DRAFT FINAL

PROPOSED PLAN

FOR

LHAAP-47, PLANT 3 AREA

SOLID ROCKET MOTOR FUEL PRODUCTION

LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

Prepared For:

ON THE LINE

U.S. Army Corps of Engineers

Prepared By:

AECOM

AECOM Technical Services

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THE U.S. ARMY ANNOUNCES THE PROPOSED PLAN FOR LONGHORN ARMY AMMUNITION PLANT LHAAP-47 (PLANT 3 AREA, SOLID ROCKET MOTOR FUEL PRODUCTION)

1.0 INTRODUCTION

The U.S Army (Army) is issuing this Proposed Plan for public comment and participation in accordance with Section 117(a) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended, and Sections 300.430(f)(2) and (f)(3) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Registry Part 300).

The primary purpose of this Proposed Plan is to facilitate public involvement in the remedy selection process for environmentally impacted sites. It provides the public with basic background information about Longhorn Army Ammunition Plant (LHAAP) and site LHAAP-47, the rationale for selecting the Preferred Alternative, and summaries of other alternatives considered for protecting human health and the environment from the contamination detected in soil and groundwater at the LHAAP-47 site. The Preferred Alternative for the LHAAP-47 site is Alternative 2: Excavation, In-situ Bioremediation, Monitored Natural Attenuation (MNA), and Land Use Controls (LUCs). Additional detail on the Preferred Alternative is provided below.

The Army is the lead agency for environmental response actions at LHAAP and acts in partnership with United States Environmental Protection Agency (USEPA) Region 6 and the Texas Commission on Environmental Quality (TCEQ). As the lead agency, the Army is charged with planning and implementing remedial actions at LHAAP. The regulatory agencies assist the Army by providing technical support, project review, project comment, and oversight in accordance with the CERCLA and the NCP as well as LHAAP Federal Facilities Agreement.

The Army, in consultation with USEPA Region 6 and TCEQ, will select a final remedy for the site after reviewing and considering all information submitted during the 30-day public comment period. The Preferred Alternative may be modified or another response action presented in the Proposed Plan may be selected

DATES TO REMEMBER

***PUBLIC COMMENT PERIOD*:**

January 1 to January 31, 2013

The U.S. Army invites you to participate during the public comment period by submitting comments on the LHAAP-47 Proposed Plan. The U.S. Army will accept written comments on the Proposed Plan during the public comment period.

PUBLIC MEETING: The U.S. Army will hold a public meeting to explain the Proposed Plan for LHAAP-47. The meeting will be held on January 9, 2013 from 6:00 p.m. to 7:00 p.m. at the Karnack Community Center. Oral and written comments will be accepted at the meeting. Comments can also be mailed to the attention of Dr. Rose M. Zeiler at the mailing address listed in the box below or submitted via email to the attention of Dr. Zeiler (rose.zeiler@us.army.mil).

For more information, see the Administrative Record at the following location:

Marshall Public Library

300 S. Alamo

Marshall, Texas 75670

Business Hours: Monday – Thursday

(10.00 a.m. – 8.00 p.m.)

Friday – Saturday (10.00 a.m. – 5.00 p.m.)

For further information on LHAAP-47, please contact:

Dr. Rose M. Zeiler
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based on new information or public comments. Therefore, the public is encouraged to review and comment on all alternatives presented in this Proposed Plan.

The Proposed Plan summarizes information contained in the Administrative Record file for the LHAAP-47 site. It summarizes the site characteristics, scope and role of response action, and summary of site risks. This is followed by a presentation of the Remedial Action Objectives (RAOs) and summary of remedial alternatives. Finally, an evaluation of alternatives and a summary of the Preferred Alternative are presented.

2.0 SITE BACKGROUND

LHAAP is located in central-east Texas in the northeast corner of Harrison County **(Figure 1**). The former installation occupied 8,416 acres between State Highway 43 at Karnack, Texas, and the western shore of Caddo Lake. Approximately 7,000 acres have transferred to the United States Fish and Wildlife Service and Comprise the Caddo Lake National Wildlife Refuge. The nearest cities are Marshall, Texas, approximately 14 miles to the southwest, and Shreveport, Louisiana, approximately 40 miles to the southeast (Shaw, 2011).

Caddo Lake, a large freshwater lake situated on the Texas-Louisiana border, bounds LHAAP to the north and east.

The Army has transferred nearly 7,000 acres to the U.S. Fish and Wildlife Service (USFWS) for management as the Caddo Lake National Wildlife Refuge. The property transfer process is continuing as response is completed at individual sites. The local restoration advisory board has been kept informed of previous investigations at this site through regularly held quarterly meetings. Additionally, the administrative record is updated quarterly and is available at the Marshall Public Library.

Due to releases of chemicals from operations at the facility, LHAAP was placed on the Superfund National Priorities List (NPL) on August 9, 1990. Activities to remediate contamination associated with the NPL listing of LHAAP began in 1990. The Army, the USEPA, and the Texas Water Commission (now known as the TCEQ), entered into a CERCLA Section 120 Federal Facilities Agreement for remedial activities at LHAAP effective December 30, 1991. LHAAP operated until 1997 when it was placed on inactive status and classified by the U.S. Army Armament, Munitions, and Chemical Command as excess property.

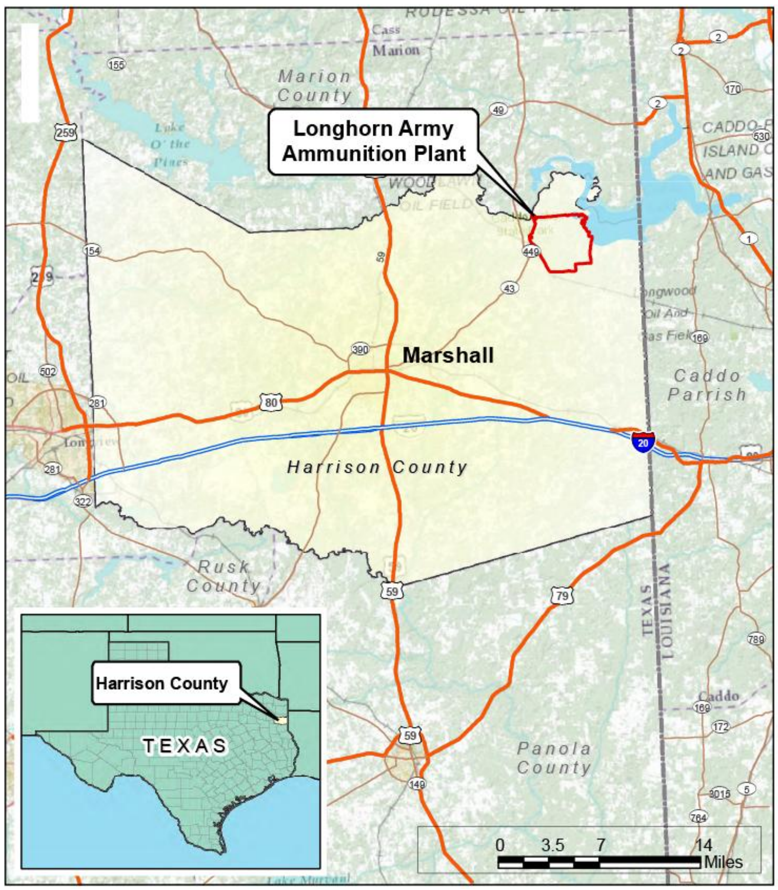

Figure 1- LHAAP Location

LHAAP-47

LHAAP-47, known as Site 47, was identified in historical records as Plant 3 (or Plant 3 Area) and is located in the north-central portion of the former plant covering an area of approximately 275 acres (**Figure 2**).

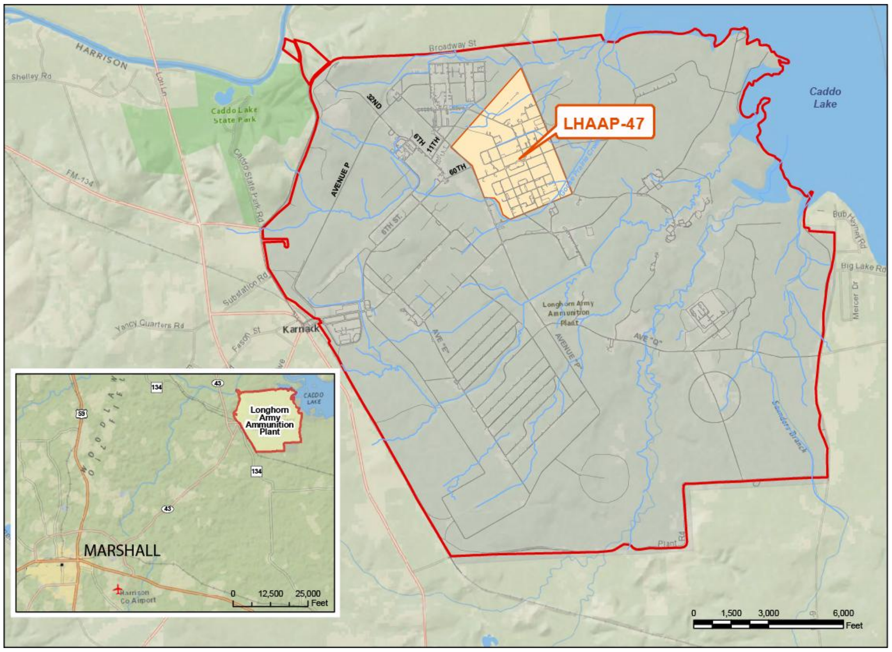

Figure 2 - LHAAP-47 Site Location

The LHAAP-47 site produced rocket motor, pyrotechnic, and illumination devices. Construction of Plant 3 began in July 1953 and production of rocket motors began in December 1954. Rocket motor production continued until the early 1980s. Some of the rocket motor production facilities were converted to produce pyrotechnic and illumination devices and were active until approximately 1997. Industrial solid wastes and hazardous wastes, such as parts cleaners and spent solvents, may have been generated by these activities. Fifty waste process sumps and three waste rack sumps were located within the LHAAP-47 site (Shaw, 2011). The environmental media (soil, groundwater, surface water, and sediment) at the LHAAP-47 site have been the subject of numerous investigations to identify potential contamination (Shaw, 2011). Jacobs Engineering conducted Phase I, Phase II, and Phase III remedial investigations in 1993, 1995, and 1998, respectively, and additional remedial investigations from 1996 through 2001.

Several follow-up investigations at the site were performed to delineate the extent of contamination including a data gaps investigation in 2004 (Shaw, 2007a) and a 2006 soil sampling event for the evaluation of waste process sumps (Shaw, 2008). The Army completed additional groundwater investigations in 2007, 2008, and 2009. In 2010, a soil investigation program was conducted and soil samples were collected from the vicinity of Building 25-C and Building 25-D, located in the southern part of the LHAAP-47 site and analyzed for perchlorate (Shaw, 2011). Reports associated with the investigations mentioned above are included in the Administrative Record file for the LHAAP-47 site.

A Baseline Human Health Risk Assessment (HHRA) and Screening Level Ecological Risk Assessment were performed for the Group 4 sites, which includes the LHAAP-47 site, in 2003 (Jacobs, 2003). Subsequent to the risk evaluation in the HHRA, an installation-wide Baseline Ecological Risk Assessment (BERA) was performed in 2007 (Shaw, 2007b). Results of the risk assessments are discussed in Section 5.0.

Perchlorate in soil near Building 25-C is identified as a potential residual source for groundwater perchlorate contamination and a principal threat. In November 1999, plastic liner material was placed around Building 25-C by the U.S. Army over areas known to contain perchlorate in the soil to prevent migration of perchlorate into the Goose Prairie Creek. The extent of liner was noted in the site-wide perchlorate investigation report (STEP, 2005).

The major chemicals of concern (COCs) in shallow, shallow/intermediate, and intermediate zones of groundwater are listed in the table below:

COCs in shallow, shallow/intermediate, and intermediate zones of groundwater	
Anions	• Perchlorate
VOCs	• 1,1-Dichloroethene • 1,2-Dichloroethane • Acetone • Chloroform • Cis-1,2-dichloroethene • Tetrachloroethene • Trans-1,2-dichloroethene • Trichloroethene • Vinyl chloride
SVOCs	• Bis(2-ethylhexyl) phthalate • Pentachlorophenol
Explosives	• 2,4,6-trinitrotoluene • 2,4-dinitrotoluene • 2,6-dinitrotoluene
Metals	• Aluminum • Antimony • Arsenic • Cadmium • Chromium • Cobalt • Manganese • Nickel • Silver • Strontium • Thallium • Tin • Vanadium

The most recent results identified explosive 2,4,6-trinitrotoluene (TNT) below laboratory detection limits. No COCs were identified in the deep groundwater zone. A Feasibility Study (FS) document which discusses the identification of COCs at the LHAAP-47 site was completed in 2011 (Shaw, 2011) and is available in the Administrative Record (AR) for the site.

There are currently no contaminants in surface water or sediment that pose a risk/hazard to human health or the environment.

The FS document developed and evaluated remedial alternatives to address identified risks in soil and groundwater at the LHAAP-47 site resulting in the remedial alternatives discussed in this Proposed Plan.

3.0 SITE CHARACTERISTICS

The surface features at the LHAAP-47 site are a mixture of asphalt-paved roads, parking areas, remnants of building foundations, and overgrown wooded and grassy vegetation-covered areas (Shaw, 2011). The topography in this area is relatively flat with surface water drainage flowing into tributaries of Goose Prairie Creek. Surface water runoff from the site enters Caddo Lake via Goose Prairie Creek (**Figure 2**).

The soil at the LHAAP-47 site consists of layers of silty clay, underlain by silty sand to clayey sand. Below this are rocks of the Wilcox Group, generally consisting of interbedded silts and clays (Shaw, 2011).

Groundwater at the site is divided into four zones: shallow, shallow/intermediate, intermediate and deep. The shallow and intermediate groundwater zones are interconnected over much of the site except in the east-central portion of the site where they are separated by a clay layer. The groundwater flow direction in the shallow and intermediate saturated zones is to the northeast, with groundwater in the deep zone flowing to the north/northeast (Shaw, 2011).

Conceptual Site Model

The conceptual site model for the LHAAP-47 site identified that a risk of exposure to groundwater for a hypothetical future maintenance worker is the driver for remediation based upon conclusions of the HHRA as presented in Section 5 below.

Soil

Risks from direct exposure to soil were found to be acceptable. However, soil with perchlorate concentrations greater than the GWP-Ind value is a potential residual source for perchlorate contamination in surface water and groundwater.

Perchlorate contaminated soil is located near the former Building 25-C and extends to depths of 10 ft with an estimated volume of 9,000 cubic yards. In November 1999, plastic liner material was placed around Building 25-C by the U.S. Army over areas known to contain perchlorate in the soil to prevent migration of perchlorate into the Goose Prairie Creek. The primary objective of the liner placement was to mitigate perchlorate runoff to surface water as well as mitigate leaching of perchlorate in soil into groundwater. The liner placement provided an interim measure to mitigate soil to surface water and soil to groundwater pathways. Therefore, all remedial alternatives discussed for LHAAP-47 site include removal of the liner and the perchlorate-contaminated soil beneath and around the liner as a permanent remedy with the exception of the no action alternative.

Groundwater

Groundwater at the site is currently not used and is not projected to be used in the future. The reasonably anticipated future use of the site is a wildlife refuge. The groundwater pathway considered for remediation is potential groundwater ingestion by the hypothetical future maintenance worker. Modeling calculations performed indicated that contaminants present in the shallow groundwater at the LHAAP-47 site would not adversely impact surface water in Goose Prairie Creek (Shaw, 2007c). However, due to lack of calibration and use of literature-based degradation rates, there are unacceptable uncertainties associated with the model. Due to these uncertainties, surface water monitoring will be performed to verify that groundwater COCs do not result in unacceptable impact to adjacent surface water.

Perchlorate, VOCs, SVOCs, TNT, 2,4-DNT, 2,6-DNT, and metals are the major COCs that exceed the respective maximum contaminant levels (MCLs) or site-specific cleanup levels in groundwater.

Two separate plumes of perchlorate and trichloroethene (TCE) exist in shallow and intermediate groundwater at the LHAAP-47 site. **Figure 3** depicts the perchlorate and TCE plumes in shallow and intermediate groundwater zones, respectively, representing a principal threat and requiring remediation. The most recent available data indicates that in 2010, high

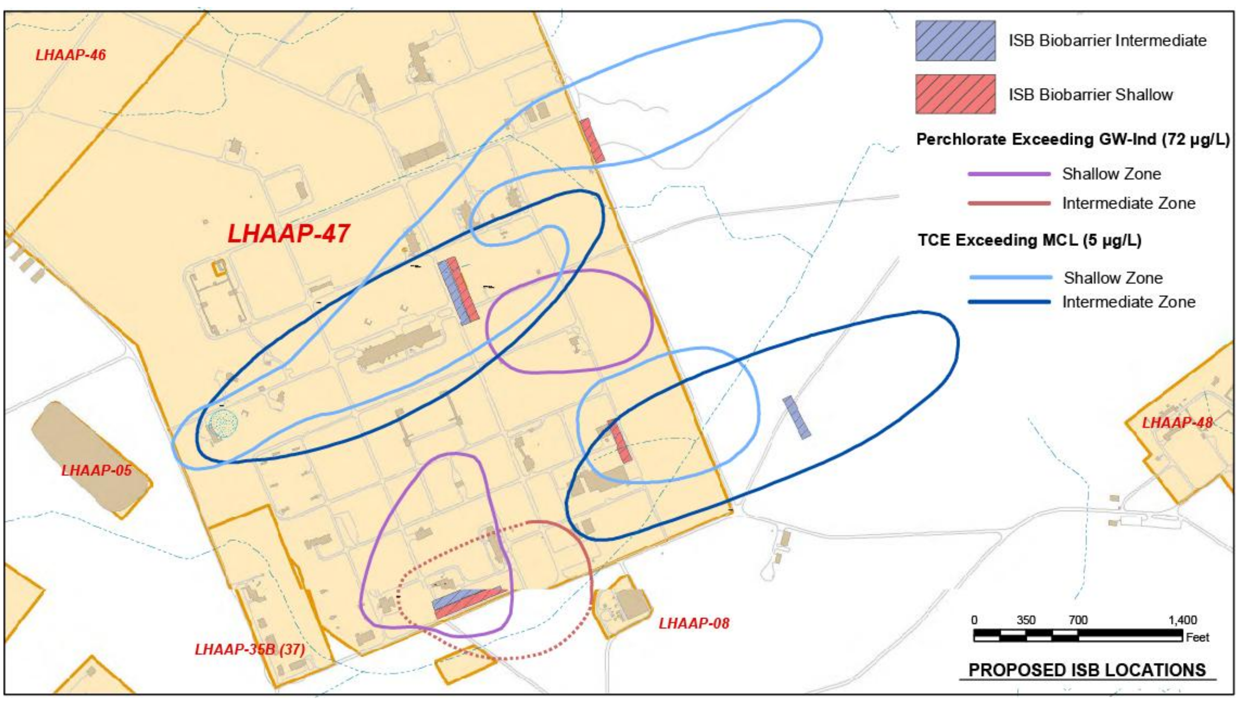

Figure 3 – Proposed In-situ Bioremediation Areas

concentrations of perchlorate were detected in monitoring well LHSMW60 (56,600 µg/L) in the shallow zone and in monitoring well 47WW38 (4,110 µg/L) in the intermediate zone.

Similarly, several areas have higher TCE concentrations within the plume in the shallow groundwater zone, including 13,300 µg/L at monitoring well 47WW25, and 6,210 µg/L at monitoring well LHSMW43, both near buildings where solvents were used. Within the intermediate zone, highest TCE concentrations were detected at monitoring wells 47WW09 (1,720 µg/L) and 47WW34 (1,340 µg/L)

These areas with high perchlorate and VOC concentrations potentially represent secondary sources of groundwater contamination.

The other COCs (SVOCs, TNT, 2,4-DNT, 2,6-DNT) in groundwater are isolated and do not indicate a widespread plume of contamination (Shaw, 2011).

Surface Water and Sediment

Overland flow of surface water does not currently appear to be contributing to the migration of contaminants, as ditch surface water samples did not detect VOCs, SVOCs, explosives, pesticides, or polychlorinated biphenyls. Likewise, ditch sediment data did not indicate the presence of VOCs, SVOCs, explosives, or pesticides. Some metals were detected in surface water and sediment, but were at concentrations low enough to occur naturally (Shaw, 2011).

Perchlorate concentrations in surface water samples have been less than the TCEQ allowable surface water contact recreational level and the Groundwater Medium Specific Concentration for Residential Use value (Shaw, 2011). Thus, surface water in Goose Prairie Creek along and downgradient of LHAAP-47 site meets the Groundwater Medium Specific Concentration for Residential Use standard and is not contributing perchlorate to Caddo Lake in concentrations exceeding the TCEQ standards (Shaw, 2011).

The LHAAP-47 site is currently not suitable for unlimited use and unrestricted exposure (i.e. residential land use) due to soil and groundwater contamination. Appropriate LUCs will be established and maintained until such time that contaminant levels in affected media are reduced to below levels consistent with residential use.

Based on the above, the Army's current judgment is that the Preferred Alternative identified in this Proposed Plan or one of the other active measures considered to address soil and groundwater, is necessary to protect public health, welfare, or the environment from actual or threatened risks from identified contaminants.

4.0 SCOPE AND ROLE OF THE PROPOSED REMEDY

The overall strategy for remediation activities at the LHAAP-47 site is to eliminate risks to the maintenance worker.

Perchlorate in soil is a potential residual source for contamination to surface water and groundwater. The plastic liner placed in 1999 around Building 25-C over areas with known perchlorate contaminated soil provided an interim measure to mitigate soil contaminant migration to surface water and the groundwater. Therefore, the Preferred Alternative will include removal and offsite disposal of the plastic liner and perchlorate contaminated soil to eliminate potential for migration of perchlorate from soil into the surface water and groundwater.

The COCs in groundwater are perchlorate, VOCs, SVOCs, TNT, 2,4-DNT, 2,6-DNT, and metals including arsenic, with the most widespread being perchlorate and VOCs. The groundwater at LHAAP is not currently being used as drinking water and, absent Land Use Controls, there is a very low probability that groundwater will be used in the future based on its reasonably anticipated use as a national wildlife refuge. When establishing the RAOs for this response action, the U.S. Army has considered the NCP's expectation to return useable groundwater to its potential beneficial use wherever practicable. The U.S. Army has also considered the State of Texas designation of all groundwater as potential drinking water, unless otherwise classified, consistent with Texas Administrative Code, Title 30, §335.563 (h)(1). In-situ bioremediation with MNA in groundwater is expected to reduce COCs, achieve RAOs, prevent migration of the plume, and reduce or eliminate exposure to contaminated groundwater. LUCs will be maintained until it is demonstrated that the COCs are at levels that allow for unlimited use and unrestricted exposure.

5.0 SUMMARY OF LHAAP-47 SITE RISKS

The planned future use of LHAAP-47 is as wildlife refuge as part of the Caddo Lake Wildlife Refuge. The LHAAP-47 site is currently not suitable for residential use and the anticipated human health exposure scenario for LHAAP-47 from the 2003 risk assessment was for a hypothetical future wildlife worker.

Soil data through December 2000 and groundwater data through February 2001 from the LHAAP-47 site were used to calculate the aggregate risk values, which were then compared to the USEPA target risk range of 1 x 10^{-6} to 1 x 10^{-4} for excess lifetime cancer risk and a hazard index (HI) of 1 for potential non-carcinogenic effects.

Soil

For the hypothetical future maintenance worker, the carcinogenic risk and non-carcinogenic hazard from exposure to the contaminants in soil at LHAAP-47 are 1.8 x 10^{-5} and 0.46, respectively, and are lower than the USEPA target risk range and HI (Jacobs, 2003). Thus, site contaminants do not pose a carcinogenic risk or non-carcinogenic hazard (Jacobs, 2003).

The human health risk assessment did not identify a risk from perchlorate in soil. However, perchlorate in soil is at concentrations greater than the GWP-Ind value and may act as a residual source for groundwater contamination, requiring action to remediate perchlorate soil.

Groundwater

For the hypothetical future maintenance worker, groundwater at the LHAAP-47 site presented a total cancer risk of 7.1 x 10-3, which is greater than the acceptable cancer risk range of 1 x 10-6 to 1 x 10-4. The total HI from groundwater was 1,100, which is greater than the acceptable HI of 1.

Based on the risk assessment, groundwater at the LHAAP-47 site is impacted with the following COCs:

COC	Risk(1)
Perchlorate	HQ(2) = 900
Trichloroethene	cancer risk = 5.7 x 10-3
Cis-1,2-dichloroethene	HQ = 2.5
Vinyl chloride	cancer risk = 7.3 x 10-4
1,1-dichloroethene	cancer risk = 2.6 x 10-4
Tetrachloroethene	cancer risk = 1.5 x 10-4
1,2-dichloroethane	cancer risk = 1.2 x 10-4
Acetone	HQ = 8.1
Chloroform	HQ = 69
2,4,6-trinitrotoluene (TNT)	HQ = 0.13
2,4-dinitrotoluene	cancer risk = 3.30 x 10-6
2,6-dinitrotoluene	cancer risk = 3.30 x 10-6
Bis(2-ethylhexyl)phthalate	cancer risk = 1.70 x 10-6
Pentachlorophenol	cancer risk = 1.2 x 10-5
Aluminum	HQ = 0.84
Antimony	HQ = 1.9
Cadmium	HQ = 3.9
Chromium	HQ = 0.28
Cobalt	HQ = 0.15
Manganese	HQ = 1.6
Nickel	HQ = 3.9
Silver	HQ = 2
Strontium	HQ = 0.31

COC	Risk(1)
Thallium	HQ = 11
Tin	HQ = 2
Vanadium	HQ = 0.18

Notes: (1) Risk values are adopted from the Risk Assessment document (Jacobs, 2003).
(2) HQ = hazard quotient

The HQs and overall HI were developed in the risk assessment using very conservative assumptions. Additionally, Arsenic was added as a groundwater COC based upon exceedances of the MCL.

Ecological Risk Assessment

The baseline ecological risk assessment completed in 2007 evaluated environmental setting through habitat mapping, preliminarily identified complete exposure pathways, assessed measurement endpoints, developed exposure equations and exposure assumptions, and refined contaminants of potential concern, in addition to completing risk characterization and uncertainty analysis and identified no potential risk to ecological receptors in the industrial sub-area, which includes the LHAAP-47 site (Shaw, 2007b). A new data collection effort to collect and report explosives data to replace data identified as invalid from the 2007 baseline ecological risk assessment is currently underway. If the findings of the new data collection and assessment identify ecological risks from explosives at the site, those ecological risks and associated explosive COCs will be added as part of the Five-Year Review for the site. If the newly collected explosives data identifies no impact or ecological risks requiring action or monitoring, no changes to the current remedial action is anticipated.

Evaluation of Additional Data Collected since Risk Assessment

Since the completion of risk assessments, additional soil and groundwater data was collected at the LHAAP-47 site.

Additional soil samples were collected in September 2001 (Lynntech, 2001), during the perchlorate investigation in 2002 (STEP, 2005), during the sumps investigation in September 2006 (Shaw, 2008), during the baseline ecological risk assessment in November 2006 (Shaw, 2007b), and during the soil sampling in 2010.

Chemical concentrations detected during these additional soil sampling events were less than the concentrations evaluated for human health risks in the 2003 risk assessment, with the exception of perchlorate and arsenic. The risk associated with the greatest perchlorate concentrations found in soil is less than the allowable hazard quotient of 1 (Shaw, 2011). Similarly, the risk associated with the highest arsenic concentration found in soil is within the acceptable risk range of 10^{-6} to 10^{-4}, and does not change the outcome of the human health risk assessment (Shaw, 2011).

Additional groundwater data collected in 2009 and 2010 did not change the outcome of the human health risk assessment (Shaw, 2011).

Proposed Cleanup Levels

For perchlorate in soil, the GWP-Ind value of 7.2 mg/kg soil medium specific concentration for industrial use based on groundwater protection has been established as the clean up level.

Groundwater cleanup levels have been established for the COCs at the LHAAP-47 site. For COCs with MCLs established by the USEPA, MCLs are the cleanup levels. For those COCs with no established MCLs, site-specific risk-based cleanup levels were calculated by making various adjustments to the risk factors using criteria provided in TCEQ Risk Reduction Rules (RRR) Tier 3.

6.0 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) are established to protect human health and the environment while also meeting Applicable or Relevant and Appropriate Requirements (ARARs). The identification of RAOs must consider the environmental issues at the site and the receptors that are affected.

The chemical-specific, location-specific, and action-specific ARARs are listed in the FS document (Shaw, 2011).

The conceptual site model identifies the following primary environmental issues at the LHAAP-47 site:

- Major VOCs in groundwater are TCE, tetrachloroethene, cis-1,2-dichloroethene, 1,1-dichloroethene, and vinyl chloride.
- Perchlorate exceeds its cleanup level in groundwater indicating the potential to impact future maintenance worker via the groundwater ingestion pathway.
- There are areas with high concentrations of contaminants within the perchlorate and TCE plumes in the groundwater indicating potential secondary sources of contamination.
- Soil near Building 25-C has perchlorate concentrations in excess of the GWP-Ind value indicating the potential to continue as a source for surface water and groundwater contamination.

The U.S. Army recognizes USEPA's policy to return all groundwater to beneficial uses, based on the non-binding programmatic expectation in the NCP.

Based on these considerations, the RAOs for LHAAP-47 are as follows:

- Protection of future maintenance worker by preventing exposure to contaminated groundwater via the groundwater ingestion pathway;
- Prevent perchlorate in soil from migrating to groundwater and surface water;
- Prevent groundwater contaminated with perchlorate from migrating into nearby surface water;
- Return of groundwater to its potential beneficial use, wherever practicable, within a reasonable time period given the particular site circumstances.

7.0 SUMMARY OF REMEDIAL ALTERNATIVES

Excavation of perchlorate impacted soil, MNA, LUCs, long-term monitoring (LTM), and Five-Year Reviews are common to all the action alternatives. These common elements are described below.

Excavation of Perchlorate Impacted Soil

Perchlorate contaminated soil extends to depths of 10 ft with an estimated volume of 9,000 cubic yards.

Excavated perchlorate-contaminated soil will be sampled to determine if it is a characteristic hazardous waste prior to transportation and disposal. Prior to excavation of perchlorate contaminated soil, the plastic liner located on top of the perchlorate contaminated soil will be removed and disposed off appropriately. Excavation and disposal of the contaminated soil will result in eliminating the potential continuing source for perchlorate impacts to groundwater. Confirmation sampling from the excavation area will be performed to verify that all soils with perchlorate impacts exceeding the GWP-Ind value are removed. The excavation area will be backfilled with appropriate fill material.

Monitored Natural Attenuation

MNA is a remedial technology that relies upon naturally occurring physical, chemical, and biological processes to reduce the mass and concentrations of groundwater COCs under favorable conditions over time along with groundwater monitoring to demonstrate how MNA is working.

MNA is effective when source releases have been addressed (such as by removal of soil contaminated with perchlorate), off-site migration of contaminants at unacceptable levels are not occurring, and it can be demonstrated that natural attenuation mechanisms are occurring. An MNA evaluation for LHAAP-47 site demonstrated that natural attenuation is occurring and is effectively controlling COCs in the shallow and intermediate groundwater zones outside of the well field area (Shaw, 2011). Under MNA, regular monitoring will be conducted throughout the program to confirm that natural attenuation is progressing towards cleanup objectives. If MNA is not found to be effective in areas outside of direct active treatment, a contingency remedy may be implemented. The contingency remedy would be determined based on aquifer conditions at that time.

Land Use Control's

LUCs are any restriction or control, arising from the need to protect human health and the environment, that limits the use of and/or exposure to any portion of that property, including water resources.

Proposed LUCs as part of the action alternatives are:

- LUC to restrict land use to nonresidential use until it is demonstrated that the COCs in soil and groundwater are at levels that allow for unlimited use and unrestricted exposure.
- LUC prohibiting potable use of groundwater above cleanup levels until it is demonstrated that the COCs in groundwater are at levels that allow for unlimited use and unrestricted exposure.

Five-Year Reviews

Five-Year Reviews are intended to evaluate whether the response action remains protective of human health and the environment, is functioning as designed, and necessary operation and maintenance is being performed. The Five-Year Reviews may indicate the need for components of the remedy to be maintained, modified, or replaced. For the LHAAP-47 site, the Five-Year Review will focus on effectiveness of the remedial action and achievement of specific performance levels established in the Record of Decision (ROD). Five-Year Reviews will include document reviews, review of cleanup standards, inspections, technology reviews, and preparation of a report summarizing the findings and recommendations. Five-Year Reviews will be performed until the contaminant levels are reduced to levels suitable for unlimited use and unrestricted exposure.

Long Term Monitoring

LTM is the monitoring conducted after a remedy is selected and implemented, and is used to evaluate the progress and degree to which a remedial action achieves its objectives. LTM will include monitoring of select number of groundwater monitoring wells and surface water locations to evaluate contaminant migration, monitor degradation of COCs in groundwater and verify that the COCs do not exceed the cleanup levels and do not migrate in the nearby surface water bodies.

The LTM will be continued as required to demonstrate effectiveness of the remedy and compliance with ARARs, until RAOs are achieved.

The unique elements of each remedial alternative are identified below.

Alternative 1 – No Action

The No Action Alternative is required by CERCLA and serves as a baseline for comparison to other alternatives. Under this alternative, the soil and groundwater will be left 'as-is', without implementing any additional containment, removal, treatment, or other mitigating actions. The No Action Alternative will not eliminate risks or achieve RAOs. The No Action alternative is required to be listed for baseline comparison purposes, but is not considered as a realistic alternative for implementation.

There are no costs associated with the No Action alternative.

*Estimated Total Present Worth (*PW*) Cost: $0*

Alternative 2 – Excavation, In-situ Bioremediation, Biobarriers, MNA, LTM, LUCs

This alternative uses a combination of In-situ Bioremediation, MNA with LTM, soil excavation and LUCs to achieve the RAOs. Perchlorate contaminated soil will be excavated as described in the common elements above.

A combination of In-situ Bioremediation and MNA will be used to reduce COCs in groundwater until they attain cleanup levels.

As discussed earlier in Section 3.0, there are areas of high perchlorate and TCE concentrations within the perchlorate and TCE plumes in groundwater. These areas with high concentrations represent potential secondary sources of groundwater contamination.

In general, components of the In-situ Bioremediation include direct injection in the hot-spot area near well 47WW25 and installation of biobarriers in areas near wells 47WW09, 47WW30, 47WW34, LHSMW43, LHSMW56, and LHSMW60.

In the hot-spot area near monitoring well 47WW25, the substrate solution will be injected via direct push injection points Additional direct injection events in this hot-spot area may be conducted as necessary.

Biobarriers consisting of the In-situ Bioremediation technology will be installed in the vicinity of monitoring wells to treat contaminants and mitigate the risk of contaminant migration from groundwater into surface water in Goose Prairie Creek. Specifically, biobarriers will be installed by closely spaced injection points in the shallow and intermediate zones near monitoring wells LHSMW60 and 47WW38, respectively. In addition, biobarriers will also be installed near monitoring wells LHSMW43, 47WW09, LHSMW56, 47WW34, and 47WW30.In-situ bioremediation technology encourages growth and reproduction of indigenous microorganisms to enhance biodegradation of organic constituents in the saturated groundwater zone. The microbiological processes are used to degrade or transform contaminants to ultimately less toxic or non-toxic forms. A substrate will be injected in the target treatment areas via injection points or wells. The exact type of substrate to be injected will be determined during the Remedial Design phase. Bioaugmentation, which consists of introduction of microbial cultures capable of degrading the organic constituents in the subsurface environment, will be performed as necessary. The In-situ Bioremediation target treatment areas including the hot-spot area via direct push injections will be in the vicinity of wells in which VOCs greater than 1,000 micrograms per liter (µg/L) and perchlorate greater than 20,000 µg/L are detected.

Direct push injections and biobarriers containing an appropriate substrate for in-situ bioremediation as identified during the Remedial Design phase will be installed to provide treatment as necessary. LTM and LUCs will be implemented as described in the common elements section.

It is estimated that cleanup levels in the groundwater would be achieved within 30 years in the treatment areas; however, it will require approximately 100 additional years for the balance of the plume to attain cleanup levels (Shaw, 2011). If MNA is not found to be effective in areas outside of direct active treatment, a contingency remedy may be implemented. The contingency remedy would be determined based on aquifer conditions at that time. For the purposes of alternative evaluation, the duration of this alternative is estimated to be approximately 30 years. Actual time to achieve RAOs is likely to be longer than this estimate. The monitoring parameters will include VOCs, SVOCs, TNT, 2,4-DNT, 2,6-DNT, and metals (those that may be mobilized by In-situ bioremediation).

The estimated PW costs for this Alternative are based on two years of quarterly monitoring followed by three years of semiannual monitoring; annual monitoring thereafter until the next Five-Year Review; and thereafter once every five years.

Estimated Total Direct Capital Cost:

$2.98 million

Estimated Total Operation and Maintenance (O&M) Cost: *$2.11 million*

Estimated Total PW Cost: *$5.09 million*

Alternative 3 – Excavation, Re-circulating In-situ Bioremediation, MNA, LTM, LUCs

This alternative uses a combination of In-situ Bioremediation with groundwater recirculation, MNA with LTM, soil excavation and LUCs to achieve the RAOs. Perchlorate contaminated soil will be excavated as described in the common elements section.

In-situ Bioremediation along with groundwater recirculation and MNA and LTM will be used to address COCs in site groundwater.

For the In-situ Bioremediation, the selected substrate will be injected into the target treatment areas via injection points or wells. Bioaugmentation will be performed as necessary to introduce the appropriate kind of microbial culture into the subsurface environment. The In-situ Bioremediation target treatment areas will be in the vicinity of wells in which VOCs greater than 1,000 µg/L and perchlorate greater than 20,000 µg/L are detected.

In addition to direct application of In-situ Bioremediation in the hot spot areas, recirculation zones will be established in four target areas near wells 47WW09, 47WW30, 47WW34, and LHSMW60 which have elevated COCs. Extraction and injection wells will be used to re-circulate groundwater in these zones.

The recirculation component is expected to enhance bioremediation by increased mixing and improving contact between contaminants and injected substrate and microbes. MNA will be performed in areas outside and down gradient of the treatment areas.

LTM and LUCs will be implemented as described in the common elements section. The LUCs will remain in place until the COCs are reduced to below levels supporting unlimited use and unrestricted exposure.

It is estimated that cleanup levels in the groundwater will be attained within 30 years within the treatment areas; however, it would require approximately 100 additional years for the rest of the plume to attain cleanup levels (Shaw, 2011). If MNA is not found to be effective in areas outside of direct active treatment, a contingency remedy may be implemented. The contingency remedy would be determined based on aquifer conditions at that time. For the purposes of alternative evaluation, the duration of this alternative is estimated to be approximately 30 years. Actual time to achieve RAOs is likely to be longer than this estimate.

The estimated PW costs for this Alternative are based on two years of quarterly monitoring followed by three years of semiannual monitoring; annual monitoring thereafter until the next Five-Year Review; and once every five years for the next 30 years.

The O&M of the recirculation component will include periodic inspections of the system for leaks from pipelines, tanks, pumps, or equipment and is anticipated to last for five years or less.

Estimated Total Direct Capital Cost:

$5.51 million

Estimated Total O&M Cost: *$2.11 million*

Estimated Total PW Cost: *$7.62 million*

Alternative 4 – Excavation, Pump and Treat, In-situ Bioremediation, MNA, LTM and LUCs

This alternative uses a combination of pump and treat technology, In-situ Bioremediation, MNA with LTM, soil excavation and LUCs to achieve the RAOs. Perchlorate contaminated soil will be excavated as described in the common elements section.

A pump and treat system will target groundwater in areas with highest COC concentrations and MNA in areas outside the pump and treat zones until COCs attain cleanup levels. Areas in the vicinity of wells with high COC concentrations, but which have insufficient groundwater yield for effective pumping and treatment will be treated via In-situ Bioremediation.

Pump and treat is a technology in which contaminated groundwater is extracted and treated to remove or neutralize the contaminants. Pump and treat at LHAAP-47 site will consist of extraction wells in target areas with high COC concentrations and sufficient yield available for effective pumping. Extracted groundwater will be transported and treated at the existing groundwater treatment plant (GWTP) at Burning Ground No. 3. The treated effluent is required to meet discharge criteria.

In-situ Bioremediation will be applied in target areas near three wells (47WW25, LHSMW43, and LHSMW56) which have high COC concentrations but have insufficient groundwater yield for extraction.

LTM and LUCs will be implemented as described in the common elements section. The LUCs will remain in place until the COCs are reduced to below levels supporting unlimited use and unrestricted exposure.

It is estimated that cleanup levels in the groundwater would be achieved within 30 years in the treatment areas; however, it would require approximately 100 additional years for the balance of the plume to attain cleanup levels (Shaw, 2011). If MNA is not found to be effective in areas outside of active treatment, a contingency remedy may be implemented. The contingency remedy would be determined based on aquifer conditions at that time. For the purposes of alternative evaluation, the duration of this alternative is estimated to be approximately 30 years. Actual time to achieve RAOs is likely to be longer than this estimate.

The estimated PW costs for this Alternative are based on two years of quarterly monitoring followed by three years of semiannual monitoring; annual monitoring thereafter until the next Five-Year Review; and once every five years thereafter for thirty years.

O&M of the pump and treat system will include periodic inspections of the system for leaks from pipelines, tanks, pumps, or equipment. Maintenance for pumps and equipment is assumed to be done once every 10 years.

Estimated Total Direct Capital Cost:

$3.04 million

Estimated Total O&M Cost: *$4.86 million*

Estimated Total PW Cost: *$7.90 million*

8.0 EVALUATION OF ALTERNATIVES

Nine criteria identified in the NCP 300.430(f)(1)(i), are used to evaluate the different remediation alternatives individually and against each other in order to select a remedy. The evaluation includes threshold criteria (requirements that must be met) and balancing criteria (used to weigh trade-offs). The modifying criteria (anticipated agency and public acceptance) will be evaluated based on comments received on this Proposed Plan.

1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is the primary objective of a remedial action. The No Action Alternative will not achieve the RAOs and provides no reduction in risks to human health. The other three alternatives are expected to achieve the RAOs for LHAAP-47 site. Alternatives 2, 3, and 4 include removal of the soil that may act as a continuing source of perchlorate contamination to groundwater. Active treatment in Alternative 2 is performed in-situ only. Impacted groundwater is brought to the surface in Alternative 3 and Alternative 4 which has the potential for human exposure. Alternatives 2, 3, and 4 all provide overall protection of human health and the environment. LUCs would also prevent exposure to contaminated groundwater during the time required for active treatment.

2. Compliance with ARARs

ARARs are environmental laws that are identified on a site-specific basis. Alternative 1 does not comply with chemical-specific ARARs as no remedial action or measure will be implemented. Location and action-specific ARARs do not apply to Alternative 1 since no remedial activities will be conducted. Alternatives 2, 3, and 4 are expected to comply with chemical-specific, location-specific, and action-specific ARARs.

3. Long-Term Effectiveness and Permanence

Alternative 1 will be least effective and least permanent because no contaminant removal or treatment will take place and no active measures will be implemented to control risks posed by the contaminated site. Alternatives 2, 3, and 4 all offer a similar level of long-term effectiveness and permanence provided the underlying technologies (In-situ Bioremediation and pump and treat technology) are effective. Alternatives 2 and 3 primarily rely upon In-situ Bioremediation and their effectiveness and longevity is dependent upon the substrate used and microbial processes. Alternatives 3 and 4 have the additional benefit of providing hydraulic control of the plume via groundwater pumping, provided that conditions are favorable for such a system. In Alternative 4, the extracted groundwater will be treated and discharged off-site. However, the pump and treat remedy component under Alternative 4 is expected to require a longer duration to attain required cleanup levels. Alternatives 2, 3, and 4 all also may require contingency remedies once remedies are in place and have been monitored over a period of time

Alternatives 2, 3, and 4 also rely upon LUCs for long-term effectiveness.

4. Reduction in Toxicity, Mobility, or Volume Through Treatment

Alternative 1 does not include a remedy, so there is no documentation of reduction in toxicity, mobility, or volume.

The soil excavation components of Alternatives 2, 3, and 4 provide a reduction in mobility because perchlorate is removed from the site and placed in a permitted disposal facility. Reduction in toxicity and volume of perchlorate will be achieved at the site, but overall reduction will depend upon any treatment processes that may be applied by the disposal facility.

Alternatives 2 and 3 offer a similar degree of reduction of toxicity, mobility, and volume through treatment. Alternative 2 is designed to treat groundwater through direct injection bioremediation and construction of biobarriers. Alternative 3 is designed to treat groundwater via recirculation bioremediation and direct injection bioremediation.

In Alternative 4, the volume of contaminants in site groundwater is expected to be reduced via extraction, their reduction in toxicity and mobility is dependent upon the treatment processes used in the off-site treatment system.

5. Short-Term Effectiveness

Short-term effectiveness is used to evaluate the length of time needed to implement an alternative to mitigate risk to on-site workers and the nearby community during remedial action implementation.

Alternative 1 does not involve any remedial actions, so implementation of the alternative will pose no additional short-term risk to workers, the community or the environment.

Alternatives 2, 3, and 4 involve utilization of excavation, drilling and construction equipment and also pose operational safety hazards to on-site workers. The implementation of Alternatives 2, 3, and 4 will require more time than Alternative 1 due to requirements for pre-design activities and remedial design. Alternative 3 involves some level of O&M due to the recirculation component, but the recirculation component is expected to improve degradation rates significantly over direct injection bioremediation alone, thus reducing the duration of this alternative.

Alternative 4 is construction and O&M intensive due to the pump and treat component, thereby providing greater potential for short-term physical safety risks to on-site workers or visitors to the refuge.

By planning the construction, excavation, and transportation activities in accordance with industry and OSHA codes and requirements, risks from contaminant exposure and construction operations will be controlled to acceptable levels. Appropriate personal protective equipment will be required for remediation workers.

6. Implementability

Administratively, all of the alternatives are implementable. Under Alternative 1, no remedial action will be taken. Therefore, no difficulties or uncertainties will be associated with its implementation.

Alternatives 2, 3, and 4 can easily be implemented from a technical standpoint as all equipment, materials, and services required are readily available. The excavation, MNA, LTM, and LUC portions of Alternatives 2, 3, and 4 are all equivalent, so the primary differences in implementability result from differences in the groundwater treatment portions of the alternatives. In addition, underground injection control permit will be required from the TCEQ for the active alternatives (Alternatives 2, 3, and 4) prior to implementation of the In-situ Bioremediation and groundwater recirculation components.

Alternative 2 is the easiest to implement. Biobarriers and direct injection bioremediation may be implemented with minimal studies or testing. No permanent piping is necessary.

Alternative 3 requires provision of power and piping in the groundwater recirculation component area and design and testing of wells and control systems will be necessary.

Alternative 4 is the most difficult to implement, involving construction and operation of a groundwater extraction system which will require provision of power and piping, as well as design and testing of wells and control systems. The collection tank and pipeline to the existing GWTP will require additional construction and modifications and improvements to the existing GWTP physical plant and control system, in addition to more O&M costs for equipment repair, maintenance and potential replacement over the remedy duration.

7. Cost

Cost estimates are used in the CERCLA FS process to eliminate those remedial alternatives that are significantly more expensive than competing alternatives without offering commensurate increases in performance or overall protection of human health and the environment. For each alternative addressed in the comparative analysis, a total PW cost was developed including both capital and long-term O&M costs. These costs are estimates with an intended accuracy range of +50% to -30% of the estimates. Of the action alternatives, Alternative 2 is the least expensive, followed by Alternative 3, and then Alternative 4, which is the most expensive Alternative.

Alternative 1 Total PW Cost: $0

Alternative 2 (Preferred Alternative) Total PW Cost: $5.09 million

Alternative 3 Total PW Cost: $7.62 million

Alternative 4 Total PW Cost: $7.90 million

8. State/Support Agency Acceptance

The TCEQ and the EPA concur with the Preferred Alternative.

9. Community Acceptance

Community acceptance of the Preferred Alternative will be evaluated after the public comment period ends. A Responsiveness Summary will be included in the LHAAP-47 ROD.

9.0 SUMMARY OF THE PREFERRED ALTERNATIVE

Based on the evaluation of alternatives, Alternative 2 - Excavation, In-situ Bioremediation, MNA, LTM, and LUCs is the Preferred Alternative for remediation of the LHAAP-47 site because it:

- Is protective of human health;
- Is expected to comply with ARARs;
- Is expected to achieve RAOs;
- Has been shown to be both effective at other LHAAP sites with similar site setting and contaminants;
- Is easy to implement with short-term impacts that can be controlled via appropriate health and safety measures and precautions;
- Is more cost-effective than Alternatives 3 and 4.

The plastic liner installed around the building 25-C and the soil with perchlorate concentrations exceeding the GWP-Ind value will be excavated and disposed off-site at a Resource Conservation and Recovery Act Subtitle D-permitted landfill. Excavation and disposal of the contaminated soil will result in eliminating the potential source for perchlorate impacts to surface water and groundwater (**Figure 4**).

Confirmation sampling from the excavation areas will be performed to verify that soils with perchlorate exceeding the GWP-Ind value are removed. The excavated area will be backfilled with appropriate clean fill material.

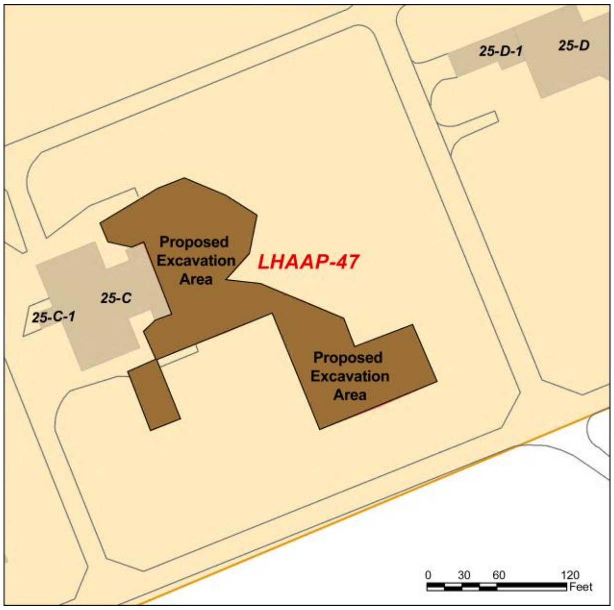

Figure 4 –Proposed Soil Excavation Areas

Groundwater in areas with highest COC concentrations will be targeted with In-situ Bioremediation. Bioaugmentation will also be performed as needed during the In-situ Bioremediation.

A pre-design investigation will be performed to refine the target treatment areas proposed for In-situ Bioremediation. It is anticipated that In-situ Bioremediation will be performed in the vicinity of wells in which VOCs greater than 1,000 µg/L and perchlorate greater than 20,000 µg/L have been detected. The target areas are expected to be around monitoring wells 47WW09, 47WW25, 47WW30, 47WW34, LHSMW43, and LHSMW56 for VOCs, and at LHSMW60 for perchlorate (**Figure 3**).

In general, components of the In-situ Bioremediation include direct injection in the hot-spot area near well 47WW25 and installation of biobarriers in areas near wells 47WW09, 47WW30, 47WW34, LHSMW43, LHSMW56, and LHSMW60.

In the hot-spot area near monitoring well 47WW25 (**Figure 3**), the substrate solution will be injected via direct push injection points with spacing of approximately 20 feet between points. The target treatment depth interval will be at approximately 30 ft below ground surface (bgs). Additional direct injection events in this hot-spot area may be conducted as necessary.

The biobarriers will be installed by direct injection of substrate and a microbial culture within the hot-spot areas (**Figure 3)**. Biobarrier injection points will have a 20-foot spacing to ensure overlap of injected material. The biobarriers will be installed in the first year, with follow-up injections in the biobarriers administered as necessary to ensure conditions conducive to contaminant degradation through reductive dechlorination are maintained. For cost estimating purposes, it is assumed that biobarriers may be renewed at ten-year intervals.

Performance monitoring will be used to evaluate remedy effectiveness using monitoring wells at the target areas and appropriate peripheral locations. Five additional monitoring wells are proposed to be installed at appropriate locations and depths to monitor effectiveness of ISB and MNA. Wells will be monitored quarterly for a period of two years, followed by semiannual monitoring for another three years, then annually until the Five-Year Review, followed by once every five years if the data suggest less frequent sampling is appropriate. Evaluation of natural attenuation will be performed after completion of two years (8 quarterly events) of monitoring. The monitoring parameters will include VOCs, SVOCs, TNT, 2,4-DNT, 2,6-DNT, and metals (those that may be mobilized by In-situ bioremediation).

If MNA is not found to be effective in areas outside of direct active treatment, a contingency remedy may be implemented. The contingency remedy would be determined based on aquifer conditions at that time.

In addition, surface water monitoring in Goose Prairie Creek will be conducted to monitor surface water quality. Surface water sampling will occur concurrently with groundwater sampling and the location(s) will be determined during the remedial design phase.

The Army will implement LUCs under this alternative after the Remedial Design phase. The LUCs will remain in place until the COCs are reduced to below levels supporting unlimited use and unrestricted exposure.

The anticipated future use of the site is wildlife refuge as part of Caddo Lake National Wildlife Refuge based on a Memorandum of Agreement between the USFWS and the Army (U.S. Army, 2004). A notification will be recorded with Harrison County that the site is unsuitable for residential use. The notification will also be included in the Environmental Protection Provisions in the Environmental Condition of Property document to be prepared for transferring the property to the USFWS (Shaw, 2011).

The Preferred Alternative presented here can change in response to public comments or new information.

Based on information currently available, the Army believes the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the alternatives with respect to the balancing and modifying criteria. The U.S. Army expects the Preferred Alternative to satisfy the following requirements of CERCLA Section 121(b):

- protect human health and the environment;
- comply with ARARs; and
- be cost effective.

10.0 COMMUNITY PARTICIPATION

The Army, USEPA, and TCEQ provide information regarding LHAAP-47 through public meetings and the Administrative Record file for the facility. The public is encouraged to use this information to gain a more comprehensive understanding of the site.

The public comment period for this Proposed Plan will offer the public an opportunity to provide input to the LHAAP-47 remedial action planning process. The Proposed Plan is available in the Administrative Record at the Marshall, Texas Public Library. The public comment period will begin on January 1, 2013 and end on January 31, 2013.

After the public has had an opportunity to review this Proposed Plan during the public comment period and the Army reviews the public comments received, the Army will publish the selected remedy for LHAAP-47, the basis for its selection, the associated RAOs, and any contingency planning in the Decision Document. The Army will also incorporate a Responsiveness Summary addressing public comments in the ROD.

11.0 REFERENCES

Jacobs, 2003, Final Baseline Human Health and Screening Ecological Risk Assessment for the Group 4 Sites (Sites 04, 08, 35A, 35B, 35C, 46, 47, 48, 50, 60, 67, Goose Prairie Creek, Saunders Branch, Central Creek, and Caddo Lake), Longhorn Army Ammunition Plant, Karnack, Texas, Final, Oak Ridge, Tennessee, June.

Lynntech, Inc., 2001, Email from Hellen Heekyung Kim to Cliff Murray, Jonna Polk, Dawn Knight, and David Tolbert, "Perchlorate in Soil at Building 25-C", October 11.

Shaw, 2007a, Final Data Gaps Investigation, Longhorn Army Ammunition Plant, Karnack, Texas, April 2007.

Shaw, 2007b, Final Installation-Wide Baseline Ecological Risk Assessment, Longhorn Army Ammunition Plant, Karnack, Texas, Houston, Texas, February 2007.

Shaw, 2007c, Final Modeling Report, Derivation of Soil and Groundwater Concentrations Protective of Surface Water and Sediment, Longhorn Army Ammunition Plant, Karnack, Texas, April.

Shaw, 2008, Final Data Evaluation Report Chemical Concentrations in Soil Samples Associated with LHAAP-35/36 Sumps, (Final Sump Report), January 2008.

Shaw, 2011, Final Feasibility Study Report for LHAAP-47, Plant Area 3, Group 4, Longhorn Army Ammunition Plant, Karnack, Harrison County, Texas, July 2011.

Solutions to Environmental Problems (STEP), 2005, Plant-Wide Perchlorate Investigation, Longhorn Army Ammunition Plant, Karnack, Texas, Final, Oak Ridge, Tennessee, April.

U.S. Army, 2004, Memorandum of Agreement Between the Department of the Army and the Department of the Interior for the Interagency Transfer of Lands at the Longhorn Army Ammunition Plant for the Caddo Lake National Wildlife Refuge, Harrison County, Texas.

Signed by the Department of the Interior on April 27, 2004 and the Army on April 29, 2004.

GLOSSARY OF TERMS

Specialized terms used in this Proposed Plan are defined below:

Administrative Record File: A file which is maintained and contains all information used by to make a decision on the selection of a response action under CERCLA.

Applicable or Relevant and Appropriate Requirements (ARARs): The federal and state environmental laws and regulations that must be complied with when undertaking a selected remedy. These requirements may vary among sites and alternatives.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): A law that establishes a program to identify hazardous waste sites and procedures for cleaning up sites to be protective of human health and the environment, and evaluate damages to natural resources.

Excess Lifetime Cancer Risk: A risk for an individual experiencing the reasonable maximum exposure estimate to develop cancer as a result of site-related exposure.

Five-Year Review: A process that evaluates the protectiveness of the remedy and determines whether conditions remain protective of human health and the environment. CERCLA Section 121(c) and the National Contingency Plan at 40 Code of Federal Registry Section 300.430(f)(4)(ii) require that remedial actions that result in hazardous substances, pollutants, or contaminants remaining at a site above levels that allow for unlimited use and unrestricted exposure be reviewed every 5 years to ensure protection of human health and the environment.

Hazard Index: The hazard index is a summation of all the hazard quotients for all chemicals of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. A hazard index value of 1.0 or less indicates that no adverse non-cancer human health effects are expected to occur.

Hazard Quotient: Hazard quotient is a comparison of an estimated chemical intake (dose) with a reference dose level below which adverse health effects are unlikely. Each hazard quotient is expressed as a ratio of the estimated intake (numerator) to the reference dose (denominator). The value is used to evaluate the potential for non-cancer health effects, such as organ damage from chemical exposures.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): Also referred to as the National Contingency Plan, it is a plan required by CERCLA and codified at 40 Code of Federal Registry Section 300 that provides a framework for responding to releases or threats of release of hazardous substances and oil discharges.

Present Worth (PW) Analysis: A method to evaluate expenditures that occur over different time periods. By discounting all costs to a common base year, the costs for different remedial action alternatives can be compared. When calculating present worth costs for Superfund sites, capital as well as operation & maintenance costs are included.

Proposed Plan: A public participation requirement of CERCLA Section 117 in which the lead federal agency summarizes the preferred cleanup strategy, the rationale for the preference, the alternatives evaluated in the remedial investigation/feasibility study, and any ARAR waivers proposed for site cleanup. The Proposed Plan is issued to the public to solicit public review and comment on all alternatives under consideration.

Public Comment Period: A prescribed period during which the public may comment on the Proposed Plan.

Remedial Action: The means selected to achieve RAOs; also, the construction or implementation phase that follows the remedial design of the selected cleanup alternative at an NPL site.

Remedial Action Objective (RAO): The goals established for a remedy that ensure protection of human health and the environment.

Risk Assessment: An analysis of the potential adverse health effects (current and future) caused by hazardous substances at a site in the absence of any actions to control or mitigate the releases (i.e., under an assumption of no action). The assessment contributes to decisions regarding appropriate response alternatives.

ACRONYMS

ARARs	applicable or relevant and appropriate requirements
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	Chemicals of concern
FS	Feasibility Study
ft	feet
GWP-Ind	Soil Medium Specific Concentration for Industrial Use Based on Groundwater Protection
HI	Hazard Index
LHAAP	Longhorn Army Ammunition Plant
LUC	Land Use Control
LTM	long-term monitoring
µg/L	micrograms per liter
MCL	maximum contaminant level
MNA	Monitored Natural Attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
PW	present worth
RAO	remedial action objective
ROD	Record of Decision
SVOCs	semi-volatile organic compounds
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOCs	volatile organic compounds