Record of Decision
TCE Groundwater Contamination Site (HAA-17)
Hunter Army Airfield, Georgia

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Record of Decision

TCE Groundwater Contamination Site (HAA-17)
Hunter Army Airfield, Georgia

Acknowledgment and Concurrence for remedial actions to be implemented at HAA-17:

11 May 2022

MANUEL F. RAMIREZ
Colonel, MI
Commanding

Date

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Acronyms

Acronym	Definition
µg/L	Micrograms per Liter
AWQC	Ambient Water Quality Criteria
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	Conceptual Site Model
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
COPEC	Contaminant of Potential Ecological Concern
CVOC	Chlorinated Volatile Organic Compound
DERP	Defense Environmental Restoration Program
DPT	Direct Push Technology
ERA	Ecological Risk Assessment
ERD	Enhanced Reductive Dechlorination
EVO	Emulsified Vegetable Oil
ft	Foot/Feet
g/L	Grams per Liter
GAC	Granular Activated Carbon
GAEPD	Georgia Environmental Protection Division
HAAF	Hunter Army Airfield
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
IRZ	In-situ Reductive Zone
ISCO	In Situ Chemical Oxidation
IWQS	Instream Water Quality Standards
LUC	Land Use Controls
MCA	Military Construction Area
MCL	Maximum Contaminant Level
mg/kg	Milligrams per kilogram
MNA	Monitored Natural Attenuation
NCP	National Oil And Hazardous Substances Pollution Contingency Plan
NFA	No Further Action
O&M	Operation and Maintenance
OU	Operable Unit
PRG	Preliminary Remediation Goals
RA	Risk Assessment
RAO	Remedial Action Objective
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSLs	Regional Screening Levels
RAO	Remedial Action Objectives
ROD	Record of Decision
RSLs	Regional Screening Levels
SARA	Superfund Amendments and Reauthorization Act
SOF	Special Operations Forces
SSL	Soil Screening Level
SVOC	Semi Volatile Organic Compound
TCE	Trichloroethene
TMV	Toxicity, Mobility, or Volume

Acronym	Definition
TOC	Total Organic Carbon
TRV	Toxicity Reference Value
USEPA	U.S. Environmental Protection Agency
UST	Underground Storage Tank
USTMP	Underground Storage Tank Management Plan
UU/UE	Unrestricted Use/ Unrestricted Exposure
VC	Vinyl Chloride
VISL	Vapor Intrusion Screening Levels
VOC	Volatile Organic Compound

1 DECLARATION

1.1 Site Name and Location

Site Name: The Trichloroethylene (TCE) Groundwater Contamination Site at Hunter Army Airfield (HAAF), or HAA-17. HAA-17 includes the Former Underground Storage Tanks (USTs) 25 and 26, Former Purge Facility, Building 1290, a former dry cleaning facility that was located east of Building 1290, a former weapons cleaning facility south of the former dry cleaner, and the former Strategic Air Command (SAC) special weapons area west of the UST 25 & 26 area.

Site Location: Hunter Army Airfield, Savannah, Georgia.

1.2 Statement of Basis and Purpose

This decision document presents the Selected Remedy for HAA-17, at HAAF, Georgia, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record file for this Site, which is available for review at the Department of Public Works Prevention and Compliance Branch, 1550 Veterans Parkway Building 1137, Fort Stewart, Georgia 31314. The State of Georgia supports the Selected Remedy without comment; regulatory approval is included in Appendix A.

1.3 Assessment of the Site

The response action selected in this Record of Decision (ROD) is necessary to protect public health, welfare, or the environment from actual or threatened releases of hazardous substances from this site which may present an imminent and substantial endangerment to public health or welfare. Investigations from 2009 to 2015 identified TCE impacts to groundwater at HAA-17. Multiple soil and groundwater investigations identified the former UST 25 & 26 area as the primary source of TCE impacts at HAA-17. Groundwater sampling at the purge facility at 2010 and 2015 indicated chromium, barium, and arsenic did not exceed the USEPA maximum contaminant levels (MCLs) in any sample. The COCs in groundwater at HAA-17 are TCE and its daughter products, cis-1,2-dichloroethylene (DCE) and vinyl chloride (VC), as well as benzene.

1.4 Description of Selected Remedy

The strategy at HAA-17 is to reduce the mass of the primary COCs in groundwater through Enhanced Reductive Dechlorination (ERD), to allow COCs at lower concentrations to naturally attenuate, and to prevent future exposure through onsite land use controls (LUCs). This strategy is a balance of protection of the environment, regulatory compliance; reduction in toxicity, mobility, and volume (TMV) of contaminants; long and short term effectiveness; cost effectiveness; implementability; and community/state acceptability. This strategy of balancing these criteria is also consistent with the strategies employed at other sites across HAA (e.g. HAA-01, HAA-15). Performance standards for this remediation include Remedial Action Objectives (RAOs) and Applicable or Relevant and Appropriate Requirements (ARARs). RAOs for HAA-17 include:

Groundwater

1) Reduce potential cancer risk and potential non- cancer health hazards for people (i.e., site workers and construction workers) exposed to TCE in contaminated groundwater

2) Reduce potential exposure of ecological receptors to TCE in groundwater

3) Prevent potential for migration of TCE at unacceptable levels to off-site locations.
4) Return useable groundwaters to their beneficial use whenever practicable.

ARARs are divided into three categories: chemical-specific, action-specific, and location-specific requirements.

Chemical-specific: Chemical-specific ARARs establish health-based concentration limits, risk-based concentration limits, or ranges for specific hazardous substances in different environmental media that provide media cleanup levels or a basis for calculating cleanup levels for COCs. Chemical-specific ARARs identified for remedial action at the site include USEPA RSLs for soil and USEPA MCLs, and Region 4 Tapwater RSLs for groundwater.

Location-specific: Location-specific ARARs set restrictions on the types of remedial activities that can be performed based on site-specific characteristics or location (e.g., proximity to wetlands, historic buildings, etc.) HAA-17 will remain a commercial/industrial use property requiring that all remedial alternatives address potential residential exposure to COCs in groundwater through the application of institutional controls. Buildings and paved areas at HAA-17 cannot be removed or modified if the result is a reduction in mission readiness.

Action-specific: Action-specific ARARs set controls or restrictions on the design, implementation, and performance of actions. These provide a basis for assessing the feasibility and effectiveness of the remedial alternatives by specifying performance levels, actions, or technologies and specific levels for discharge of residual chemicals. Action-specific ARARs identified include air emission standards for any air discharge in the motor pool area and compliance with National Pollutant Discharge Elimination System (NPDES) and base requirements for any treated water discharged to proximate canals.

The proposed action will reduce the risk associated with exposure to contaminated groundwater above Preliminary Remediation Goals (PRGs). PRGs are based on calculated Health Based Goals (HBG) and the United States Environmental Protection Agency (USEPA) MCLs. HAAF has established PRGs as follows:

Groundwater

- VOCs:
  - TCE – 5 µg/L
  - Cis-1,2-DCE – 70 µg/L
  - VC – 2 µg/L
  - Benzene – 5 µg/L
  - Chromium (total) – 100 µg/L

The selected remedy for Groundwater at HAA-17 is:

- Enhanced Reductive Dechlorination (ERD)
  - One-time injection of emulsified vegetable oil (EVO)
  - Targeting source area where TCE concentrations are > 500 µg/L
    - Exact quantity and location of injection points pending the results of baseline sampling.
  - Performance monitoring to monitor ongoing effectiveness and determine if additional injections are required.
- Monitored Natural Attenuation (MNA)
  - Performance monitoring of selected wells to monitor the overall effectiveness of MNA in achieving remedial goals

- Onsite Land Use Controls (LUCs)
    - Included in the HAA Base Master Plan
    - Prohibit installation of water wells within or downgradient to the source area
- CERCLA five-year reviews

1.5 Statutory Determinations

The Selected Remedy is protective of human health and the environments, complies with Federal and State Requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

The remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e. reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment), in that the selected remedy for groundwater utilizes treatment as a principal element.

Because this remedy is anticipated to take more than five years to attain remedial action objectives (RAO) and cleanup levels, a policy review may be conducted within five years of construction completion for the site to ensure that the remedy is, or will be, protective of human health and the environment.

1.6 ROD Data Certification Checklist

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

- Chemicals of concern and their respective concentrations.
- Baseline risk represented by the chemicals of concern.
- Cleanup levels established for chemicals of concern and the basis for these levels.
- How source materials constituting principal threats are addressed.
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD.
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy.
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected.
- Key factor(s) that led to selecting the remedy (i.e. description of how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision.)

1.7 Authorizing Signatures and Support Agency Acceptance of Remedy

The State of Georgia supports the Selected Remedy without comment; regulatory approval is included in Appendix A..

2 DECISION SUMMARY

2.1 Site Name, Location, and Description

HAA-17, or the TCE Groundwater Contamination Site at HAAF, includes the Former USTs 25 and 26, Former Purge Facility, Building 1290, a former dry cleaning facility that was located east of Building 1290, a former weapons cleaning facility south of the former dry cleaner, and the former Strategic Air Command (SAC) special weapons area west of the UST 25 & 26 area. HAAF is the responsible party for site activities, and the Georgia Environmental Protection Division (GAEPD) oversees regulatory actions for this site.

HAAF is an active military installation located in Savannah, Georgia that contains areas of industrial, commercial, and temporary residential properties. HAA-17 is located in the northern portion of HAAF. A Site map showing where HAA-17 is located within HAAF is shown as **Figure 2-1**, and the investigation areas comprising HAA-17 are shown on **Figure 2-2**.

2.2 Site History and Enforcement Activities

Investigations at HAA-17 from 1998 through 2015 have identified CVOCs to be the primary COCs in groundwater at the Site. Based on observed concentrations in site-wide investigations, the former UST 25 and 26 area is the general source area for elevated TCE concentrations observed at HAA-17.

Initial investigations in the area were conducted to determine petroleum impact associated with the USTs, but during these activities, TCE and other CVOC impact was observed in groundwater in addition to petroleum hydrocarbons. The extent of petroleum-impacted groundwater was delineated in accordance with the requirements of the GAEPD UST Management Program (USTMP) (Facility ID No. 9-025008). In a letter dated August 19, 2008, the GAEPD USTMP states that no further action is required for the petroleum release.

RI/FS activities were conducted from November 2009 through January 2015. The focus was on delineating VOC impacts in groundwater, particularly TCE and daughter products, and identifying a potential source. Metal impacts were also investigated where previous data had indicated potential impact around the Purge Facility. The RI/FS investigations were site-side across HAA-17, including soil and groundwater sampling, and MIP investigations in the former UST area and around Building 1290 (Arcadis 2019).

2.3 Community Participation

The Proposed Plans for HAA-17 were made available to the public in July 2021. They are located in the Administrative Record at Fort Stewart, online at the Fort Stewart Department of Public Works Prevention and Compliance Branch's webpage, and in the Southern Chatham County Public Library. Notice of availability of the plans was published in the Savannah Morning News and The Frontline prior to the public comment period starting on June 24 and July 1, 2021, respectively. A public comment period was held from July 14 to August 14, 2021. A public meeting was to be scheduled if requested during the public comment period, but no public meeting was requested. No comments were received during the public comment period.

2.4 Scope and Role of Operable Unit or Response Action

HAA-17 is an OU covering groundwater impacts at the Site. The planned sequence of actions for HAA-17 is to implement ERD, MNA, and LUCs to manage impacts to groundwater and to meet established RAOs. HAAF is responsible for implementing remediation at the Site, with regulatory oversite from the GAEPD.

2.5 Site Characteristics

HAA-17 is in the northern portion of HAAF and includes administrative and industrial buildings, former motor pool facilities, a former dry cleaner facility, and the former SAC special weapons area. The area is topographically relatively flat and commercial/industrial in use. The primary COCs in groundwater are CVOCs, TCE and its daughter products, and benzene. Based on observed concentrations, groundwater flow direction, and historical use, the area around former USTs 25 & 26 is considered the primary source at HAA-17. The highest concentrations of TCE in shallow and deep groundwater are observed in the former UST area, with a small hot spot in the deep surficial aquifer near the purge facility. TCE is not detected upgradient to the UST area. Vertical profile analyses suggest the highest TCE concentrations are observed at the former UST area approximately 20 to 30 ft bgs.

The former UST 25 & 26 area is located in the 260th Quarter Master Motor Pool along Tubb Road. UST 25 had a 25,000-gallon capacity and was used to store diesel fuel. UST 26 had a 6,000-gallon capacity and was used to store gasoline. Both USTs were fiberglass-coated steel and occupied the same tank pit. The refueling station was constructed in 1986 and became operational in 1989. The piping was preplaced in 1992 and the tanks and their associated piping were abandoned in place in July 1998. The tanks were later removed from the ground in 2006. Investigations at HAA-17 were initiated to identify potential impacts from a petroleum release from the USTs, during which TCE impact was observed in groundwater.

The HAAF purge facility is located in the southern section of HAA-17 and was used to clean tanker trucks that transported and stored petroleum products, mainly JP-8. The facility is no longer used for cleaning tanker trucks.

Building 1290 is located in the western section of HAA-17, adjacent to the airfield. It is an aircraft hangar that formerly had a degreasing system in the facility.

HAA-17 also includes a former dry-cleaning facility east of Building 1290. A new building exists in the same location. The former weapons cleaning facility was located south of the former dry cleaners. The SAC special weapons area was formerly located west of the former UST 25 and 26 area. From 1950 through 1963, when HAAF operated as a SAC Air Force Base, this training area was used to train personnel in assembling and handling special weapons.

2.5.1 Conceptual Site Model

The Conceptual Site Model (CSM) identifies the primary sources, primary release mechanism, secondary sources, potential pathways, and receptors. The CSM also identifies potentially complete pathways, wherein there exists a pathway to exposure and known potential receptor present or potentially present at the Site. The CSM is summarized in **Figures 2-3a,b**.

2.5.1.1 Primary Sources and Release Mechanisms

Groundwater
Previous investigations have concluded that the primary source of COCs in groundwater at HAA-17 is the former UST 25 and 26 area. The highest concentrations of CVOCs at HAA-17 are observed in the former UST area, with a smaller secondary hot spot observed near the purge facility.

2.5.1.2 Secondary Sources and Release Mechanisms

Groundwater
The highest CVOC concentrations in groundwater in the former UST 25 and 26 area in the deeper units of the upper aquifer. Interbedded clays between 35-50 ft bgs have prevented significant vertical migration to the deeper aquifers. There is a second, smaller source area exhibiting lower COC concentrations to the

south of the purge facility in the deep surficial aquifer. Primary COCs in groundwater at HAA-17 are TCE; cis 1,2-DCE; VC; and benzene.

Groundwater may release contaminants through groundwater discharge to other units of groundwater, surface waters, or sediment.

2.5.1.3 Pathway- Exposure Medium and Routes

Groundwater
Pathway exposure media for groundwater include groundwater (direct), surface water, and sediment, although no COCs or potential COCs were identified in surface water or sediment. Potential exposure routes for these media include ingestion, direct contact/uptake, or food chain exposure to groundwater; ingestion, dermal contact, inhalation of vapors, direct contact/uptake, and food chain exposure for surface water; and ingestion, dermal contact, direct contact/uptake, and food chain exposure for sediment.

Soil
Pathway exposure media for soil contamination in surface soil include surface soil (direct), air, surface water, and sediment. Potential exposure routes for these media include ingestion, dermal contact, direct contact/uptake, and food chain exposure for surface soil; inhalation for air; ingestion, dermal contact, inhalation of vapors, direct contact/update, and food chain exposure for surface water; and ingestion, dermal contact, direct contact/update, and food chain exposure for sediment. No COCs have been identified in soil for HAA-17.

2.5.1.4 Receptors

Receptors are people, plants, or animals that may be exposed to contaminants at the Site. HAA-17 is currently an industrial-use location at HAAF that is not used for residential purposes. Receptors at HAA-17 include site workers, construction workers, hypothetical future residents, trespassers, terrestrial wildlife, soil dwelling invertebrates, and terrestrial plants. While trespassers are not currently anticipated at the Site based on restricted access to HAAF, consideration to trespassers is extended to be conservative in the same way that hypothetical future residents are considered.

25.1.5 Potentially Complete Exposure Pathways

Exposure pathways include the source, route, and mechanisms through which a contaminant might reach a receptor. Complete exposure pathways, or potentially complete exposure pathways, exist when a continuous link exists between the contaminant source, release mechanism, transport medium, exposure route, and potential receptor. Exposure to lead in soil poses an unacceptable risk to hypothetical adult and child residents exposed to surface soil and utility worker exposure to combined surface and subsurface soil.

Groundwater
Groundwater at HAA-17 is not recommended for use as a potable water source, and none of the receptors are anticipated to interact directly with groundwater at the Site. The only potentially complete pathways identified in the CSM groundwater contaminants was for hypothetical future residents or site workers should groundwater ever be used as a potable water supply or through inhalation of vapors migrating to indoor air, and for future construction/site workers potentially contacting soil and shallow groundwater.

Soil
Contaminants in surface soils may reach site workers, construction workers, hypothetical residents, trespassers, terrestrial wildlife, and invertebrates through ingestion and dermal contact. A potentially complete pathway also exists for trespassers, wildlife, invertebrates, and plants through direct contact/uptake; and for terrestrial wildlife through the food chain. The inhalation pathway is potentially complete through inhalation of contaminants by site workers, construction workers, hypothetical future residents, and trespassers.

Contaminants in subsurface soils could potentially reach site workers, construction workers, hypothetical residents, and terrestrial wildlife through ingestion, dermal contact, direct contact/uptake, and food chain exposure. Soil invertebrates could potentially be exposed to subsurface soil through ingestion, dermal contact, and direct contact/uptake. A potentially complete pathway also exists for terrestrial plants through direct contact/uptake of subsurface soils.

2.5.2 Contamination

COCs at HAA-17 include VOCs in groundwater. These COCs are discussed further in this section and summarized in **Table 2-1.**

Groundwater

TCE is commonly used as a solvent to remove grease from metal. Physiological effects of TCE exposure include dermatitis, central nervous system depression, neurological abnormalities, liver damage, abdominal pain, nausea, and vomiting. TCE is reasonably projected to be a human carcinogen.

Benzene is a natural constituent of crude oil and is therefore a common constituent in hydrocarbon products. Physiological effects of exposure to benzene include neurological and immunological damage. Benzene is a known human carcinogen.

Cis-1-2-DCE is commonly used in chemical mixtures, to produce solvents, and is a daughter product- or produced during breakdown of- trichloroethene (TCE). Physiological effects of exposure to cis-1,2-DCE include liver and kidney damage, drowsiness, nausea, and cardiovascular complications. Cis-1,2-DCE is reasonably projected to be a human carcinogen.

VC is used to manufacture polyvinyl chloride (PVC), a very common synthetic plastic polymer. Like cis-1,2-DCE, VC is also a daughter product of TCE. Physiological effects of exposure to VC include central nervous system depression, ataxia, tingling of the extremities, visual disturbances, coma, and death. VC can aggravate the eyes, mucous membranes, and the respiratory tract. VC is a known human carcinogen.

2.5.3 Hydrogeology and Hydrology

The geology at HAA-17 consists primarily of sand from land surface to at least 45 ft bgs. The western portions of HAA-17 interpreted to represent beach and open marine shallow foreshore depositional facies, with well sorted sands and occasional thin clay lenses at depth. The depositional facies around the former UST area is dominated by poorly sorted, fine-grained, silty sand with some clays from ground surface to about 40 ft bgs. Observation of clays in soil borings around 25-30 ft bgs increases in frequency eastward. A consistent clay layer was observed underlying the entire site between 40-45 ft bgs that is considered a confining layer. The Hawthorne Clay is a regionally extensive clay unit at the base of the upper aquifer, considered to be an additional confining unit underlying HAAF (120-125 ft bgs), separating the observed groundwater impacts at the site from the underlying Floridian Aquifer (200-800 ft bgs).

Groundwater flow direction for most of the HAA-17 area is to the southeast toward the former UST area and a nearby drainage canal with a horizontal groundwater gradient of approximately 0.003 ft/ft. Horizontal groundwater flow at the former UST area follows a relatively steep slope to the southeast at approximately 0.009 ft/ft. The drainage canal southeast of the UST area appears to be a discharge point for shallow groundwater, while deeper groundwater continues flowing eastward under the canal. Based on groundwater data collected in 2000 and 2010, there is an apparent groundwater drainage divide around Building 1290 and Lightning Drive, with groundwater in this area and to the west flowing west-southwestward.

The shallow surficial aquifer at most of HAA-17 is unconfined and no significant vertical gradient is detected in most nested pairs of monitoring wells at the Site. A slight downward vertical gradient (1.75 ft in 2015) is observed around the former UST area, and a slight upward hydraulic gradient it observed farther east around the drainage canal (0.23 ft in 2015).

Observed hydraulic conductivities at HAA-17 range from 0.55 to 0.66 ft/day in the shallower zones, and from 1.6 to 63 ft/day in the deeper groundwater zones. Groundwater velocities in the former UST area range from 0.02 to 2.3 ft/day based on 2009 (Pika/Arcadis 2019).

Pond 35, located northeast of the former UST 25 and 26 area, is cross-gradient from the former UST area, and there are nested pairs of wells with no detected TCE between Pond 35 and the former UST area. It is not considered impacted or at risk of being impacted by the observed groundwater impacts discussed in this report.

2.6 Current and Potential Future Site Resources Uses

2.6.1 Land use

HAAF is an active military installation and access to the Site is restricted. HAA-17 is located in the northern portion of HAAF. HAA-17 includes commercial/industrial use buildings and a pond (35) to the northeast that is considered cross-gradient to the observed groundwater impacts at HAA-17. HAA-17 will remain a commercial/industrial use property requiring that all remedial alternatives address potential residential exposure to COCs in soil and groundwater through the application of institutional controls. Residential PRGs are not developed for the property. No ecological-based PRGs are proposed. According to the Base Master Plan (US Army 2017), there are no current plans for future conversion of the site for permanent residential use.

2.6.2 Ground and Surface Water

There are no potable wells in the surficial aquifer at HAA-17, and the surficial aquifers in which contamination at HAA-17 is observed are not recommended for use as drinking water. The surficial aquifer is between 2 and 10 ft bgs at HAA-17. Surface water at the site includes Pond 35 and a drainage canal, COCs were not identified in either.

2.7 Summary of Site Risks

Based on the land and water uses described in Section 2.6, the current primary risk of exposure to humans or ecological receptors consists of direct exposure to, ingestion of, or inhalation of vapors from groundwater by site workers and construction workers. No contaminants detected in sediment or surface water exceeded applicable screening levels. While there is no current risk to residential receptors, nor known plans for future residential use of the Site, remedies are expected to consider potential exposure to hypothetical future residents. The Ecological Risk Assessment (ERA), summarized in Section 2.7.2, found potential ecological risks to be considered negligible overall at HAA-17.

The primary basis for taking action at this Site is the threat of exposure to COCs in groundwater by site workers and construction workers.

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances to the environment.

2.7.1 Summary of Human Health Risk Assessment

The baseline HHRA estimates what risks HAA-17 poses if no action were taken. This provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section summarizes the HHRA for the Site as presented in the RI/FS (Pika/Arcadis 2019).

2.7.1.1 COCs

The first step of the HHRA process is compiling and evaluating data to select the Contaminants of Potential Concern (COPCs). The objective is to identify the most toxic, persistent, and prevalent COPCs at the site that are expected to contribute the majority of the potential exposure risk. COPC selection involves a conservative, risk-based screening evaluation, and can be based on criteria including toxicity, frequency of detection, comparison to background concentration, or whether a constituent can be considered a common laboratory contaminant (e.g. acetone).

COCs in this HHRA were identified for retention by comparing maximum detected concentrations of COPCs with health-based screening levels, including:

- USEPA RSLs: assuming a Hazard Quotient (HQ) of 0.1 and a target cancer risk of $1x10^{-6}$. (USEPA 2018a)
- USEPA MCL-based Soil Screening Levels (SSLs), or in the absence of MCL-based SSLs, the tap water-based SSLs (USEPA 2018a)
- USEPA Vapor Intrusion Screening Levels (VISLs) based on a target HQ of 0.1 and a target cancer risk of $1x10^{-6}$ (USEPA 2018b)
- Georgia Instream Water Quality Standards (IWQS; GAEPD 2015) were used to identify surface water COPCs, or in the absence of Georgia IWQS, the USEPA National Recommended Ambient Water Quality Criteria (AWQC) were used (USEPA 2015).

COCs are summarized in **Table 2-1.**

2.7.1.2 Exposure Assessment

The exposure assessment is the process of measuring or estimating the intensity, frequency, and duration of human exposure to substances present in the environment. The purpose of the assessment is to evaluate the ways the receptors might be exposed to COPCs at HAA-17. Exposure can only occur when the potential exists for a receptor to contact COPCs or when there is a mechanism for COPCs to be transported to a receptor. With no exposure, there is no risk. The exposure assessment includes characterization of the physical environment; identification of exposure pathways, including migration pathways, exposure points, and exposure routes; and identification of receptors- potentially exposed individuals and populations.

Exposure pathways are defined by four elements:

1. A source and mechanism of constituent release to the environment.
2. An environmental transport medium for the released constituent.
3. A point of potential contact by the receptor with the medium containing the constituent (exposure point).
4. A route of exposure to the receptor at the exposure point (e.g. dermal contact, ingestion, inhalation).

To identify and evaluate the ways a population may be exposed to COPCs, the assessment includes estimating concentrations along potential pathways using site-specific data and, when necessary, mathematical modeling. In this assessment, doses and risks were calculated for the reasonable maximum exposure scenarios.

Receptors

Receptors were identified to include site workers (e.g. those who periodically mow and maintain the site) and construction/utility workers. While there are no plans to use the site for residential purposes, hypothetical future residents were included in the assessment. Trespassers are considered unlikely based on the nature of restricted access to the military installation but were nevertheless evaluated as potential receptors.

Receptors at the Site were identified to include site workers, construction workers, and hypothetical future residents.

Exposure Pathways

The exposure pathways and the associated exposure medium identified for the receptors at the site are described below. Potential future use of groundwater as a potable water supply is assumed to be a complete exposure pathway. Soil contact may occur if the site were used in the future. Either workers or residents could contact the soil and be exposed through incidental ingestion, dermal contact, and inhalation of vapors or dust. If construction were to occur at HAA-17, construction workers or utility workers could contact the soil as well. Finally, VOCs were detected in groundwater, and potential inhalation exposure to VOCs migrating from the subsurface into a building were evaluated in the HHRA. The exposure pathways include:

- Hypothetical future adult and child residents potentially exposed to surface and subsurface soil through direct contact, groundwater used as a potable water supply, and if appropriate, inhalation of vapors migrating to indoor air;
- Current and hypothetical future commercial/industrial workers potentially exposed to surface and subsurface soil through direct contact, ingestion of groundwater used as a potable water supply, and if appropriate, inhalation of vapors migrating to indoor air;
- Hypothetical future construction/utility workers potentially contacting soil and shallow groundwater; and
- Current and hypothetical future adolescent trespassers contacting soil.

Exposure Evaluation

Exposure point concentrations were estimated using site-specific data and a statistical approach consistent with USEPA methodology. Receptor exposure assumptions including body weight and ingestion rates and scenario specific assumptions including the total period of receptor is exposed and the frequency of exposure were obtained based on USEPA guidance. Receptor exposure assumptions were selected such that the risk calculated would be for the Reasonable Maximum Exposure (RME) scenario. Potential risk from exposure to constituents in each medium were calculated considering the fate and transport of COPCs, which is dependent on their physical and chemical properties, the environmental transformation processes affecting them, and the media through which they migrate. Calculations, assumptions, and chemical properties (e.g. molecular weight, solubility, diffusivity in air and water) are all included in the HHRA within the RI/FS (Pika/Arcadis 2019).

2.7.1.3 Toxicity Assessment

The toxicity assessment describes the relationship between the administered and/or the absorbed dose of a constituent and the magnitude or likelihood of adverse health effects (USEPA 1989). Toxicity values for potential non-carcinogenic and carcinogenic effects were obtained consistent with the recommended USEPA hierarchy and USEPA guidance. Therefore, the following sources were used to obtain toxicity values, in the order in which they are presented below.

- USEPA's Integrated Risk Information System (USEPA 2019a)
- USEPA Provisional Peer Reviewed Toxicity Values (USEPA 2019b)
- The USEPA Superfund Program Health Effects Assessment Summary Tables (USEPA 2011b)
- Toxicity values from the agency for Toxic Substances and Disease Registry (2019)
- The California Environmental Protection Agency, Office of Environmental Health Hazard Assessment's Toxicity Criteria Database (CalEPA 2019)

Summaries of Cancer and Non-Cancer Toxicity Data for HAA-17 are provided in **Tables 2-2a** and **2-2b**, respectively.

2.7.1.4 Risk Characterization

Risk characterization is the integration of the results of the data evaluation, exposure assessment, and toxicity assessment to yield a quantitative measure of cancer risk and non-cancer hazard. Potential risks to human health are evaluated quantitatively by combining calculated exposure levels and toxicity data. Risk calculations are presented in the RI/FS (Pika/Arcadis 2019) and summarized in **Table 2-3** of this ROD.

The available data were evaluated and compared to applicable screening levels. COPCs were identified for soil and groundwater. None of the constituents detected in sediment or surface water exceeded applicable screening levels. The results of the risk assessment are summarized in **Table 2-3**. The use of groundwater as a potable water source drives the risk assessment. The risks from exposure to soil and groundwater not used as a potable water supply were within the USEPA target risk range and the non-cancer hazards were less than the benchmark of 1, with the exception of construction or utility worker exposure to TCE in groundwater.

2.7.2 Summary of Ecological Risk Assessment

The ERA estimates what risks HAA-17 poses to ecological receptors if no action were taken. This section summarizes the ERA for this Site, as presented in the RI/FS (Pika/Arcadis 2019).

COPECs

The refinement of Contaminants of Potential Ecological Concern (COPECs) is necessary to help focus further risk assessment activities on those constituents that pose the greatest potential hazard to ecological receptors. It is intended as an incremental iteration of exposure, effects, and risk characterization. Constituents are either excluded as COPECs or retained for further evaluation in the ERA process. The process to refine COPECs includes:

1. Comparison with background and upgradient concentrations- This is only applicable for inorganic constituents unless organic constituents being considered also occur in background or upgradient media unaffected by the site. Soil background levels for inorganics were identified from the Revised Final CSR and were incorporated in the ERA.

2. Frequency of Detection – constituents detected in greater than 5% of the samples in a given medium are typically retained as COPECs and considered in the next step of the refinement process.

For HAA-17 the COPECs retained through the end of the screening are heavy molecular weight PAHs.

Exposure Assessment

The undeveloped areas of HAA-17 are primarily managed grasslands and neighboring forestland. Common fauna in the grasslands includes earthworms and other soil-dwelling invertebrates, and transient wildlife including birds (e.g. robins), mammals (e.g. shrews, rabbits, and raccoons). Beyond the drainage ditches, the neighboring forestland consists mainly of mixed hardwood bottomland forest with a few interspersed pines. Common fauna in the forestland include a wide variety of birds and mammals including wild turkey, grey squirrel, and white-tailed deer. The drainage ditches in HAA-17 are typically dry, with only intermittent flow driven by precipitation runoff. These ditches are considered intermittent drainage conveyances that provide, at best, an extremely marginal habitat for aquatic life.

Indicator species were chosen to represent a cross-section of feeding guilds for selected assessment endpoints. The American robin (*Turdus migratorius*) was chosen to represent the invertivorous birds, and the short-tailed shrew (*Blarina brevicaudus*) was chosen to represent the invertivorous mammals. The

American robin is prolific in the United States with a home range that includes Georgia, tends to forage in open areas and the ecotone between woodlands and open areas, and has sufficient exposure-related and toxicological information available to be used in assessments. The short-tailed shrew is one of the most common mammals in North America and may be present at the Site. The short-tailed shrew also has a high ingestion rate and as such may be used as a conservative species in an ERA. With a relatively high consumption of earthworms, and if hazards are not expected for this species, then hazards should not be expected for species with lesser exposures to bio accumulative constituents (e.g. herbivorous mammals).

Risks were characterized for ecological receptors by considering direct contact with constituents of potential ecological concern (COPECs) in surface soil (0 to 4 feet below ground surface) and through ingestion of prey tissue through a food web model to upper-trophic level wildlife. Pathways of concern are summarized in **Table 2-4**.

Ecological Effects Assessment

Toxicity Reference Values (TRVs) were obtained from the toxicological database presented in USEPA's EcoSSL documents (USEPA 2007) or, when unavailable in the EcoSSL documents, from the open literature. Toxicological benchmarks were used in food chain modeling such that a range of predicted food chain impacts could be evaluated. Food chain ingestion- based exposure calculations were used to identify potential adverse effects for wildlife at the site via wildlife dose models. Estimated ingestion intakes were divided by TRVs to obtain HQs for bioaccumulative COPECs. A HQ value of 1 or less is considered to indicate that adverse effects are not expected. An HQ above 1 indicates the need for further investigation. COPEC Concentrations Expected to Provide Adequate Protection of Ecological Receptors are summarized in **Table 2-5**.

Eco Risk Characterization

Potential risks were characterized for ecological receptors at the site by considering direct contact with COPECs in surface soil (0 to 1 ft bgs), soil (0 to 4 ft bgs), and sediment through ingestion of prey tissue via food chain modeling. Overall, the potential ecological risks are considered negligible for exposure to site surface soil and sediment. Most COPECs have HQs below 1. While the HQ for exposure to high molecular weight -PAHs in soil is slightly above 1, population-level effects for terrestrial receptors are not expected because concentrations are within documented background ranges and the site has low-quality habitat that is not attractive as a foraging or resting area for mammals and birds. Based on this assessment, potential ecological risks at the site are considered negligible, and no further evaluation is required at HAA-17 (Pika/Arcadis 2019).

2.8 Remedial Action Objectives

Cleanup at HAA-17 will afford protection of human and environmental health for the current and reasonably anticipated future land use at HAA-17. For HAA-17, this will involve reducing concentrations of COCs in groundwater to acceptable levels (i.e. PRGs established in accordance with calculated health-based goals and USEPA MCLs).

RAOs are site-specific, initial clean-up objectives that are established on the basis of the nature and extent of contamination, the resources that are currently and potentially threatened, and the potential for human and environmental exposure. HAA-17 contains multiple commercial/industrial facilities. Military and civilian workers are present at the Site during the work week. Access to the site is restricted, and trespassers are not expected. It is unlikely that the site will be used for permanent residential housing based on the HAAF Master Plan not including plans for family housing in the area (US Army 2017).

The Defense Environmental Restoration Program (DERP) Manual states, "if remedial action for groundwater is necessary to protect human health or the environment, the DoD Component should consider the NCP expectation that useable groundwater will be returned to their beneficial uses whenever practicable, within a timeframe that is reasonable given the particular circumstances of the site, when establishing RAOs in accordance with the NCP (300.430[a][1][iii][F]).” The cited section of the NCP states “EPA expects to return usable groundwaters to their to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site. When restoration of groundwater to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated groundwater, and evaluate further risk reduction.”

Upper surficial aquifer groundwater is not used as a potable water supply. The deeper Floridan aquifer is used as the potable water supply but is not hydraulically connected to the surficial aquifer where the contamination has been observed. The depth to water in the shallow upper aquifer is approximately 2 to 10 ft bgs, and construction workers may contact the groundwater during construction activities. The RAOs for HAA-17 include:

Groundwater

1) Reduce potential cancer risk and potential non- cancer health hazards for people (i.e., site workers and construction workers) exposed to TCE in contaminated groundwater
2) Reduce potential exposure of ecological receptors to TCE in groundwater
3) Prevent potential for migration of TCE at unacceptable levels to off-site locations.
4) Return useable groundwaters to their beneficial use whenever practicable.

ARARs are divided into three categories: chemical-specific, action-specific, and location-specific requirements.

Chemical-specific: Chemical-specific ARARs establish health-based concentration limits, risk-based concentration limits, or ranges for specific hazardous substances in different environmental media that provide media cleanup levels or a basis for calculating cleanup levels for COCs. Chemical-specific ARARs identified for remedial action at the site include USEPA RSLs for soil and USEPA MCLs, and Region 4 Tapwater RSLs for groundwater.

Location-specific: Location-specific ARARs set restrictions on the types of remedial activities that can be performed based on site-specific characteristics or location (e.g. proximity to wetlands, historic buildings, etc.). HAA-17 will remain a commercial/industrial use property requiring that all remedial alternatives address potential residential exposure to COCs in groundwater through the application of institutional controls. Buildings and paved areas at HAA-17 cannot be removed or modified if the result is a reduction in mission readiness.

Action-specific: Action-specific ARARs set controls or restrictions on the design, implementation, and performance of actions. These provide a basis for assessing the feasibility and effectiveness of the remedial alternatives by specifying performance levels, actions, or technologies and specific levels for discharge of residual chemicals. Action-specific ARARs identified include air emission standards for any air discharge in the motor pool area and compliance with National Pollutant Discharge Elimination System (NPDES) and base requirements for any treated water discharged to proximate canals.

PRGs were established based on USEPA RSLs, USEPA MCLs, and Georgia IWQS Criteria. PRGs for the Site include:

Groundwater

- VOCs:
    - TCE – 5 µg/L

- Cis-1,2-DCE – 70 µg/L
- VC – 2 µg/L
- Benzene – 5 µg/L
- Chromium (total) – 100 µg/L

The RAOs address risks identified in the RA by reducing or limiting exposure of site workers and construction workers to COCs in groundwater and soils, reducing concentrations of COCs in soil and groundwater, and preventing potential for migration of COCs to offsite locations.

2.9 Description of Alternatives

Remedial alternatives are discussed in this section. Alternatives are presented in consecutive order corresponding to their order in the RI/FS report. Alternatives are evaluated based on effectiveness (overall protectiveness of human health and the environment; compliance with RAOs; long-term and short-term effectiveness; and reduction of toxicity, mobility, or volume [TMV] of contaminants), implementability, cost effectiveness, and state and community acceptance.

The alternatives are:

Groundwater
Alternative 1: No Action
Alternative 2: In situ chemical oxidation (ISCO), MNA and LUCs
Alternative 3: ERD, MNA, and LUCs
Alternative 4: Groundwater Extraction, MNA, and LUCs

These alternatives are summarized below.

2.9.1 Groundwater

2.9.1.1 Groundwater Alternative 1: No Action

Under this alternative, HAAF would take no action at the site to prevent exposure to groundwater contamination or to reduce TMV of contaminants. There are no technological barriers to implementation of the No Action alternative, however the potential risks identified in the RA would not be mitigated by this response. This response is evaluated as required based USEPA guidance.

2.9.1.2 Groundwater Alternative 2: ISCO, MNA, and LUCs.

Groundwater Alternative 2 will actively reduce concentrations of CVOCs in groundwater by enhancing the mass removal of TCE impacted groundwater at HAA-17 around the former USTs 25 and 26 area. Groundwater Alternative 4 will utilize:

- ISCO for mass removal of CVOCs
    - Injections of oxidizing compounds to the aquifer to chemically destroy contaminants
    - Will target the area with elevated CVOC concentrations
    - Performance sampling events will be conducted after injections
- MNA to treat residual COCs after an IRZ is established
- Onsite LUCs prohibiting potable water well installation and groundwater consumption within or downgradient of the source area.

ISCO injections would be implemented via 40 direct push injection points of approximately 35,000 gallons total of an oxidant such as sodium persulfate and an activator such as sodium hydroxide.

Performance sampling events will be conducted for two years after injections. Performance monitoring will include eight sampling events consisting of five wells for VOCs, sulfate, and persulfate anion after each injection. Sampling will be conducted weekly for one month, monthly for two months, then at six and 12 months. Once the injection and initial performance monitoring events are complete, MNA monitoring will continue. These groundwater monitoring programs will track progress of remediation, to ensure that conditions remain favorable for continued natural attenuation, and to determine when the RAOs have been achieved. This remedy will also include CERCLA five-year reviews until the RAOs are achieved, during which the effectiveness of the implemented remedy will be assessed and whether the implementation of additional remedial action is appropriate

Estimated Capital Cost: $208,592
Estimated Annual O&M Cost: $174,232 (injection years)
Estimated Present Worth Cost: $971,382
Estimated Construction Timeframe: 2 year
Estimated Time to Achieve RAOs: 15 years

2.9.1.3 Groundwater Alternative 3: ERD, MNA, and LUCs

Groundwater Alternative 3 will actively reduce concentrations of CVOCs in groundwater associated with the former USTs 25 and 26 area through mass removal. Groundwater Alternative 3 will utilize:

- ERD system for mass removal of CVOCs
  - One time Injection of EVO to establish a long-lived source of organic carbon to promote degradation of CVOCs.
  - Will target the area with elevated CVOC concentrations
  - Performance monitoring to determine that an in-situ reduction zone (IRZ) has been established.
- MNA to treat residual COCs after an IRZ is established
- Onsite LUCs prohibiting potable water well installation and groundwater consumption until site groundwater concentrations are at levels that allow UU/UE.

Exact location and quantity of injection wells to be installed in the former UST 25 and 26 are pending the results of baseline sampling. Continued monitoring in the form of performance sampling events and long term MNA monitoring for VOCs will be conducted for several years after injections. These groundwater monitoring programs will track progress of remediation, ensure that conditions remain favorable for continued natural attenuation, indicate whether another injection is required, and determine when the RAOs have been achieved. This remedy will also include CERCLA five-year reviews until RAOs are achieved, during which the effectiveness of the implemented remedy will be assessed and whether the implementation of additional remedial action is appropriate.

Estimated Capital Cost: $206,479
Estimated Present Worth Cost: $846,503
Estimated Construction Timeframe: 1 year
Estimated Time to Achieve RAOs: 14.9 years

2.9.1.4 Groundwater Alternative 4: Groundwater Extraction, MNA, and LUCs

Groundwater Alternative 4 will actively reduce concentrations of CVOCs in groundwater associated with the TCE through a combination of groundwater extraction, ex-situ treatment and disposal, and MNA. Groundwater Alternative 4 will utilize:

- Treatment system for mass removal of CVOCs
  - Two granular activated carbon (GAC) units and a low-profile air stripper.

  - o Multimedia filter to remove large particles in influent groundwater
  - o Effluent groundwater would be discharged to surface water drains or the canal
  - o Will target the area with elevated CVOC concentrations
- MNA to treat residual COCs after an IRZ is established
- Onsite LUCs prohibiting potable water well installation and groundwater consumption until site groundwater concentrations are at levels that allow UU/UE.

Groundwater Alternative 4 would require the installation of seven extraction wells installed on 20-ft centers. The extraction wells would have a larger diameter (4-inches or greater) than the monitoring wells in order to maximize the productivity of each well. A treatment building would be constructed to house all of the equipment needed for the treatment system.

Excavation would be required to lay piping from the treatment building to the extraction wells. Trenches would be dug to a depth of 3 ft bgs to install piping. Trenches would be backfilled with native material after installation. Well vaults would be installed at each extraction well. The system would draw groundwater from all extraction wells concurrently. The extraction well transects would be designed to capture the groundwater flux, eliminating migrations beyond the extraction transect.

A groundwater monitoring program would be implemented to track the progress of remediation to ensure that conditions remain favorable for continued natural attenuation and to determine when the RAOs have been achieved. The long-term monitoring well network would incorporate some of the existing monitoring wells plus new monitoring wells installed as part of the active remedy.

LUCs prohibiting the use of groundwater at HAA-17 as a potable source would be implemented and maintained as long as COCs remain over applicable screening levels. This remedy will also include CERCLA five-year reviews until RAOs are achieved, during which the effectiveness of the implemented remedy will be assessed and whether the implementation of additional remedial action is appropriate.

Estimated Capital Cost: $903,226
Estimated Annual O&M Cost: $402,825
Estimated Present Worth Cost: $2,862,184
Estimated Construction Timeframe: 2 years
Estimated Time to Achieve RAOs: 15 years

2.10 Comparative Analysis of Alternatives

Alternatives are evaluated relative to 9 evaluation criteria listed in the NCP:

- *Overall protectiveness of human health and the environment*- whether the alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
- *Compliance with ARARs* – whether the alternative meets Federal and State environmental statutes, regulations, and other requirements pertaining to the site, or whether a waiver is justified.
- *Long-term effectiveness and permanence* – the ability of an alternative to maintain protection of human health and the environment over time.
- *Reduction of toxicity, mobility, volume, or mass of contaminants* - an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environments, and the amount of contamination present.
- *Short-term effectiveness* – the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.

- *Implementability* – the technical and administrative feasibility of implementing an alternative, including factors such as the relative availability of goods and services.
- *Cost* – includes estimated capital and annual O&M costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
- *State/support agency acceptance* – whether the State agrees with HAAF's analyses and recommendations, as described in the RI/FS and Proposed Plan.
- *Community acceptance* – whether the local community agrees with the analysis and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

A comparative analysis of the alternatives is provided below and summarized in **Tables 2-6** and **2-7**.

2.10.1 Protection of Human Health and the Environment

Each remedial alternative except the "no action" alternative would provide adequate protection of human health and the environment by eliminating, reducing, or controlling risk through treatment, engineering controls, and/or institutional controls.

Alternative 4's extraction and treatment of groundwater removes COC mass and creates a concentration gradient for mass transfer of COCs into the dissolved phase into more transmissible zones. The extraction of groundwater further enhances the protection of human health and environment by creating a gradient for containment of the contamination plume.

Alternative 3 would provide ERD of impacted groundwater and would enhance natural biological degradation by stimulating naturally occurring bacterial populations that can break down CVOCs. The IRZ further enhances the protection of human health and environment by degrading COCs that exceed the PRGs within the mass flux portion of the contamination plume.

Alternative 2's ISCO of impacted groundwater would degrade chlorinated volatile organic compounds (CVOCs) through oxidation. The introduction of an oxidizer and activator solution into the aqueous environment reduces total CVOC mass in the source area. ISCO may temporarily reduce natural attenuation of CVOCs. Soon after ISCO is completed, CVOCs may exhibit "rebound", wherein observed concentrations of COCs may decrease during ISCO treatment, then increase shortly thereafter, and additional injections may be required. ISCO enhances the protection of human health and environment by oxidizing COCs that exceed the PRGs within the mass flux portion of the contamination plume.

Onsite LUCs instituted as part of the groundwater alternatives will further protect human health and the environment by limiting the types of construction that can occur at the site (e.g., no water supply wells, restrictions on residential buildings).

2.10.2 Compliance with ARARs

With the exception of the "no action" alternative, these alternatives would meet their respective ARARs . The "No Action" alternatives will not be discussed further in this comparison. Each alternative applies MNA or source reduction technologies to reduce contamination below chemical-specific ARARs including USEPA RSLs/MCLs, and Region 4 Tapwater RSLs for groundwater. Each alternative addresses potential residential exposure to COCs through institutional controls. Action-specific ARARs include adherence to air emission standards and compliance with NPDES and installation requirements for any treated water discharged to proximate canals. These are satisfied where applicable (e.g., Alternative 4 which includes air stripping and potential discharge of treated water to onsite canals).

2.10.3 Long-Term Effectiveness and Permanence

Alternatives 2, 3, and 4 would all target the higher concentration zone around the former UST area and accelerate the reduction in volume and toxicity. Reduction of the mobility, toxicity, and volume of COCs would be confirmed through regular groundwater monitoring for each proposed alternative. Alternative 2 would leave a long-term carbon substrate in the subsurface to continue to enhance CVOC degradation. Alternative 3 may demonstrate CVOC "rebound", where observed concentrations rise after an injection and additional injections may be required.

2.10.4 Reduction of Toxicity, Mobility, Volume, and Mass

Reduction of the mobility, toxicity, volume, and mass of COCs in groundwater would be confirmed through regular groundwater monitoring for each proposed groundwater alternative. In addition, Groundwater Alternatives 2 and 3 would utilize in situ technologies to accelerate the reduction in TMV of the elevated CVOC concentration zones. Groundwater Alternative 4 would utilize ex situ treatment technologies to accelerate reduction in TMV of COCs in groundwater.

2.10.5 Short-Term Effectiveness

Alternative 3 would result in minimal risks to the community, workers, and the environment. Degradable carbon that would be used to create the IRZ would be in the form of molasses, corn syrup, whey, or other similar products that would not result in additional risks to the community, workers, and the environment.

Alternative 4 would result in minimal risks to the community, workers, and the environment. Groundwater would be treated to meet required standards and would not result in additional risks to the community, workers, and the environment.

Alternative 2 requires use of hazardous chemicals, which would result in moderate short-term risks to the community, workers, and the environment. The chemicals used for ISCO would be handled in compliance with all health and safety requirements. This approach would result in rapid oxidation of dissolved phase COCs.

Alternatives 2, 3, and 4 would handle purge water from monitoring well sampling using approved methods.

2.10.6 Implementability

Alternatives 2 and 3 are both technically and administratively feasible. Alternatives 2 and 3 would require temporary injection points to implement ISCO and ERD, respectively. Injection points would be installed using standard direct push technology (DPT) or drilling methods and materials. These services are readily available, as are the services and materials necessary for the collection and analysis of groundwater samples.

Similar to Alternatives 2 and 3, Alternative 4 is both technically and administratively feasible. Extraction wells would be required to implement the strategy. Wells would be installed using standard well drilling methods and materials. The treatment system would require ongoing operation and maintenance. These services are readily available, as are the services and materials necessary for the collection and analysis of groundwater samples.

2.10.7 Cost

The estimated present worth cost of Alternative 3 is less than Alternative 2 and Alternative 4. When comparing the total allotted time to complete remediation, LUCs, and MNA for each alternative, Alternative 3 is the least costly with the same amount of approximate time to complete remedial goals.

2.10.8 State/Support Agency Acceptance

The State of Georgia supports the Preferred Alternative, Groundwater Alternative 3 (ERD, MNA, and LUCs) without comment. The GAEPD acceptance letter of the Proposed Plans is included in Appendix A.

2.10.9 Community Acceptance

The Proposed Plans for HAA-17 were made available to the public in July 2021 in the Administrative Record at Fort Stewart, online, and in the Southern Chatham County Public Library. Notice of availability of the plans was published in the Savannah Morning News and The Frontline prior to the public comment period starting on June 24 and July 1, 2021, respectively. A public comment period was held from July 14 to August 14, 2021. The public accepted the Preferred Alternative without comment.

2.11 Principal Threat Waste

The NCP establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable. The "principal threat" concept applies to the characterization of "source materials". A source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to ground water, surface water, air, or acts as a source for direct exposure. Contaminated groundwater generally is not considered to be a source material, however NAPL in groundwater may be viewed as a 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. Contaminated groundwater at HAA-17 does not constitute Principal Threat Waste.

2.12 Selected Remedy

The preferred alternative selected for remediating the CVOC impacts to groundwater at HAA-17 is Groundwater Alternative 3 (ERD, MNA, and LUCs).

2.12.1 Summary of Rationale for the Selected Remedy

All of the groundwater alternatives are implementable, but Groundwater Alternative 3 was rated the most favorable. Alternative 3 meets the RAOs, is effective in mitigating and controlling risks at the site, and results in the reduction of the volume and mobility of onsite waste. Furthermore, Alternative 3 eliminates the risks and costs associated with hazardous chemical handling as in Alternative 2, and ongoing O&M of an operating system at the active site as in Alternative 4.

2.12.2 Description of the Selected Remedy

Groundwater Alternative 3

This alternative includes an ERD system to enhance mass removal associated with CVOCs near the former USTs 25 and 26 area, MNA for remaining contaminants, onsite LUCs preventing installation of potable wells within or downgradient to the source areas, and CERCLA five-year reviews until RAOs are achieved.

An ERD system will enhance the mass removal associated with the chlorinated VOC impacted groundwater at HAA-17. The conceptual design assumptions for the ERD installation associated with Alternative 3 are as follows:

- One-time injection of EVO from a network of temporary DPT injection points to establish a long-lived source of organic carbon to promote degradation of chlorinated VOCs.
- Target area with exceedances of 1,000 µg/L TCE (approximately 7,500 square feet)
- Forty total injection points with 10-ft on-center spacing (5 ft radius of influence) for delivery of approximately 35,000 gallons of 2% EVO solution (see **Figure 2-8**).
- Advance temporary points to target depths between 20 and 35 ft bgs and use deployable 4-ft temporary screens to achieve delivery across the vertical interval.
- Performance monitoring of five monitoring wells located inside the treatment zone for VOCs, light gases (methane, ethene, and ethane), total organic carbon, and field parameters.
- Eight performance sampling events after the injection event scheduled weekly for one month, monthly for two months, then at six months and 12 months.

- Five years of semi-annual MNA of 25 wells for VOCs and four wells for total and dissolved chromium (around the purge facility)
- Twenty-five years of annual MNA monitoring for VOCs and four wells for total and dissolved chromium.

Implementation of ERD would reduce the higher concentration zone within three years of operation, allowing for the residual mass to attenuate naturally. Long-term monitoring of downgradient monitoring wells and any necessary new monitoring well installations at the site would also be conducted to ensure that the selected remedy continues to be effective.

The remedy would also include five-year reviews until RAOs are achieved, per CERCLA 121(c), which requires any remedial action that results in contaminants remaining onsite at concentrations greater than those allowing unrestricted use must be reviewed at least once every five years. Concentrations of COCs in groundwater may remain that preclude the unrestricted use of the site under this alternative. During five-year reviews, an assessment is made of whether the implemented remedy continues to be protective of human health and the environment or whether the implementation of additional remedial action is appropriate.

The infrastructure required to implement monitoring is an adequate monitoring network, which is already in place at HAA-17, translating to relatively low capital costs and moderate O&M costs for sampling, analysis, and monitoring. Monitoring would be performed in conjunction with LUCs to maintain protection of human health and the environment until site groundwater contaminant concentrations are at levels that allow UU/UE.

LUCs will be put in place so that protection to human health and the environment is maintained and land and groundwater use is restricted until site groundwater contaminant concentrations are at levels that allow unrestricted use and unlimited exposure. The USEPA requires LUCs when site levels do not allow unrestricted use and unlimited exposure. They can also serve to notify current and future users about the environmental conditions of the property. LUCs are expected to remain in place until site groundwater contaminant concentrations are at levels that allow UU/UE.

ERD and MNA address the chemical specific ARARs of USEPA MCLs, and Region 4 Tapwater RSLs by source reduction of contamination until concentrations meet these requirements. LUCs address location-specific ARARs by restricting potential residential exposure to COCs in groundwater through application of institutional controls. Action-specific ARARs including adherence to air emission standards or NPDES and installation requirements for water discharge do not apply to this alternative as no air emissions or discharges of water to surface water/canals are anticipated.

2.12.3 Summary of Estimated Remedy Costs

The information in the following cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternatives. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, and ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

Selected Remedy Cost Estimates

Alternative	Total Cost	Present Worth Total Cost	Capital Cost	Total Annual O&M and Periodic Costs	Present Worth of Total Annual O&M and Periodic Costs	Estimated Timeframe of Alternative
Groundwater Alternative 3	$1,323,360	$846,503	$160,767	$1,116,881	$640,025	30 Years

Notes:

1. The estimated timeframe of each alternative assumed for costing may not reflect the actual time to cleanup.
2. Estimations based off USEPA Guidance (1988).

2.12.4 Expected Outcomes of Selected Remedy

The selected remedy is expected to result in restricted use of the site with exposure controlled through use of treatment and institutional controls. Long-term attenuation of CVOCs in groundwater will require LUCs prohibiting residential use of the site and prohibition of use of the shallow surficial aquifer as a potable water source.

2.13 Statutory Determinations

Under CERCLA and the NCP, selected remedies must be protective of human health and the environment, comply with ARARs (unless a waiver is justified), be cost effective, and use permanent solutions and treatment or resource recovery technologies to the extent practicable. The following sections discuss how the selected remedy meets these statutory requirements and explains the Five-Year Review requirements.

2.13.1 Protection of Human Health and the Environment

The selected remedy (Groundwater Alternative 3: ERD, MNA, and LUCs) are protective of human health and the environment.

Groundwater Alternative 3 will reduce the mass/volume of contaminants present in groundwater through ERD and MNA. This remedy will prevent direct exposure to contaminants through the use of LUCs preventing use of groundwater as a potable source while COCs are still present above applicable screening levels.

2.13.2 Compliance with ARARs

Remedial actions selected must comply with all ARARs. ARARs for this project include:

- Chemical specific ARARs include USEPA RSLs for soil, USEPA MCLs and USEPA Region 4 Tapwater RSLs for groundwater.
- Location-specific ARARs include institutional controls such that HAA-17 will remain a commercial/industrial use property requiring that all remedial alternatives address potential residential exposure to COCs through the application of LUCs.
- Action-specific ARARs identified include air emission standards for any air discharge and compliance with NPDES and base requirements for any treated water discharged to surface waters/proximate canals.

The selected remedy will reduce COC concentrations in groundwater via ERD and natural attenuation following the implementation phase. The selected remedy will comply with all ARARs. ERD and MNA address the chemical specific ARARs of USEPA MCLs, and Region 4 Tapwater RSLs by source reduction of contamination until concentrations meet these requirements. LUCs address location-specific ARARs by restricting potential residential exposure to COCs in groundwater through application of institutional controls. Action-specific ARARs including adherence to air emission standards or NPDES requirements do not apply to this alternative as no air emissions or surface water discharges are anticipated.

2.13.3 Cost-Effectiveness

The cost-effectiveness of the proposed remedy must be considered. Cost effective remedies are considered those for which the costs are proportional to its overall effectiveness. While more than one cleanup alternative can be cost-effective, the NCP does not mandate that the selection of the most cost-effective cleanup alternative. The most cost-effective remedy may not necessarily be the remedy that provide the best tradeoff with respect to the remedy selection criteria.

Cost effectiveness is considered by evaluating the long-term effectiveness and permanence, reduction in TMV through treatment, and short term effectiveness.

The estimated present worth cost of Alternative 3 is less than Alternative 2 and Alternative 4. When comparing the total allotted time to complete remediation, LUCs, and MNA for each alternative, Alternative 3 is the least costly with the same amount of approximate time to complete remedial goals. Alternative 3 is the most cost effective of the alternatives.

2.13.4 Utilization of Permanent Solutions and Alternative Treatment

The selected remedy provides the best balance of trade offs among the alternatives with respect to the balancing criteria such that it represents the maximum extent to which permanence and treatment can be practicably utilized at this time. Emphasis is placed on long term effectiveness and reduction of TMV through treatment. The selected groundwater remedy includes use of ERD to actively reduce TMV of primary COCs with MNA for remaining COCs. This alternative was equally as effective in the long term and in reduction of TMV as Alternatives 2 and 4, and with the utilization of a longer-lived carbon source, the probability of dissolved phase COC rebound that may occur with Alternative 2 is less likely to occur with Alternative 3. Alternative 3 would require less ongoing operation and maintenance than Alternative 4.

2.13.5 Preference for Treatment as a Principal Element

This remedial action satisfies the statutory preference for treatment as a principal element in that the selected remedy for Groundwater utilizes treatment as a principal element. Treatment includes ERD to reduce TMV of COCs present.

2.13.6 Five Year Review Requirements

CERCLA five-year reviews are required in any remedial action that results in contaminants remaining onsite at concentrations greater than those allowing unrestricted use. These will be required for HAA-17 until it is demonstrated that groundwater concentrations have declined below applicable PRGs. The review will evaluate whether the implemented remedies currently are or will be protective of human health and the environment, and whether additional action is required.

2.14 Documentation of Significant Changes

The Proposed Plans for HAA-17 were released for public comment in July 2021. The Proposed Plans identified Groundwater Alternative 3 (ERD, MNA, and LUCs) without comment. No comments were received during the public comment period, and no significant changes to the remedy as originally identified in the Proposed Plans were necessary or appropriate.

3 RESPONSIVENESS SUMMARY

3.1 Stakeholder Issues and Lead Agency Responses

The Proposed Plans for HAA-17 were released for public comment in July 2021. The Proposed Plans identified Groundwater Alternative 3 (ERD, MNA, and LUCs) as the Preferred Alternative. No comments were received during the public comment period, and the State of Georgia supports the Preferred Alternative without comment.

3.2 Technical and Legal Issues

There are no known technical or legal issues at this time.

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Tables

Table 2-1
Summary of Chemicals of Concern and Medium-Specific Exposure Pont Concentrations

Scenario Timeframe: Current										
Exposure Point	Chemical of Concern	Media	Exposure Media	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
				Min	Max					
Soil On-Site-Direct Contact	Benzo(a)pyrene	Soil (1-10ft)	Soil	3.82E-02	2.52E-01	mg/kg	6/38	1.17E-01	mg/kg	UCL
	Chromium			1.80E+00	9.80E+00	mg/kg	10/10	7.14E+00	mg/kg	UCL
Groundwater - Drinking Water	Benzene	Groundwater	Drinking Water	1.60E-04	2.10E-03	mg/L	10/49	7.76E-04	mg/L	UCL
	Cis-1,2-dichloroethene			1.90E-04	1.10E-01	mg/L	20/49	2.17E-02	mg/L	UCL
	Trichloroethene			2.30E-04	1.00E+00	mg/L	19/49	1.60E-01	mg/L	UCL
	Vinyl Chloride			5.20E-04	5.90E-03	mg/L	4/49	5.90E-03	mg/L	Max
	Chromium			2.90E-03	3.50E-03	mg/L	2/5	3.50E-03	mg/L	Max

Notes:
mg/kg - milligrams per kilogram
mg/L - milligrams per liter
Max - Maximum detected concentration
UCL - Upper Confidence Limit

Table 2-2a
Cancer Toxicity Data Summary

Pathway: Oral, Dermal				
Chemical of Concern	Oral Cancer Slope Factor	Dermal Cancer Slope Factor	Slope Factor Units	Weight of Evidence/Cancer Guideline Description
Benzo(a)pyrene	1.00E+00	1.00E+00	$(mg/kg/day)^{-1}$	A
Chromium	5.00E-01	2.00E+01	$(mg/kg/day)^{-1}$	A
Benzene	5.50E-02	5.50E-02	$(mg/kg/day)^{-1}$	A
Cis-1,2-dichloroethene	NA	NA	$(mg/kg/day)^{-1}$	C
Trichloroethene	4.60E-02	4.60E-02	$(mg/kg/day)^{-1}$	A
Vinyl Chloride	7.20E-01	7.20E-01	$(mg/kg/day)^{-1}$	A

Pathway: Inhalation				
Chemical of Concern	Inhalation Unit Risk	Slope Factor Units	Weight of Evidence/Cancer Guideline Description	Source
Benzo(a)pyrene	6.00E-05	$(\mu g/m^3)^{-1}$	H	I
Chromium	8.40E-02	$(\mu g/m^3)^{-1}$	A	S
Benzene	7.80E-06	$(\mu g/m^3)^{-1}$	A	I
Cis-1,2-dichloroethene	NA	$(\mu g/m^3)^{-1}$	C	NA
Trichloroethene	4.10E-06	$(\mu g/m^3)^{-1}$	A	I
Vinyl Chloride	4.40E-06	$(\mu g/m^3)^{-3}$	A	I

Notes:
$(mg/kg/day)^{-1}$ - Inverse miligram per kilogram per day (risk per unit dose)
$(\mu g/m^3)^{-1}$ - Inverse microgram per cubic meter (risk per unit does)
A - Human Carcinogen (sufficient evidence of carcinogenicity in humans) (USEPA, 2019a)
B - Not Classifiable as to Human Carcinogenicity (inadequate or no evidence)
B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
C - Not classifiable as to Human Carcinogenicity (inadequate or no evidence)
H - Carcinogenic to Humans
I - USEPA, Integrated Risk Information System (IRIS) (USEPA 2019a)
J - New Jersey Department of Environmental Protection as referenced in USEPA 2018
S - USEPA RSLs user guide (Section 5; USEPA 2018)
NA - Not available or applicable

Table 2-2b
Non-Cancer Toxicity Data Summary

Pathway: Oral, Dermal								
Chemical of Concern	Oral RfD Value (mg/kg/day) [a]				Dermal RfD (mg/kg/day) [b]		Primary Target Organ	Combined Uncertainty/Modifying Factors
	Subchronic	[ref]	Chronic	[ref]	Subchronic	Chronic		
Benzo(a)pyrene	NA	NA	3.00E-04	I	NA	3.00E-04	Developmental	medium/300
Chromium	5.00E-03	A	3.00E-03	I	1.30E-04	7.50E-05	NR	low/300
Benzene	1.00E-02	P	4.00E-03	I	1.00E-02	4.00E-03	Blood	medium/300
Cis-1,2-dichloroethene	2.00E-02	P	2.00E-03	I	2.00E-02	2.00E-03	Kidney	low/3000
Trichloroethene	5.00E-04	c	5.00E-04	I	5.00E-04	5.00E-04	Heart, immune system	high/10 to 100
Vinyl Chloride	3.00E-03	c	3.00E-03	I	3.00E-03	3.00E-03	Liver	medium/30

Pathway: Inhalation						
Chemical of Concern	Oral RfD Value (mg/kg/day) [a]				Primary Target Organ	Combined Uncertainty/Modifying
	Subchronic	[ref]	Chronic	[ref]		
Benzo(a)pyrene	NA	NA	2.00E-06	I	Developmental	low to medium/3000
Chromium	3.00E-04	A	1.00E-04	I	Lung	medium/300
Benzene	8.00E-02	P	3.00E-02	I	Blood	medium/300
Cis-1,2-dichloroethene	NA	NA	NA	NA	NA	NA
Trichloroethene	2.15E-03	A	2.00E-03	I	Heart, Immuny System	high/10 to 100
Vinyl Chloride	7.67E-02	A	1.00E-01	I	Liver	medium/30

Notes:
A - Agency for Toxic Substances Disease Registry (ATSDR 2017)
c - The chronic value is used if available
I - USEPA, Integrated Risk Information System (IRIS) (USEPA 2019a)
P - Provisional Peer Reviewed Toxicity Values (PPRTV) (USEPA 2019b)
NA - Not Applicable
NR - None Reported
mg/kg/day - Milligram per kilogram per day
[a] - Toxicity values were obtained following USEPA recommended hierarchy (USEPA 2003a)
[b] - The oral-to-dermal adjustment factor (oral absorption efficiency) as used to calculate the dermal RfD values (USEPA 2004b)

Table 2-3

Risk Characterization Summary - Carcinogens and Non-Carcinogens

Scenario Timeframe: Current
Receptor Population: Current or Hypothetical Site Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemcial of Concern	Carcinogenic Risk				Primary Target Organ/Critical Effect	Non-Carcinogenic Risk			
				Oral	Dermal	Inhalation	Exposure Routes Total		Oral	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil (1-10ft)	Soil On-Site - Direct Contact	Benzo(a)pyrene	3.60E-08	2.00E-08	1.60E-13	5.60E-08	Gastrointestinal, respiratory	3.30E-04	1.80E-04	3.60E-07	5.10E-04
			Chromium	1.10E-06	NA	1.30E-09	1.10E-06	Lung	2.00E-03	NA	4.40E-07	2.00E-03
Groundwater	Drinking Water	Groundwater - Potable Water	Benzene	1.30E-07	5.10E-09	2.50E-07	3.85E-07	Leukemia	1.70E-03	6.50E-05	3.00E-03	4.77E-03
			Cis-1,2-dichloroethene	NA	NA	NA	0.00E+00	-	9.30E-02	3.00E-03	NA	9.60E-02
			Trichloroethene	1.80E-05	7.60E-07	2.10E-05	3.98E-05	Liver, NHL, kidney	2.20E+00	9.20E-02	7.20E+00	9.49E+00
			Vinyl Chloride	1.30E-05	2.60E-07	1.10E-06	1.44E-05	Liver	1.70E-02	3.30E-04	6.70E-03	2.40E-02
			Chromium	5.40E-06	1.90E-07	NA	5.59E-06	Lung	1.00E-02	3.50E-04	NA	1.04E-02
						Subsurface Soil Risk Total =	**1.16E-06**				**Subsurface Soil Risk Total =**	**2.51E-03**
						Groundwater Risk Total =	**6.01E-05**				**Groundwater Risk Total =**	**9.63E+00**

Scenario Timeframe: Current
Receptor Population: Hypothetical Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemcial of Concern	Carcinogenic Risk				Primary Target Organ/Critical Effect	Non-Carcinogenic Risk			
				Oral	Dermal	Inhalation	Exposure Routes Total		Oral	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil (1-10ft)	Soil On-Site - Direct Contact	Benzo(a)pyrene	2.00E-09	8.40E-10	1.20E-11	2.85E-09	Gastrointestinal, respiratory	9.40E-04	3.90E-04	1.40E-03	2.73E-03
			Chromium	5.90E-08	NA	9.90E-08	1.58E-07	Lung	3.30E-03	NA	5.50E-04	3.85E-03
Groundwater	Drinking Water	Groundwater - Potable Water	Benzene	5.40E-12	3.60E-10	2.10E-09	2.47E-09	Leukemia	1.40E-06	9.10E-05	4.70E-04	5.62E-04
			Cis-1,2-dichloroethene	NA	NA	NA	0.00E+00	-	1.90E-05	1.00E-03	NA	1.02E-03
			Trichloroethene	7.40E-10	4.70E-08	1.40E-07	1.88E-07	Liver, NHL, kidney	4.50E-03	2.90E-01	2.20E+00	2.49E+00
			Vinyl Chloride	5.40E-10	1.90E-08	1.00E-08	2.95E-08	Liver	3.50E-05	1.30E-03	4.20E-03	5.54E-03
			Chromium	2.20E-10	3.10E-08	NA	3.12E-08	Lung	1.30E-05	1.80E-03	NA	1.81E-03
						Subsurface Soil Risk Total =	**1.61E-07**				**Subsurface Soil Risk Total =**	**6.58E-03**
						Groundwater Risk Total =	**2.51E-07**				**Groundwater Risk Total =**	**2.50E+00**

Scenario Timeframe: Current
Receptor Population: Hypothetical Trench Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemcial of Concern	Carcinogenic Risk				Primary Target Organ/Critical Effect	Non-Carcinogenic Risk			
				Oral	Dermal	Inhalation	Exposure Routes Total		Oral	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil (1-10ft)	Soil On-Site - Direct Contact	Benzo(a)pyrene	1.50E-10	6.40E-11	9.20E-13	2.15E-10	Gastrointestinal, respiratory	5.30E-04	2.20E-04	7.80E-04	1.53E-03
			Chromium	4.50E-09	NA	7.50E-09	1.20E-08	Lung	1.90E-03	NA	3.10E-04	2.21E-03
Groundwater	Drinking Water	Groundwater - Potable Water	Benzene	4.20E-13	2.80E-11	1.60E-10	1.88E-10	Leukemia	7.80E-07	5.10E-05	2.60E-04	3.12E-04
			Cis-1,2-dichloroethene	NA	NA	NA	0.00E+00	-	1.10E-05	5.70E-04	NA	5.81E-04
			Trichloroethene	5.70E-11	3.60E-09	1.10E-08	1.47E-08	Liver, NHL, kidney	2.50E-03	1.60E-01	1.20E+00	1.36E+00
			Vinyl Chloride	4.20E-11	1.50E-09	7.80E-10	2.32E-09	Liver	2.00E-05	7.10E-04	2.40E-03	3.13E-03
			Chromium	1.70E-11	2.40E-09	NA	2.42E-09	Lung	7.00E-06	9.90E-04	NA	9.97E-04
						Subsurface Soil Risk Total =	**1.22E-08**				**Subsurface Soil Risk Total =**	**3.74E-03**
						Groundwater Risk Total =	**1.96E-08**				**Groundwater Risk Total =**	**1.37E+00**

Scenario Timeframe: Current
Receptor Population: Hypothetical Adolescent Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemcial of Concern	Carcinogenic Risk				Primary Target Organ/Critical Effect	Non-Carcinogenic Risk			
				Oral	Dermal	Inhalation	Exposure Routes Total		Oral	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil (1-10ft)	Soil On-Site - Direct Contact	Benzo(a)pyrene	7.90E-09	4.40E-09	4.80E-15	1.23E-08	Gastrointestinal, respiratory	6.20E-05	3.40E-05	9.40E-09	9.60E-05
			Chromium	2.40E-07	NA	4.10E-11	2.40E-07	Lung	3.80E-04	NA	1.15E-08	3.80E-04
						Subsurface Soil Risk Total =	**2.52E-07**				**Subsurface Soil Risk Total =**	**4.76E-04**

Scenario Timeframe: Current
Receptor Population: Hypothetical Future Resident Receptor for Exposures to Subsurface Soil and All Groundwater Used as Potable Water

Medium	Exposure Medium	Exposure Point	Chemcial of Concern	Carcinogenic Risk Age-Specific with a Mutagenic Mode of Action Carcinogenic Constituents							
				0-2 years				2-6 years			
				Oral	Dermal	Inhalation	Exposure Routes Total	Oral	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil (1-10ft)	Soil On-Site - Direct Contact	Benzo(a)pyrene	4.30E-07	1.30E-07	5.20E-13	5.60E-07	2.60E-07	7.90E-08	3.10E-13	3.39E-07
			Chromium	1.30E-05	NA	4.50E-09	1.30E-05	7.80E-06	NA	2.70E-09	7.80E-06
Groundwater	Drinking Water	Groundwater - Potable Water	Benzene	NA	NA	NA	NA	NA	NA	NA	NA
			Cis-1,2-dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
			Trichloroethene	1.70E-05	2.40E-06	1.70E-05	3.64E-05	1.00E-05	1.50E-06	1.00E-05	2.15E-05
			Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA
			Chromium	2.50E-05	4.40E-06	NA	2.94E-05	1.50E-05	2.60E-06	NA	1.76E-05
						Subsurface Soil Risk Total =	**1.36E-05**			**Subsurface Soil Risk Total =**	**8.14E-06**
						Groundwater Risk Total =	**3.64E-05**			**Groundwater Risk Total =**	**2.15E-05**

Table 2-3
Risk Characterization Summary - Carcinogens and Non-Carcinogens

Scenario Timeframe: Current
Receptor Population: Hypothetical Future Resident Receptor for Exposures to Subsurface Soil and All Groundwater Used as Potable Water (Continued)

Medium	Exposure Medium	Exposure Point	Chemcial of Concern	Carcinogenic Risk Age-Specific with a Mutagenic Mode of Action Carcinogenic Constituents							
				6-16 years				16-26 years			
				Oral	Dermal	Inhalation	Exposure Routes Total	Oral	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil (1-10ft)	Soil On-Site - Direct Contact	Benzo(a)pyrene	6.00E-08	3.30E-08	7.80E-13	9.30E-08	2.00E-08	1.10E-08	2.60E-13	3.10E-08
			Chromium	1.80E-06	NA	6.70E-09	1.81E-06	6.10E-07	NA	2.20E-09	6.12E-07
Groundwater	Drinking Water	Groundwater - Potable Water	Benzene	NA	NA	NA	NA	NA	NA	NA	NA
			Cis-1,2-dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
			Trichloroethene	1.50E-05	2.40E-06	2.60E-05	4.34E-05	5.00E-06	8.10E-07	8.60E-06	1.44E-05
			Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA
			Chromium	2.20E-05	5.00E-06	NA	2.70E-05	7.50E-06	1.70E-06	NA	9.20E-06
						Subsurface Soil Risk Total =	**1.90E-06**			**Subsurface Soil Risk Total =**	**6.43E-07**
						Groundwater Risk Total =	**4.34E-05**			**Groundwater Risk Total =**	**1.44E-05**

Scenario Timeframe: Current
Receptor Population: Hypothetical Future Resident Receptor for Exposures to Subsurface Soil and All Groundwater Used as Potable Water (Continued)

Medium	Exposure Medium	Exposure Point	Chemcial of Concern	Total Cancer Risk							
				Age-Specific Risk with a Non-Mutagenic Mode of Action Carcinogenic Constituents							
				0-6 years				6-26 years			
				Oral	Dermal	Inhalation	Exposure Routes Total	Oral	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil (1-10ft)	Soil On-Site - Direct Contact	Benzo(a)pyrene	NA	NA	NA	0.00E+00	NA	NA	NA	0.00E+00
			Chromium	NA	NA	NA	0.00E+00	NA	NA	NA	0.00E+00
Groundwater	Drinking Water	Groundwater - Potable Water	Benzene	1.80E-07	2.40E-08	2.50E-07	4.54E-07	3.70E-07	5.50E-08	8.30E-07	1.26E-06
			Cis-1,2-dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
			Trichloroethene	2.00E-05	2.90E-06	1.60E-05	3.89E-05	4.00E-05	6.40E-06	5.40E-05	1.00E-04
			Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA
			Chromium	NA	NA	NA	NA	NA	NA	NA	NA
						Subsurface Soil Risk Total =	**0.00E+00**			**Subsurface Soil Risk Total =**	**0.00E+00**
						Groundwater Risk Total =	**3.94E-05**			**Groundwater Risk Total =**	**1.02E-04**

Scenario Timeframe: Current
Receptor Population: Hypothetical Future Resident Receptor for Exposures to All Groundwater Used as Potable Water

Medium	Exposure Medium	Exposure Point	Chemcial of Concern	Total Cancer Risk				Non-Cancer Hazard				Non-Cancer Hazard			
				Route-Specific Risk				Route-Specific Hazard				Route-Specific Hazard			
				0-26 years				0-6 years				6-26 years			
				Oral	Dermal	Inhalation	Exposure Routes Total	Oral	Dermal	Inhalation	Exposure Routes Total	Oral	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil (1-10ft)	Soil On-Site - Direct Contact	Benzo(a)pyrene	7.60E-07	2.50E-07	1.90E-12	1.01E-06	5.00E-03	1.50E-03	1.50E-06	6.50E-03	4.70E-04	2.60E-04	1.50E-06	7.32E-04
			Chromium	2.30E-05	NA	1.60E-08	2.30E-05	3.00E-02	NA	1.90E-06	3.00E-02	2.90E-03	NA	1.90E-06	2.90E-03
Groundwater	Drinking Water	Groundwater - Potable Water	Benzene	5.50E-07	7.90E-08	1.10E-06	1.73E-06	9.70E-03	1.30E-03	1.20E-02	2.30E-02	5.80E-03	8.70E-04	1.2-2	6.67E-03
			Cis-1,2-dichloroethene	NA	NA	NA	0.00E+00	5.40E-01	6.00E-02	NA	6.00E-01	3.30E-01	4.00E-02	NA	3.70E-01
			Trichloroethene	1.10E-04	1.60E-05	1.30E-04	2.56E-04	1.30E+01	1.80E+00	3.00E+01	4.48E+01	7.60E+00	1.20E+00	3.00E+01	3.88E+01
			Vinyl Chloride	9.85E-06	2.80E-04	2.20E-05	3.12E-04	9.80E-02	6.60E-03	2.80E-02	1.33E-01	5.90E-02	4.60E-03	2.80E-02	9.16E-02
			Chromium	7.00E-05	1.40E-05	NA	8.40E-05	5.80E-02	1.00E-02	NA	6.80E-02	3.50E-02	7.80E-03	NA	4.28E-02
						Subsurface Soil Risk Total =	**2.40E-05**			**Subsurface Soil Risk Total =**	**3.65E-02**			**Subsurface Soil Risk Total =**	**3.63E-03**
						Groundwater Risk Total =	**5.70E-04**			**Groundwater Risk Total =**	**4.56E+01**			**Groundwater Risk Total =**	**3.93E+01**

Table 2-4
Ecological Exposure Pathways of Concern

Exposure Medium	Sensitive Environment Flag (Y or N)	Receptor	Endangered/Threatened Species Flag	Exposure Routes	Assessment Endpoints	Measurement Endpoints
Surface Soil (0-2ft)	N	Terrestiral Wildlife	N	Incidental ingestion of soil, direct contact of surface soil, ingestion of prey tissue	• Sustainability of mammal populations; • Sustainability of avian populations; • Sustainability of terrestrial plant communities; • Sustainability ofsoil invertebrate communities	•HQ is the measurment endpoint. The HQ is the ratio of the EPC of a given constituent to it's ecological screening value.
	N	Terrestrial Soil Invertebrates	N	Direct contact of surface soil and ingestion of surface soil		
	N	Terrestrial Plants	N	Direct contact of surface soil		
Soil (0-4ft)	N	Terrestiral Wildlife	N	Direct contact of surface soil and ingestion of subsurface soil		
	N	Terrestrial Soil Invertebrates	N	Direct contact of surface soil and ingestion of subsurface soil		
	N	Terrestrial Plants	N	Direct contact of subsurface soil		

Notes:
HQ - Hazard Quotient
EPC - Exposure Point Concentration, lower of either UCL on the mean or the maximimum concentration

Table 2-5
COC Concentrations Expected to Provide Adequate Protection of Ecological Receptors

Potentially Impacted Species	Exposure Medium	COPEC	Protective Level	Units	Basis	Assessment Endpoint
Short-Tailed Shrew	Subsurface Soil	High Molecular Weight PAHs	0.615 - 3.07	mg/kg	Site specific LOAEL - NOAEL	• Sustainability of mammal populations; • Sustainability of avian populations; • Sustainability of terrestrial plant communities; • Sustainability ofsoil invertebrate communities
		Mercury	1 - 10			
American Robin	Subsurface Soil	High Molecular Weight PAHs	10 - 100			
		Mercury	0.45 - 0.9			

Notes:
mg/kg: Milligrams per kilogram
PAHs - Polycyclic aromatic hydrocarbons
LOAEL - Lowest observed adverse effect level
NOAEL - No observed adverse effect level

Table 2-6 Detailed and Comparative Analysis of Source Area Groundwater Remedial Action Alternatives
HAA-17, Hunter Army Airfield, Georgia

Evaluation Criteria		**Alternative 1** No Action	**Alternative 2** ISCO, MNA and Institutional Controls	**Alternative 3** ERD, MNA and Institutional Controls	**Alternative 4** Groundwater Extraction, Treatment and Discharge; MNA and Institutional Controls
Threshold Criteria					
1)	Overall protection of human health and the environment	Does not provide overall protection of human health or the environment. Does not minimize, reduce, or control COC impacts in source area soil or groundwater or associated exposure risks. Source area RAOs would not be met.	Protective of human health and the environment by eliminating potential exposure to COCs in source area soil and groundwater. Source area RAOs would be met.	Protective of human health and the environment by eliminating potential exposure to COCs in source area soil and groundwater. Source area RAOs would be met.	Protective of human health and the environment by eliminating potential exposure to COCs in source area soil and groundwater. Source area RAOs would be met.
2)	Compliance with ARARs	No established ARARs, remediate to the following USEPA MCL levels: PCE: 5 ppb, TCE: 5 ppb, VC: 2 ppb	No established ARARs, remediate to the USEPA MCLs	No established ARARs, remediate to the USEPA MCLs	No established ARARs, remediate to the USEPA MCLs
Balancing Criteria					
3)	Long-term effectiveness and permanence	Not effective or permanent. Potential exposure risks associated with COCs in source area soil or groundwater would remain with no controls or long-term management plan.	Effective in protecting human health and the environment as long as the institutional controls are maintained. Long-term management plan necessary for ensuring permanence of institutional controls.	Effective in protecting human health and the environment as long as the institutional controls are maintained. Long-term management plan necessary for ensuring permanence of institutional controls.	Effective in protecting human health and the environment as long as the institutional controls are maintained. Long-term management plan necessary for ensuring permanence of institutional controls.
4)	Reduction of mobility, toxicity, or volume	Natural attenuation processes may reduce mobility, toxicity, or volume of source area impacts, although monitoring of these processes would not be performed.	Reduces mobility, toxicity, and volume of VOCs in source area groundwater and saturated soil.	Reduces mobility, toxicity, and volume of VOCs in source area groundwater and saturated soil.	Reduces mobility, toxicity, and volume of VOCs in source area groundwater and saturated soil.
5)	Short-term effectiveness	No activities would be implemented that would present potential short-term exposure risks to human health or the environment.	Well installation and injection system installation may expose workers, adjacent populations, or the environment to potential exposure risks but risks would be easily minimized through engineering controls. Potential risks would be limited to onsite populations. Remedial response objectives would be met in <6 months.	Well installation, and injection system installation may expose workers, adjacent populations, or the environment to potential exposure risks but risks would be easily minimized through engineering controls. Potential risks would be limited to onsite populations. Remedial response objectives would be met in <6 months.	Well installation and treatment and discharge system installation may expose workers, adjacent populations, or the environment to potential exposure risks but risks would be easily minimized through engineering controls. Potential risks would be limited to onsite populations. Remedial response objectives would be met in <6 months.
6)	Implementability	Technically feasible due to lack of technical components. However, not administratively feasible due to lack of monitoring or protection of human health or the environment.	Technically and administratively feasible. Well installation and injection tasks would be coordinated with the Army to minimize interference with ongoing operations at HAAF.	Technically and administratively feasible. Well installation and injection tasks would be coordinated with the Army to minimize interference with ongoing operations at HAAF.	Technically and administratively feasible. Well installation and teatment system construction would be coordinated with the Army to minimize interference with ongoing operations at HAAF.
7)	Cost	No cost.	Present Worth = $971,382	Present Worth = $846,503	Present Worth = $2,862,184
Modifying Criteria					
8)	State Acceptance	Likely not acceptable	Assessed following comment on the CAP.	Assessed following comment on the CAP.	Assessed following comment on the CAP.
9)	Community Acceptance	Likely not acceptable	Assessed following comment on the CAP.	Assessed following comment on the CAP.	Assessed following comment on the CAP.

Notes:
All costs are estimated to an accuracy of +50 percent to -30 percent (USEPA, 2000)

Abbreviations:

ARAR	Applicable or Relevant and Appropriate Requirement
CAP	Corrective Action Plan
COC	Constituent of Concern
ERD	Enhanced Reductive Dechlorination
ISCO	In-Situ Chemical Oxidation
LNAPL	Light Non-Aqueous Phase Liquid
MNA	Monitored Natural Attenuation
RAO	Remedial Action Objective
SOB	Statement of Basis

From Pika/Arcadis 2019

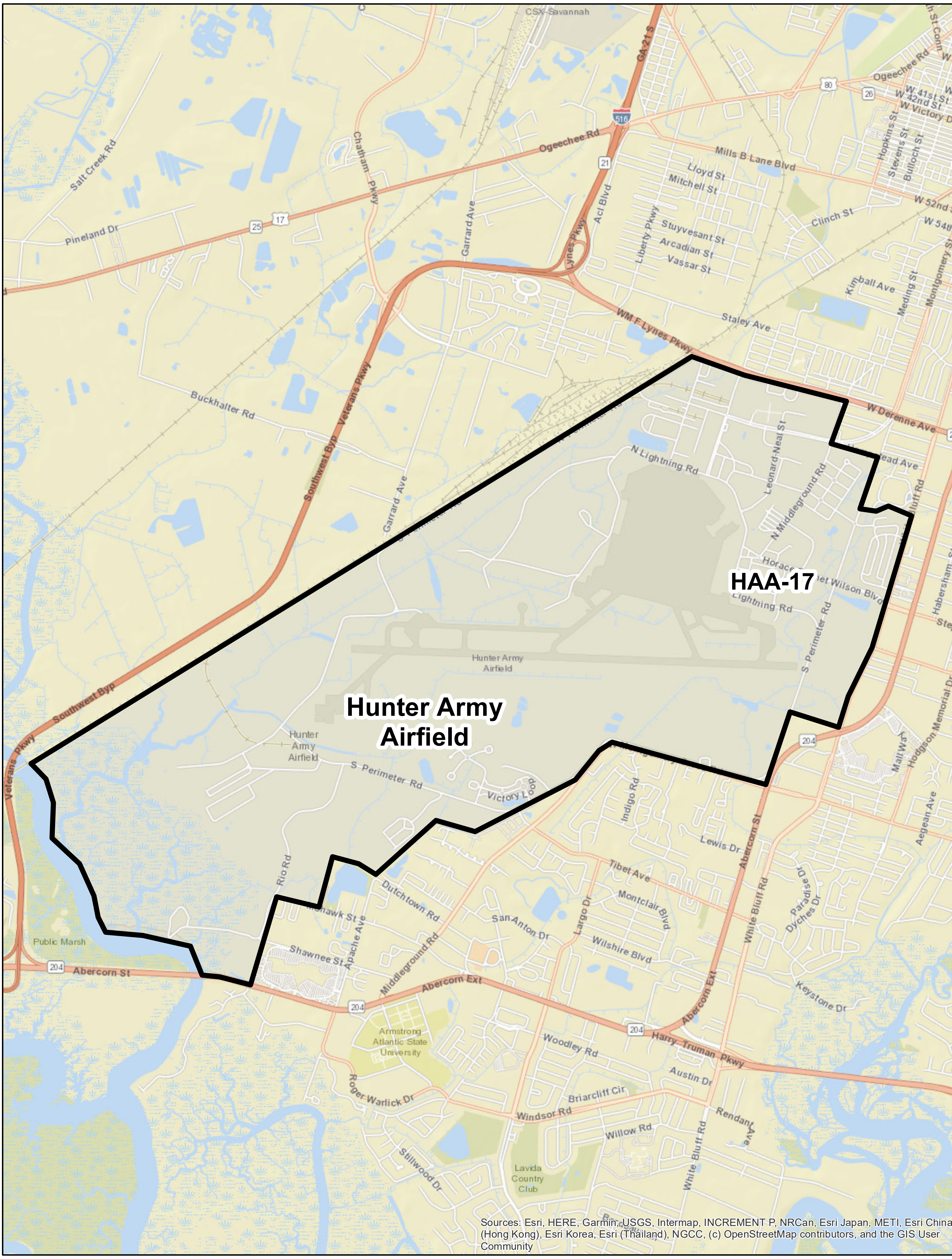
Table 2-7
Comparative Analysis - Performance Rankings of Remedial Alternatives
HAA-17, Hunter Army Airfield, Georgia

Alternative No.		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Remedial Timeframes and Lifecycle Costs (1)					
1)	Remedy Name	No Action	ISCO in the source area with downgradient MNA and IC	ERD in source area with downgradient MNA and IC	GW extraction and treatment in source area with downgradient MNA and IC
2)	Estimated Remedial Timeframe	30 years	5 years	5 years	7 years
3)	Estimated Lifecycle Costs	No Cost	$ 1,520,400	$ 1,323,360	$ 3,729,876
Remedy Performance Evaluation Ranking (2)					
1)	Overall protection of human health and the environment	**4**	**1**	**1**	**1**
2)	Compliance with applicable regulations	**4**	**2**	**2**	**2**
3)	Long-term effectiveness and permanence	**4**	**2**	**1**	**2**
4)	Reduction of toxicity, mobility, and volume	**4**	**1**	**1**	**2**
5)	Short-term effectiveness	**4**	**2**	**2**	**3**
6)	Implementability	**4**	**2**	**2**	**3**
7)	Relative Cost	**1**	**2**	**2**	**4**
8)	Community Acceptance	**4**	**2**	**1**	**1**
	Total Ranking Score (Lowest score is the best performing)	**29**	**14**	**12**	**18**
	Average Score (Lowest score is the best performing)	**3.6**	**1.8**	**1.5**	**2.3**

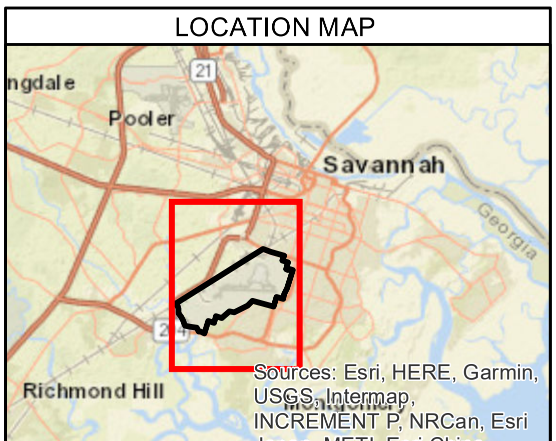
Notes:
(1) Includes an opinion of probable cost for capital expenses related to system installation, operations and maintenance, and management for the project lifecycle
(2) Performance Ranking Scale
1 = Most Favorable
4 = Least Favorable
.

From Pika/Arcadis 2019

Figures



LOCATION MAP



0 2,000 4,000

Feet

NOTES & SOURCES

Map Coordinates: WGS 1984, UTM Zone 17 N (feet)

LEGEND

Installation Boundary

TITLE

Hunter Army Airfield
HAA-17
Site Location Map

KEMRON ENVIRONMENTAL SERVICES Hunter Army Airfield

PROJECT: U.S. Army Garrison Hunter Army Airfield
Directorate of Public Works, Building 615
Stephen Douglas Street
Hunter Army Airfield, Georgia 31409

DRAWING DATE: 3/18/2021

Drawn by:	Reviewed by:
CJ	MSC

N

FIGURE

2-1

Document Path: L:\GIS\SH4943 - Ft Stewart Hunter Army Airfield\Hunter Army Airfield\MXDs\HAA-17\Site_Location.mxd

KEMRON ENVIRONMENTAL SERVICES Hunter Army Airfield

PROJECT: U.S. Army Garrison Hunter Army Airfield
Directorate of Public Works, Building 615
Stephen Douglas Street
Hunter Army Airfield, Georgia 31409

DRAWING DATE: 7/24/2020

Drawn by:	Reviewed by:
CJ	MSC

NOTES & SOURCES

Map Coordinates: NAD 1983, State Plane Georgia East

TITLE

HAA-17: Site Layout

N

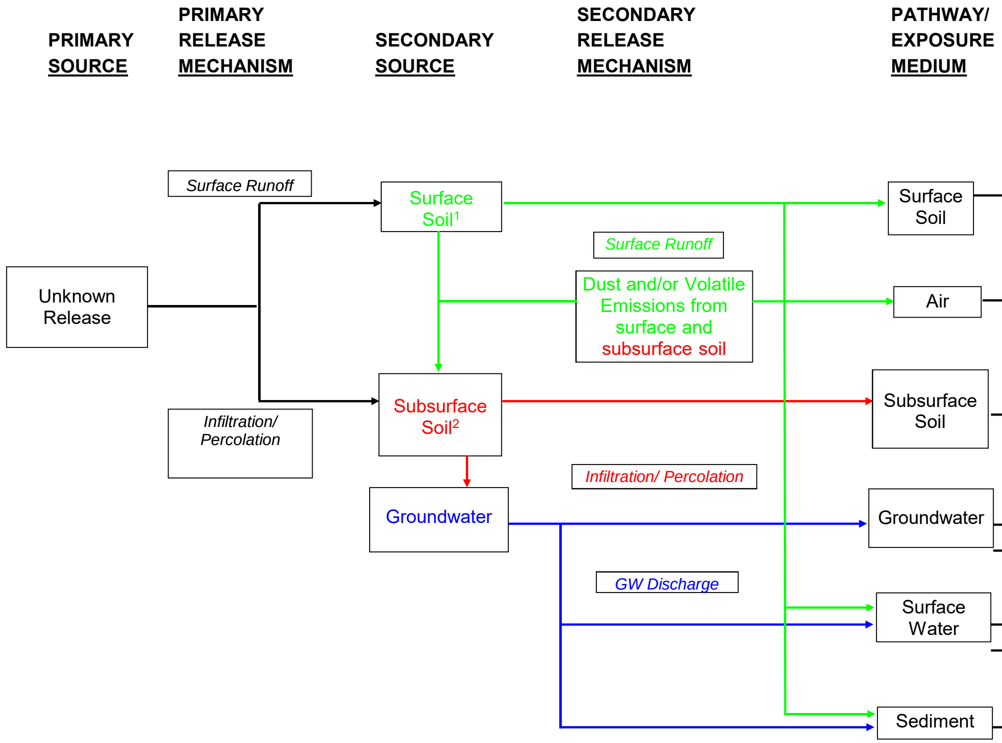
0 200 400

Feet

FIGURE

2-2

Document Path: L:\GIS_Databases\GIS\SH4943 - Ft Stewart Hunter Army Airfield\Hunter Army Airfield\MXDs\HAA-17\1- Site Layout.mxd



Pathway/Exposure Medium	Exposure Route	Site Worker	Construction Worker	Utility Worker	Hypothetical Future Adult and Child Resident	Adolescent Trespasser
Surface Soil	Ingestion	x	x	x	x	x
	Dermal Contact	x	x	x	x	x
Air	Inhalation	x	x	x	x	x
Subsurface Soil	Ingestion	x	x	x	x	x
	Dermal Contact	x	x	x	x	x
Groundwater	Ingestion	x	x	x	x	NA
	Dermal Contact	x	x	x	x	NA
	Inhalation	x	x	x	x	NA
Surface Water	Ingestion	x[3]	x[3]	x[3]	x[3]	x[3]
	Dermal Contact	x[3]	x[3]	x[3]	x[3]	x[3]
	Inhalation	x[3]	x[3]	x[3]	x[3]	x[3]
Sediment	Ingestion	x[3]	x[3]	x[3]	x[3]	x[3]
	Dermal Contact	x[3]	x[3]	x[3]	x[3]	x[3]
	Inhalation	x[3]	x[3]	x[3]	x[3]	x[3]

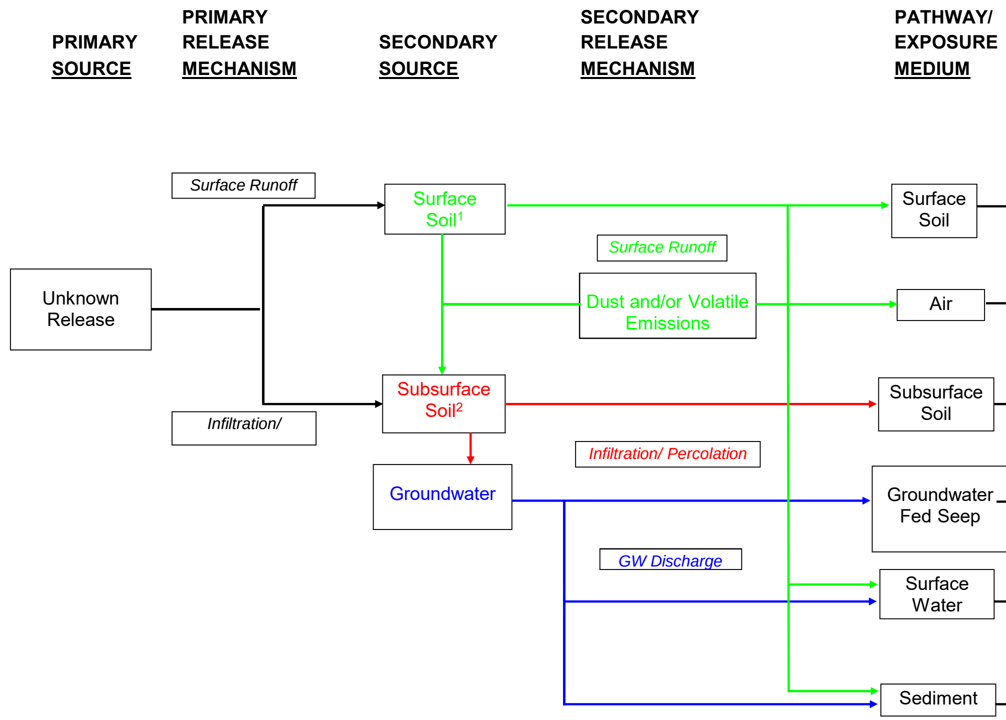
[1] Surface soil is defined as soil in the top 1 foot of the soil column for human receptors.
[2] Subsurface soil is defined as soil between 1 and 10 feet of the soil column for human receptors.
[3] Potential exposures to surface water and sediment were not evaluated further because no constituents of potential concern were identified.

NA Pathway not applicable.
x Potentially complete pathway.

From Pika/Arcadis 2019

Conceptual Site Exposure Model for Potential Human Receptors
Hunter Army Airfield, Georgia (HAA-17)
Remedial Investigation/Feasibility Study

Figure 2-3a



Pathway/Exposure Medium	Exposure Route	Terrestrial Wildlife	Terrestrial Plants	Soil Invertebrates
Surface Soil	Ingestion	x	NA	x
	Direct Contact/Uptake	x	x	x
	Food Chain	x	NA	NA
Air	Inhalation	NA	NA	NA
Subsurface Soil	Ingestion	NA	NA	NA
	Direct Contact/Uptake	NA	NA	NA
	Food Chain	NA	NA	NA
Groundwater Fed Seep	Ingestion	NA	NA	NA
	Direct Contact/Uptake	NA	NA	NA
	Food Chain	NA	NA	NA
Surface Water	Ingestion	NA	NA	NA
	Direct Contact/Uptake	NA	NA	NA
	Food Chain	NA	NA	NA
Sediment	Ingestion	NA	NA	NA
	Direct Contact/Uptake	NA	NA	NA
	Food Chain	NA	NA	NA

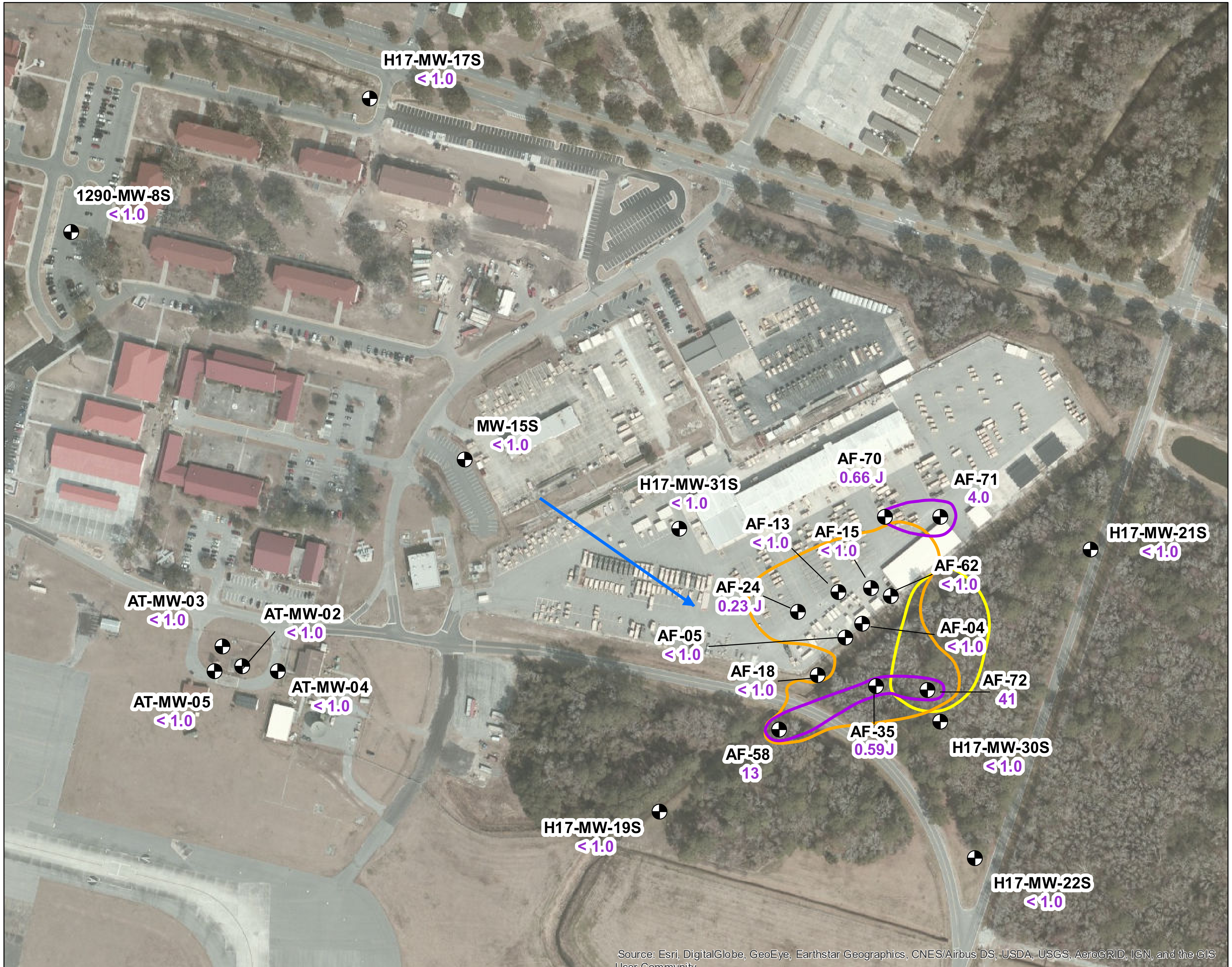
[1] Surface soil is defined as soil in the top 3 feet of the soil column for ecological receptors.
[2] Subsurface soil is defined as soil from 3 feet or deeper in the soil column for ecological receptors.

NA Pathway not applicable.
x Potentially complete pathway.

From Pika/Arcadis 2019

Conceptual Site Exposure Model for Potential Ecological Receptors
Hunter Army Airfield, Georgia (HAA-17)
Remedial Investigation/Feasibility Study

Figure 2-3b



LEGEND

- Shallow Monitoring Well
- 4.0 TCE Concentration
- TCE isocontour (>0.49 ug/L)
- General VOC isocontour (>10 ug/L)
- cis-1,2-DCE isocontour (>36 ug/L)
- Groundwater Flow Direction

NOTES & SOURCES

-Map Coordinates: NAD 1983, State Plane Georgia East
-All concentrations in micrograms per Liter (ug/L)
-Results shown are for the locations analyzed for the target compound in January 2015
-Tapwater RSL for TCE 0.49 ug/L, and for cis-1,2-DCE is 36 ug/L
-"<" values are not detected at the given value

0 200 400
Feet

TITLE

HAA-17: Isocontours Upper Zone of Shallow Aquifer

Kemron Environmental Services — Hunter Army Airfield

PROJECT: U.S. Army Garrison Hunter Army Airfield
Directorate of Public Works, Building 615
Stephen Douglas Street
Hunter Army Airfield, Georgia 31409

DRAWING DATE: 7/27/2020

Drawn by:	Reviewed by:
CJ	MSC

N

FIGURE 2-4

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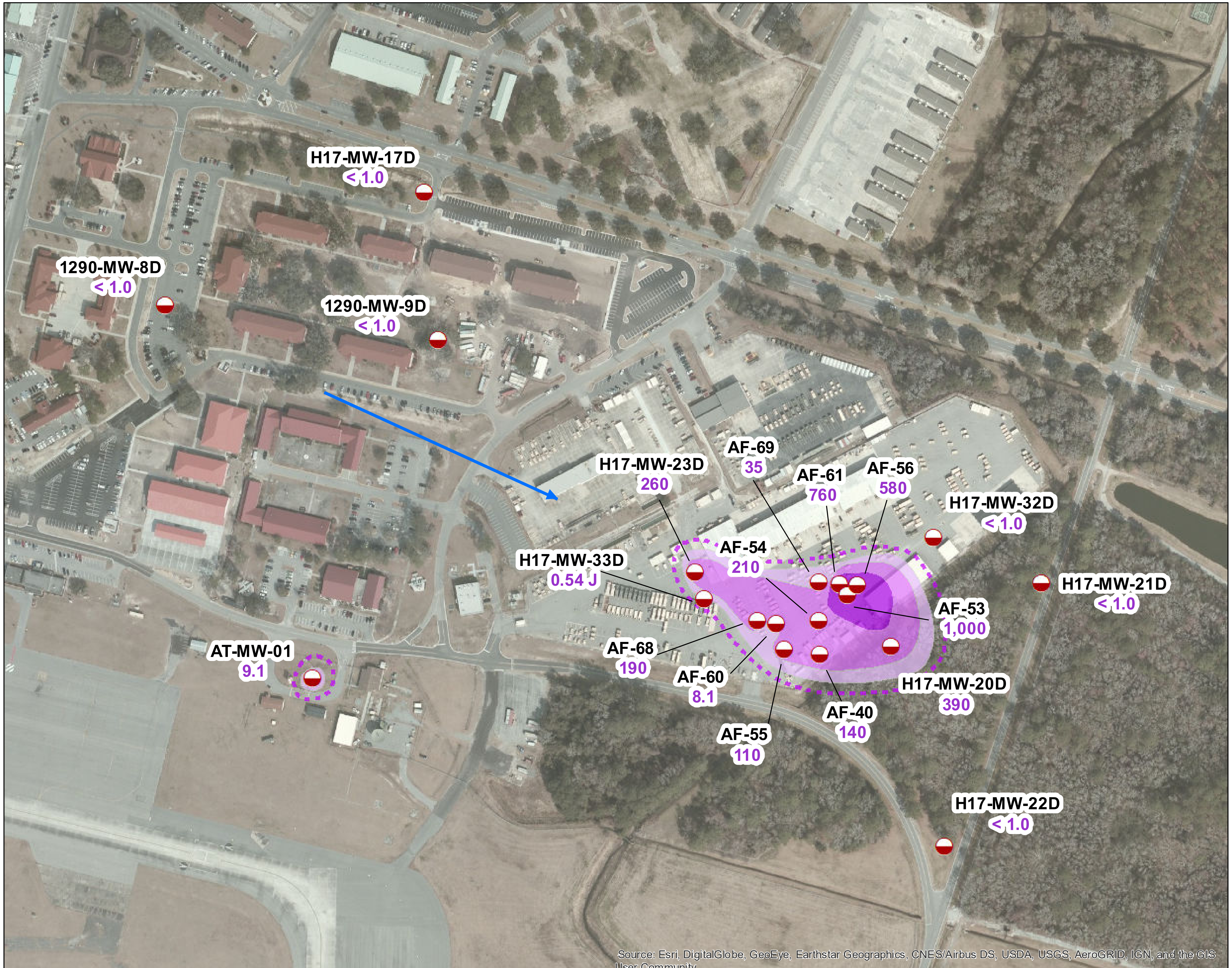

LEGEND

- Deep Monitoring Well
- 210 TCE Concentration
- Groundwater Flow Direction

TCE Concentration Contours

- 0.49 - 4.9 ug/L
- 5.0 - 49.9 ug/L
- 50 - 500 ug/L
- > 500 ug/L

NOTES & SOURCES

- Map Coordinates: NAD 1983, State Plane Georgia East
- All concentrations in micrograms per Liter (ug/L)
-Resutls shown are for locations analyzed for the target compound during the January 2015 event.
- Tapwater Regional Screening Level (RSL) is 0.49 ug/L
- Maximum Contaminant Level (MCL) is 5.0 ug/L
- J values are estimated.
- < values were non-detects at the method detection limit (value listed).

0 200 400
Feet

TITLE

HAA-17: TCE Isocontours
Deep Zone of Upper Aquifer

KEMRON ENVIRONMENTAL SERVICES Hunter Army Airfield

PROJECT: U.S. Army Garrison Hunter Army Airfield
Directorate of Public Works, Building 615
Stephen Douglas Street
Hunter Army Airfield, Georgia 31409

DRAWING DATE: 7/24/2020

Drawn by: CJ
Reviewed by: MSC

N

FIGURE
2-5

Document Path: L:\GIS_Databases\GIS\SH4943 - Ft Stewart Hunter Army Airfield\Hunter Army Airfield\MXDs\HAA-17\Deep Isocontours.mxd

PROJECTION: NAD_1983_StatePlane_Georgia_East_FIPS_1001_Feet
REFERENCE: SAGIS (2008).

LEGEND

Storm Water Drainage Canal	Groundwater Contour (ft amsl)
Monitoring Well (shallow)	(inferred where dashed)
(NM) Not Measured	Direction of Groundwater Flow
(28.11) Groundwater Elevation (ft amsl) Measured January 12, 2015	

0 160 320 480 640
SCALE IN FEET

HUNTER ARMY AIRFIELD, GEORGIA

TCE GROUNDWATER CONTAMINATION (HAA-17) REMEDIAL INVESTIGATION/FEASIBILITY STUDY

Shallow Potentiometric Surface Map (January 2015)

From Pika/Arcadis 2019

FIGURE
2-6

CITY: (KNOXVILLE) DIV/GROUP: (ENV/GIS) LD: (B.ALTOM) PIC: (T.TALELE) PM: (S.GIBBONS) TM: (S. BOSTIAN) BY: DHOLMES SAVED: 5/19/2015
PROJECT: 10153001.0001 PATH: G:\GIS\HAAF_PIKA\MAPDOCS\H17\2015\H17 RIFS\F3-1 H17_RIFS 201501 POT S DSIZE.MXD

PROJECTION: NAD_1983_StatePlane_Georgia_East_FIPS_1001_Feet
REFERENCE: SAGIS (2008).

LEGEND

Storm Water Drainage Canal	Groundwater Contour (ft amsl)
Monitoring Well (deep)	(inferred where dashed)
(NM) Not Measured	Direction of Groundwater Flow
(28.11) Groundwater Elevation (ft amsl) Measured January 12, 2015	

0 160 320 480 640
SCALE IN FEET

HUNTER ARMY AIRFIELD, GEORGIA

TCE GROUNDWATER CONTAMINATION (HAA-17)
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

Deep Potentiometric Surface Map (January 2015)

From Pika/Arcadis 2019

FIGURE
2-7

CITY: (KNOXVILLE) DIV/GROUP: (ENV/GIS) LD: (B.ALTOM) PIC: (T.TALELE) PM: (S.GIBBONS) TM: (S. BOSTIAN) BY: DHOLMES SAVED: 5/19/2015
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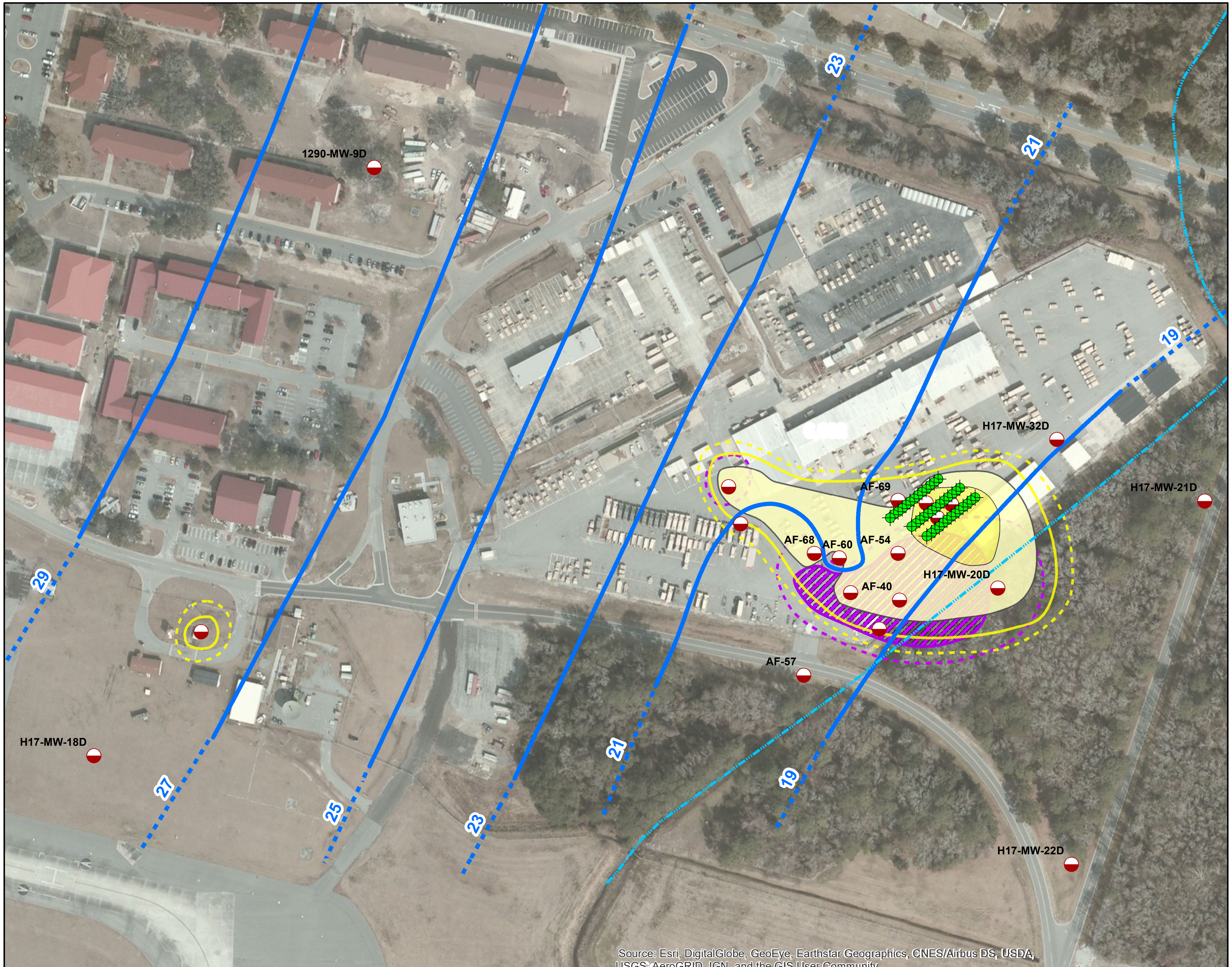

LEGEND

Surface Water

Deep Monitoring Wells

Potentiometric Contours (ft amsl)

(Inferred)

Proposed Injection Points

Deep TCE Isocontours

0.49-4.9 µg/L (>RSL)

5.0-49.9 µg/L (>MCL)

50-500 µg/L

>500 µg/L

Deep cis-1,2-DCE Isocontours

36-69.9 µg/L (>RSL)

>70 µg/L (>MCL)

NOTES & SOURCES

Map Coordinates: NAD 1983, UTM Zone 16

0 200 400

Feet

TITLE

HAA-17: Deep Interval with Planned Injections

KEMRON ENVIRONMENTAL SERVICES Hunter Army Airfield

PROJECT: Hunter Army Airfield HAA-17

DRAWING DATE: 07/23/2020

Drawn by: CJ

Reviewed by: MSC

N

FIGURE

2-8

Document Path: M:\GIS\Hunter Army Airfield\MXDs\HAA-17\Isocontours_HAA-17_Deep.mxd

Appendix A
GAEPD Approval Letter

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Richard E. Dunn, Director

Land Protection Branch
2 Martin Luther King, Jr. Drive
Suite 1054, East Tower
Atlanta, Georgia 30334
404-656-7802

March 10, 2021

Mr. James L. Heidle, Public Works Director
Headquarters, 3D Infantry Division (Mechanized) and Fort Stewart
Directorate of Public Works, Building 1137
Environmental Branch
1550 Veterans Parkway
Fort Stewart, GA 31314-4927

RE: Final Proposed Plan for HAA-17 TCE Groundwater Contamination; Hunter Army Airfield, Savannah, Georgia.

Dear Mr. Heidle:

The Land Protection Branch of the Georgia Environmental Protection Division (EPD) has reviewed the above referenced document, received December 18, 2020. Based on that review, no comments were generated. A copy of the document will be placed on file at EPD's office.

Should you have any questions concerning this correspondence, please contact Sharon Priyadarshini or Mo Ghazi at (404) 656-2833.

Sincerely,

Kim B. Hembree

Kim Hembree, Manager
Department of Defense Facilities Unit
Hazardous Waste Management Program

cc: Tressa Rutland, Fort Stewart (tressa.m.rutland2.civ@mail.mil)
Algeana L. Stevenson (algeana.l.stevenson.civ@mail.mil)

File: Hunter Army Airfield (G)

S:\Desk Top\EPD DoD Sites\Hunter Army Air Field\HAAF-17\Approval Final Proposed Plan HAAF-17_March 2021