Nevada Environmental Response Trust

# Feasibility Study Work Plan for OU-1 and OU-2

June 30, 2023

Revised October 3, 2023

# Feasibility Study Work Plan for OU-1 and OU-2

## Nevada Environmental Response Trust Site
## (Former Tronox LLC Site)
## Henderson, Nevada

**Nevada Environmental Response Trust (NERT) Representative Certification**

I certify that this document and all attachments submitted to the Division were prepared at the request of, or under the direction or supervision of NERT. Based on my own involvement and/or my inquiry of the person or persons who manage the system(s) or those directly responsible for gathering the information or preparing the document, or the immediate supervisor of such person(s), the information submitted and provided herein is, to the best of my knowledge and belief, true, accurate, and complete in all material respects.

Office of the Nevada Environmental Response Trust

Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

**Signature:** Jay A Steinberg, President Not Individually, but Solely as President of the Trustee

**Name:** Jay A. Steinberg, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

**Title:** Solely as President and not individually

**Company:** Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

**Date:** 10/3/23

# Environmental Certification Jurat

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of my knowledge, comply with all applicable federal, state and local statutes, regulations and ordinances.

Description of Services: Feasibility Study Work Plan for OU-1 and OU-2, Nevada Environmental Response Trust Site, Henderson, Nevada.

October 3, 2023

Yun Y. Wang
Principal Environmental Engineer
CEM No. 2125 (expires 10/18/2025)

Date

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# Figures

# Acronyms

| | |
|---|---|
| AP | Ammonium Perchlorate |
| ARARs | Applicable or Relevant and Appropriate Requirements |
| BHRA | Baseline Health Risk Assessment |
| bgs | Below Ground Surface |
| BMI | Black Mountain Industrial |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| COPCs | Chemicals of Potential Concern |
| FS | Feasibility Study |
| FS Report | Feasibility Study Report for OU-1 and OU-2 |
| FS Work Plan | Feasibility Study Work Plan for OU-1 and OU-2 |
| IWF | Interceptor Well Field |
| GRAs | General Response Actions |
| GWETS | Groundwater Extraction and Treatment System |
| NCP | National Contingency Plan |
| NPDES | National Pollutant Discharge Elimination System |
| NPL | National Priority List |
| NDEP | Nevada Division of Environmental Protection |
| NERT | Nevada Environmental Response Trust |
| OSSM | Olin, Stauffer, Syngenta, and Montrose |
| OU | Operable Unit |
| PRGs | Preliminary Remediation Goals |
| PRPs | Potentially Responsible Parties |
| ROD | Record of Decision |
| RAOs | Remedial Action Objectives |
| RI | Remedial Investigation |
| SLERA | Screening Level Ecological Risk Assessment |
| SFCs | Specific Factor Considerations |
| TBC | To Be Considered |
| USEPA | United States Environmental Protection Agency |

# 1 Introduction

This Feasibility Study Work Plan for OU-1 and OU-2 (FS Work Plan) describes the scope of work that will be implemented to complete the Feasibility Study (FS) evaluation of Operable Units (OUs) 1 and 2 within the Nevada Environmental Response Trust (NERT or the "Trust") Remedial Investigation (RI) Study Area (Study Area) in Henderson, Nevada. At the direction of NERT, this proposed FS evaluation strictly follows the United States Environmental Protection Agency (USEPA) Guidance for Conducting Remedial Investigations and Feasibility Studies Under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; USEPA 1988). The FS evaluation will be documented in the Feasibility Study Report for OU-1 and OU-2 (FS Report).

Although the NERT RI Study Area is not on the National Priorities List (NPL), cleanup of the NERT RI Study Area is required to follow CERCLA, as specified in the Interim Consent Agreement between NERT and the Nevada Division of Environmental Protection (NDEP), effective February 14, 2011, and all work performed by the Trust must be consistent with the National Contingency Plan (NCP). As such, this FS Work Plan specifies strict adherence to the FS process detailed in the USEPA's 1988 guidance. The USEPA's 1988 guidance presents a flexible and dynamic framework to facilitate the evaluation and defensible screening of treatment technologies, the assemblage of relevant treatment technologies into remedial alternatives, and then appropriate development, screening, and comparison of those remedial alternatives. As each step of the FS process in the USEPA's 1988 guidance unfolds, a logical progression is established to achieve the Remedial Action Objectives (RAOs), comply with Applicable or Relevant and Appropriate Requirements (ARARs), and to consider the "to-be-considered" (TBC) criteria. Therefore, components of the FS process are iterative to incorporate feedback and comparative evaluation and ultimately arrive at the most efficient development of the remedial alternatives.

The FS will be conducted in accordance with "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" (USEPA 2000), which contains cost-related information that supersedes information described in USEPA's 1988 guidance. As requested by NDEP, the FS will also consider "Contaminated Sediment Remediation Guidance for Hazardous Waste Sites. OSWER Publication 9355.0-85. Draft." (USEPA 2005) and "Remediating Contaminated Sediment Sites – Clarification of Several Key Remedial Investigation/Feasibility Study and Risk Management Recommendations, and Updated Contaminated Sediment Technical Advisory Group Operating Procedures" (USEPA 2017), as applicable.

While the FS Report will not be a decision-making document, its goal is to present a clear, thoroughly documented, comprehensive, and defensible evaluation of remedial alternatives to achieve the RAOs, comply with ARARs, and consider TBC criteria. This evaluation will allow for well-informed decisions to be made in subsequent phases of the CERCLA process, specifically the Proposed Plan and the Record of Decision.

While the NERT RI Study Area is comprised of three OUs encompassing approximately 5,200 acres, after consultation with NDEP, EPA and the NERT Stakeholders (defined in Section 3.2), the Trust bifurcated the FS evaluations into OU-1 and OU-2 before OU-3, in a strategic effort to expedite implementation of the final remedy within OU-1 and OU-2. Accordingly, this FS Work Plan, and the associated FS Report, is limited to OU-1 and OU-2 (the "FS Area"). The following sections of the FS Work Plan present the FS evaluation process as it is described in the USEPA's 1988 guidance, discuss the necessity of evaluating the impact of multiple commingling groundwater plumes within the FS Area, and conclude with general schedule assumptions.

This FS Work Plan details the FS evaluation process that will develop, screen, and compare remedial alternatives to address four primary chemicals of potential concern (COPCs) and numerous Other COPCs (as defined in the RI Report for OU-1 and OU-2) within soil and groundwater within the FS Area to achieve the RAOs, comply with ARARs, and consider TBC criteria. Resulting from prior decision making by NDEP related to surrounding sites and contamination assigned to other parties withing the footprint of NERT's OU-2, and as detailed in NERT's RI

Report for OU-1 and OU-2, NERT's obligations in OU-2 are different than in OU-1 in that in the Eastside Sub-Area, located east of Pabco Road, NERT is only responsible for addressing perchlorate and chlorate in soil below 10 feet and in groundwater. To accomplish the FS evaluation, the universe of remediation technology types and process options will be identified, explained, and preliminarily screened for relevance to the FS Area. Those remediation technology types and process options retained will be further screened according to effectiveness, implementability, and relative cost, and organized into remedial alternatives. The developed remedial alternatives will then be screened using the same criteria (i.e., according to their effectiveness, implementability, and relative cost) such that only those remedial alternatives that meet the screening criteria are carried forward for detailed evaluation and then comparatively analyzed. For each impacted media, limited, moderate, and aggressive remedial alternatives, along with a No Further Action alternative to serve as a basis of comparison, will be evaluated according to the nine criteria specified in the USEPA's 1988 guidance, which include two threshold, five balancing, and two modifying criteria. The comparative analysis will be documented using both a criterion weighting and numerical ranking to semi-quantitatively evaluate each remedial alternative.

The FS Area is much more complex than traditional sites evaluated under CERCLA given the overall size of OU-1 and OU-2, the site-specific geology and hydrogeology, the extensive COPC release history, the commingling of the multiple groundwater plumes originating from different sites, and the magnitude of the current environmental impacts while at the same time acknowledging the constraints of the NERT Trust Agreement and NDEP's BMI Complex Regional Goals and Directives. This necessitates a commensurate level of effort to fairly, transparently, thoroughly, and logically evaluate potential remedial options to achieve the stated RAOs, comply with ARARs, and consider TBC criteria. It should also be noted that the FS Work Plan and FS Report will not evaluate remedial alternatives for impacted media in OU-3. After the RI Report for OU-3, the BHRA Report for OU-3, and the Baseline Ecological Risk Assessment Report for OU-3 have been submitted and resolution of NDEP comments completed, the preparation of the FS Work Plan for OU-3 can begin. There is hydraulic connection between OU-1, OU-2, and OU-3, and this hydraulic connection will be considered in the Feasibility Study for OU-1 and OU-2 as it relates to achievement of the Remedial Action Objectives for OU-1 and OU-2 and how the effectiveness, implementability, and cost of a remedial alternative are affected by this hydraulic connection. In addition, the hydraulic connection between OU-2 and OU-3 will be given substantial consideration within the FS for OU-3 as it relates to achievement of the RAOs for OU-3. Finally, while NERT currently contemplates completing two FS evaluations and reports for the three NERT OUs, it is acknowledged that the Trust has a finite amount of funding for implementation of final remedy in each of the three OUs and all remedial decision making subsequent to completion of both FSs (i.e. development of the Proposed Plan or Plans) will be done with an emphasis on a holistic perspective across the entirety of the NERT RI Study Area.

This FS Work Plan is being prepared absent regulatory approvals on the NERT RI Report for OU-1 and OU-2, the Baseline Health Risk Assessment (BHRA) Reports for OU-1 and OU-2 Soil Gas and Groundwater, and the Screening Ecological Risk Assessment Reports for OU-1 and OU-2; however, NDEP has provided feedback on NERT's responses to NDEP comments on these documents such that advancing to the FS Report stage of the project for OU-1 and OU-2 is possible. Furthermore, the Unit 4 Source Area In-Situ Bioremediation Treatability Study, which is evaluating source control remedial options in OU-1, is ongoing. However, NERT anticipates that this treatability study will be completed prior to submittal of the FS Report for OU-1 and OU-2.

## 1.1 Purpose of the Feasibility Study

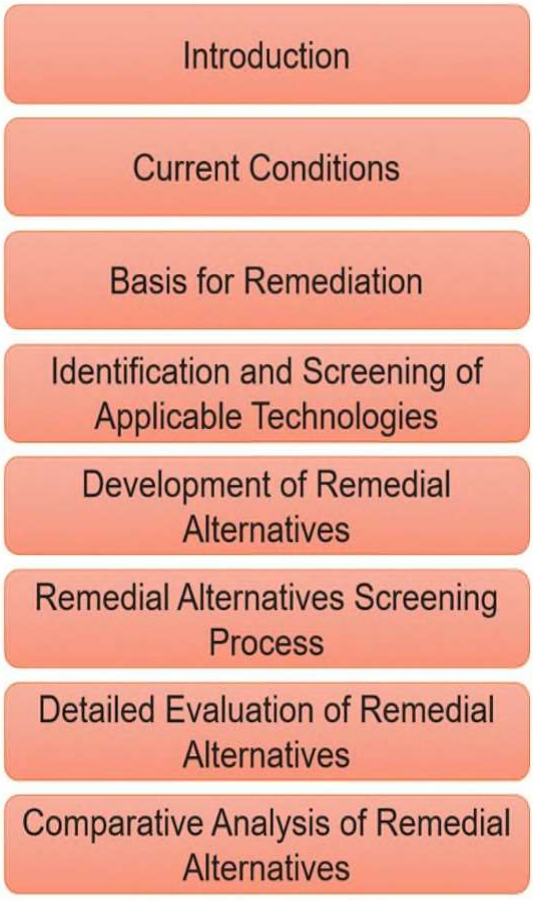
In its simplest form, the FS process is designed to fairly and logically evaluate potential remedial options to achieve the RAOs, comply with ARARs, and consider TBC criteria at a site with impacted environmental media (e.g., soil, soil gas, groundwater, surface water, and/or air). While a FS report does not officially select specific remedial alternatives, the detailed evaluation of all potential remedial options that will ultimately yield the selection of remedial alternatives will be documented in a FS report. Therefore, the consideration of all available remedial

options and an easily understandable comparative evaluation against meaningful decision criteria represent the basis of what will be included in a FS report.

# 2 Components of the NERT Feasibility Study Report

The following section discusses the approach and steps for conducting the FS. It is generally consistent with yet supersedes the approach outlined in NERT's 2014 RI/FS Work Plan and provides greater detail on the process than was originally outlined in the 2014 RI/FS Work Plan. Accordingly, this document supersedes Sections 5.3, 6.10, 6.11, and 6.12 of the 2014 RI/FS Work Plan, Revision 2 in its entirety. It should also be noted that modifications to the RI component of the 2014 RI/FS Work Plan that were made based on requests and approvals from NDEP are summarized in Sections 6.3.2 and 6.4.2 of the RI Report for OU-1 and OU-2 (Ramboll 2023).

***Figure 1:*** *Conceptual outline of the proposed FS Report*




The FS Report will follow the recommended outline based on the USEPA's 1988 guidance, presented conceptually as **Figure 1.** Each section of the FS Report is further described below.

## 2.1 Introduction

The introduction section of the FS Report explains the purpose of the FS process, identifies the subsections of the report, and presents an organization of the document.

## 2.2 Current Conditions

While the OU-1 and OU-2 RI is intended to delineate the nature and extent of the environmental impacts and summarize the release history, commingling of multiple groundwater plumes, and identification of COPCs, the FS Report will be a stand-alone document and part of the administrative record. Therefore, the current conditions section of the FS Report will present concise summaries of the site history, the relevant OUs, historical removal actions, the nature and extent of environmental impacts, COPC fate and transport, the risk assessments which identify impacted media containing contaminants at concentrations that pose an unacceptable risk to human health and the environment, the identification of COPCs, the conceptual site model, nature of the commingling of multiple groundwater plumes, and remedial technology treatability studies with the relevant document citations as appropriate. The current conditions section of the FS Report will serve to describe the size and complexities of the FS Area, and the corresponding degree of the remedial alternative evaluation necessary.

## 2.3 Basis for Remediation

The third section of the FS Report is designed to present the basis for remediation of the FS Area and will:

- Document and screen chemical-specific, action-specific, and location-specific ARARs as presented in the RI Report for OU-1 and OU-2 and to the extent there have been changes in the applicable or relevant regulations since the RI Report for OU-1 and OU-2 was drafted, update the ARARs;
- Present the TBC criteria as documented in the RI Report for OU-1 and OU-2 and to the extent there have been changes since the RI Report for OU-1 and OU-2 was drafted, update the TBCs;
- Articulate the RAOs as documented in the RI Report for OU-1 and OU-2;
- Present the preliminary remediation goals (PRGs); and
- Present the associated General Response Actions (GRAs) for each of the impacted media within the FS Area.

The PRGs are numerical criteria based on readily available information and chemical-specific ARARs and are typically finalized based on the results of the baseline risk assessments and associated risks of each alternative.

The GRAs are the actions deemed necessary to achieve RAOs and are media specific. Examples of GRAs include containment, in-situ treatment, institutional controls, disposal, and a combination of GRAs may be used at a site.

The scale of a FS evaluation process is directly related to the number of impacted media, the corresponding number of COPCs, the RAOs, ARARs, and TBC criteria, and other site-specific complexities (e.g. commingling plumes). The delineation of the nature and extent of impacts is summarized in the RI Report for OU-1 and OU-2. The impacted media associated with OU-1 and OU-2 are soil, groundwater, and soil gas.

The FS evaluation of the FS Area will be limited to impacted media and COPCs resulting from historical activities within OU-1 and therefore the relevant GRAs for this FS Report will be limited to OU-1 vadose zone soil, OU-1 groundwater (both within the source area and at the downgradient boundary), and OU-2 soil and groundwater. However, and as previously detailed in the RI Report for OU-1 and OU-2, the COPCs to be evaluated by NERT in the Eastside Sub-Area have been administratively limited by NDEP to perchlorate and chlorate in soil deeper than 10 feet bgs and in groundwater.

As detailed in the RI Report for OU-1 and OU-2, perchlorate, chlorate, hexavalent chromium, and chloroform have been defined as “Primary COPCs” as they are widely distributed in groundwater in OU-1 and OU-2 above the RI screening levels. While the RI Report for OU-1 and OU-2 did identify additional COPCs associated with the impacted media, the BHRAs for OU-1 and OU-2 will ultimately dictate if any of the additional COPCs will be included in the FS evaluation process.

The RAOs for the relevant media in OU-1 and OU-2 are as follows:

- Plume Containment and Source Control for OU-1; and
- Mid-Plume Containment and Mass Removal for OU-2.

The significance of this section of the FS Report cannot be understated as it establishes federal and state regulatory metrics by which remedial alternatives will be measured, administrative constraints that can influence remedial cost estimates, and the fundamental criteria dictating the need for active remediation. Comprehensive consideration of ARARs and TBCs early in the FS process is particularly important as they may impose site-specific administrative issues that will influence the screening of treatment technologies and chemical- specific ARARs and TBCs can influence the established PRGs. The stated RAOs for the FS Area

directly inform the GRAs necessary for each impacted media. Furthermore, this section will also expand on the nature of commingling plumes to include information with respect to the planned remedial actions of other parties, as communicated to the Trust by NDEP. Finally, this section will account for NERT's obligations under the Trust Agreement and the NDEP's BMI Complex Regional Goals and Directives.

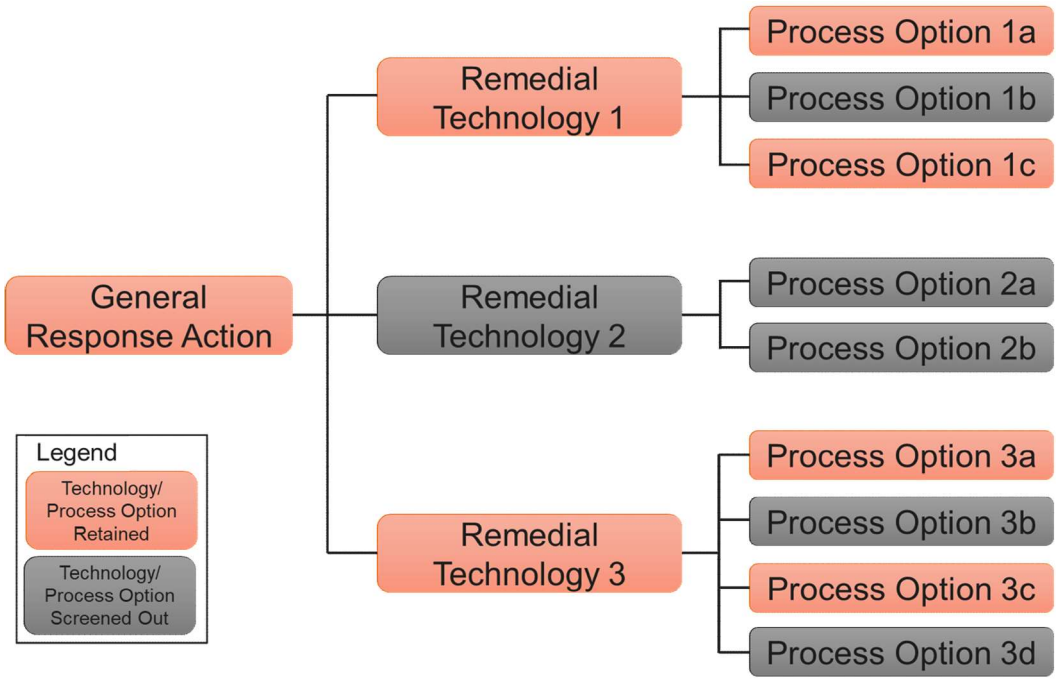
## 2.4 Identification and Screening of Applicable Technologies

An exhaustive identification and initial screening of treatment technologies for each impacted media (e.g. groundwater and soil) within the FS Area will be the basis for the fourth section of the FS Report. To be consistent with USEPA's 1988 guidance and for clarity herein, a treatment technology refers to the general category of technology, such as capping, groundwater extraction, or thermal destruction while process options are the specific processes within each treatment technology. For example, the GRA of in-situ treatment would include the treatment technology of physical treatment, and soil vapor extraction would be the process option.

The initial screening will be for technical implementability of a technology, organized by GRA, and will eliminate remedial technology types or process options that are not applicable based on the COPCs or site-specific characteristics as described in the RI Report for OU-1 and OU-2. The technology types and process options will be identified utilizing a variety of sources including state and federal guidance, other Records of Decision (RODs) deemed comparable or relevant to NERT, and professional experience with the COPCs. The screening will be site specific, and the basis for retaining or screening out a process option will be documented.

At the technology screening stage of the FS evaluation, the GRAs will have been evaluated to adequately achieve the RAOs, comply with the ARARs, and consider TBC criteria, and the volumes and/or areas of the actionable impacted environmental media will have been calculated or sufficiently estimated. All these components will be developed from existing information collected as part of the RI or data derived through NERT's various treatability and pilot studies.

***Figure 2:*** *Conceptual screening of remedial technology types and the associated process options*



The goal of screening the remedial technology types and the process options is to retain only those technologies/process options that are relevant to the impacted environmental matrices, Primary COPCs, and RAOs/ARARs/TBCs. In other words, those remedial technology types and process options eliminated following the initial screening will be documented in a series of screening tables within the FS Report for OU-1 and OU-2 and no longer be considered or incorporated into assembled remedial alternatives. A conceptual example of the remedial technology type and process option screening is presented in **Figure 2**.

## 2.5 Development of Remedial Alternatives

Once the initial technology type and process option screening is complete, a secondary screening of the retained technology types and process options will be performed and documented in Section Five. This section represents the first distinct feasibility evaluation of the FS process by electing to retain or eliminate remedial technology types and process options. As the process options are evaluated against the specified decision criteria of effectiveness, implementability, and relative cost as it pertains to the GRAs and quantities of impacted media, evaluation of their feasibility will be highly comprehensive to establish technically sound and readily understandable rationales for retention or elimination. The conclusion of this section will entail assembling the retained process options into remedial alternatives to address the FS Area holistically. This section of the FS Report will identify those retained remedial alternatives that will be screened, evaluated, and compared in subsequent sections of the FS Report.

Given the finite nature of this screening process, USEPA's 1988 guidance stipulates specific components of decision criteria that generally fall within effectiveness, implementability, and cost. Within this section, the three screening criteria are applied to the technologies and GRAs they satisfy and not to the FS Area as a whole. Effectiveness is evaluated for the potential in handling estimated areas and volumes of media and meeting the PRGs, along with potential impact to human health and the environment during the remedial action, and how proven and reliable the process is for the COPCs and site conditions. At this screening, implementability is screened for technical and administrative feasibility of implementation, including the ability to obtain permits, the availability of services, equipment, or workers to implement. Screening for cost is based on relative capital and operations & maintenance costs only, and methods from USEPA's 1988 and 2000 guidance will be used for cost estimating with engineering judgement used to rate a process option as high, medium-high, medium, medium-low, or low cost relative to other process options of the technology type.

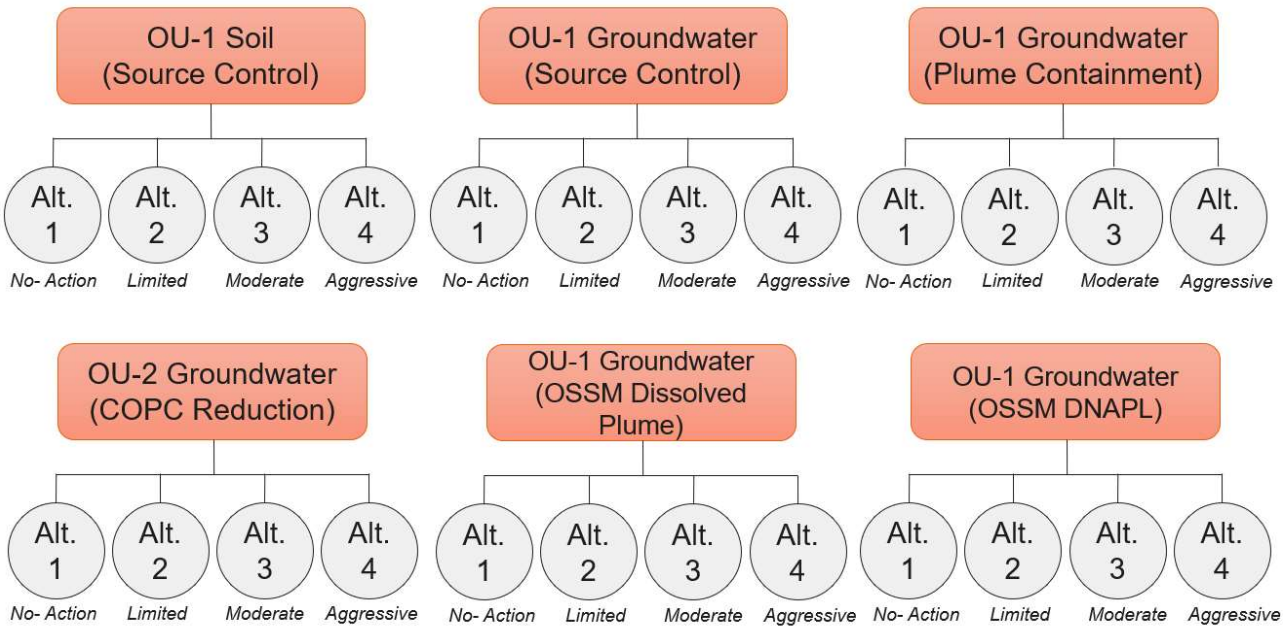
Screening based on cost has a limited role at this point in the FS and is a minimal component of the decision to retain or eliminate a remediation technology type or process option and greater consideration is given to the effectiveness and implementability. As in Section Four, the process and rationale for a process option that is screened out or moved forward at this stage is documented to clearly memorialize that the universe of remedial technology types was considered with sufficient rigor and those eliminated from consideration were done so with appropriate justification. A table (or a series of tables) will be used for both the initial screening in Section Four and secondary screening in Section Five to clearly articulate the justification for elimination.

Once the screening is complete, OU-specific remedial alternatives will be assembled and described with location of areas, volumes, and the other information needed to describe the alternative and document the logic behind the assembly of the alternative. A remedial alternative is a combination of different technologies and process options that collectively could meet the RAOs. The intent in assembling the remedial alternatives is to develop a range of treatment alternatives that will start at No Further Action and proceed from limited action alternatives to complex alternatives. The FS will clearly define each of the alternatives, including the No Further

Action alternative that will serve as the baseline. The remedial alternatives will be developed by assembling relevant process options to address the four Primary COPCs and other actionable COPCs (as defined in the RI Report for OU-1 and OU-2, the BHRA for OU-1 Soils, the BHRA for OU-1 Soil Gas and Groundwater, and the BHRA for OU-2 Soil Gas and Groundwater) within the specified impacted environmental matrix to accomplish the RAOs and comply with ARARs and consider TBC criteria. Multiple process options may be combined in a specific alternative. At the completion of this portion of the FS, each process option will either have been screened out or will be part of one or more remedial alternatives.

Each impacted environmental media will have specific GRAs and multiple potential technologies. Each of the GRAs will require an evaluation of several remedial alternatives for the Primary COPCs and other actionable COPCs with respect to the stated RAOs (and comply with ARARs and consider TBC criteria) while taking into account the Trust Agreement, commingling of multiple groundwater plumes, and the BMI Complex Regional Goals and Directives. Additionally, the evaluation will be limited to perchlorate and chlorate in soil below 10 feet bgs and in groundwater within the Eastside Sub-Area of OU-2, east of Pabco Road. Examples of the permutations of remedial alternatives likely required are shown in **Figure 3**, including the required No Further Action (as required and defined in USEPA's 1988 guidance) remedial alternative to serve as a comparison.

***Figure 3:*** *Conceptual remedial alternatives pertaining to the relevant impacted media, COPCs, and RAOs.*



The assemblage of the remedial alternatives concludes the identification and screening of remediation technology types and process options.

## 2.6 Remedial Alternatives Screening Process

The assembled remedial alternatives will then proceed through a screening process against the decision criteria of effectiveness, implementability, and relative cost and will be presented in Section Six of the FS Report. To conduct this screening, it will be necessary to define aspects of the process options that significantly influence critical components of the remedial alternatives (e.g., access, size requirements, remediation timeframes, sitewide protectiveness requirements, special implementation considerations) in sufficient detail to differentiate between the alternatives based on effectiveness, implementability and relative cost. Developing the process option specific design aspects also enables the identification of common elements, which may streamline the subsequent remedial alternatives evaluation and comparisons.

Development of the individual remedial alternatives must be accomplished prior to evaluating and comparing the assembled remedial alternatives. This evaluation and comparison must include a clear description of the logic behind why the process options were assembled to create the remedial alternative with respect to the areas and volume of impacted environmental media, the targeted COPCs, and how the selected process options will achieve the RAOs. Of critical importance with respect to the development of the remedial alternatives is the discussion as to why the process options that form the remedial alternative were retained. The No Further Action alternative will also be defined and described as part of this section of the report consistent with USEPA's 1988 guidance.

The initial screening of remedial alternatives will be against the short-and long-term aspects of each criteria, with the intent to reduce the number of alternatives that will undergo detailed analysis to just the most viable. At this point, screening will evaluate the alternative and not just a specific remedial technology. Effectiveness will be evaluated for the protectiveness of human health and the environment and reductions in toxicity, mobility, or volume of COPCs for both the short-term during the construction and implementation phase and for the long-term after the remedial action is complete. Implementability evaluation for this screening is both the technical ability to construct the alternative and operate it while meeting regulations and the administrative implementability (e.g., land access, permitting, etc.) with agency acceptance and the availability of equipment or services. Evaluation of relative cost at this initial screening is a comparative analysis (i.e., low, medium-low, medium, medium-high, or high cost compared to other alternatives) with relative accuracy and considering both capital and O&M costs with present worth analyses. The remedial timeframes utilized for O&M costs at this initial screening level will be relative and developed utilizing site-specific data. More detailed remedial timeframes will be developed for the retained remedial action alternatives as further discussed in Sections 2.7 and 2.8.

## 2.7 Detailed Evaluation of Remedial Alternatives

Section Seven of the FS Report for OU-1 and OU-2 will present the second distinct feasibility evaluation of the FS process. In this section, each of the assembled remedial alternatives retained after the screening process will be evaluated against the nine evaluation criteria specified in the USEPA's 1988 guidance. The nine evaluation criteria include two threshold factors (overall protection of human health and the environment and compliance with ARARs), five balancing factors that consider different forms of effectiveness, implementability, and cost, and lastly two modifying considerations (state and community acceptance) as presented in **Figure 4**.

***Figure 4:*** *Identification of the nine evaluation criteria and their role in remedial alternative evaluation and comparison*

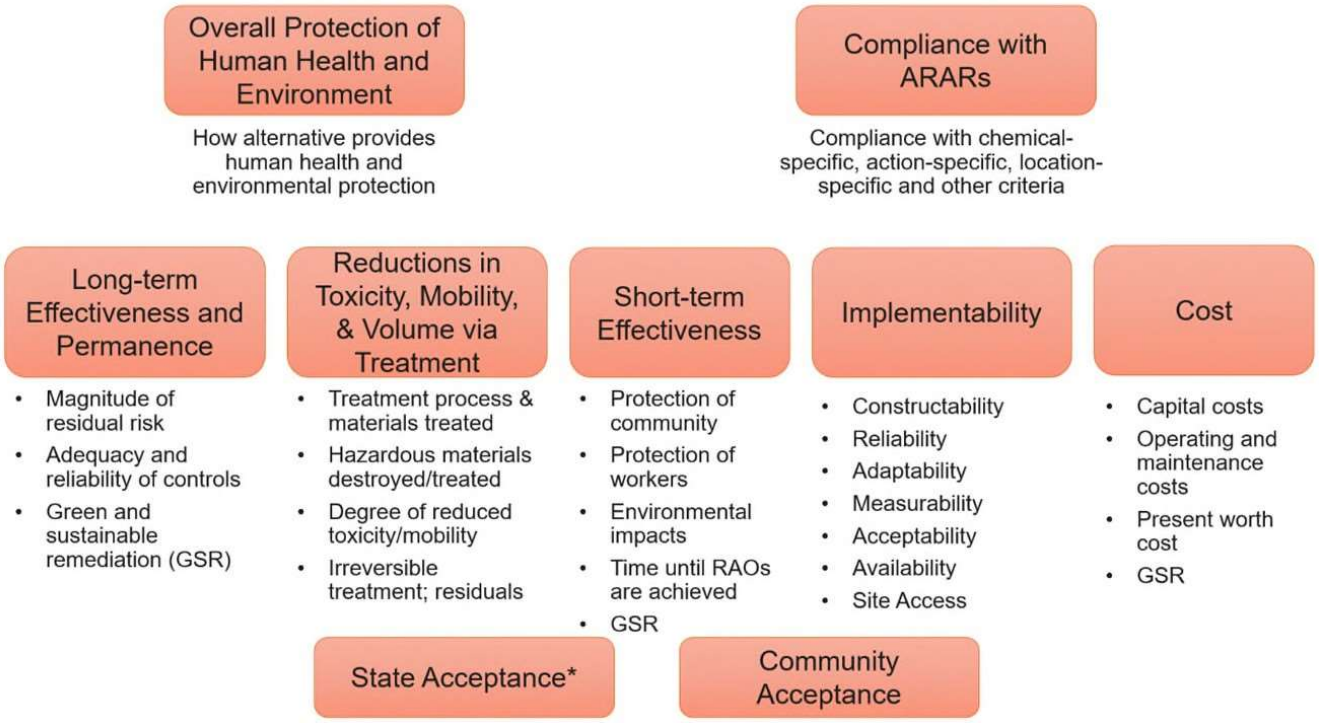

* State acceptance is identified in USEPA's 1988 guidance as a modifying criteria based on the assumption that USEPA is the lead agency. At this site, the State is the lead, therefore the evaluation in the FS Report will consider USEPA acceptance.

The completeness of the evaluation will necessitate development of a conceptual design (which will include items such as a detailed description of the remedial system and plan views of the implementation area but will not include items such as detailed drawings of equipment) at a consistent scale across the remedial alternatives. When put into context of the FS Area, the design level consideration of each of the remedial alternatives will be a time intensive and iterative exercise. This section of the FS Report will result in only those remedial alternatives that meet the threshold factors, rank favorably with respect to the balancing factors, and appropriately correspond with the modifying considerations. It will be these remedial alternatives retained after Section Seven that are comparatively analyzed in the next section of the FS Report.

As specified in USEPA's 1988 guidance, the remedial alternative evaluation may identify data gaps that could be addressed through pre-design investigations or additional pilot/treatability studies. However, and with respect to additional studies, NERT has implemented a robust treatability and pilot study program, some of which are still in progress, to improve the evaluation of the remedial alternatives during the FS thus accelerating the path to final remedy. Because USEPA's 1988 guidance is intentionally flexible to enable the FS evaluation to be performed in many ways at different sites and to accommodate drastically different scales of sites, the proposed remedial alternative evaluation during this component of the FS evaluation for OU-1 and OU-2 will thoroughly justify why each remedial alternative has been assembled with respect to the nine evaluation criteria.

The assemblage, development, screening, and comparison of the remedial alternatives include a consideration of threshold, balancing, and modifying criteria, each of which has several sub-criteria. The evaluation of the remedial alternatives will be based on the Specific Factor Considerations (SFCs) stipulated in USEPA's 1988 guidance. For each of the nine evaluation criteria, multiple questions and considerations such as capital costs, adequacy and reliability of results, or constructability are posed to ensure remedial alternatives are evaluated consistently and comprehensively (**Figure 5**). Additionally, while green and sustainable remediation and best management practices are not specifically included in the nine criteria dictated by the NCP, consideration of green and sustainable remediation and best management practices will be integrated into the nine NCP criteria, while prioritizing consistency with the NCP.

***Figure 5:*** *Succinct description of Specific Factor Conditions for each of the nine evaluation criteria*




* State acceptance is identified in USEPA's 1988 guidance as a modifying criteria based on the assumption that USEPA is the lead agency. At this site, the State is the lead, therefore the evaluation in the FS Report will consider USEPA acceptance.

As indicated earlier in this section, many of the sub-criteria (particularly for the FS Report cost estimates) will require a conceptual design of some or all components of the process options to appropriately evaluate the subject alternative. This aspect of the FS evaluation is anticipated to be detail and time intensive considering the scale of the FS Area. For perspective, typical source areas associated with many OUs at Superfund sites may be limited to approximately 5 acres, and the distal groundwater plumes associated with these typical source areas often are less than a mile in length. The areal estimate of the contributing historical operations to the OU-1 source area (Unit 4 and 5, Former Beta Ditch, Former Ammonium Perchlorate [AP] Plant and Associated Facilities, Former Trade Effluent Ponds, Former Interceptor Well Field [IWF] Recharge Trenches) is 346 acres with impacts observed at depths greater than 120 feet bgs in some locations. The figures presented in the RI Report for OU-1 and OU-2 indicate that perchlorate, chlorate, hexavalent chromium, and chloroform contamination extends beyond the northern boundary of OU-2 (more than 2 miles offsite) covering more than 2,600 acres with impacts observed at depths greater than 120 feet bgs in the northern portion of OU-1 and also the southern portion of OU-2.

For typical FS evaluations, it is prudent to make approximations to estimate timeframes or cost estimates in the absence of site-specific demonstration data of a particular process option. Therefore, the USEPA's 1988 guidance document specifies the range of accuracy for cost estimates associated with FS evaluations to be approximately -30 percent to +50 percent for the detailed analysis of alternatives. In other words, the cost estimates are permitted to have some degree of uncertainty to them so as not to constrain the consideration at this point of the FS process and potentially prematurely eliminate a viable alternative from consideration.

For example, the acceptable accuracy of a $1,000,000 cost estimate could range from $700,000 to $1,500,000. Cost estimates for the detailed evaluation will be developed utilizing professional judgement, data from the costs incurred for all of NERTs investigative and study efforts to date, and industry cost estimating tools such as RSMeans. Given that NERT has already conducted eight treatability/pilot studies with two additional treatability studies anticipated to be completed in 2024, substantial work has already been completed to evaluate the performance of several applicable process options. The available data will greatly benefit the comparative analysis of those remedial alternatives including the process options for which treatability study data exists, and it will also increase the level of sophistication of the comparison making it more realistic, compelling, and complex. Typical Superfund sites may have one or two pilot-scale treatability studies to support an FS evaluation, but the number and extent of the treatability studies available to support the FS Report enables a far more detailed comparative analysis. The substantial treatability and pilot programs increase the certainty around the suitability and anticipated performance of remedial options to be evaluated. Pilot performance data will allow for a greater degree of confidence in estimating the size and cost of some remedial components, allowing for an increase in the overall quality of the cost estimate. An additional benefit of the pilot program conducted by NERT should translate into allowing for a focused pre-design investigation where the exact information to be collected will be informed by the laboratory and field testing programs. Further, the data set of treatability study results is still developing and will continue to grow through performance of the treatability studies being executed in parallel with this FS evaluation. Specifically, data acquired during the ongoing Unit 4 Source Area In-Situ Bioremediation and Las Vegas Wash ZVI-Enhanced Bioremediation Treatability Studies will need to be considered prior to finalizing the FS Report.

The assumed duration for each remedial alternative at this stage will be developed in the FS Report and will consider site-specific data. In developing the remedial timeframes, the following factors may be considered as appropriate:

a. Technology selected.
b. Mass and its distribution of COPCS in soil, groundwater, and hydrogeologic units.
c. Existing GWETS time series mass removal rate.
d. Groundwater age dating data and tracer study results (DRI, 2023).
e. Groundwater flow and transport model.
f. AWF Capture Zone and Matrix Diffusion Evaluation (Ramboll, 2021).
g. Other relevant site data or third-party case studies.

With respect to NERT's groundwater flow and transport model, much development effort has been put into this over the years. Through the FS evaluation, Arcadis will obtain the Phase 7 groundwater flow and transport model when completed and will utilize it to support development of remedial timeframes.

[1] A total of 10 treatability or pilot studies have been implemented in the field or are in process by NERT: Soil Flushing Treatability Study, Groundwater Bioremediation Treatability Study, Seep Well Field Area Bioremediation Treatability Study, In-Situ Chromium Treatability Study, AP Area Soil Flushing Treatability Study, Unit Building 4 Source Area In-situ Bioremediation Treatability Study, Vacuum Enhanced Recovery Treatability Study, Las Vegas Wash ZVI-Enhanced Bioremediation Treatability Study, Las Vegas Wash Bioremediation Pilot Study, and Hydrogen Gas Permeable Membrane Pilot Study. In addition, laboratory bench scale testing was completed associated with the In-Situ Bioelectrochemical Treatability Study although field implementation was not performed given the novel nature of the technology and engineering challenges associated with a full-scale implementation.

## 2.8 Comparative Analysis of Remedial Alternatives

The final section of the FS Report will be the comparative analysis of the developed remedial alternatives for the FS Area based on the nine evaluation criteria. This represents the third and final distinct feasibility evaluation of the FS process. The goal of the comparative analysis is to present all analysis and relevant information needed for remedial alternative selection for the Proposed Plan and the subsequent ROD. This distinct difference from a decision-making process is of critical importance as the remedial comparison analysis presents an exhaustive record of all information necessary to make the decision thereby eventually justifying the decision that will be included in the ROD. The level of effort of the comparative analysis is based upon the available site-specific data, the number and type of remedial alternatives being compared, and the degree to which the remedial alternatives were previously developed and evaluated. The comparative analysis of the remedial alternatives will consist of an assessment and summation of each remedial alternative against the evaluation criteria and a comparison of each remedial alternative against the relative performance with respect to the nine evaluation criteria. For purposes of the FS evaluation for OU-1 and OU- 2, the comparative analysis of remedial alternatives will be scored according to an established numerical ranking (1 being least favorable to 5 being most favorable). The weighting of each screening criteria will be considered, and development and justification of the weighting will be documented in the FS Report. After the comparative analysis of each of the nine evaluation criteria (i.e. each of the nine criteria being evaluated will be assigned a discrete ranking between 1 and 5 and weighting is applied), an evaluation of the resultant numerical ranking sums will indicate the preferred remedial alternative(s).

Just as the remedial alternatives will be evaluated according to the SFCs of each of the nine evaluation criteria, so will the comparative analysis closely follow these conditions. An abbreviated summation of the SFCs associated with the nine evaluation criteria is presented in **Figure 5**, but the exhaustive list of questions and considerations will closely follow USEPA's 1988 guidance. Given the scope of the FS Report for OU-1 and OU-2, the development of remedial alternative evaluations and comparative analyses according to these SFCs will be significant. Specifically, for the FS Report for OU-1 and OU-2, this degree of transparency and documentation with respect to the comparative analysis of the remedial alternatives is essential because it will serve as the rationale for the selection of the OU specific remedial alternatives to effectively accomplish the RAOs.

As discussed in the preceding section, the costs developed during the comparative analysis of the remedial alternatives stage of the FS process will be developed to a -30 percent to +50 percent level of accuracy as is typical for a CERCLA FS. The costs for each remedial alternative developed during the FS process will be detailed to provide the following information.

- Capital cost (Capex)
- Annual operation and maintenance (O&M) costs (Opex)
- Schedule and cost for periodic but non-annual events (Opex)
- Assumed duration of remedial activities and basis for assumption utilizing site-specific data
- Non-discounted and net present value (NPV) costs for each alternative

The quality of the cost estimates are especially important for the NERT project as the project is funded via a trust and therefore must accomplish the remedial objectives with a finite source of funding. Furthermore, as this FS Report only covers OU-1 and OU-2 and does not include OU-3, an acceptable cost for an OU-1 and OU-2 remedial program must allow sufficient remaining funding for OU-3 remediation. Based on the current remedial program schedule, the FS for OU-3 will begin before the FS Report for OU-1 and OU-2 is approved.

Furthermore, it is highly likely that the FS for OU-3, Revision 0 will be submitted 6 months before the Proposed Plan for OU-1 and OU-2 is finalized. Therefore, and as prudence would dictate, the Trust will holistically evaluate the total cost of remedy during the Proposed Plan process utilizing data from both FS Reports.

In addition, some of the remedial alternatives will address commingled plumes from two or more potentially responsible parties (PRPs) located within the BMI Complex and adjacent industrial properties. In cases where treatment of a commingled plume is evaluated, and as dictated by the NERT Trust Agreement, the portion of the cost for the remedy attributed to third-party contamination will need to be addressed. For the purpose of the FS Report, an assessment of the impacts of the non-NERT plume(s) on the total remedial alternative cost will be made and the costs of the remedial alternative associated with the non-NERT plume will be presented. The basis for dividing costs between the PRPs will be clearly stated. Examples of the type of cost-related impacts that commingled plumes could have include the use of additional treatment technologies, changes in the size of treatment equipment, changes in expected duration of remedial operations, and chemical or amendment consumption.

As the number of considered remedial alternatives increases, so does the extent and degree of the comparative analysis for each OU and impacted media. The identification of common elements of remedial alternatives, establishing GRAs, and calculating treatment quantities earlier in the FS Report is a critical component of the comparative analysis and may, in some ways, help simplify the degree of comparative analysis. However, the comparative analysis may require an iterative approach as previously unconsidered parameters arise as the comparative evaluation unfolds.

# 3 NERT Specific Considerations for the Feasibility Study

## 3.1 Consideration of Multiple Responsible Parties

NERT COPCs found within the FS Area commingled with COPCs attributable to other PRPs (Section 9.5 of the RI Report for OU-1 and OU-2; Ramboll, 2021) will be summarized and discussed in this section. The relevance of discussing COPC commingling within this FS Work Plan is that during the development of remedial alternatives, it will be necessary to identify and quantify those COPCs attributable to other PRPs. It may not be possible to completely isolate commingling COPCs. Therefore, this requires the FS Report to quantify costs associated with NERT's and other PRPs' commingling plumes to support cost sharing discussions with the appropriate PRP. The FS Report is the appropriate document to convey NERT's expectations with respect to cost and resource allocation such that NERT has sufficient funding for the selected remedial alternatives, and NERT's funds are spent consistent with the NERT Trust Agreement.

### 3.1.1 Olin, Stauffer, Syngenta, and Montrose Site

As presented in the NERT RI Report for OU-1 and OU-2, the property immediately to the west of OU-1 is referred to as the Olin, Stauffer, Syngenta, and Montrose (OSSM) site. Historical operations within the OSSM site are complex given that operations began in 1941/1942 and multiple companies manufactured an extensive range of chemicals over the last 80 years. A groundwater extraction and treatment system (OSSM GWETS) was installed by OSSM in 1983 within OU-1 and was designed to capture contaminants migrating offsite, north of the current OSSM site property boundary. Components of the OSSM GWETS, namely extraction wells, monitoring wells and recharge trench system are physically located within the northwestern corner of OU-1 partially on property owned by NERT. The treated groundwater associated with the OSSM

GWETS is reinjected immediately downgradient of these extraction wells, and the injection trenches are also located within OU-1. As such, a portion of OSSM's reinjection of water occurs within OU-1 and must be considered in evaluating containment remedial alternatives as this water will become trapped behind any containment barrier if constructed along the entirety of the OU-1 northern border. As reported in the RI Report for OU-1 and OU-2, there are two sources of long-term groundwater contamination resulting from OSSM's historical activities that have affected OU-1; historical dissolved groundwater contamination within OU-1 migrating into OU-2 and DNAPL which has and continues to migrate into OU-1. Resulting from the fact that each of the sources, while originating from the same property, is regulated by NDEP as two distinct matters and each is at a different stage in the remedial decision process, each source will be addressed separately in the NERT FS evaluation.

#### 3.1.1.1 OSSM Dissolved Plume Trespass

As detailed in the RI Report for OU-1 and OU-2, a dissolved phase contaminant plume originating at the OSSM site has migrated into OU-1. As further detailed in the RI Report for OU-1 and OU-2, particle tracking simulations conducted by NERT suggest that migration of the dissolved phase contaminant plume from the OSSM site into OU-1 has largely been mitigated due to the continued operation of the OSSM GWETS. However, residual OSSM site contaminants which migrated into OU-1 before operation of the OSSM GWETS remain within OU-1 and, along with the trespassing DNAPL (discussed below), represent the most significant source of VOCs within OU-1. Furthermore, the residual dissolved phase contaminant plume continues to migrate across OU-1 and Warm Springs Road into OU-2 without being captured by OSSM's GWETS or the NERT GWETS (within OU-1). The evaluation of the "OU-1 Groundwater (OSSM Dissolved Plume)" remedial alternative will identify options to: i) mitigate any remaining trespass of OSSM's dissolved phase contaminant plume not otherwise captured by the OSSM GWETS; and, ii) treat residual OSSM dissolved phase contaminants to the extent such treatment is required for NERT to achieve its RAO of plume containment and source control. Implementation of containment remedial action alternatives will result in the capture of OSSM's dissolved phase contaminant plume likely requiring VOC treatment not otherwise required to address NERT COPCs. This alternatives analysis will include the development of FS level costing representing the costs that would be necessary to address the OSSM contaminants as such costs are not the responsibility of NERT. It should be noted that an updated version of the OSSM Groundwater Remedial Alternative Study (RAS) is currently under NDEP review and, at NDEP's request, NERT recently provided feedback on a specific section of the RAS related to OSSM's dissolved phase contaminant plume as it affects the NERT site. Accordingly, the final version of the RAS which receives NDEP approval may affect the evaluation of the "OU-1 Groundwater (OSSM Dissolved Plume)" remedial alternative as presented above.

#### 3.1.1.2 OSSM DNAPL Trespass

Additionally, and as detailed in the RI Report for OU-1 and OU-2, DNAPL has also migrated onto OU-1 from the OSSM site that will pose a long-term threat to groundwater quality in OU-1. Similar to the dissolved phase contaminants discussed above, the DNAPL has historically migrated onto the NERT site but dissimilar to the dissolved phase contaminants discussed above, operation of the OSSM GWETS has not mitigated the ongoing trespass of the DNAPL. Therefore, as part of the FS Report, it will be necessary for NERT to develop a remedial alternative to address the DNAPL source area in OU-1 associated with the OSSM site. The evaluation of the "OU-1 Groundwater (OSSM DNAPL)" remedial alternative will identify options to: i) prevent the DNAPL from trespassing into OU-1; and, ii) remediate DNAPL to the extent such remediation required for NERT to achieve its RAO of plume containment and source control. This alternatives analysis will include the development of FS level costing representing the costs that would be necessary to remediate the DNAPL as such costs are not the responsibility of NERT. It should be noted that in August of 2023,

NDEP requested that OSSM submit a RAS for DNAPL both on and off-site of the OSSM site, and more specifically, that a proposed schedule for the DNAPL RAS be submitted to NDEP by November 1, 2023. While acknowledging the fact that the DNAPL is still migrating into OU-1 and that the DNAPL present in OU-1 represents an ongoing source to shallow groundwater in OU-1, OSSM's response to the NDEP request and subsequent submittal of the DNAPL RAS will greatly inform NERT's efforts related to the "OU-1 Groundwater (OSSM DNAPL)" remedial alternative.

### 3.1.2 TIMET Site

As presented in the NERT RI Report for OU-1 and OU-2, the property immediately to the east of OU-1 is referred to as the TIMET site. Based on the findings of the RI Report for OU-1 and OU-2, there is commingling of NERT's COPCs with TIMET COPCs on the TIMET site. As indicated in Section 9 of the RI Report for OU-1 and OU-2, COPCs originating from the Unit Buildings 4 and 5 source area are migrating onto the TIMET site at a depth interval of 90 to 130 feet bgs. The upward vertical gradient in this area has resulted in the presence of perchlorate, chlorate, hexavalent chromium, and chloroform in shallow groundwater on the TIMET site. However, there is also evidence that other sources of chloroform contamination in shallow groundwater exists within the TIMET site. NERT was directed by NDEP to construct an extension to the NERT GWETS, called the Treatment System Extension (TSE) to treat perchlorate, chlorate and hexavalent chromium from extracted groundwater beneath the TIMET site; however, as part of final remedy NERT will evaluate containment alternatives to prevent COPCs originating from the Unit Buildings 4 and 5 source area from migrating onto the TIMET site at a depth interval of 90 to 130 feet bgs. In 2014 TIMET completed installation of a barrier wall and groundwater extraction system at the northern property boundary. Prior to construction of the NERT and TIMET GWETS, COPCs freely migrated offsite from the TIMET site and NERT OU-1 into NERT OU-2. Within the area immediately west of Pabco Road in OU-2, COPCs that migrated northward from OU-1 and the TIMET site are also commingling. Similar to the trespassing OSSM plume and DNAPL on the western boundary of NERT OU-1, the presence of TIMET's COPCs result in commingling chloroform plumes within OU-2 and must be considered in the FS Report.

### 3.1.3 AMPAC

Although not located within the BMI Complex, AMPAC and PEPCON produced perchlorate at a plant located approximately 1.5 miles west of the BMI Complex. The former AMPAC facility was operated by AMPAC from 1982 to 1988 and the Pacific Engineering and Production Company of Nevada (PEPCON) from 1958 to 1982. The facility experienced a catastrophic explosion in 1988.

The perchlorate plume associated with the former AMPAC facility is generally located to the west of the NERT perchlorate plume. Perchlorate from the AMPAC plume also discharges to the Las Vegas Wash within OU-3 similar to the NERT plume although predominately in an area upstream of discharges associated with the NERT plume. Endeavour LLC (Endeavour) currently operates an FBR treatment system built by AMPAC that is designed to treat perchlorate in groundwater extracted from a series of 14 extraction wells located in two clusters approximately one mile west of OU-1 and approximately 1.5 miles north of OU-1 (Endeavour 2018). Within OU-2 the NERT and AMPAC perchlorate plumes begin to commingle near the Athens Road Well Field (AWF). In order to maintain capture of the COPCs migrating via groundwater from OU-1 using the existing GWETS, NERT must operate the AWF in a manner that also captures a portion of the AMPAC plume. The extracted groundwater is routed to OU-1 for treatment. Since perchlorate is common between the NERT and AMPAC plumes, the FS Report must document how much additional cost will be incurred to treat AMPAC's perchlorate within OU-2 to support future cost sharing discussions. While outside the scope of this FS

Report, the complex dynamics surrounding how the AMPAC and NERT perchlorate plumes further commingle in OU-3 and discharge into the Las Vegas Wash will be extensively discussed in NERT's RI Report for OU-3 and the FS Report for OU-3.

### 3.2 NERT Stakeholder Engagement

Arcadis has been advised by NERT that the Colorado River Authorities, a group of project stakeholders defined in the NERT Trust Agreement, hereafter referred to as the NERT Stakeholders, have requested that the Trust host various working sessions to provide the NERT Stakeholders a means to discuss, understand, and provide input to the FS decision making process. To facilitate this, NERT has developed plans to host two FS Roundtables with the NERT Stakeholders. The two FS Roundtable meetings will be planned to coincide with the Identification and Screening of Treatment Technologies (Section 4) and Comparative Analysis of Remedial Alternatives (Section 8) stages of the FS evaluation. From a timeline perspective, these FS Roundtable meetings will occur at approximately month 8 and 16, respectively, of a planned 18 month process. Relevant documentation will be distributed ahead of each roundtable to afford ample time for the Stakeholders to bring questions to and provide feedback during the roundtables. During these roundtables, NERT will discuss the justification for retaining and eliminating treatment technologies, how remedial action alternatives were assembled, and the proposed relative ranking of each remedial alternative.

# 4 Schedule

NERT estimates that the FS Report for OU-1 and OU-2 will be submitted to NDEP and USEPA approximately 18 months after approval of the FS Work Plan. However, adjustments to the schedule might be necessary to ensure sufficient data from the Unit 4 Source Area In-Situ Bioremediation and Las Vegas Wash ZVI-Enhanced Bioremediation Treatability Studies have been acquired to fully evaluate these remedial approaches in the FS Report. Furthermore, this schedule could also be affected by dialogue and/or feedback received from NDEP, EPA, or the NERT Stakeholders resulting from the planned Stakeholder FS Roundtables and future dialogue and/or correspondence received from NDEP or USEPA as well as details surrounding remedy discussions involving the OSSM site.

# 5 References

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