VC has been detected in source area groundwaters at concentrations up to 8.2 µg/L. VC has been detected in source area soils at concentrations up to 1.6 mg/kg.

It is EPA's current judgment that the Preferred Alternatives identified in this Proposed Plan, or one of the other remedial alternatives considered in the Proposed Plan, are necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

F. REMEDIAL ACTION OBJECTIVES

In order to develop remedial alternatives to protect the long-term integrity of the WMA cap and to address principal threat source material in overburden and bedrock, RAOs are first developed to guide remediation. The RAOs developed for the WMA cap and the principal threat source area material at OU-3 of the Site are as follows:

- Prevent direct contact with landfill waste and minimize infiltration of precipitation into the landfill.
- Reduce mass and concentration of the source area contaminants to allow groundwater plume concentrations beyond the waste management area to achieve MCLs in the future.

For purposes of creating a substantial decrease in TCE concentrations downgradient of the WMA and facilitating future achievement of concentrations below the MCLs on the downgradient/western side of the landfill, Preliminary Remedial Goals (PRGs) are established for source area soils and groundwater.

The PRG developed for removing/treating TCE contamination in soil in the overburden source area is 25 mg/kg. TCE concentrations in soil in the overburden source area are up to 25,000 mg/kg. This PRG was selected to guide source area overburden treatment alternatives. The concentration was selected based on analysis using the EPA Region 3 Soil Screening & Remediation Goals Tool (Version 2.2, August 2011), which incorporates site-specific parameters including chemical concentrations in soil and groundwater as well as soil type and properties of underlying geologic layers. This selected a concentration to guide source area remediation and limit downgradient contamination. Treatment of TCE between 25 mg/kg and 25,000 mg/kg in soil within the source area is expected to substantially decrease the total contaminant mass at the Site and result in a substantial decrease in downgradient groundwater concentrations.

The PRG for removing/treating TCE contamination in source area bedrock/groundwater will be selected during the remedial design of the remedy, with the goal of establishing 1,000 µg/L in the greatest area practicable. The investigations conducted during the remedial design will further evaluate the extent of contaminated bedrock/groundwater and potential treatment locations. TCE concentrations in bedrock/groundwater in the source area are up to 120,000 µg/L. Treatment of TCE principal threat at concentrations between 1,000 µg/L and 120,000 µg/L in groundwater is expected to substantially decrease the total contaminant mass at the Site and result in a substantial decrease in downgradient groundwater concentrations.

The PRGs may be modified during remedial design or remedial action in order to meet the RAOs, such that compliance with applicable standards is achieved in downgradient groundwater in the future. Following implementation of the OU-3 remedial action, the need for further groundwater treatment will be evaluated and considered under OU-1, restoration of Site-wide contaminated groundwater, which EPA expects to be the final remedial action for the Site.

G. SUMMARY OF REMEDIAL ALTERNATIVES

The alternatives evaluated below were designed to meet the RAOs established in this Proposed Plan. One remedial alternative was developed to address the WMA. Other remedial alternatives were developed to address principal threat source material in overburden, while some were developed to address principal threat source material in bedrock/groundwater. Remedial alternatives will need to be combined to meet RAOs and fully address the WMA and principal threat source material in overburden and bedrock/groundwater. Analysis of the remedial action alternatives focused on the ability of each alternative to address following areas:

- WMA containment;
- Principal threat source removal in overburden; and
- Principal threat source removal in bedrock.

EPA's Preferred Alternative to address the WMA, the principal threat source material in overburden and principal threat source material in bedrock/groundwater is the combination of the three alternatives presented below:

- WMA:
  - **Alternative 2 –** Landfill Cap Repair and Maintenance with LUCs
- Principal Threat Source Material:
  - Overburden:
    - **Alternative 3A –** Principal Threat Source Excavation and Offsite Disposal
  - Bedrock:
    - **Alternative 5B –** *In Situ* Bioremediation and Chemical Reduction of Principal Threat Source Material in Bedrock/groundwater

Table 3: Summary of all Evaluated Alternatives

Alternative	Description
1	No Action
2	Landfill Cap Repair, and Maintenance with LUCs
3A	Principal Threat Source Area Overburden Excavation and Offsite Disposal
3B	Principal Threat Source Area Overburden Excavation and Soil Treatment with Onsite Disposal

4	Principal Threat Source Area Bedrock Groundwater Extraction and Treatment with Cosolvent/Surfactant Flushing and Recirculation
5A	In Situ Bioremediation and Chemical Reduction of Principal Threat Source Material in Overburden and Bedrock
5B	In Situ Bioremediation and Chemical Reduction of Principal Threat Source Material in Bedrock
6A	In Situ Chemical Oxidation of Principal Threat Source Material in Overburden and Bedrock
6B	In Situ Chemical Oxidation of Principal Threat Source Material in Bedrock
7	In Situ Thermal Treatment/Ex Situ Treatment of Extracted Vapor for Principal Threat in Overburden and Bedrock

Common Elements

Alternative 2 is the only alternative developed to address the WMA. Alterative 2 needs to be coupled with an alternative or alternative(s) to address the principal threat source material in overburden and bedrock. Alternatives 5 and 6 are divided into two separate alternatives listed as “A” and “B”. Alternatives 5A and 6A contain a remedial technology that addresses principal threat source material in both overburden and bedrock while alternatives 5B and 6B contain a remedial technology that addresses principal threat source material only in bedrock.

All alternatives were developed to achieve the RAOs for the cap and the principal threat source material at OU-3 of the Site.

Alternative 1: NO ACTION

Consideration of this alternative is required by the NCP at 40 C.F.R. § 300.430(e)(6). Alternative 1 requires no additional remedial action to be taken at the Site. The No Action alternative serves as a basis against which each of the other proposed remedial alternatives can be compared. Under this alternative, the Site would remain in its present condition, groundwater contamination would be subject to natural processes only and the landfill cap would not be maintained.

Alternative 2: LANDFILL CAP REPAIR AND MAINTENANCE WITH LAND USE CONTROLS

The landfill cap was installed in 1986 and not been maintained since 1997. During the first year of implementation of Alternative 2, it is anticipated that significant time and effort would be required to complete repair and maintenance. Annual inspection and maintenance thereafter would require a reduced effort.

Repair and maintenance may include filling holes, including those made by wildlife or trespassers, with topsoil; if the clay cap has been penetrated, clay would be used first to repair the cap). Maintenance may also include replacing fallen trees on the landfill to help stabilize landfill slopes and help limit infiltration. Native tree species would be selected for tree replacement. There is currently no defined future land use for the landfill. Disturbance of the cap is prohibited and would continue to be prohibited in the future by implementation of LUCs.

An implementation plan for LUCs would be prepared to clarify maintenance activities, defining the land use, land use restrictions, and identifying responsibility for implementation of LUCs. Land use restrictions will include no action may be taken at the landfill property which obstructs, interferes with, or alters the landfill cap and remedy. LUCs will include restricting the use of groundwater for any purpose other than environmental remediation, testing, or monitoring until performance standards for the COCs are achieved. In addition, the Commonwealth of Virginia has applicable regulations that limit certain uses and activities on the landfill property.

Alternative 3A: PRINCIPAL THREAT SOURCE AREA OVERBURDEN EXCAVATION AND OFFISTE DISPOSAL

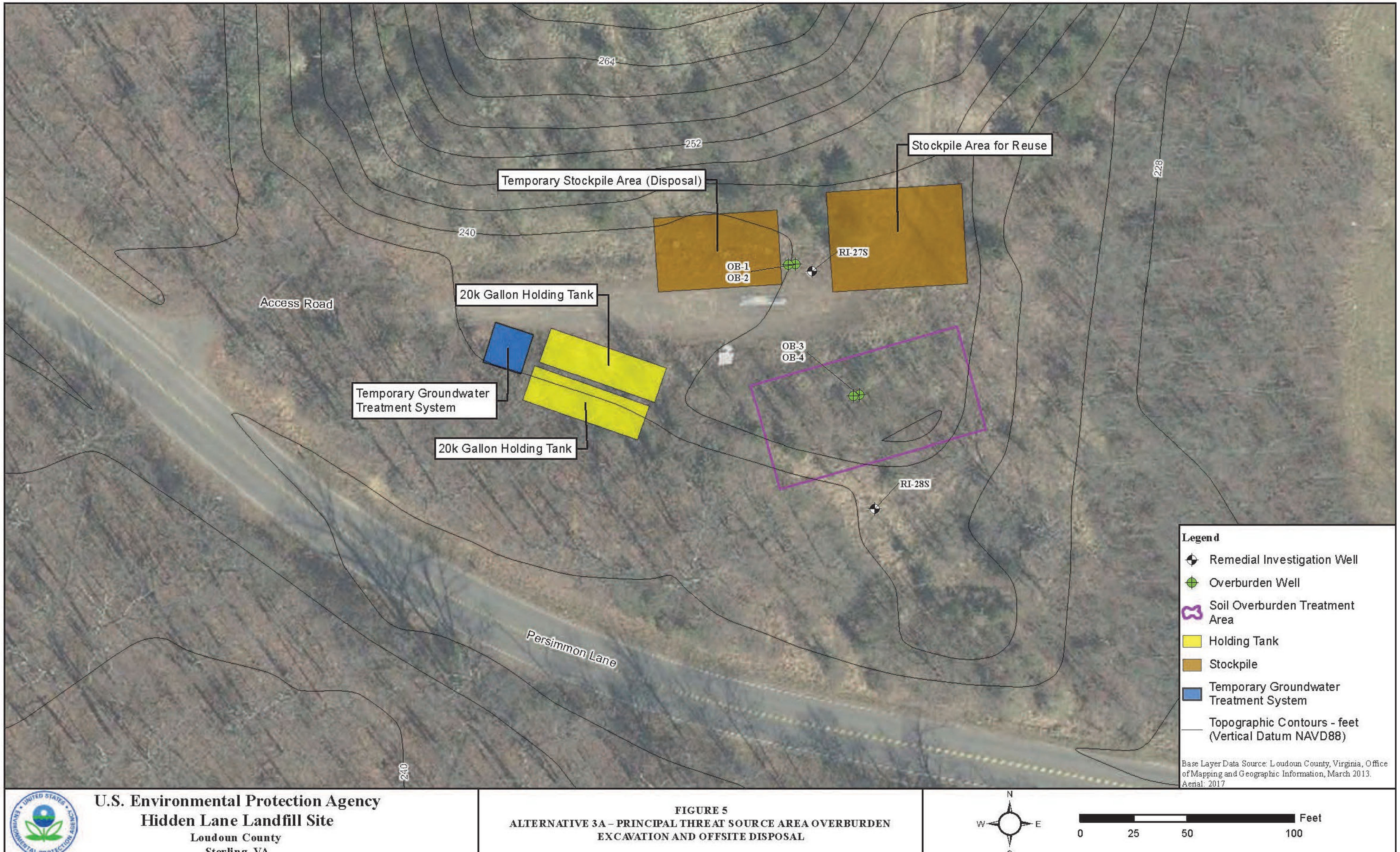
Alternative 3A includes excavation of principal threat source material in the overburden followed by offsite disposal.

Contaminated soil would be removed via excavation from an area delineated by soil data with concentrations that exceed the principal threat PRG for overburden soil of 25 mg/kg. Based on the data collected from the RI and Supplemental RI, the soil excavation area was established and is approximately 100 ft. in length by 50 ft. in width. The excavation depth would be to the top of bedrock, approximately 30 – 35 ft. bgs. It is anticipated that the top 8 ft. of soil would be set aside and stockpiled onsite to be used as backfill after offsite disposal.

Excavation could require installation of shoring, such as sheet piling, to ensure the integrity of the side slopes during excavation activities. If perched groundwater is present in the overburden, dewatering would be necessary, and a temporary groundwater treatment system could be required onsite to treat the collected water.

Alternative 3A also includes the offsite disposal of the contaminated material at an approved facility, licensed to accept the waste. A detailed contaminant analysis would be required before an offsite disposal facility would accept materials. Following excavation, the area would be backfilled with clean material and regraded. A layer of clay or other low permeability material would be placed above the bedrock interface during backfilling to avoid creating a zone of high permeability between the ground surface and the groundwater in the excavation area. An infiltration gallery may be installed between the clay layer and top of bedrock to facilitate bedrock remedial options. Following grading and backfilling, a low permeability material such as concrete or low-permeability asphalt would be placed at the surface. See Figure 5 below for details of this remedial alternative.

Figure 5: Alternative 3A – Principal Threat Source Area Overburden Excavation and Offsite Disposal

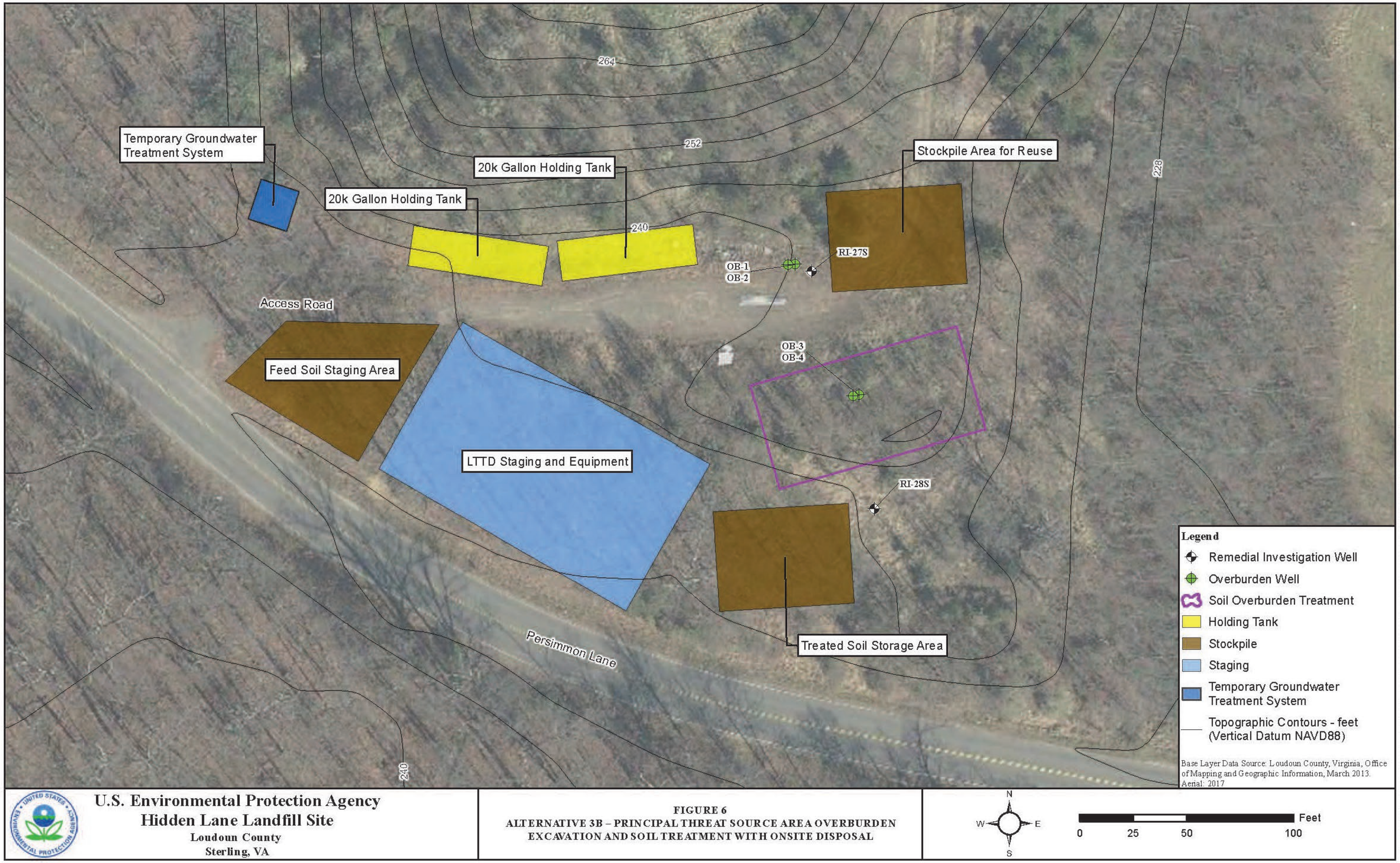


Alternative 3B: PRINCIPAL THREAT SOURCE AREA OVERBURDEN EXCAVATION AND SOIL TREATMENT WITH ONSITE DISPOSAL

Alternative 3B includes excavation of principal threat source material in the overburden, followed by *ex situ* treatment low temperature thermal desorption (LTTD) and onsite disposal. The principal threat material excavation is as described above in Alternative 3A, however this alternative includes onsite disposal instead of offsite disposal.

This alternative would include clearing trees to stage the excavated material for onsite treatment via LTTD and space for equipment. A mobile treatment system would be required onsite to implement LTTD and an extension of power supply would be required to power the equipment. Excavated soils would be placed in the mobile treatment system and heated to a temperature appropriate to remove VOCs. Off-gas from the soil treatment containing VOCs would be collected and treated. It is expected that treated soils would be available to backfill the excavation. See Figure 6 below for details of this remedial alternative.

Figure 6: Alternative 3B – Principal Threat Source Area Overburden Excavation and Soil Treatment with Onsite Disposal



Alternative 4: PRINCIPAL THREAT SOURCE AREA BEDROCK GROUNDWATER EXTRACTION AND TREATMENT WITH COSOLVENT/SURFACTANT FLUSHING AND RECIRULATION

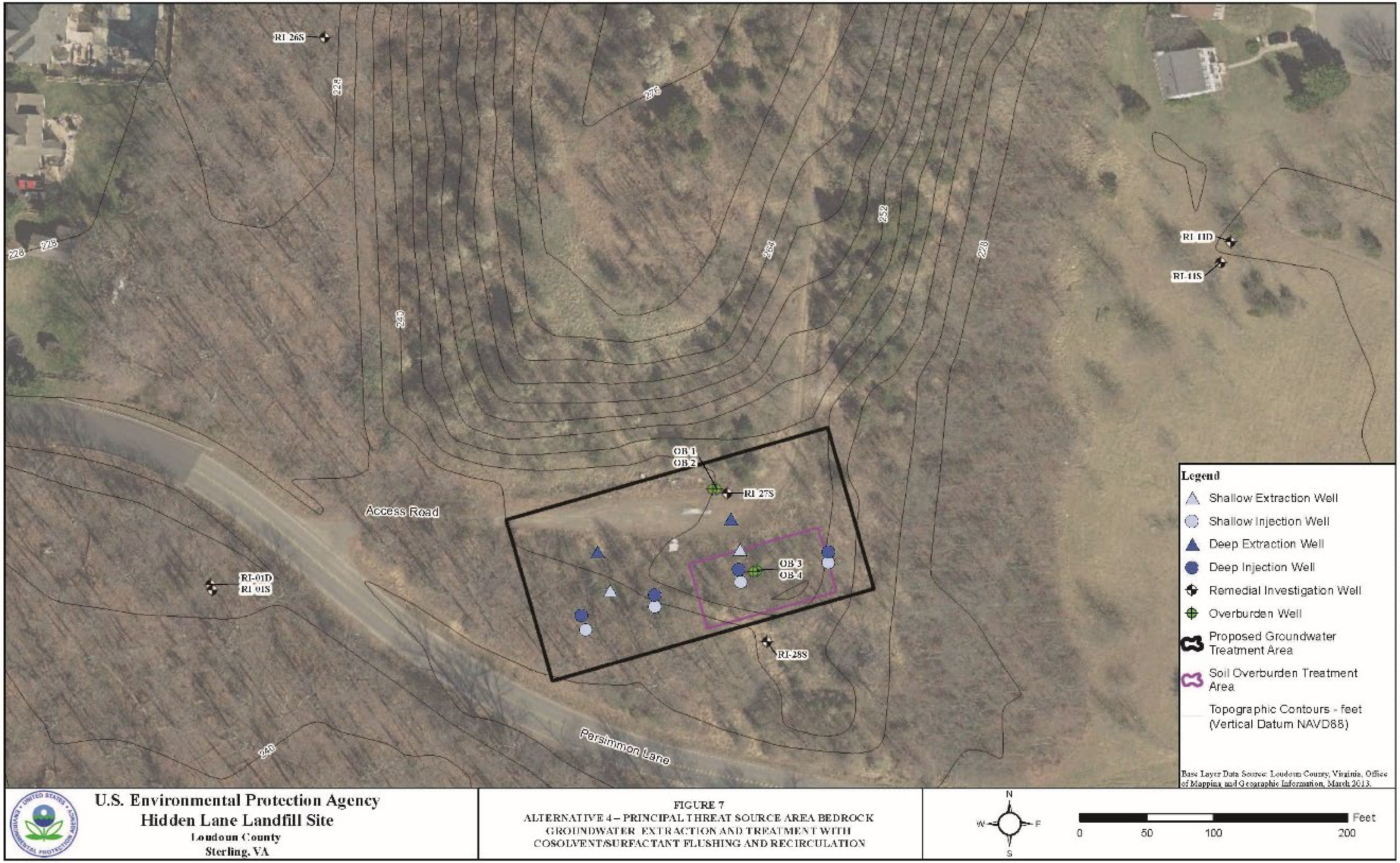
Alternative 4 includes extraction of principal threat groundwater from the bedrock in the source area. The extracted groundwater would be treated with a cosolvent/surfactant and reinjected upgradient of or within the source area.

Groundwater extraction wells would be installed in the downgradient (western) portion of the source area. It is anticipated that two extraction wells would be installed in the shallow bedrock (top of bedrock down to 100 ft. bgs) and two extraction wells would be installed approximately 20 ft. farther downgradient in the deeper bedrock (100 - 200 ft. bgs) to capture groundwater from the source area. See Figure 7 below for details of this remedial alternative.

The effectiveness of groundwater capture by the groundwater extraction system would be assessed by monitoring drawdown in the extraction wells and nearby monitoring wells. The groundwater extracted by the system would be transported through a piping network to an aboveground treatment facility onsite where the groundwater would be treated and then amended with cosolvents/surfactants. The groundwater treatment facility would utilize an air stripper and granular activated carbon (GAC) for treatment of the groundwater; vapor-phase GAC would also be required for treatment of the vapor removed by the air stripper.

The treated groundwater containing cosolvents/surfactants would then be reinjected in the upgradient (eastern) portion of the source area, to promote mobilization of COC mass and removal by the extraction wells. The groundwater pump and treat system would remain in operation until TCE concentrations in groundwater in the source area meet the RAO. Any treated water that is not reinjected could be discharged to a local surface water body under a site-specific Virginia Pollutant Discharge Elimination System permit, or to a public sewer system to be treated further at a public wastewater treatment facility.

Figure 7: Alternative 4 – Principal Threat Source Area Bedrock Groundwater Extraction and Treatment with Cosolvent/Surfactant Flushing and Recirculation



Alternative 5A: IN SITU BIOREMEDIATION AND CHEMICAL REDUCTION OF PRINCIPAL THREAT SOURCE MATERIAL IN OVERBURDEN AND BEDROCK

Alternative 5A includes *in situ* bioremediation and chemical reduction of principal threat source material in overburden and bedrock. Amendments to promote chemical reduction and promote biological activity would be injected into the source area overburden and bedrock.

A treatability study was conducted in 2017 to determine whether *in situ* anaerobic biotic/abiotic treatment with bioaugmentation is a viable remedial alternative for remediating the TCE groundwater plume at the Site. Results indicated that injections established appropriate conditions for bioremediation and chemical reduction. The enhanced bioremediation and chemical reduction program developed under this alternative would be based on the injections performed as part of the treatability study.

Amendments could include multiple components, such as zero-valent iron to promote chemical reduction, activated carbon to decrease contaminant mobility, and a carbon substrate and a bioaugmentation culture to promote biological activity. Addition of activated carbon to the amendment could enhance back diffusion rates and sequester COCs within the treatment zone, facilitating treatment and further decreasing downgradient migration of COCs from the source area. For amendments intended to promote bioremediation, addition of a bioaugmentation culture would be helpful to facilitate complete TCE dechlorination since that culture may not naturally be present in groundwater at high enough concentrations. The amendments to promote bioremediation and chemical reduction would be injected into the bedrock and could also be injected into the overburden. It is anticipated that this alternative would include two rows of injection wells with five wells in each row to inject the amendments into the bedrock.

One row of injection wells would be placed in the overburden source area, where TCE concentrations exceed PRGs at depths of approximately 10 – 35 ft. bgs. These wells would inject a less mobile, longer lasting amendment to promote TCE degradation in the bedrock beneath the overburden source area. This technique would reduce the frequency of reinjections, and the amendment would remain within the bedding planes/fractures, treating any upgradient groundwater that comes in contact with it.

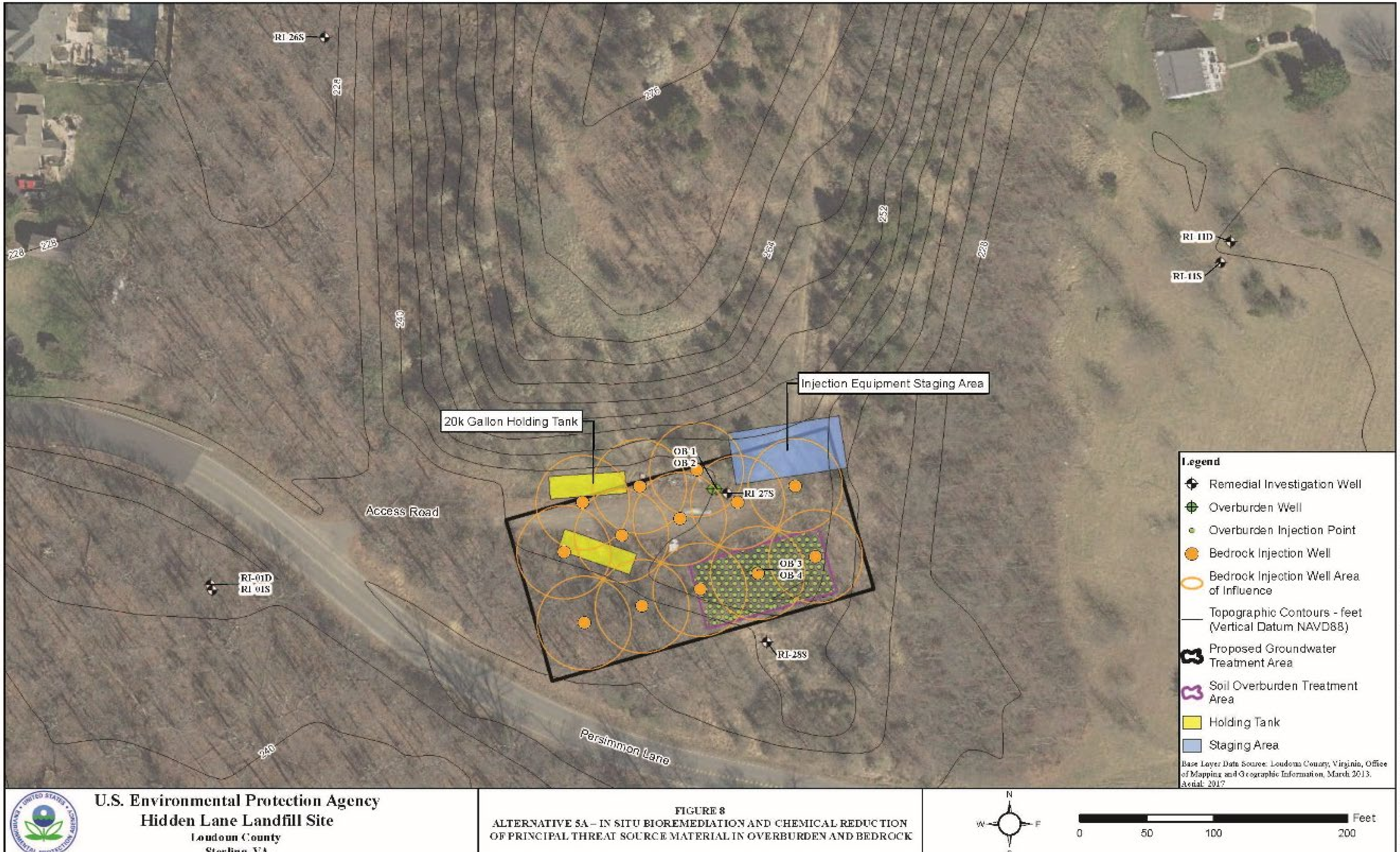
Potential amendments for the first line of wells, closest to the overburden source area, would include BOS 100® and EHC®-Plus. BOS 100® is an *in situ* chemical reduction technology specifically designed to degrade chlorinated solvents. It is manufactured from food-grade carbon impregnated with metallic iron. EHC®-Plus is composed of controlled-release organic carbon to stimulate biological activity, zero-valent iron for chemical reduction, and activated carbon to reduce mobility of the contaminants.

The second row of injection wells would be placed at the beginning of the landfill to the south, where TCE concentrations exceed PRGs at depths of approximately 200 ft. bgs. These wells would inject a more mobile amendment to transport downgradient to address elevated TCE concentrations in groundwater extending below the landfill.

Potential amendments for the second line of wells, at the beginning edge of the landfill, would include PlumeStop®, which consists of a very fine suspension of activated carbon, along with a microscale zero-valent iron to promote chemical reduction. The suspension has a water-like viscosity and is therefore mobile in the subsurface.

The injection volumes would be based on overburden porosity and total (matrix and fracture) bedrock porosity. Water for injection could be obtained from the injection wells and pumped into water conditioning frac tanks, where it would be treated with sodium lactate to establish anaerobic conditions prior to injection. The amendment would likely be delivered to the target intervals following a top-down injection procedure, with monitoring of injection flow rates and pressures. See Figure 8 below for details of this remedial alternative.

Figure 8: Alternative 5A – In Situ Bioremediation and Chemical Reduction of Principal Threat Source Material in Overburden and Bedrock

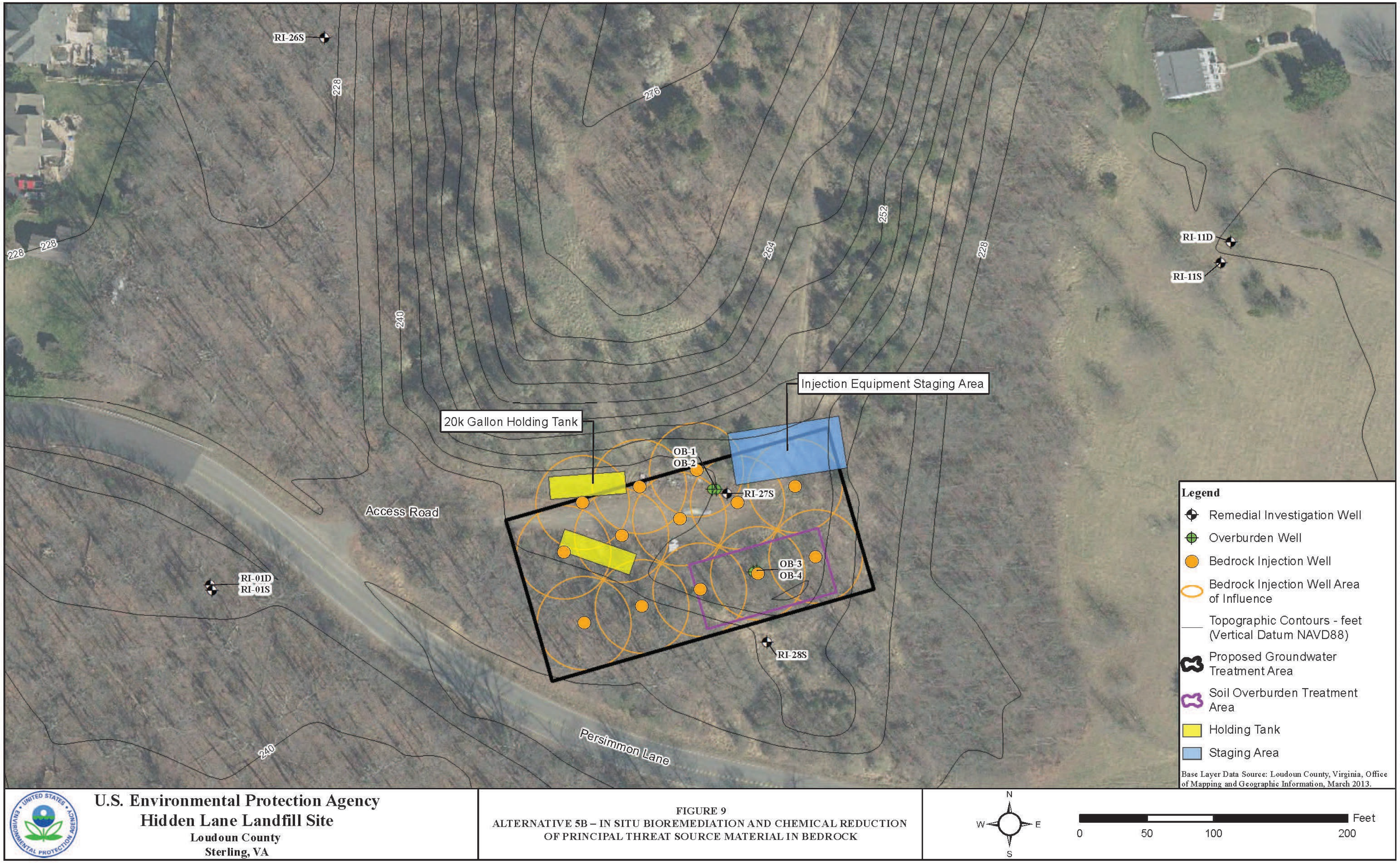


Alternative 5B: IN SITU BIOREMEDIATION AND CHEMICAL REDUCTION OF PRINCIPAL THREAT SOURCE MATERIAL IN BEDROCK

Alternative 5B includes *in situ* bioremediation and chemical reduction of principal threat source material in overburden and bedrock. Amendments to promote chemical reduction and promote biological activity would be injected into the bedrock.

The description of *in situ* bioremediation and chemical reduction of principal threat source material is as described above in Alternative 5A, however this alternative does not include injection in the overburden. The exact number and location of bedrock injection wells will be determined following additional vertical and horizontal delineation of bedrock requiring injection to meet the RAOs, and after any overburden alternative is implemented. This alternative is specific to treating principal threat source material in bedrock and would have to be paired with an alternative for treating principal threat source material in overburden. See Figure 9 below for details of this remedial alternative.

Figure 9: Alternative 5B – In Situ Bioremediation and Chemical Reduction of Principal Threat Source Material in Bedrock



Alternative 6A: IN SITU CHEMICAL OXIDATION OF PRINCIPAL THREAT SOURCE MATERIAL IN OVERBURDEN AND BEDROCK

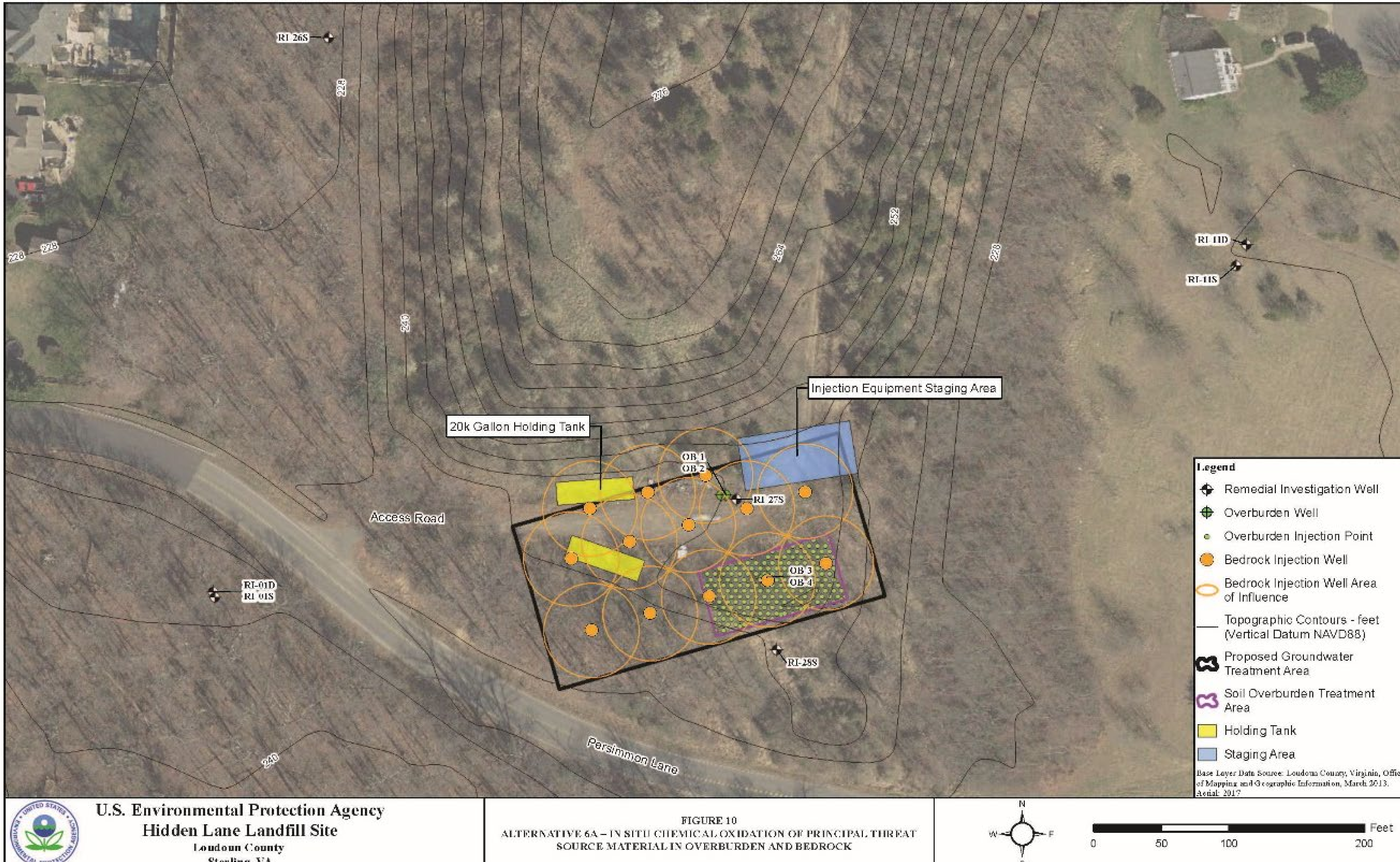
Alternative 6A include *in situ* chemical oxidation (ISCO) of principal threat source material in overburden and bedrock. Chemical oxidants would be injected in the source area overburden and bedrock to degrade COCs.

Oxidant injection in the overburden would be conducted within the source area, where TCE concentrations exceed PRGs, at depths of approximately 10-35 ft. bgs. Oxidant would be injected at regular depth intervals, and groundwater would be monitored to assess the continued effectiveness of the chemical oxidation program for decreasing COC concentrations in groundwater.

Potential chemical oxidants for this alternative could include sodium permanganate or caustic persulfate. Caustic persulfate has a lower persistence when compared to sodium permanganate and would require an additional injection to provide sufficient mass reduction.

Post-injection monitoring events would be conducted in the injection wells and the surrounding monitoring network to monitor changes in the groundwater quality in and around the treatment area following injection of the oxidant. See Figure 10 below for details of this remedial alternative.

Figure 10: Alternative 6A – In Situ Chemical Oxidation of Principal Threat Source Material in Overburden and Bedrock

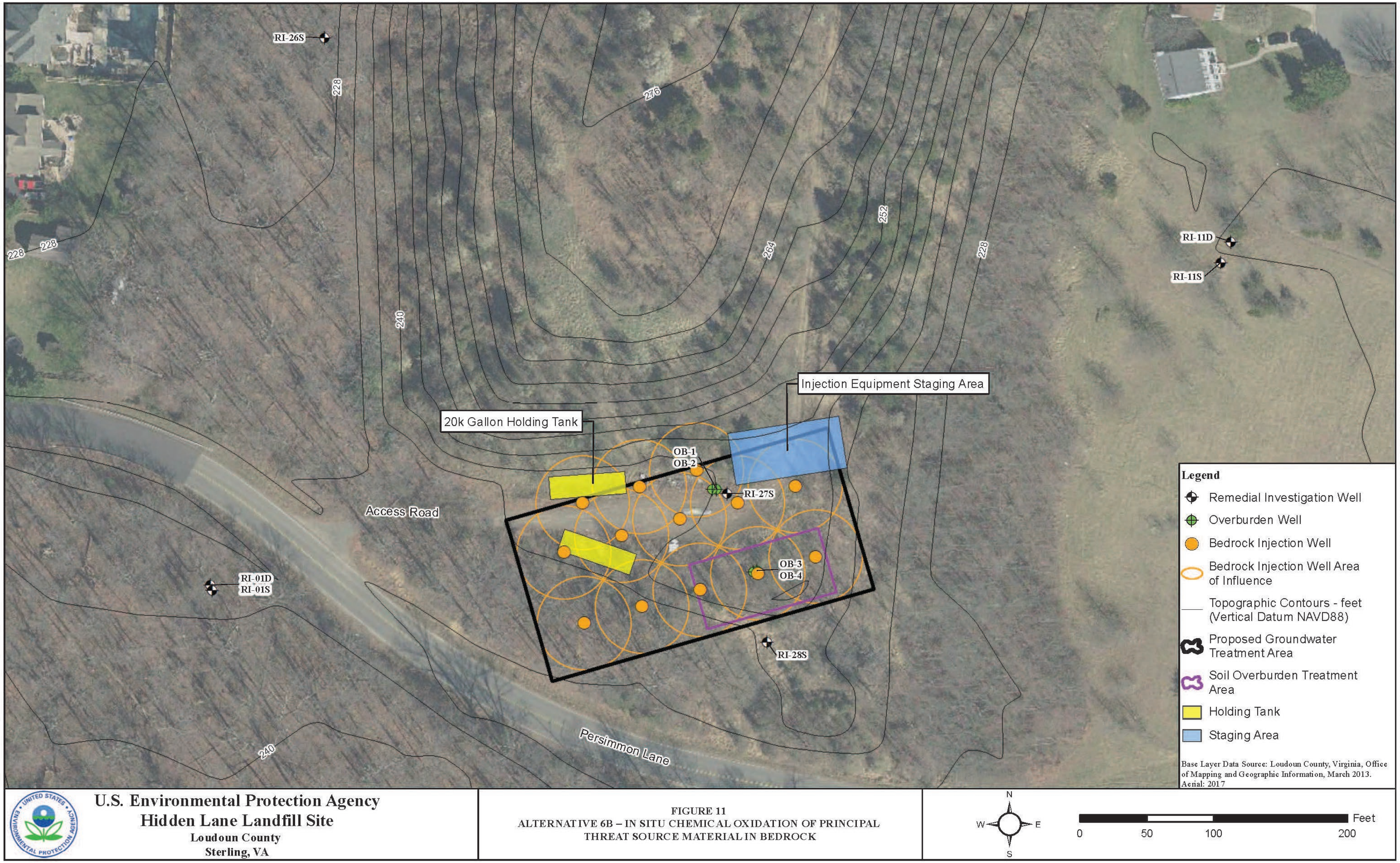


Alternative 6B: IN SITU CHEMICAL OXIDATION OF PRINCIPAL THREAT SOURCE MATERIAL IN BEDROCK

Alternative 6B includes ISCO of principal threat source material in bedrock.

The description of ISCO of principal threat source material is as described above in Alternative 6A, however this alternative does not include injection in the overburden. Oxidant injection in the bedrock would be conducted within the source area, where TCE concentrations exceed PRGs, at depths of approximately 200 ft. bgs. This alternative is specific to treating principal threat source material in bedrock and would have to be paired with an alternative for treating principal threat source material in the overburden. See Figure 11 below for details of this remedial alternative.

Figure 11: Alternative 6B – In Situ Chemical Oxidation of Principal Threat Source Material in Bedrock



Alternative 7: IN SITU THERMAL TREATMENT/EX SITU TREATMENT OF EXTRACTED VAPOR FOR PRINCIPAL THREAT IN OVERBURDEN AND BEDROCK

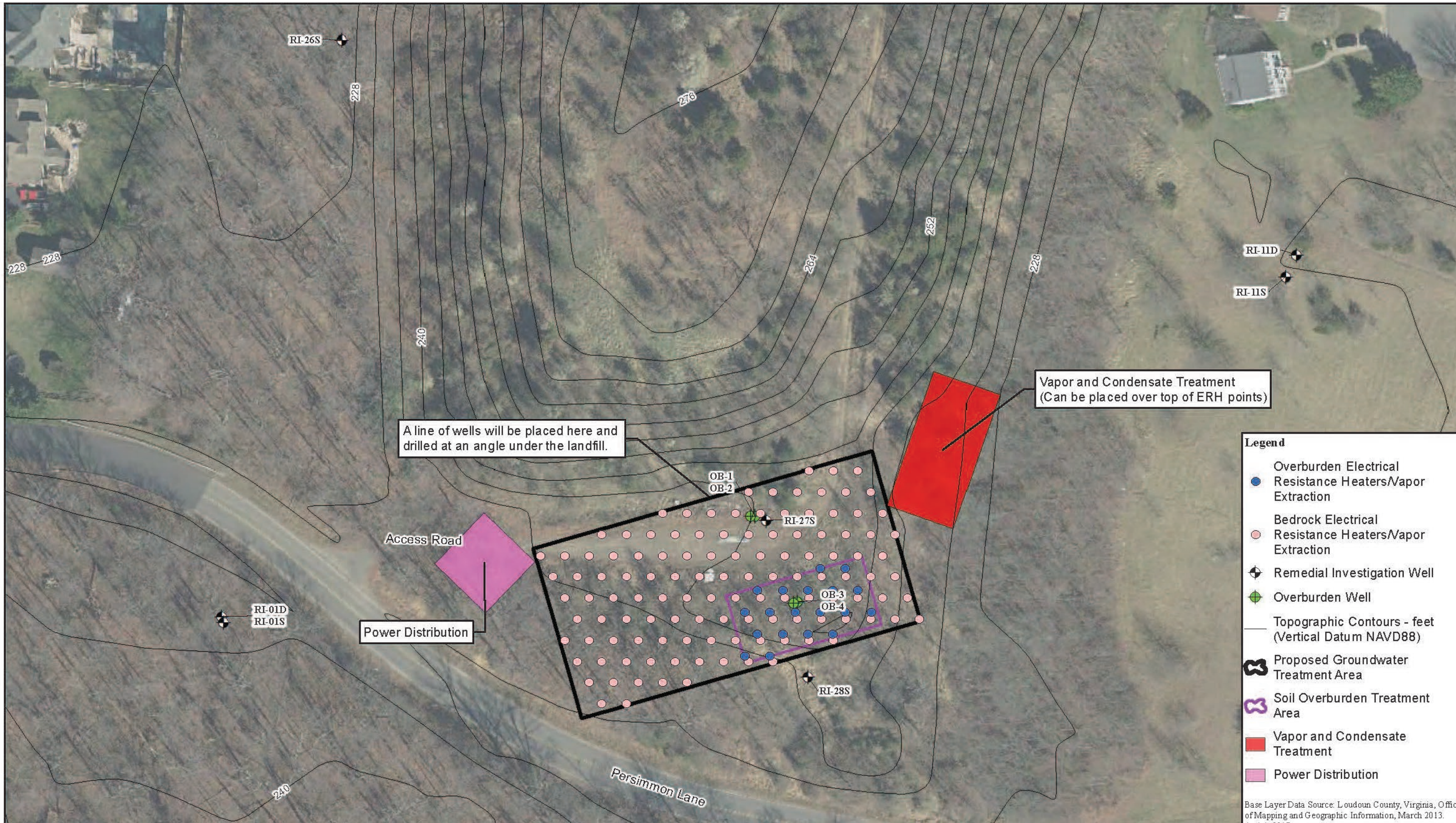
Alternative 7 includes *in situ* thermal treatment of principal threat source material in overburden and bedrock. The *in situ* thermal treatment technology would be Electrical Resistivity Heating (ERH). ERH would eliminate the human health risks associated with principal threat source material in the area where it is applied.

For this alternative, electrodes would be installed into the overburden and bedrock. The electrodes would be heated to temperatures above the boiling points of the contaminants, enhancing volatilization of adsorbed VOCs. Volatilized compounds are removed by applying a vacuum to the treatment area. The extracted vapor would be treated using a vapor-phase GAC system, and condensate would then be treated using liquid-phase GAC. Vapor and liquid treatment system monitoring would be conducted to monitor for mass removal and discharge compliance. See Figure 12 for details of this remedial alternative.

To be effective, ERH would be subject to performance standards consisting of the following elements:

- Heat the overburden and bedrock to establish and maintain subsurface temperatures of 85° C in the vadose zone and 100° C in the saturated zone through the treatment area to boil principal threat source material soil and groundwater;
- Extract vapor and steam using vapor recovery wells;
- Establish and maintain control of vapor, steam, and principal threat source material within the treatment area.
- Cool and treat extracted vapor and steam.
- Monitor and report the following parameters throughout treatment:
    - Temperature in the vadose and saturated zones;
    - Vapor and steam extraction rates; and,
    - Groundwater contaminant concentrations;
    - Air emissions from the thermal treatment system, if any.
- Conduct groundwater and soil sampling and analysis prior to, during, and following the conclusion of thermal treatment. Post-treatment sampling would be conducted a minimum of fourteen (14) days following shutdown of the thermal treatment system. Continue treatment until EPA determines that the following parameters indicate the maximum treatment of principal threat waste within the treatment area has been achieved:
    - Temperature in the vadose and saturated zones;
    - Vapor and steam extraction rates;
    - Groundwater and vapor contaminant concentrations; and,
    - Soil concentrations.
- Monitor and report groundwater contaminant concentrations following treatment until temperatures within vadose and saturated zones return to ambient levels;
- Conduct additional treatment within the treatment area or portions thereof, based on the results of post-treatment sampling prescribed above, until EPA determines the maximum treatment of principal threat waste has been achieved.

Figure 12: Alternative 7 – In Situ Thermal Treatment/Ex Situ Treatment of Extracted Vapor for Principal Threat in Overburden and Bedrock



U.S. Environmental Protection Agency
Hidden Lane Landfill Site
Loudoun County
Sterling, VA

FIGURE 12
ALTERNATIVE 7 – IN SITU THERMAL TREATMENT/EX SITU TREATMENT OF EXTRACTED VAPOR OF PRINCIPAL THREAT MATERIAL IN OVERBURDEN AND BEDROCK

N S W E

Feet
0 50 100 200

H. EVALUATION OF ALTERNATIVES

This section compares the remedial alternatives summarized above to each other using the nine criteria set forth in 40 C.F.R. § 300.430(e)(9)(iii) and is listed in Table 4 below. In the remedial decision- making process, EPA describes the relative performance of each alternative against the evaluation criteria and notes how each alternative compare to the other alternatives under consideration. A detailed analysis of alternatives can be found in the OU-3 FS, which is in the Administrative Record file for the Site.

These evaluation criteria relate directly to requirements of Section 121 of CERCLA, 42 U.S.C. § 9621, for determining the overall feasibility and acceptability of a remedy. The nine criteria fall into three groups described as follows:

Threshold criteria must be satisfied for a remedy to be eligible for selection.
Primary balancing criteria are used to weigh major tradeoffs between remedies.
Modifying criteria are considered after public comment is received on the Proposed Plan.

Table 4: Evaluation Criteria for Superfund Remedial Alternatives	
Threshold Criteria	**1. Overall Protection of Human Health and the Environment** determines whether an alternative can adequately protect human health and the environment by eliminating, reducing, or controlling exposures to hazardous substances, pollutants or contaminants to levels that do not pose an unacceptable risk.
	2. Compliance with ARARs evaluates whether an alternative meets Federal and more stringent State environmental laws or facility siting laws, or whether a waiver is justified.
Primary Balancing Criteria	**3. Long-term Effectiveness and Permanence** considers the ability of an alternative to maintain protection of human health and the environment over time.
	4. Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
	5. Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
	6. Implementability considers the technical and administrative feasibility of implementing an alternative, including factors such as the relative availability of goods and services.
	7. Cost includes the estimated capital and annual operation and maintenance costs, as well as present worth cost of an alternative. Present worth cost is the total cost of an alternative over time in today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

Modifying Criteria	**8. State/ Support Agency Acceptance** considers whether the State agrees with EPA's analyses and recommendations, as described in the Feasibility Study and Proposed Plan.
	9. Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

Detailed Analysis of Proposed Remedial Alternatives

1. Overall Protection of Human Health and the Environment

The results of the HHRA indicated that current and future exposure to groundwater was identified as the only medium of concern for human health. Concerns for human health exposure to groundwater near the Site in the short-term is currently being addressed as part of OU-2 (Waterline). The ERA did not identify risks to ecological receptors, therefore, environmental protection is already achieved.

Alternative 1 (No Action) does not include measures to prevent current and future receptors from using contaminated groundwater. The No Action alternative fails this threshold criterion and is therefore eliminated from further consideration under the remaining eight criteria. Further, because the No Action alternative for the WMA or principal threat source material treatment does not reduce the mass or decrease mobility of the COCs, it would not be protective of human health or the environment.

Alternative 2 is protective of human health and the environment because maintenance of the landfill cap minimizes risks to ecological and human receptors by maintaining the physical barrier of the cap to prevent contact with material under the cap. The environmental protection and prevention of human exposure provided by the cap would continue to be achieved through maintenance and LUCs.

Alternatives 3 through 7 are all protective of human health and the environment but to varying degrees. Alternatives 3A and 3B would contribute to protecting human health in the long-term by removing the principal threat source mass that contributes contamination to downgradient groundwater.

Alternative 4 and 7 would protect human health in the long-term by removing COC mass and decreasing potential COC migration downgradient.

Alternatives 5A, 5B, 6A, and 6B would protect human health in the long-term by degrading COC mass and decreasing potential COC migration downgradient.

2. Compliance with ARARs

Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), and the NCP at 40 C.F.R. § 300.430(f)(1)(ii)(B), require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law, which are collectively referred to as "ARARs," unless such ARARs are waived under Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4), and the NCP at 40 C.F.R. § 300.430(f)(1)(ii)(C).

"Applicable" requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility-siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Only those State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be applicable.

"Relevant and appropriate" requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility-siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be relevant and appropriate.

Based on a detailed evaluation, Alternatives 2 through 7 will comply with ARARs, a threshold criterion. Major ARARs include, but are not limited to:

- National Primary Drinking Water Standards: 40 C.F.R. § 141. 11, 141.13,141.22-23.
- Virginia Groundwater Standards: 9VAC25-280, -30-, -40, -50, and -70. Because all groundwater in Virginia is viewed as a potential source of drinking water, remedial action should be implemented with a target goal of achieving groundwater standards.
- Transportation and Disposal standards for soil excavation: 40 C.F.R. § 261.10 -11 and 262.83.
- Underground Injection: 40 C.F.R. 144.12 and 144.82 Regulates the subsurface emplacement of liquids through the Underground Injection Control program, which governs the design and operation of five classes of injection wells to prevent contamination of underground sources of drinking water. The Underground Injection Control program regulates well construction, well operation, and monitoring. Groundwater treatment alternatives include substrate injections. Permits and administrative reviews are not required for on-site CERCLA injection wells; however, the remedial action will comply with the substantive requirements of the regulations.

3. Long Term Effectiveness and Permanence

Alternative 2 in combination with 3A or 3B, would be the most effective alternatives in the long term for landfill and the overburden source area because the landfill cap would be maintained, and the contaminated soil in the overburden would be removed and either disposed of offsite or treated onsite.

Alternatives 5B and 7 would be the most effective alternatives in the long term and also the most permanent for treatment of COC mass in the bedrock. Thermal treatment as part of Alternative 7 would be expected to efficiently remove the majority of source mass from both the overburden and the bedrock.

In situ treatment under Alternatives 5A and 5B would degrade COCs in groundwater within bedrock fractures in the treatment area. Although multiple regular injections would be necessary to maintain the groundwater PRGs for the source area groundwater over time to be achieved by enhanced bioremediation and chemical reduction, the effects of the amendments on groundwater chemistry and the resulting increase in degradation rates would persist after the last injection.

Alternatives 4, 6A, and 6B would also address the area of the highest TCE concentrations in groundwater; however, the effectiveness of these alternative would likely be limited by difficulty in achieving complete hydraulic control, due to bedrock fractures limiting groundwater flow. This would result in a longer remedial time frame under Alternative 4, and difficulty achieving and maintaining sufficient oxidant concentrations under Alternatives 6A and 6B.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

All the alternatives except Alternatives 2 and 3A have the potential to be effective at reducing the toxicity, mobility, and volume of the COCs through treatment.

Alternatives 2, and 3A do not include treatment and therefore do not reduce the toxicity, mobility, and volume of the COCs through treatment. Treatment of excavated soil using LTTD as part of Alternative 3B would decrease the volume and toxicity of the removed soil.

Alternative 4 would use groundwater extraction, treatment and recirculation, to decrease the toxicity and volume of impacted groundwater and could also decrease the mobility of groundwater impacts, to the degree that hydraulic control can be achieved.

Alternatives 5A, 5B would decrease the toxicity of the COCs and reduce the volume of COCs in groundwater by a mix of biotic and abiotic degradation.

Alternatives 6A, 6B would use chemical oxidation to decrease the toxicity of COCs and reduce the volume of COCs in groundwater and soil.

Alternative 7 would use thermal treatment to decrease the toxicity and volume of the COCs in groundwater and soil.

Alternatives 5A, 5B, 6A, 6B, and 7 would achieve the greatest overall decrease in toxicity, mobility, and volume of COCs, through *in situ* destruction of TCE and other VOCs in the source area.

5. Short-Term Effectiveness

Alternatives 3 through 7 all pose some short-term impacts to the surrounding community due to application of the technologies and required drilling at the Site. Implementation of Alternatives 2 through 7 all pose some risk to workers. These risk concerns include construction-related disturbances and hazards; contact with impacted groundwater during well installation, groundwater sampling, and system maintenance; and contact with injected amendments. Under any of these alternatives, such concerns and hazards would be addressed in the site-specific Health and Safety Plan, using personal protective equipment and other precautions, as necessary.

Alternatives 3A and 3B would pose the most potential impacts to workers and to the community, due to the challenges of excavation to 35 ft. bgs and the need to transport and/or handle contaminated material onsite or offsite for disposal. Alterative 3A would impact the surrounding community due to increased truck traffic associated with contaminated soil transport off-site.

Alternatives 5A and 5B also would have the potential to cause a temporary increase in dissolved phase contaminant concentrations, which could potentially lead to additional impacts to residential wells.

The timeframe for achieving PRGs in overburden is expected to be shortest under Alternatives 3A and 3B, followed by Alternative 7. The timeframe for achieving PRGs in bedrock groundwater is expected to be shortest under Alternative 7. PRGs in overburden are also expected to be met at relatively the same time under Alternatives 5A, 5B, 6A and 6B. Alternative 4 would take the longest to implement and optimize, due to the time required for maximization of hydraulic control and matrix diffusion.

6. Implementability

Alternatives 2, 3A, and 5B would be the most implementable at the Site and are all technically feasible to implement.

The excavation required under Alternatives 3A and 3B is highly implementable using standard construction equipment.

Alternatives 3B, 4, 5A, 6A, 6B, and 7 are also expected to be readily implementable.

For Alternative 3B, a large area would be needed, requiring tree clearing and potentially regrading, for the treatment equipment as well as untreated and treated soil piles. Alternative 7 would require tree clearing for the network of thermal wells, power distribution, and thermal oxidizer. Alternatives 4, 5A, 5B, 6A and 6B would require less tree clearing and installation of shallow and deep wells.

Alternatives 5A and 6A are somewhat less implementable because they require injection into the clay overburden in order to ensure effectiveness. Long-term operations and maintenance, up to 30 years, would be required for Alternative 4, whereas multiple injections would likely be required for Alternatives 5A, 5B, 6A, and 6B.

7. Cost

Present worth cost information for Alternatives 2 through 7 including a discount rate of 3 percent over a presumed 30-year period is presented below. These preliminary cost estimates are anticipated to be within -30 percent to +50 percent of the actual costs for implementing each alternative. The combined cost for Alternative 2, 3A and 5B is less than the cost of Alternative, 4, 5A, 6A, 6B or 7, individually. A summary of the capital costs, O&M costs and total costs are presenting in the Table 5 below.

Table 5: Costs Associated with Remedial Alternatives

Alternative	Depth Range(s) Addressed			Capital Cost	Periodic and O&M	Total Cost
	Landfill Cap	Overburden	Bedrock			
Alternative 1 – No Action	X	X	X	$0	$0	$0
Alternative 2 – Landfill Cap Repair and Maintenance with Land Use Controls	X			$52,000	$227,000	$280,000
Alternative 3A – Principal Threat Source Area Overburden Excavation with Offsite Disposal		X		$2,040,000	$0	$2,040,000
Alternative 3B – Principal Threat Source Area Overburden Excavation with Onsite Treatment		X		$2,232,000	$0	$2,232,000
Alternative 4 – Principal Threat Source Area Bedrock Groundwater Extraction and Treatment with Cosolvent/Surfactant Flushing and Recirculation			X	$3,573,000	$9,673,000	$13,246,000
Alternative 5A – *In Situ* Bioremediation and Chemical Reduction of Principal Threat Source Material in Overburden and Bedrock		X	X	$7,672,000	$1,311,000	$8,983,000
Alternative 5B – *In Situ* Bioremediation and Chemical Reduction of Principal Threat Source Material in Bedrock			X	$4,625,000	$1,311,000	$5,936,000
Alternative 6A – *In Situ* Chemical Oxidation of Principal Threat Source Material in Overburden and Bedrock		X	X	$19,248,000	$1,311,000	$20,559,000

Alternative 6B – *In Situ* Chemical Oxidation of Principal Threat Source Material in Bedrock			X	$9,831,000	$1,311,000	$11,142,000
Alternative *7* – *In Situ* Thermal Treatment/*Ex situ* Treatment of Extracted Vapor of Principal Threat Material in Overburden and Bedrock		X	X	$25,729,000	$1,311,000	$27,040,000

8. State Acceptance

EPA has coordinated closely with VDEQ in the preparation and evaluation of this Proposed Plan. Commonwealth of Virginia acceptance of the Preferred Alternative will be evaluated after the public comment period ends. Commonwealth comments and EPA's response to any such comments will be available in the Responsiveness Summary section of the ROD for OU-3.

9. Community Acceptance

EPA will evaluate community acceptance of the Preferred Alternative after the public comment period ends. Public comments and EPA's response to any such comments will be included in the Responsiveness Summary section of the ROD for OU-3.

I. PREFERRED ALTERNATIVE

EPA's Preferred Alternative to address the WMA, principal threat source material in overburden and principal threat source material in bedrock at the Site is the combination of the three alternatives presented below:

- WMA:
  - **Alternative 2 –** Landfill Cap Repair and Maintenance with LUCs

- Principal Threat Source Material:
  - Overburden:
    - **Alternative 3A –** Principal Threat Source Excavation and Offsite Disposal
  - Bedrock:
    - **Alternative 5B –** *In Situ* Bioremediation and Chemical Reduction of Principal Threat Source Material in Bedrock

Alternatives 2, 3A and 5B combined ranked highest when balancing remedial timeframe, short- and long-term effectiveness, implementability, and cost. Alternative 2 is required to address the Landfill Cap, Alternative 3A will permanently remove principal threat in the overburden, and Alternative 5B has the potential to completely eliminate principal threat in bedrock. The total estimated cost for the combination of Alternatives 2, 3A and 5B is $8.3 million.

Statutory Determination

Based on the information available at this time, EPA believes the Preferred Alternatives (Alternatives 2, 3A, and 5B) together meet the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing criteria. EPA expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA 42 U.S.C Section 121(b): 1) to be protective of human health and the environment; 2) to comply with ARARs; 3) to be cost-effective; and 4) to utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The Preferred Alternatives satisfy the preference for treatment as a principle element and eliminates principal threat source material in the overburden and bedrock at the Site.

J. COMMUNITY PARTICIPATION

Due to the 2020 pandemic, a recorded video presentation has been published in place of a public meeting. EPA encourages the public to review the presentation and gain a more comprehensive understanding of the Hidden Lane Landfill Superfund Site and the remedial action proposed in this Proposed Plan and to submit comments for consideration by EPA. A public comment period will open April 12, 2021 and close May 12, 2021. All comments must be postmarked by May 12, 2021.

Written comments, questions about the Proposed Plan or public meeting, and requests for information can be sent to:

Chris Vallone (3SD23)
Remedial Project Manager
U.S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103
(215) 814-3306
Vallone.Christopher@epa.gov

Alexander Mandell (3RA22)
Community Involvement Coordinator
U.S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103
(215) 814-5517
Mandell.Alexander@epa.gov

Public Meeting – A recorded video presentation has been published in place of a public meeting. To review the Proposed Plan, watch the recorded presentation, and read the transcript to the presentation, please visit: www.epa/gov/superfund/hiddenlane

The public is encouraged to review the Proposed Plan and submit comments to EPA between April 12, 2021 and May 12, 2021. Comments may be submitted any one of three ways. All comments received will be treated equally.

- **Mail (postmarked no later than 05/12/2021):** U.S. EPA Region 3 Attn: Chris Vallone 1650 Arch Street (Mail code: 3SD23) Philadelphia, PA 19103

- **E-mail:** vallone.christopher@epa.gov

- **Voicemail:** Call 215-814-2007 to leave a message. Please speak slowly and clearly and include your name and phone number.

EPA will host a question and answer session on Wednesday, April 21, 2021 from 6:00pm to 7:00pm. Instructions for connecting to this question and answer session are below. This session will provide an opportunity for the public to raise, with EPA personnel and others on the call, questions and issues regarding the Proposed Plan. A transcript of this session will be included in the Administrative Record supporting the ROD.

Instructions for Connecting to the Question and Answer Session
To join the audio conference call for the question and answer session on Wednesday, April 21, 2021, please dial **484-352-3221**. When prompted, enter the Conference ID code: **722-199-998#** All participants will be muted on the line during a brief opening message from EPA, and then will be prompted to ask questions. To unmute the line, participants may press ***6**.

Detailed information on the material discussed herein may be found in the Administrative Record file for the Site, which includes the OU-3 FS and other information used by EPA in the decision-making process. EPA encourages the public to review the Administrative Record file to gain a more comprehensive understanding of the Site and the Superfund activities that have taken place there. Copies of the Administrative Record file are available for review at www.epa.gov/superfund/hiddenlane or at the following locations:

Cascades Library
21030 Whitefield Place
Potomac Falls, VA 20165
Hours: Call (703) 444-3228
http://library.loudoun.gov

EPA Administrative Records Room
Attn: Administrative Records Coordinator
1650 Arch Street
Philadelphia, PA 19103
(215) 814-3157
Hours: Monday through Friday, 8:00am to 4:30pm; by appointment only.

Following the conclusion of the public comment period on this Proposed Plan, EPA, in consultation with VDEQ, will select the remedial action to address the principal threat source material in the overburden and/or bedrock and address the WMA, reviewing and considering all information submitted during the 30-day public comment period. EPA, in consultation with VDEQ, may modify the Preferred Alternative or select another response action presented in this Proposed Plan based on new information or public comments.

EPA will then prepare a formal decision document, the ROD, in which EPA will identify the selected remedial action for the Site. EPA will prepare a Responsiveness Summary which will summarize and respond to comments received during the public comment period. The OU-3 ROD will include the Responsiveness Summary. Copies of the OU-3 ROD for the remedial action will be available for public review in the Administrative Record following issuance of the ROD. EPA will notify the public of its availability.