Formerly Used Defense Sites (FUDS) Program
U.S. Army Corps of Engineers (USACE)

PROPOSED PLAN
Former Raco Army Airfield and Missile Site
Chippewa County, Michigan
January 2020

US Army Corps of Engineers®

DATES TO REMEMBER
PUBLIC COMMENT PERIOD: Jan. 27, 2020 to Feb. 26, 2020
PUBLIC MEETING: Feb. 4, 2020

USACE will accept written comments on the Proposed Plan via U.S. mail or electronic mail during the public comment period. Written comments must be postmarked or posted no later than the last day of the public comment period and mailed to Mr. Aaron Steele.

Mr. Aaron Steele
USACE, Louisville District
PO Box 59
Louisville, Kentucky 40201-0059

PUBLIC MEETING: Tuesday, Feb. 4, 2020; 6:00 to 8:00 pm EST

USACE will hold a public meeting to explain the Proposed Plan and the preferred alternative presented. Oral and written comments will also be accepted during the meeting. The meeting will be held at:

Bay Mills Resort and Casino, Sunset Meeting Room
11386 West Lakeshort Drive,
Brimley, Michigan 49715

For more information, see the Administrative Record File at one of the locations below:

Bayliss Public Library	Bay Mills Community College	U.S. Army Corps of Engineers
541 Library Drive	Library (electronic copies only)	Public Affairs Office
Sault Ste Marie, Michigan 49783	12214 W. Lakeshore Dr.	600 Dr. Martin Luther King Jr. Place
(906) 632-9331	Brimley, Michigan 49715	Louisville, Kentucky 40202
	(906) 248-8418	(502) 315-6773

Or on the Internet:
https://www.lrl.usace.army.mil/Missions/Environmental/Raco-Army-Airfield/

1. INTRODUCTION

This document presents the **Proposed Plan**[1] for the U.S. Army Corps of Engineers (USACE[2]), Louisville District (CELRL). GEO Consultants prepared this report for CELRL under Contract Number W91237-15-D-0011, Delivery Order CY02. The Proposed Plan presents the Preferred Alternative and provides

[1] All terms appearing in bold print are defined in the Glossary of Terms in Attachment A on pages 19 and 20.
[2] A list of Acronyms and Abbreviations is provided in Attachment B on page 21.

information to support use of the Preferred Alternative to remedy contaminated groundwater at the **Formerly Used Defense Site (FUDS)** Former Raco Army Airfield and Missile Site (the Raco Site). This Proposed Plan also describes the site background and remedial objectives, and includes summaries of other alternatives evaluated for use at the site.

U.S. Army environmental investigations and remediation at the Raco Site are administered under the FUDS program in accordance with the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)**, as amended by the Superfund Amendments and Reauthorization Act (SARA), and the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)**. Execution of the FUDS program was delegated by the Department of Defense (DoD), through Headquarters of the Army, to the USACE. The delegation made USACE the chief executor for environmental restoration activities at FUDS. The FUDS program was established under the Defense Environmental Restoration Program (DERP) and addresses releases or threatened releases attributable to DoD activities on FUDS properties. FUDS properties are properties that were owned by, leased to, or otherwise possessed by the U.S. and under the jurisdiction of the Secretary of Defense that were transferred from DoD control prior to 17 October 1986.

The Proposed Plan is a document issued by USACE, the lead agency for environmental response actions under FUDS at the Raco Site, to fulfill public participation requirements as required under Section 117(a) of CERCLA and Section 300.430(f)(2) of the NCP. The public participation process gives the public a reasonable opportunity to submit written and oral comments on the proposed determination concerning the need for remedial action at the Raco Site.

The three alternatives assessed for use at the site included:

- Alternative 1 – No Action
- Alternative 2 – Monitored Natural Attenuation (MNA), institutional control on federal land, educational control on private land, and private well sampling
- Alternative 3 – MNA, institutional control on federal land, educational control on private land, private well sampling, and in situ bioremediation by enhanced anaerobic bioremediation (EAB)

USACE chose Alternative 2 as the Preferred Alternative which includes MNA with long-term monitoring of the trichloroethene (TCE) groundwater plume for stability and natural degradation, as well as groundwater use controls. USACE, in consultation with Michigan Department of Environment, Great Lakes, and Energy (EGLE) and the U.S. Department of Agriculture (USDA) – Forest Service who manages the property for the landowner (the United States), will select the final remedy for the site after reviewing and considering information submitted during the public comment period. The Preferred Alternative presented in this Proposed Plan may be modified based on new information or public comments. Therefore, the public is encouraged to review and comment on all alternatives presented in this Proposed Plan.

USACE is issuing this Proposed Plan as part of its public participation responsibilities under 40 Code of Federal Regulations (CFR) 300.430(f)(2), the NCP. This Proposed Plan summarizes information that is provided in greater detail in the **Remedial Investigation (RI)** and **Feasibility Study (FS)** reports and other documents contained in the **Administrative Record File** for the Raco Site. USACE and EGLE encourage the public to review these documents to gain a more comprehensive understanding of the site and the FUDS activities previously conducted.

2. COMMUNITY ROLE IN THE RESPONSE ACTION SELECTION PROCESS

USACE will consider comments submitted during the public comment period. After consideration (in consultation with EGLE and the USDA Forest Service), the Army will select the final remedy. USACE, in consultation with EGLE and USDA Forest Service, may modify the preferred alternative or select another

alternative presented in this plan based on new information or public comments; therefore, the public is encouraged to review and comment on all alternatives presented in this Proposed Plan.

Responses to public comments will be provided in a "Responsiveness Summary" attached to a **Decision Document** that presents the final selected remedy for the site. More detailed information regarding the site, including the Feasibility Study Report (USACE 2019a), is available in the site Administrative Record File. The public is encouraged to review the information.

3. SITE BACKGROUND

The Raco Site is located 18 miles southwest of Sault Sainte Marie, Michigan and 4.5 miles west of the city of Raco on property that is part of the Hiawatha National Forest (Figure 1, Figure 2). The Raco Site (FUDS Property E05MI0026) consists of 1825.94 acres acquired by the U.S. government between 1942 and 1945 via various transfer permits, licenses, leaseholds, easements, and fee purchases. The Raco Army Airfield was constructed between 1942 and 1943. The missile base was constructed southeast of the airfield in 1959 and used by the U.S. Air Force from 1960 to 1972 (USAF 1972). The missile base consisted of 28 Bomarc missile launch shelters and support structures, including a wastewater treatment facility along the eastern boundary of the missile base (Figure 3). The wastewater treatment facility included a lagoon and various underground concrete vaults.

Between 1962 and 1964, the Air Force released all property interests to the USDA – Forest Service except for the 152.54-acre missile area and an additional 5-acre area. On June 30, 1973 and March 24, 1976, respectively, these 152.54-acre and 5-acre areas were released to the USDA – Forest Service. Since that time, the property has remained under USDA – Forest Service jurisdiction (USACE 2013b).

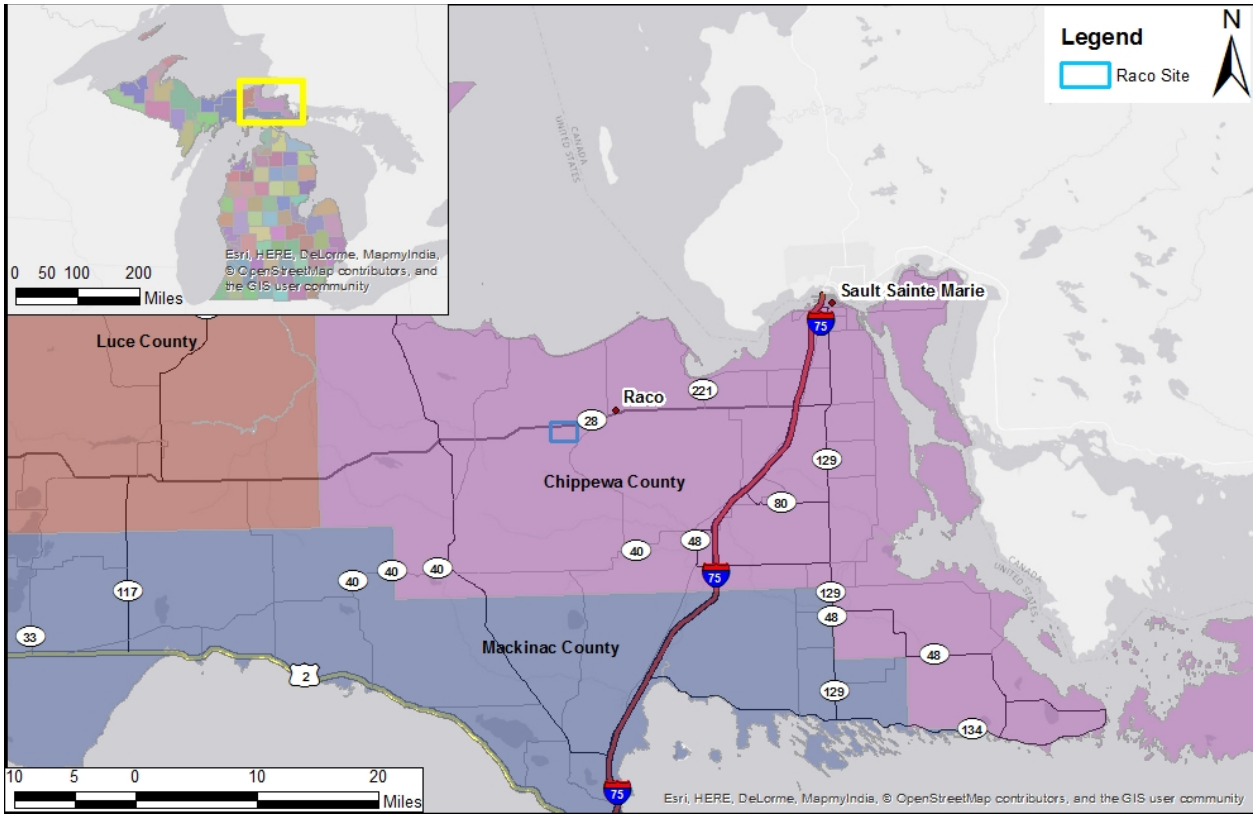

Figure 1 Site location map.

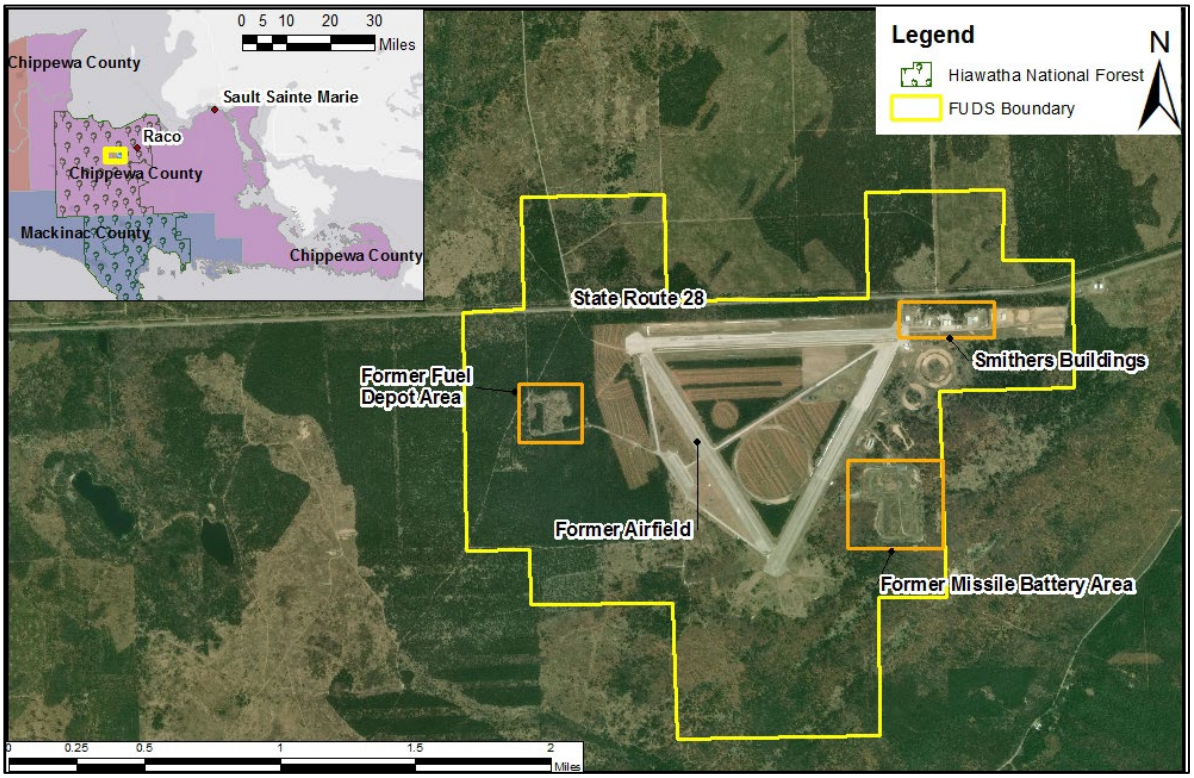

Figure 2. Raco Site location and layout.

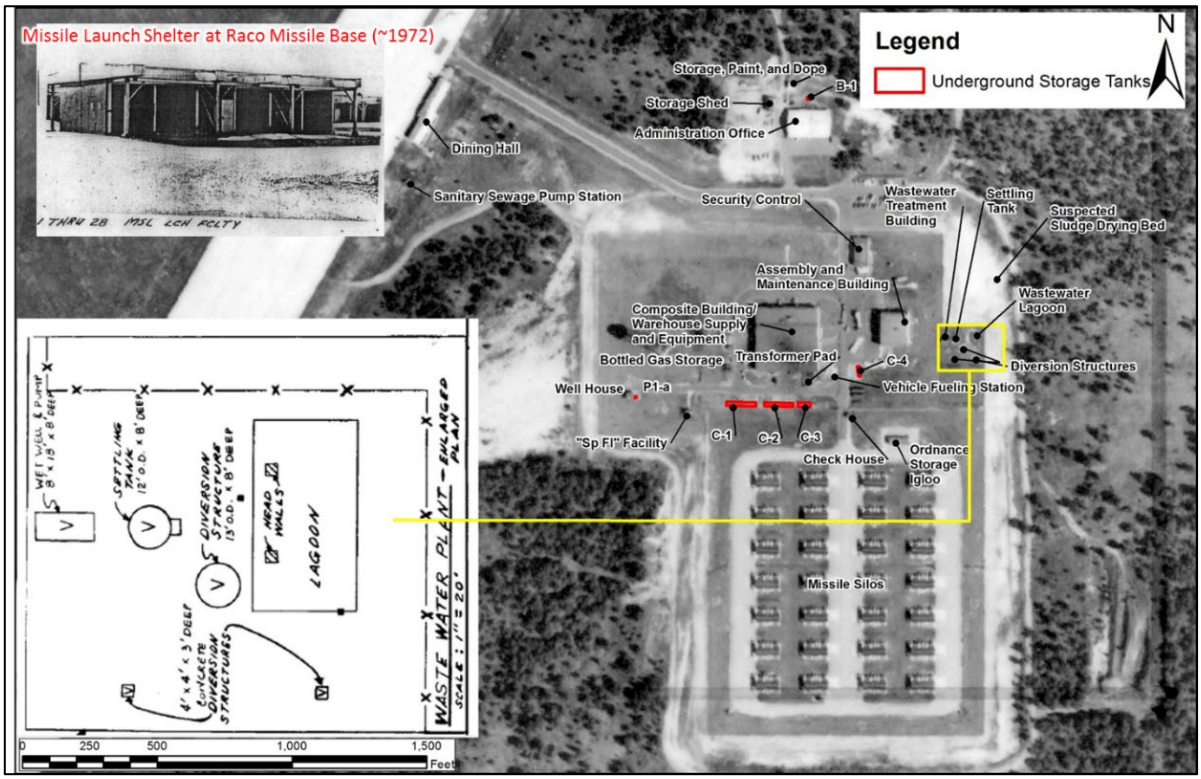

Figure 3. Former missile battery area on Base (1972 aerial photograph).
(Note: Underground storage tanks were previously removed from the Raco Site.)

Since receiving jurisdiction over the Raco Site, the USDA – Forest Service has been leasing a portion of the property including the runways and the former missile base area to Smithers Scientific Services, Inc. (Smithers) for use as a winter automotive testing facility. The forested area surrounding the Raco Site is managed by the USDA – Forest Service to provide wildlife habitat for various avian species, conifer timber products to the regional economy, and recreational areas (USDA 2006). Because of its location within the National Forest System, the Raco Site is likely to remain publicly owned and part of the Hiawatha National Forest in the future. However, there are privately owned tracts of land within the Hiawatha National Forest, two of which are located approximately 1 mile east and 1.5 miles southeast of the Raco Site. The Raco Site is currently used at irregular intervals by the Smithers Winter Test Center for vehicle testing; this industrial/commercial type use is expected to continue. There are three water wells located near the Smithers Buildings. These water wells supply drinking water, water for making ice and snow to support winter testing activities at Smithers, and water for fire engine water tanks used by USDA Forest Service.

An Abbreviated Preliminary Assessment was completed in 2013 and concluded that TCE contamination at the Raco Site was attributed to DoD based on the the use of TCE at other missile bases from approximately the same time period, Smithers Winter Test Center is unlikely to be a TCE source, there are no other known historical uses of the site, and there is no evidence of post-DoD use of the wastewater lagoon (the presumed source) by non-DoD parties (USACE 2013a).

The first environmental investigation at the Raco Site was performed in 1987 (Envirodyne 1987). In 1988, the missile base structures were demolished, underground storage tanks were removed, and remnants of the demolished structures were buried by clean fill (USACE 1987). Multiple environmental investigations have since been conducted at the site (IT Corp. 1991, BCM 1996, Barr 2002, USACE 2003, Earth Tech 2005, GEO 2008, GEO 2010, USACE 2018). From 2009 to 2017, the RI/FS was conducted at the site by USACE. The RI/FS characterized the nature and extent of contamination at the Raco Site, evaluated risk based on exposure pathways and receptors through a **Baseline Human Health Risk Assessment (BLRA)** and **Screening Level Ecological Risk Assessment (SLERA)**, and developed remedial alternatives to address DoD contamination remaining at the site. The RI/FS found that TCE in the groundwater plume exceeded the U.S. Environmental Protection Agency (USEPA) Maximum Contaminant Levels (MCLs), which is the primary drinking water regulation.

4. SITE CHARACTERISTICS

The region surrounding the Raco Site is characterized by gently rolling terrain. The Raco Site is located on a level area at an elevation of approximately 900 feet. The ground surface slopes to lower levels to the east and southeast of the Raco Site. Approximately 3 to 5 miles to the east, the landscape becomes an extensive wetland.

The water table at the Raco Site occurs 40-50 feet below ground surface (bgs). A contour map of water levels measured in monitoring wells shows overall groundwater flow to the east/southeast (USACE 2018). The hydraulic gradient was estimated at 0.0023 based on water level measurements in July 2015, October 2015, and August 2017 (USACE 2018). Using the average hydraulic conductivity from measurements during the RI, the hydraulic gradient (0.0023), and assumed porosities of 0.25 and 0.5, groundwater flow (or seepage) velocity was estimated between 53 and 107 feet/year (USACE 2018).

5. CONTAMINANT SOURCES

5.1 PLUME DELINEATION

The overall purpose of the RI was to delineate the TCE plume identified during previous investigations by collecting groundwater samples at 10-foot depth intervals and analyzing them at an on-site laboratory. TCE concentrations versus depth profiles for each borehole were obtained in near-real time and used to decide on placement of successive sampling locations to delineate the TCE plume.

The downgradient extent of the plume with respect to the MCL for TCE (5 micrograms per liter [µg/L]) was not delineated in the RI fieldwork because the outer end of the plume had descended to a depth of 300 feet and TCE was still detected at concentrations greater than the MCL (5 µg/L). Although the RI objective of fully delineating the TCE plume was not achieved, a decision was made by USACE with EGLE concurrence to complete the RI Report and proceed with the FS. The known extent of the TCE groundwater plume (>5 µg/L) is within the Hiawatha National Forest (Figure 4) apparently originating near the former wastewater treatment area at a depth approximately 10 feet below the aquifer water table (60 feet deep) extending ½ mile east-south-east, descending to a depth of 300 feet below the water table (345 feet deep) into the bedrock aquifer. As shown in Figure 4, the TCE plume is more than ½ mile away from the nearest residential wells. These residential wells intake water from much shallower depths (less than 100 feet deep). TCE was detected in groundwater from depths of 287 to 344 feet in the borehole where the most down-gradient well was installed in the TCE plume (MW-37).

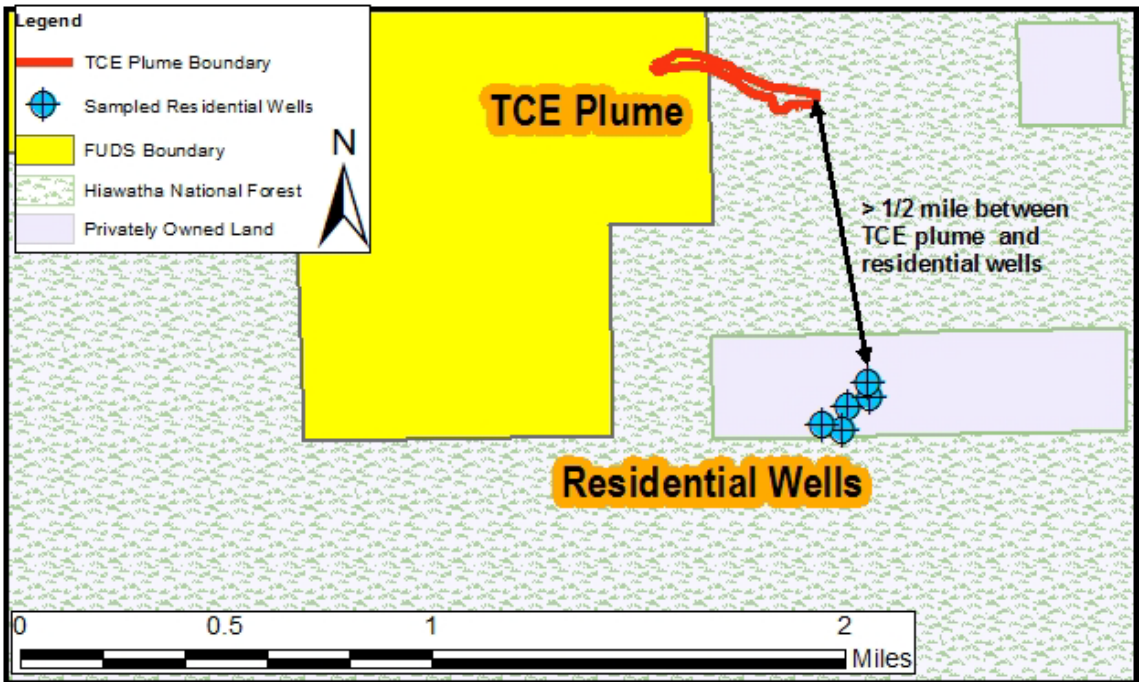

Figure 4. Location of nearby residential wells in relation to the TCE plume

Figure 5 shows the monitoring wells along the centerline of the plume and the TCE concentrations relative to the MCL of 5 µg/L in July 2015. Other than low level detections (<1 µg/L) of cis-1,2-dichloroethene (cis-1,2-DCE) in MW-31 and a single similar low level detection in MW-34, no other TCE degradataion products were detected in the monitoring wells. Based on these results, TCE in the plume does not appear to be degrading, or if degradation is occurring it is limited to the zone near MW-31/MW-32 (USACE 2018).

5.2 SOURCE INVESTIGATION

In 2016/2017, a source investigation was conducted in the former wastewater treatment area to look for remnants of the buried concrete vaults that were part of the former wastewater treatment system. The vault of primary interest as a potential source, designated as "Vault 4" during the RI, was uncovered and found to be much deeper than expected (approximately 18 feet instead of 8 feet as shown in a historical drawing), and appeared to be an Imhoff Tank instead of a conventional settling tank. Sludge-like material in the vault contained elevated levels of TCE and its degradation products. The highest TCE concentration in sludge-like samples from the vault was measured at 1,340 micrograms per kilogram (µg/kg).

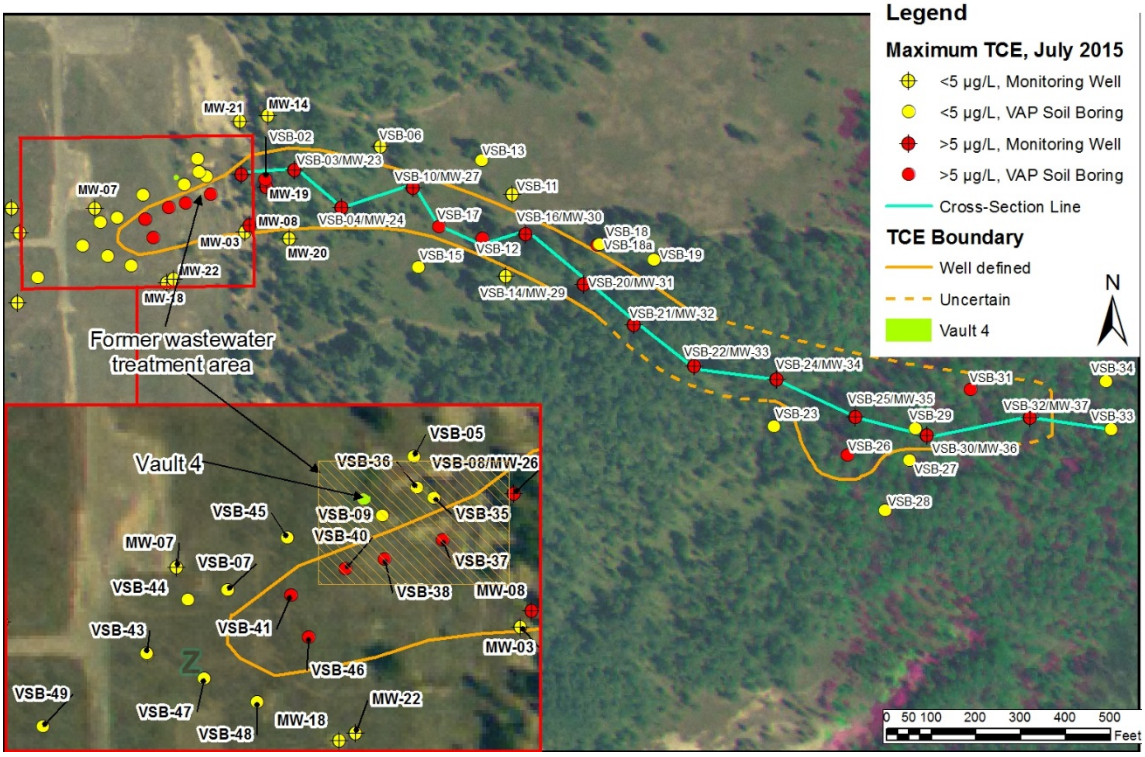

Figure 5. Monitoring wells located within the TCE plume

To evaluate whether TCE and other contaminants in the contents of the vault were leaking out of the vault, two boreholes were drilled immediately adjacent to the vault to collect soil and groundwater samples. Neither TCE nor its degradation products were detected.

Groundwater and soil samples were collected from vertical aquifer profiling (VAP) boreholes located south and southwest of the former wastewater treatment area to locate other potential impacts in this area at the Raco Site. TCE was detected in groundwater from the water table to approximately 80 feet bgs; the VAP boreholes where TCE was detected south/southwest of the former wastewater treatment area are shown on the inset in Figure 5. Neither TCE nor its degradation products were detected in soil samples above the water table collected from these boreholes. There was no evidence that the buried Vault 4 was actively leaking.

The vault was planned for removal during the source investigation to access underlying soil for sampling. However, since the vault was much deeper than anticipated and excavation equipment to handle the larger tank was not available in the field, it was left in place and re-covered. No direct evidence was found to definitively show Vault 4 was the source of the plume.

5.3 VAULT 4 REMOVAL

Vault 4 and the contaminated soils within it were removed in October 2019 as a part of a non-time critical removal action (NTCRA). Confirmation sample results were below the screening level of 100 mg/kg. As documented in the Removal Action Report, soil sampling after contaminated soil was removed from the site showed that further investigation or remediation in the vicinity of the vault are not warranted (USACE 2019b).

6. SUMMARY OF SITE RISKS

6.1 BASELINE HUMAN HEALTH RISK ASSESSMENT

In 2018, a BLRA was conducted to evaluate potential human health risks resulting from exposure to groundwater contamination if no remedial action is taken at the Raco Site. In evaluating risk from groundwater contamination, each monitoring well was considered as a separate Exposure Unit (EU) (Figure 6).

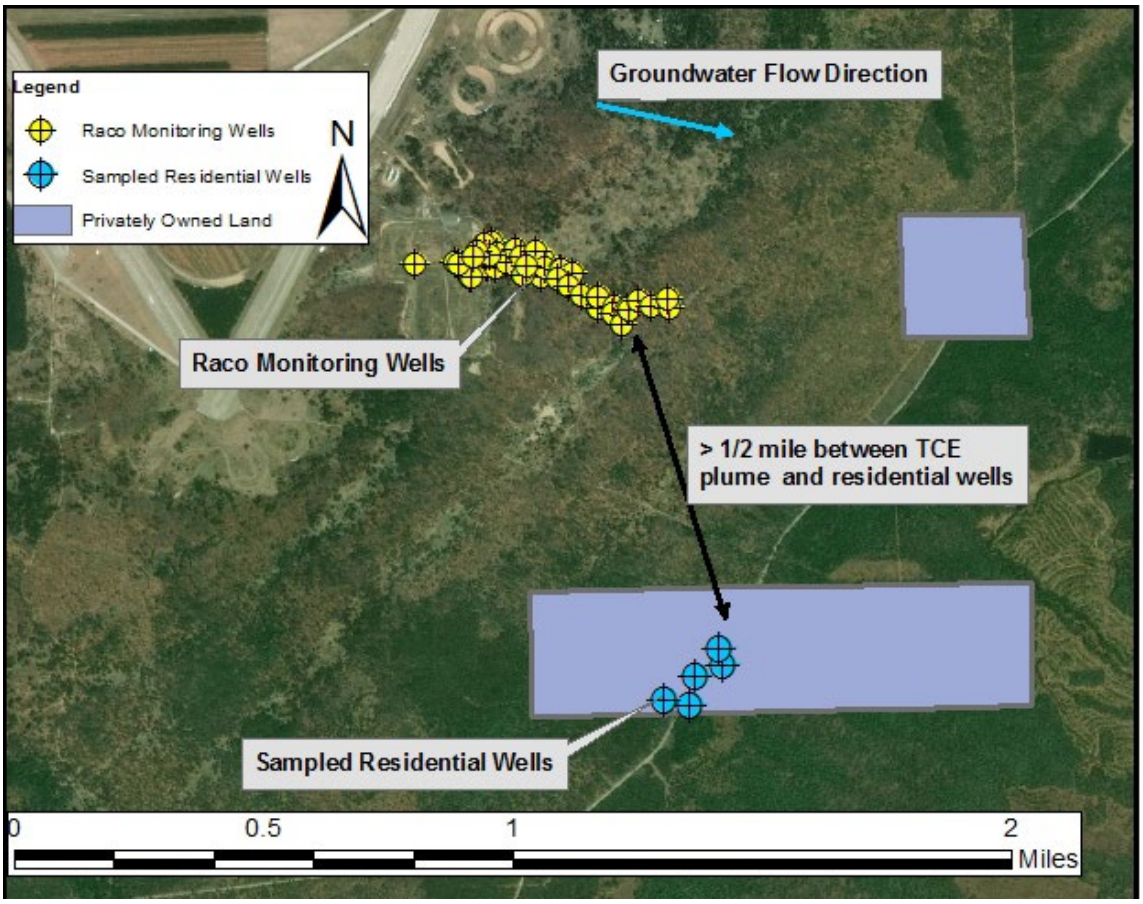

Figure 6. Location of Raco Site monitoring wells and sampled residential wells

The BLRA focused on TCE, which was the only chemical of potential concern (COPC) in groundwater where chemical analysis results from the RI exceeded risk-based screening levels and USEPA MCLs. Soil was not included in the BLRA because soil concentrations (except for inside Vault 4) were below USEPA Regional Screening Levels. Data were compared against human health screening criteria that consisted of the USEPA Regional Screening Level criteria for groundwater that were current at the time the RI report was written (November 2017), as well as state and federal drinking water standards for groundwater (EGLE Generic groundwater cleanup criteria [3] R299.44).

The site receptors considered in the BLRA were a resident (child and adult), a forest service worker, an industrial worker, and a site visitor (child and adult). The forest service worker and industrial worker were

[3] EGLE Cleanup Criteria Requirements for Response Activity, formerly the Part 201 Generic Cleanup Criteria and Screening Levels which was rescinded on December 31, 2013 and replaced with new cleanup criteria rules (299.1 to 299.50) which became effective on December 20, 2013. http://www.michigan.gov/deq/0,4561,7-135-3311_4109-251790--,00.html

based on recent land use. An unrestricted land use scenario was incorporated in the risk assessment by including residential and site visitor receptors (adult and child), although residential use is not a current or anticipated land use for the area above the known TCE plume. In the **conceptual site model**, it was assumed that there were potentially complete pathways from groundwater to all four site receptors. This completed pathway was then included in the BLRA.

The **incremental lifetime cancer risk (ILCR)** for each site receptor is shown in Table 1. The ILCRs were at the upper end of the acceptable risk range of 10^{-4} to 10^{-6} for the Resident and Industrial Worker for two of the on-site monitoring wells (Figure 5). The ILCRs were within or below the acceptable risk range for the remaining receptors and EUs (Table 1).

Table 1. Summary of ILCRs for site receptors exposed to groundwater.

	Unrestricted Land Use	Commercial/Industrial Land Use		Unrestricted Land Use
Exposure Unit	**Resident**	**Industrial Worker**	**Forest Service Worker**	**Site Visitor**
Located on Raco Site and National Forest Land used by Smithers				
MW-08	2×10^{-5}	2×10^{-5}	9.48×10^{-6}	2×10^{-6}
MW-19	5×10^{-5}	5×10^{-5}	2×10^{-5}	5×10^{-6}
MW-20	2×10^{-6}	2×10^{-6}	8×10^{-7}	2×10^{-7}
Located on Raco Site and National Forest Land not currently used by Smithers				
MW-23	**1.15×10^{-4}**	**1×10^{-4}**	5×10^{-5}	1×10^{-5}
MW-24	2×10^{-5}	2×10^{-5}	1×10^{-5}	2×10^{-6}
MW-25	1×10^{-5}	1×10^{-5}	6×10^{-6}	8×10^{-7}
MW-26	**1×10^{-4}**	**1×10^{-4}**	5×10^{-5}	6×10^{-6}
MW-27	4×10^{-5}	4×10^{-5}	2×10^{-5}	2×10^{-6}
MW-29	2×10^{-6}	2×10^{-6}	1×10^{-6}	2×10^{-7}
MW-30	2×10^{-5}	2×10^{-5}	8×10^{-6}	1×10^{-6}
MW-31	5×10^{-5}	5×10^{-5}	2×10^{-5}	3×10^{-6}
MW-32	3×10^{-5}	3×10^{-5}	2×10^{-5}	2×10^{-6}
MW-33	8×10^{-5}	8×10^{-5}	4×10^{-5}	5×10^{-6}
MW-34b	6×10^{-5}	6×10^{-5}	3×10^{-5}	4×10^{-6}
MW-34c	1×10^{-5}	1×10^{-5}	6×10^{-6}	7×10^{-7}
MW-35	2×10^{-6}	2×10^{-6}	1×10^{-6}	1×10^{-7}
MW-36	4×10^{-5}	4×10^{-5}	2×10^{-5}	2×10^{-6}
MW-37	8×10^{-5}	8×10^{-5}	4×10^{-5}	5×10^{-6}

CFR: Code of Federal Regulations; COPC: chemical of potential concern; EU: exposure unit; ILCR: incremental lifetime cancer risk; TCE: trichloroethene
Note: Acceptable cancer risk is between one in ten thousand (10^{-4}) and one in one million (10^{-6}), 40CFR 300.430(e)(2)(i)(A)(2).
TCE is the only COPC for all EUs.

The **hazard indices (HIs)** from groundwater exceeded the target hazard index of 1 for multiple monitoring wells and most of the receptors (Table 2). An HI value of less than 1 indicates that adverse non-cancer health effects are considered extremely unlikely, while an HI of greater than 1 indicates that adverse health effects may occur.

Table 2. Summary of HIs for site receptors exposed to groundwater.

	Unrestricted Land Use		Commercial/Industrial Land Use		Unrestricted Land Use	
Exposure Unit	**Resident Child**	**Resident Adult**	**Industrial Worker**	**Forest Service Worker**	**Site Visitor Child**	**Site Visitor Adult**
Located on Raco Site and National Forest Land used by Smithers						
MW-08	**3.5**	**3.2**	**1.4**	0.31	0.26	0.15
MW-19	**8.5**	**7.6**	**3.4**	0.75	0.61	0.35
MW-20	0.29	0.26	0.12	0.026	0.021	0.012
Located on Raco Site and National Forest Land not currently used by Smithers						
MW-23	**20**	**18**	**8.0**	**1.8**	**1.5**	0.84
MW-24	**4.2**	**3.8**	**1.7**	0.38	0.31	0.18
MW-25	**2.2**	**2.0**	0.87	0.19	0.11	0.057
MW-26	**18**	**16**	**7.2**	**1.6**	0.92	0.47
MW-27	**6.4**	**5.7**	**2.5**	0.56	0.33	0.17
MW-29	0.42	0.38	0.17	0.038	0.022	0.011
MW-30	**2.9**	**2.6**	**1.1**	0.25	0.15	0.075
MW-31	**8.9**	**8.0**	**3.5**	0.78	0.45	0.23
MW-32	**6.0**	**5.4**	**2.4**	0.53	0.31	0.16
MW-33	**14**	**13**	**5.6**	**1.3**	0.72	0.37
MW-34b	**11**	**9.5**	**4.2**	0.94	0.54	0.28
MW-34c	**2.1**	**1.8**	0.81	0.18	0.10	0.054
MW-35	0.39	0.35	0.15	0.034	0.020	0.010
MW-36	**6.7**	**6.0**	**2.7**	0.60	0.34	0.18
MW-37	**15**	**13**	**5.8**	**1.3**	0.74	0.38

COPC: chemical of potential concern; EU: exposure unit; HI: hazard index; OSWER: Office of Solid Waste and Emergency Response; TCE: trichloroethene; USEPA: U.S. Environmental Protection Agency

Note: Acceptable HI is below 1, USEPA OSWER Directive 9355.0-30.

TCE is the only COPC for all EUs.

6.2 ECOLOGICAL RISK ASSESSMENT

With respect to ecological risk, previous investigations and fieldwork performed for the RI did not identify significant surface contamination. An ecological reconnaissance was performed in the vicinity of the Raco Site in August 2014; the results are detailed in the RI Report (USACE 2018). Contaminated soil/sludge-like material was found in the buried remnants of Vault 4; the vault and contents were removed in October 2019. TCE-contaminated groundwater is present at the site, but the water table occurs 50 feet bgs.

Based on site conditions, direct exposure of ecological species to contaminated soil in Vault 4 (removed in October 2019) and in groundwater is considered unlikely. The RI concluded that no additional ecological site assessments or ecological risk assessments are recommended for this site.

6.3 SUMMARY

USACE's current judgement, as the lead agency on the site, that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health and welfare from actual or threatened releases of hazardous substances into the environment.

7. REMEDIAL ACTION OBJECTIVES

The selected action will be the remedial action for the TCE groundwater plume at the Raco Site. The objectives for the remedial action at the impacted portions of the Raco Site are to prevent ingestion, inhalation, and direct contact with groundwater containing TCE and degradation products above **Remedial Action Objectives (RAOs)**.

The CERCLA and the NCP define RAOs that are applicable to all Superfund sites and the development of remedial actions. Site-specific RAOs relate to potential exposure routes and specific contaminated media, such as groundwater, and are used to identify target areas of remediation and contaminant concentrations. RAOs require an understanding of the contaminants in their respective media and are based on the evaluation of risk to human health and the environment, information gathered during the RI, and applicable guidance documents.

In consideration of the data collected and the findings of the risk assessments, RAOs are recommended for groundwater only. Because there are no unacceptable risks posed by contaminants in soil, there are no recommended RAOs for soil. The RAO for groundwater is to prevent ingestion, inhalation, and direct contact with groundwater to protect current and future human populations from exposure to TCE-contaminated groundwater and degradation products (cis-1,2-DCE and vinyl chloride) above their respective USEPA MCLs (Table 3).

Table 3. Summary of exposure routes, receptors, and remediation goals.

Contaminant of Concern	Exposure Routes	Receptor	Remediation Goal
TCE	Inhalation, Ingestion, Dermal Contact	All receptors	USEPA MCL of 5 µg/L
cis-1,2-DCE	Inhalation, Ingestion, Dermal Contact	All receptors	USEPA MCL of 70 µg/L
Vinyl chloride	Inhalation, Ingestion, Dermal Contact	All receptors	USEPA MCL of 2 µg/L

cis-1,2-DCE: cis-1,2-dichloroethene; MCL: Maximum Contaminant Level; TCE: trichloroethene; USEPA:U.S. Environmental Protection Agency; µg/L: micrograms per liter

CERCLA Section 121 requires that on-site remedial actions attain or waive federal **applicable or relevant and appropriate requirements (ARARs),** or more stringent state environmental ARARs, upon completion of the remedial action. A requirement under CERCLA may be either "applicable" or "relevant and appropriate" to a site-specific remedial action, but not both. USACE, as the lead agency on the site, has determined that the ARARs for the Raco Site are the USEPA MCLs for TCE, cis-1,2-DCE, and vinyl chloride listed in Table 3..

8. SUMMARY OF REMEDIAL ALTERNATIVES

Based on the established site conditions and contaminant characteristics three potential remedial actions were evaluated in the FS (USACE 2019a). They were:

- No Action
- MNA, Institutional Control on Federal Land, Educational Control on Private Land, and Private Well Sampling
- MNA, Institutional Control on Federal Land, Educational Control on Private Land, Private Well Sampling, and In Situ Treatment with EAB

8.1 ALTERNATIVE 1 – NO ACTION

The no action response is identified, as required by the NCP, for the purpose of establishing a baseline against which other alternatives are compared. There would be no preventative or remedial action implemented as a result of the no action response and the current contamination in the groundwater would not be remedied.

8.2 ALTERNATIVE 2 – MONITORED NATURAL ATTENUATION, INSTITUTIONAL CONTROL ON FEDERAL LAND, EDUCATIONAL CONTROL ON PRIVATE LAND, AND PRIVATE WELL SAMPLING

Alternative 2 consists of MNA, institutional control on federal land, educational control on private land, and private well sampling.

Institutional control on federal land will consist of two parts: an area where installation of new groundwater wells will be prohibited by USDA – Forest Service. The area where installation of new groundwater wells will be prohibited is defined by a 3,000-foot buffer distance from the known extent of the TCE plume and a 45-degree east/southeast sector that encompasses the likely downgradient pathway of the TCE plume 2 miles[4] beyond the known extent (Figure 7). The new groundwater well prohibited area will only include federal land and will not include private lands (Figure 7). Drinking water wells exist on private land within the 3,000-foot buffer; however, several of these wells were sampled as a part of the RI and were confirmed not to contain TCE or degradation products. Drinking water wells supply water to the Smithers buildings and are within the 3,000-foot buffer; however, these wells were sampled in 2009 and confirmed not to

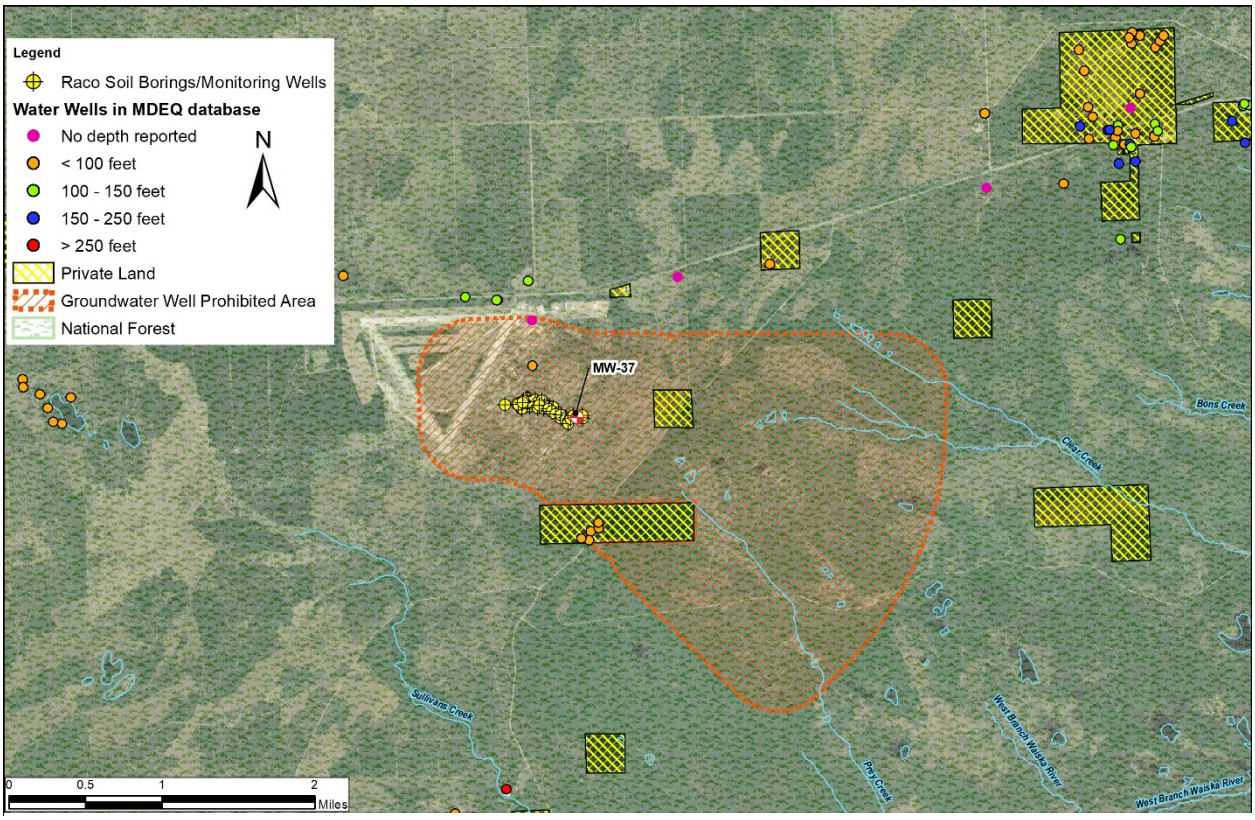

Figure 7. Proposed groundwater well prohibited areas

[4] Based on measured hydraulic conductivities, hydraulic gradients, and likely release time frames, the plume may extend approximately 1,000 feet to a mile beyond the most downgradient monitoring well (MW-37, see Figure 7 for location) (USACE 2018). Thus, the 2-mile distance from the most downgradient monitoring well specified for the groundwater well prohibition area (Figure 7) is greater than the estimated plume length.

contain TCE or degradation products. The supply wells at the Smithers buildings are also used by USDA Forest Service for filling water tanks on fire engines.

Educational control and private well sampling will be implemented on the private lands that are within 2 miles east/southeast of the most downgradient Raco Site monitoring well (MW-37, see Figure 7 for location). Letters will be sent to the private land owners informing them of the Raco Site TCE plume, the property being potentially downgradient of the TCE plume, how they might be exposed to TCE contamination in groundwater, and the private well sampling program. If granted permission by the owners, private wells will be periodically sampled and analyzed for TCE and its degradation products cis-1,2-DCE and vinyl chloride. Even though the drinking water wells supplying the Smithers buildings are not private wells, they will be sampled as a part of the private well sampling program.

MNA will involve regular sampling of monitoring wells and analysis for target contaminants (TCE and degradation products cis-1,2-DCE and vinyl chloride) and basic water quality parameters. Sampling will be performed at a frequency to be determined during remedial design. The current monitoring well network and the need for additional monitoring wells will be evaluated possibly using statistical analysis and optimization tools as part of remedial design. Selected existing monitoring wells may be abandoned as needed; the wells to be abandoned will be identified during remedial design for this alternative.

Annual reports will be prepared during sampling years summarizing monitoring results. Five-Year Reviews of the remedial action will be conducted. The area will also be periodically monitored both visually and in the EGLE well database to verify that no new wells have been installed in the groundwater well prohibited area. The EGLE well database will also be reviewed for new private wells that need to be included in the educational control and private well sampling program.

MNA, institutional control on federal land, educational control on private land, and private well sampling will continue until TCE is below its MCL (5 µg/L) in the Raco Site monitoring wells. The estimated time until groundwater concentrations are reduced to the MCL or less in monitoring wells ranges from 2 to 46 years (assuming remedial action begins in 2019). The remediation time frame for Alternative 2 was set to 55 years for estimating costs in the FS.

8.3 ALTERNATIVE 3 – MONITORED NATURAL ATTENUATION, INSTITUTIONAL CONTROL ON FEDERAL LAND, EDUCATIONAL CONTROL ON PRIVATE LAND, PRIVATE WELL SAMPLING, AND IN SITU TREATMENT WITH ENHANCED ANAEROBIC BIOREMEDIATION

Alternative 3 consists of MNA, institutional control on federal land, educational control on private land, and private well sampling as detailed in Alternative 2, plus the implementation of EAB in four target treatment zones (Figure 8). These target treatment zones were selected based on TCE concentrations in monitoring wells that exceeded 25 µg/L in the past three sampling events (2015-2017). The current monitoring well network and the need for additional monitoring wells will be evaluated as part of remedial design.

In situ treatment with EAB at the four treatment zones shown in Figure 8 will involve delivering an electron donor solution. If this remedial alternative is selected, bench-scale testing using site soil and a field pilot study will be performed to select the electron donor solution and establish the optimum concentration. Sodium lactate was selected as the electron donor for the FS because it is a low-cost substance and will be easier to inject and disperse into the subsurface as compared to semi-viscous and viscous substances such as emulsified and neat vegetable oil. This choice was also based on successful application of EAB remediation at a deep (greater than 300 feet) basalt aquifer at the Idaho National Laboratory (DOE 2009). Remedy performance will be monitored through periodic groundwater sampling for the analysis of TCE and its degradation products.

The electron donor solution will be delivered to the subsurface using permanent injection wells. A recirculation approach is proposed; the electron donor solution will be injected into injection wells while groundwater is simultaneously extracted from extraction wells placed at some distance from the injection wells (assumed to be 50 feet). As shown in Figure 9, the injection and extraction wells will be installed as "triads," where each triad consists of an injection well placed near the axis of the plume and two extraction wells, one placed on either side of the injection well along a line perpendicular to the plume axis. Recirculation through triads of injection/extraction wells will result in better hydraulic control, improved lactate dispersal, and reduced likelihood of the plume being displaced by the electron donor injections. The preliminary injection/extraction well design shown in Figure 9 was used to estimate the cost for Alternative 3.

The electron donor injections will be performed every 3 months for 5 years. MNA, institutional control on federal land, educational control on private land, and private well sampling as described in Alternative 2 will be part of Alternative 3 until groundwater concentrations of TCE reach the MCL in monitoring wells (assumed to be 20 years beyond the final EAB treatment).

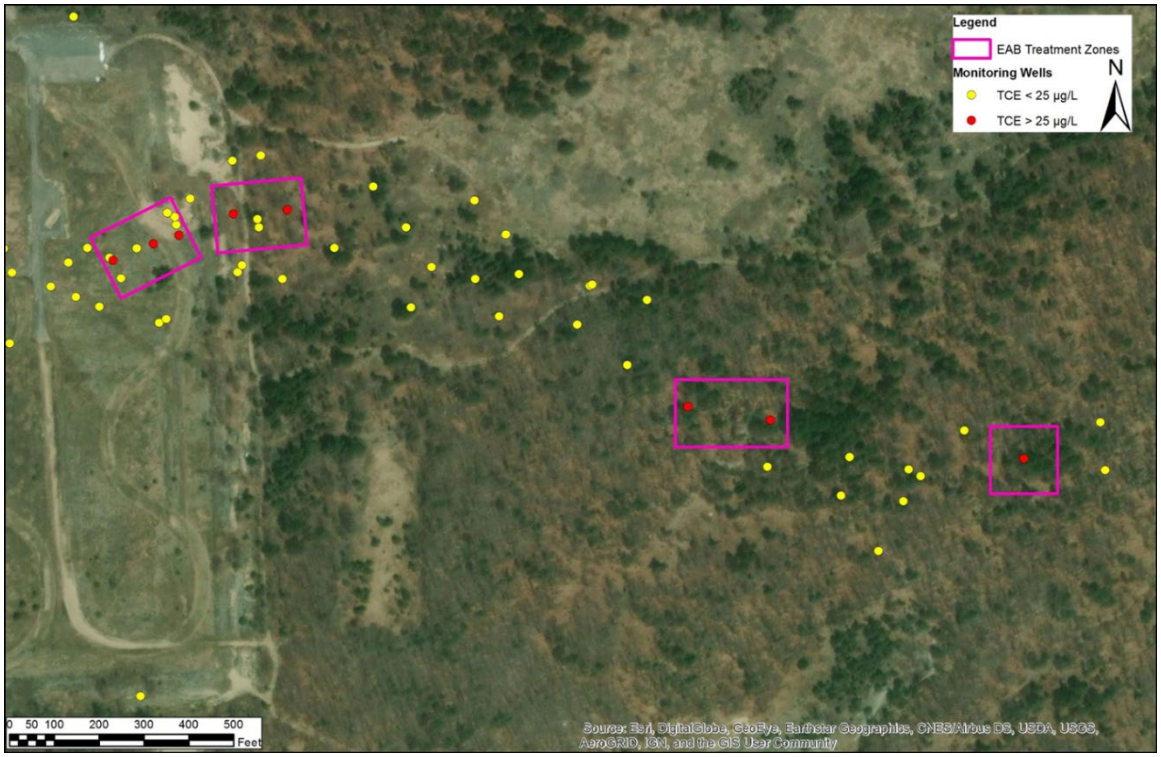

Figure 8. Proposed zones of enhanced anaerobic bioremediation for Alternative 3

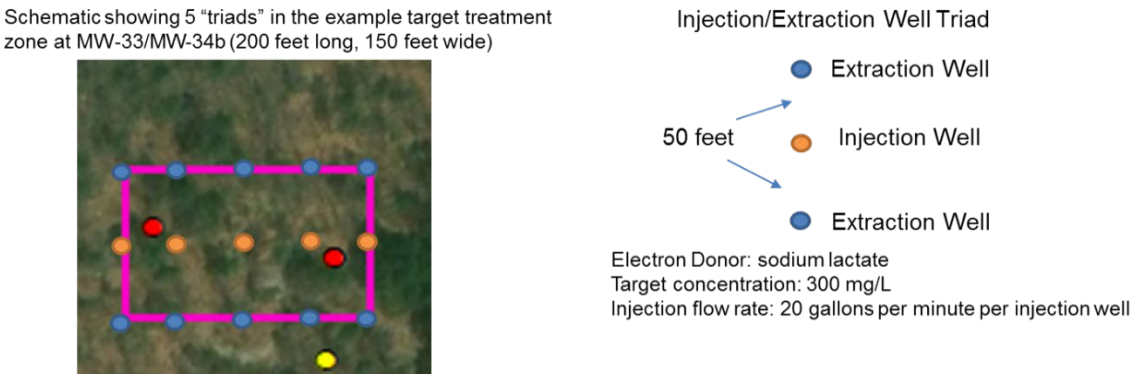

Figure 9. Example enhanced anaerobic bioremediation triad for Alternative 3

9. EVALUATION OF ALTERNATIVES

9.1 CONSIDERATION OF GREEN AND SUSTAINABLE REMEDIATION PRACTICES

The Green and Sustainable Remediation (GSR) memorandum in Appendix C of the FS (USACE 2019a) incorporates the best practices that were considered during the evaluation of remedial alternatives. GSR practices employ the following strategies throughout the remedial process:

- Use natural resources and energy efficiently.
- Reduce negative impacts on the environment.
- Minimize or eliminate pollution at its source.
- Reduce waste to the greatest extent possible.

The GSR strategy for the Raco Site includes implementing sustainability considerations through best management practices and environmental footprint evaluations. The memorandum identifies the best management practices implemented during the FS, which include evaluation of the environmental footprints of the proposed remedial alternatives using SiteWise™ Version 3 (NAVFAC 2013). The results of the evaluation are presented in Appendix D of the FS (USACE 2019a).

9.2 NCP EVALUATION

In accordance with the NCP, the remedial alternatives were evaluated against the following nine criteria:

1. overall protection of human health and the environment;
2. compliance with ARARs;
3. long-term effectiveness and permanence;
4. reduction of toxicity, mobility, or volume through treatment;
5. short-term effectiveness;
6. ease of implementation;
7. estimated cost;
8. state regulatory acceptance; and
9. community acceptance.

In order to establish priority among the screening criteria, they are separated into three groups. The first two criteria listed are threshold criteria, and must be satisfied by the remedial action alternative being considered. The next five are secondary criteria used as balancing criteria among those alternatives which satisfy the threshold criteria. State and community acceptance are evaluated after the public comment period of the Proposed Plan, and a Responsiveness Summary is incorporated into the Decision Document.

1. Overall protection of human health and the environment – Each alternative was assessed to evaluate whether it can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by contaminants at the site by eliminating, reducing, or controlling exposures to levels established during development of the remedial goals. Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

   Alternative 1 does not meet the threshold criteria of protecting human health and the environment. Alternatives 2 and 3 meet the criteria. Both Alternatives 2 and 3 include institutional control to prevent human exposure to contaminated groundwater.

2. Compliance with ARARs – Remedial alternatives are required to achieve ARARs unless specifically waived. ARARs include substantive provisions of any promulgated Federal or more

stringent state environmental or facility siting standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate requirements for a CERCLA site. ARARs include clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site. The only current ARAR is the MCL of 5 µg/L for TCE.

3. Long-term effectiveness and permanence – Each alternative was assessed for the long-term effectiveness and permanence it provides in maintaining protection of human health and the environment after the response objectives have been met.

   Alternative 1 would not be effective. Both Alternatives 2 and 3 would be effective as soon as the institutional control on federal land, educational control on private land, and private well sampling program are put in place and the MNA program is initiated.

4. Reduction of toxicity, mobility, or volume through treatment – Each alternative was assessed against this criterion to evaluate the performance of alternative-specific treatment technologies.

   Since Alternative 1 does not include any action, it has no effect on the toxicity, mobility, or volume of the contaminated groundwater. Alternative 2 does not include any active treatment, so it has no reduction of the toxicity, mobility, or volume of the contaminated groundwater through active treatment;however, toxicity of the TCE in contaminated groundwater will be reduced through passive treatment (MNA). Alternative 3 would completely degrade the TCE under ideal conditions; however, if TCE is only partially degraded by the EAB process, the resulting degradation products (cis-1,2-DCE and vinyl chloride) may be more mobile than TCE. Additionally, vinyl chloride has a lower USEPA MCL.

5. Short-term effectiveness – The short-term effectiveness of each alternative was assessed considering the short-term risks that might be posed to the community during implementation of the alternative; potential environmental impacts of the remedial action and the effectiveness and reliability of measures taken to mitigate impacts during implementation; and length of time needed until protection is achieved.

   Alternative 1 would not be effective. Both Alternatives 2 and 3 would be effective as soon as the institutional control on federal land, educational control on private land, and private well sampling program are put in place and the MNA program is initiated.

6. Implementability – The ease or difficulty of implementing each alternative was assessed by considering the following types of factors (as appropriate). 1) Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of a technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2) Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies. 3) Availability of services and materials, including the availability of necessary equipment and specialists.

   Alternative 1 could be implemented immediately. The MNA in Alternatives 2 and 3 can be easily implemented. EAB in Alternative 3 may result in more rapid reductions in groundwater TCE concentrations when compared to Alternative 2. However, the depth and length of the TCE plume may hinder the effectiveness of dispersing the EAB treatment solutions to the subsurface, leading to uncertainties on whether optimum groundwater conditions can be induced for EAB in Alternative 3 to degrade TCE faster than natural attenuation in Alternative 2.

7. Cost – The type of costs that were assessed included: capital costs, including both direct and indirect costs; annual operation and maintenance (O&M); and net present worth of capital and O&M costs. The present worth of each alternative provides the basis for the cost comparison.

   Alternative 1: There is no cost associated with this alternative.

   Alternative 2: The total present worth for this alternative is $1,831,300 to achieve the remediation objective. Costs assume monitoring for plume movement and TCE degradation through sampling for 55 years.

   Alternative 3: To achieve the remediation objective, the total present worth for this alternative is $6,596,700. Costs assume implementation of an EAB treatment process and monitoring for plume movement and TCE degradation through sampling for 25 years.

8. State regulatory acceptance – The assessment of state regulator acceptance will not be completed until after the public comment period. Based on EGLE review of the FS and the responses to the comments received on the Proposed Plan, it is expected that EGLE will accept either Alternative 2 or Alternative 3.

9. Community acceptance – This assessment includes determining which components of the alternatives interested persons in the community support, have reservations about, or categorically reject. This assessment will not be completed until after the public comment period.

10. PREFERRED ALTERNATIVE

The Preferred Alternative for remediation at impacted portions of the Raco Site is Alternative 2, which includes MNA, institutional control on federal land, educational control on private land, and private well sampling. This alternative was selected because it will achieve the remedial objectives of preventing exposure to contaminated groundwater.

USACE and EGLE believe the Preferred Alternative would be protective of human health and the environment, would achieve the remedial objectives, would meet both short-and long-term effectiveness, would provide permanence, is implementable, and is cost-effective. Alternative 2 was chosen over Alternative 3 due to the uncertainties on whether EAB will result in more rapid TCE degradation when compared to natural attenuation in Alternative 2.

Based on information currently available, USACE, as the lead agency for environmental response actions under FUDS at the Raco Site, believes the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. USACE expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA §121(b): 1) be protective of human health and the environment; 2) comply with ARARs; 3) be cost-effective; and 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Although Alternative 2 will not satisfy the preference for treatment as a principal element, there is uncertainty on whether EAB in Alternative 3 will result in more rapid TCE degradation compared to natural attenuation in Alternative 2, given the depth and length of the TCE plume at the Raco Site. The Preferred Alternative can change in response to public comment or new information. The USDA Forest Service, as the federal land management agency responsible for the administration and management of the federal property where the site is located, concurs with the Preferred Alternative proposed by USACE.

11. COMMUNITY PARTICIPATION

To send written comments or to obtain further information, please contact the following representatives:

Mr. Aaron Steele
USACE, Louisville District
PO Box 59
Louisville, Kentucky 40201-0059

Mr. William Harmon
Superfund Section, Remediation and Redevelopment Division
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, Michigan 48933

A public comment period, which extends from Jan. 27, 2020 to Feb. 26, 2020, has been established. The purpose of this comment period is to offer the public and other stakeholders the opportunity to review and comment on the Proposed Plan and other alternatives. A final decision will not be made until all comments received during the public comment period have been evaluated. Comments received will be included in the Administrative Record File and summarized in the Responsiveness Summary section of the Decision Document, the document which formalizes the selection of the remedy. The dates for the public comment period; the date, location, and time of the public meeting; and the locations of the Administrative Record Files are provided on the front page of this Proposed Plan.

CERCLA requires that USACE consider the views and comments of the public before making a decision on the remedial action. Based on public comments or new information, USACE may decide to modify the preferred alternative or select another remedial alternative. Therefore, it is important to comment on the Proposed Plan and all alternatives proposed. USACE will respond to comments received in the Responsiveness Summary, a document that will be part of the Decision Document and will be placed in the Information Repository at the Bayless Public Library and Bay Mills Community College Library. The Responsiveness Summary will be available to the public for review when the decision on the selected remedy is made and set forth in the Decision Document.

The public includes residents and organizations on the site and in nearby communities, state agencies, and other interested parties and groups. Holding a public meeting is one way for interested parties to share their views and comments about the Proposed Plan. All interested individuals are encouraged to attend the public meeting, where they will have the opportunity to present spoken and written comments on the Proposed Plan. USACE and EGLE representatives will be present. A court reporter will be present to record the meeting. The meeting is scheduled to be held at 6:00 p.m. EST, Feb. 4, 2020, in the Sunset Meeting Room located at the Bay Mills Resort and Casino, 11386 West Lakeshore Drive, Brimley, MI 49715.

An interested party may also submit comments in writing, either by letter or comment form provided at the public meeting. Written comments should be sent to USACE, in care of Mr. Aaron Steele at the address listed in the box on this page. Comments must be postmarked no later than Feb. 26, 2020.

ATTACHMENT A
GLOSSARY OF TERMS

Administrative Record File – A file maintained by the lead agency containing all the information used to make its decision on the selection of a response action under CERCLA. A copy of this file is to be available for public review at or near the site.

applicable or relevant and appropriate requirement (ARAR) – Applicable requirements are those cleanup standard, standard of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazard substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. 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. nly those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable or relevant and appropriate.

Baseline Human Health Risk Assessment (BLRA) – The NCP calls for a site-specific baseline risk assessment to be conducted as part of the RI. The BLRA characterizes the current and potential threats to human health and the environment that may be posed by contaminants at the site. The primary purpose of the BLRA is to provide risk managers with an understanding of the actual and potential risks posed by the site and any uncertainties associated with the assessment.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended (also known as the Superfund Program" – A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act (SARA). This law provides for the investigation and remediation of hazardous substances released into the environment.

conceptual site model – The set of descriptions concerning 1) how the different chemicals at the site might affect ecological components (primarily the plants and animals, but also the interactions among plants and animals); 2) ecosystems or ecosystem components potentially at risk; 3) the relationships between measurement and assessment endpoints; and 4) how plants and animals might become exposed to harmful chemicals.

Decision Document (DD) – The term adopted by the U.S. Department of Defense (DoD) for the documentation of remedial action decisions at non-National Priorities List FUDS properties.

Feasibility Study (FS) – A comprehensive evaluation of potential alternatives for remediating contamination. The FS identifies general response actions, screens potentially applicable technologies and process options, assembles alternatives, and evaluates alternatives in detail.

Formerly Used Defense Site (FUDS) – Defined as a facility or site (property) that was under the jurisdiction of the Secretary of Defense and owned by, leased to, or otherwise possessed by the United States at the time of actions leading to contamination by hazardous substances. By DoD Environmental Restoration Program policy, the FUDS program is limited to those real properties that were transferred from DoD control prior to 17 October 1986. FUDS properties can be located within the 50 states, District of Columbia, Territories, Commonwealths, and possessions of the United States.

hazard index (HI) – A numerical presentation of the health hazard, unrelated to cancer, posed by contaminants through one or more exposure pathways. An HI value of 1 is similar in concept to a "threshold level" for non-cancer toxicity. An HI value less than 1 indicates the absence of non-cancer hazard, while a value greater than 1 indicates the potential for a health hazard.

incremental lifetime cancer risk (ILCR) – Incremental probability of an individual developing cancer as a result of potential carcinogen exposure averaged over a lifetime.

National Oil and Hazardous Substances Pollution Contingency Plan (also known as the National Contingency Plan, NCP) – Revised in 1990, the NCP provides the regulatory framework for responses under CERCLA.

Proposed Plan – In the first step of the remedy selection process, the lead agency identifies the alternative that best meets the requirements in CERCLA 300.430(f)(1) and presents that alternative to the public in a Proposed Plan. The purpose of the Proposed Plan is to supplement the RI/FS and provide the public with a reasonable opportunity to comment on the preferred alternative for remedial action at a site.

Remedial Action Objective (RAO) – Site-specific goals for protecting human health and the environment. RAOs are developed by evaluating ARARs that are protective of human health and the environment and the results of the RI, including human health and ecological risk assessments.

Remedial Investigation (RI) – The study which determines how much and what kind of contamination exists at a site. An RI generally involves collecting and analyzing samples of groundwater, surface water, soil, sediment, and air.

Screening Level Ecological Risk Assessment (SLERA) – A simplified risk assessment that can be conducted with limited data; where site-specific information is lacking, assumed values should consistently be biased in the direction of overestimating risk. The need for conservatism is to provide a defensible conclusion that negligible ecological risk exists or that certain contaminants and exposure pathways can be eliminated from consideration.

ATTACHMENT B

LIST OF ACRONYMS AND ABBREVIATIONS

ARARs	applicable or relevant and appropriate requirements
BLRA	Baseline Human Health Risk Assessment
bgs	below ground surface
CELRL	U.S. Army Corps of Engineers, Louisville District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethene
COPC	chemical of potential concern
DoD	Department of Defense
EAB	enhanced anaerobic bioremediation
EGLE	Michigan Department of Environment, Great Lakes, and Energy
EU	Exposure Unit
FS	Feasibility Study
FUDS	Formerly Used Defense Site
GSR	Green and Sustainable Remediation
HI	hazard index
ILCR	incremental lifetime cancer risk
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	operation and maintenance
MCL	Maximum Contaminant Level
MNA	monitored natural attenuation
Raco Site	former Raco Army Airfield and Missile Site
RAO	Remedial Action Objective
RI	Remedial Investigation
SLERA	Screening Level Ecological Risk Assessment
Smithers	Smithers Scientific Services, Inc.
TCE	trichloroethene
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
VAP	vertical aquifer profiling
µg/kg	micrograms per kilogram
µg/L	micrograms per liter

ATTACHMENT C
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