FINAL CORRECTIVE ACTION DECISION

Former Coastal Refinery Site
El Dorado, Kansas
C2-008-70243

Kansas Department of Health and Environment
Division of Environment
Bureau of Environmental Remediation
Curtis State Office Building
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Topeka, KS 66612

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# Table of Contents

1. **Purpose of the Final Corrective Action Decision** ................................................................. 1

2. **Facility Background** .................................................................................................................. 2
   2.1. Facility Location .......................................................................................................................... 2
   2.2. Facility History ............................................................................................................................ 3

3. **Comprehensive Investigation** ................................................................................................. 4
   3.1. Site Conditions ............................................................................................................................ 4
       3.1.1. Topography ........................................................................................................................... 4
       3.1.2. Soil ......................................................................................................................................... 5
       3.1.3. Geology .................................................................................................................................. 5
       3.1.4. Surface Water ....................................................................................................................... 5
       3.1.5. Hydrogeology ...................................................................................................................... 6
   3.2. Summary of Comprehensive Investigation Results .................................................................. 6
       3.2.1. General Findings .................................................................................................................. 6

4. **Source Abatement and Interim Remedial Measure Implementation** ................................. 7
   4.1. Main Process Area Demolition, Grading, and Landfarming .................................................... 8
   4.2. Storm Water Basin ..................................................................................................................... 8
   4.3. Interceptor Trenches .................................................................................................................. 9
   4.4. Groundwater Treatment System .............................................................................................. 10
   4.5. Asphalt handling area excavation ........................................................................................... 11
   4.6. Pond(s) Stabilization, Capping, and Closure ......................................................................... 12

5. **Site Risks** .................................................................................................................................. 12
   5.1. Baseline Ecological Risk Assessment Conclusions ................................................................. 13
   5.2. Human Health Risk Assessment Conclusions ....................................................................... 13

6. **Remedial Action Objectives** .................................................................................................... 14
   6.1. Cleanup Levels .......................................................................................................................... 15

7. **Summary of Remedial Action Alternatives Evaluated** ....................................................... 15
   7.1. Main Process Area Alternatives .............................................................................................. 16
       7.1.1. Interceptor Trenches and Phytoremediation – Alternative 2 ............................................... 16
       7.1.2. Seep Interceptor Trench and Excavation – Alternative 3 ..................................................... 16
   7.2. Asphalt Handling Area Alternatives ....................................................................................... 17
       7.2.1. Main Process Area Spring and Basin Interceptor Trench – Alternative 2 ..................... 17
7.2.2. Additional Interceptor Trenches – Alternative 3 ............................................. 18
7.3. Tank Farm Alternatives ....................................................................................... 18
7.3.1. Excavation and Containment – Alternative 2.................................................. 18
7.3.2. Excavation, Containment, and Multi-Phase Extraction – Alternative 3 ......... 19
7.4. Stormwater Pond Area Alternatives................................................................. 20
7.4.1. Seep Interceptor Trench and Cap Maintenance – Alternative 2 ................. 20
7.4.2. Seep Interceptor Trench, Cap Maintenance, and MPE – Alternative 3 ....... 20

8. DESCRIPTION OF THE PREFERRED REMEDY ..................................................... 21
8.1. Elements of the Preferred Remedy .................................................................... 21

9. COMMUNITY INVOLVEMENT .............................................................................. 24

10. DOCUMENTATION OF SIGNIFICANT CHANGES .............................................. 25

11. RESPONSE TO COMMENTS SUMMARY ........................................................... 25

TABLES ...................................................................................................................... 27
   Table 3-1 – Maximum Soil Analytical Results Summary ........................................ 28
   Table 3-2 – Maximum Groundwater Analytical Results Summary ...................... 29
   Table 3-3 – Surface Water Analytical Results Summary ...................................... 30
   Table 8-1 – Summary of the Preferred Alternative .............................................. 31
   Table 8-2 – Estimated Cost of the Preferred Alternative ...................................... 31

FIGURES ..................................................................................................................... 32
   Figure 3-1 – Potentiometric Surface Map, November 2015 ................................. 33
   Figure 3-2 – Site-Wide Benzene Concentrations in Groundwater, November 2015 .................................................................................................................. 34
   Figure 3-3 – Site-Wide MTBE Concentrations in Groundwater, November 2015 .. 35
   Figure 3-4 – Site-Wide TPH-GRO Concentrations in Groundwater, November 2015 .................................................................................................................. 36
   Figure 3-5 – Site-Wide TPH-DRO Concentrations in Groundwater, November 2015 .................................................................................................................. 37
   Figure 3-6 – Site-Wide LNAPL Isopach Map, November 2015 ............................. 38
   Figure 8-1 – Preferred Alternative for EUC Component ......................................... 39
   Figure 8-2 – Existing and Preferred Alternative Interceptor Trenches .................. 40
   Figure 8-3 – Preferred Alternative for Main Process Area Soil ............................. 41
   Figure 8-4 – Preferred Alternative for Tank Farm Groundwater .......................... 42
Figure 8-5 – Preferred and Contingency Alternative for Tank Farm Waste and Soil

Figure 8-6 – Contingency Alternative for Tank Farm Groundwater and Surface Water
**ACRONYMS AND ABBREVIATIONS USED IN THIS DOCUMENT**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
<th>Unit</th>
<th>Definition</th>
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<tbody>
<tr>
<td>AHA</td>
<td>Asphalt Handling Area</td>
<td>mg/kg</td>
<td>Milligrams per kilogram</td>
</tr>
<tr>
<td>ARARs</td>
<td>Applicable or Relevant and Appropriate Requirements</td>
<td>MNA</td>
<td>Monitored Natural Attenuation</td>
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<td>bcy</td>
<td>Bank cubic yard</td>
<td>MPA</td>
<td>Main Process Area</td>
</tr>
<tr>
<td>CAD</td>
<td>Corrective Action Decision</td>
<td>MPE</td>
<td>Multi-phase Extraction</td>
</tr>
<tr>
<td>CAS</td>
<td>Corrective Action Study</td>
<td>MTBE</td>
<td>Methyl Tertiary-Butyl Ether</td>
</tr>
<tr>
<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation, and Liability Act</td>
<td>NGVD</td>
<td>National Geodetic Vertical Datum</td>
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<td>CI</td>
<td>Comprehensive Investigation</td>
<td>NSZD</td>
<td>Natural Source Zone Depletion</td>
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<tr>
<td>COC</td>
<td>Contaminant of Concern</td>
<td>O&amp;M</td>
<td>Operations and Maintenance</td>
</tr>
<tr>
<td>cy</td>
<td>Cubic yards</td>
<td>RAO</td>
<td>Remedial Action Objective</td>
</tr>
<tr>
<td>DRO</td>
<td>Diesel Range Organics</td>
<td>RBSL</td>
<td>Risk Based Screening Levels</td>
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<td>EPA</td>
<td>United States Environmental Protection Agency</td>
<td>RSK</td>
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<td>EUC</td>
<td>Environmental Use Control</td>
<td>SPA</td>
<td>Storm water Pond Area</td>
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<tr>
<td>GRO</td>
<td>Gasoline Range Organics</td>
<td>STF</td>
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<td>GTS</td>
<td>Groundwater Treatment System</td>
<td>SWMP</td>
<td>Soil-Waste Management Plan</td>
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<td>Human Health Risk Assessment</td>
<td>TPH</td>
<td>Total Petroleum Hydrocarbons</td>
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<td>IRM</td>
<td>Interim Remedial Measures</td>
<td>VOC</td>
<td>Volatile Organic Compound</td>
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<tr>
<td>IT</td>
<td>Interceptor Trench</td>
<td>WBWR</td>
<td>West Branch Walnut River</td>
</tr>
<tr>
<td>KDHE</td>
<td>Kansas Department of Health and Environment</td>
<td>µg/L</td>
<td>Micrograms per Liter</td>
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<tr>
<td>LNAPL</td>
<td>Light Non-Aqueous Phase Liquid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTM</td>
<td>Long-term Monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCL</td>
<td>Maximum Contaminant Level</td>
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-5-
Glossary

Administrative Record – The body of documents that form the basis for selection of a particular response at a site. Parts of the AR are available in an information repository near the site to permit interested individuals to review the documents and to allow meaningful participation in the remedy selection process.

Air Sparging – The process of forcing air through polluted water, typically through wells, to remove harmful chemicals. The air causes the chemicals to change from a liquid to a gas. The gas is collected and treated if necessary.

Aquifer – An underground layer of rock, sand, or gravel capable of storing water within cracks and pore spaces or between grains. When water contained within an aquifer is of sufficient quantity and quality, it can be used for drinking or other purposes. The water contained in the aquifer is called groundwater.

Applicable or Relevant and Appropriate Requirements (ARARs) – The federal and state environmental laws that a remedy will meet. These requirements may vary among sites and alternatives.

Bank Cubic Yard (bcy) – The volume measurement of one cubic yard of earth or rock in its natural state before it is excavated or removed from the ground.

Capital Costs – Expenses associated with the initial construction of a project.

Comprehensive Investigation (CI) – A study of the source, nature and extent of contamination.

Corrective Action Decision – The decision document in which KDHE selects the remedy and explains the basis for selection for a site.

Corrective Action Study (CAS) – A study conducted to evaluate alternatives for clean-up of contamination.

Environmental Use Control (EUC) – An Administrative or legal control intended to restrict or prohibit human activities and property use in such a way as to prevent or reduce human exposure to contamination.

Exposure – Contact made between a chemical, physical, or biological agent and the outer boundary of an organism. Exposure is quantified as the amount of an agent available at the exchange boundaries of the organism (e.g., skin, lungs, gut).
Groundwater – Underground water that fills pores in soils or openings in rocks to the point of saturation. Groundwater is often used as a source of drinking water via municipal or domestic wells.

Hydraulic Containment – Use of pump and treat groundwater remediation systems to hydraulically control the movement of contaminated groundwater in order to prevent continued expansion of the contamination zone.

Light Non-aqueous Phase Liquid (LNAPL) – A light non-aqueous phase liquid or solution composed of one or more organic compounds having specific gravity less than one that are immiscible or sparingly soluble in water and encompasses all potential occurrences.

Maximum Contaminant Levels (MCLs) – The maximum permissible level of a contaminant in water that is delivered to any user of a public water system.

Monitoring – Ongoing collection of information about the environment that helps gauge the effectiveness of a cleanup action. For example, monitoring wells drilled to different depths at the Site would be used to detect any migration of the plume.

Monitored Natural Attenuation – Allowing natural processes to remediate pollution in soil and groundwater while site conditions are routinely monitored.

National Oil and Hazardous Substances Pollution Contingency Plan – The federal regulations that guide the Superfund program. These regulations can be found at 40 Code of Federal Regulations, Part 300.

National Pollution Discharge Elimination System – As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches.

Natural Source Zone Depletion (NSZD) – A combination of processes that reduce the mass of LNAPL in the subsurface. Primary processes include sorption, volatilization, dissolution, and biodegradation.

Operations and Maintenance (O&M) – Activities conducted at a site after the construction phase to ensure that the cleanup continues to be effective.

Plume – A body of contaminated groundwater flowing from a specific source.
**Remedial Action Objectives** – Media specific goals for protecting human health and the environment from contaminants of concern.

**Risk** – The probability of adverse health effects resulting from exposure to an environmental agent or mixture of agents.

**Superfund** – Federal authority established by CERCLA, to respond directly to releases or threatened releases of hazardous substances that may endanger health or welfare. Also, the common name given by the press for CERCLA because the program was well funded in the beginning.

**Tier 2 Level** – Calculated risk-based cleanup value for a specific contaminant. These values can be found in Appendix A of the *Risk-Based Standards for Kansas (RSK) Manual*.

**Threshold** – The dose or exposure below which no harmful effect is expected to occur.

**Toxicity** – A measure of degree to which a substance is harmful to human and animal life.

**Vapor Intrusion** – The migration of contaminants from the subsurface into overlying and/or adjacent buildings.

**Volatile Organic Compounds (VOCs)** – Carbon compounds, such as solvents, which readily volatilize at room temperature and atmospheric pressure. Most are not readily dissolved in water, but their solubility is above health-based standards for potable use. Some VOCs can cause cancer.
1. **PURPOSE OF THE FINAL CORRECTIVE ACTION DECISION**

The primary purposes of the final Corrective Action Decision (CAD) for the Former Coastal Refinery site are to: 1) summarize information from the key site documents including the Comprehensive Investigation (CI) Reports\(^1\),\(^2\),\(^3\) and Corrective Action Study\(^4\) (CAS); 2) briefly describe the alternatives for remediation; 3) identify and describe the Kansas Department of Health and Environment’s (KDHE’s) preferred remedy for addressing contamination at the site; and 4) document comments and KDHE’s responses to the public comments received on the draft CAD.

KDHE has selected a final remedy for the site after reviewing and considering all information submitted during the 30-day public comment period. The public was encouraged to review and comment on the preferred remedy presented in the draft CAD. The public had the opportunity to submit written comments to KDHE during the public comment period held from July 12, 2016 through August 10, 2016. Section 11 reflects the comments received during the public comment period and KDHE’s responses.

Extensive investigation activities and remedial tasks have been performed on behalf of El Paso Merchant Energy-Petroleum Company (El Paso Merchant) in general accord with the February 20, 2003, Consent Order between El Paso Merchant and KDHE. The public was encouraged to review and comment on the technical information presented in the various CI reports, CAS report, and other documents contained in the Administrative Record file\(^5\). The

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\(^5\) Administrative Record File #C2-008-70243
Administrative Record file includes all pertinent documents and site information that form the basis and rationale for selecting the final remedy. The Administrative Record file was made available for public review during normal business hours at the KDHE location shown in Highlight 1-1. Also, for convenience to interested members of the public, copies of the various CI and CAS reports, as well as the draft CAD, were also available for review and copying during normal business hours at the local information repository located at the Bradford Memorial Library in El Dorado, Kansas.

2. FACILITY BACKGROUND

2.1. Facility Location

The facility is located at 1835 North Topeka Street on the northern outskirts of the City of El Dorado, Kansas, in portions of Sections 26, 27, 34, and 35, Township 25 South, Range 5 East, Butler County, Kansas, as depicted to the right. The site encompasses approximately 420 acres. Refinery operations were conducted in multiple subareas, depicted and described below:

- **Main Process Area (a.k.a. MPA)** is the former processing area for the refinery, approximately 45 acres in size.

- **South Tank Farm (Tank Farm)** is the former refinery aboveground storage tank farm located south of the MPA, encompassing approximately 260 acres. The Tank Farm area also includes an 11 acre parcel located east of North Topeka Street and south of the MPA that currently houses the field office.

- **Asphalt Handling Area (AHA)** is vacant property west of the MPA, formerly used to manage and stabilize asphalt and other solid and liquid materials generated during refinery operations. It is approximately 50 acres in size.

- **Storm water Pond Area (SPA)** refers to the former refinery waste water/storm water treatment pond area east of the MPA, approximately 45 acres in size. This area formerly contained multiple ponds used for refining operations and waste water handling.
The facility is bounded to the north and west by vacant pasture land, and bounded to the south by residential and commercial properties. The West Branch of the Walnut River (Walnut River) defines the northeastern facility boundary. Other portions of the facility are bounded by a railroad corridor, North Topeka Street, and residential properties. The Pester Refinery Superfund Site, which is located north of the SPA and east of the MPA, is not part of the facility.

2.2. Facility History

Petroleum refining began as early as 1917, when the refinery was constructed by Pester Refining Company (Pester). Petro Atlas purchased the refinery in 1958, and within six months sold the refinery to American Petrofina Oil and Chemical Company (Fina). Fina owned the refinery and surrounding property between 1958 and 1977. In 1977 Pester purchased the property from Fina and continued to operate the refinery until filing Chapter 11 bankruptcy on February 25, 1985. The crude unit and most of the other operational units at the refinery were shut down in March 1985.

On April 10, 1986, Coastal Refining & Marketing, Inc., (Coastal) purchased the facility from Pester, except for the tract of land currently known as the Pester Refinery Superfund Site and continued refinery operations. At that time, the refinery produced regular and unleaded gasoline, #2 fuel oil, #6 fuel oil, propane, and asphalt.

Refining operations were discontinued in 1993; however, asphalt blending and terminal operations continued until 2004. In January 2001 Coastal and El Paso Corporation merged, and the facility owner name changed to El Paso Merchant Energy-Petroleum Company (El Paso Merchant). Various stages of decommissioning and demolition of the refinery structures was completed between 2004 and 2010.

In 2003 KDHE and El Paso Merchant entered into a Consent Order for a Comprehensive Investigation (CI) and Corrective Action Study (CAS). The Consent Order\(^6\) outlined the requirements for investigating and evaluating cleanup alternatives.

\(^6\) Consent Order #03-E-0021, dated February 20, 2003.
3. **COMPREHENSIVE INVESTIGATION**

CI activities were performed in three phases beginning in 2003 and ending in 2009. Primary objectives included:

- Identifying and characterizing all potential source areas, including all contaminants of concern (COCs), determining the mechanisms of release, estimating the quantities of release, and determining whether these releases are ongoing or stable;
- Delineating and characterizing the vertical and horizontal extent of contamination (including migration) for each of the impacted environmental media in order to develop and evaluate remedial alternatives;
- Characterizing the environmental setting including local and regional geology, hydrogeology, and hydrology, particularly as those site physical characteristics could affect contaminant fate and transport mechanisms, or may affect the evaluation, selection and design of remedial alternatives;
- Characterizing the physiochemical properties of contaminants, their mobility and persistence in the environment, and fate and transport mechanisms as they relate to the site’s physical characteristics; and,
- Identifying any human and environmental receptors that may be threatened or affected by contamination from the site.

Risk assessment activities were performed as part of the CI from 2008 through 2012. The assessments include a Baseline Ecological Risk Assessment for the MPA and AHA\(^7\), a Baseline Ecological Risk Assessment for the Walnut River and Tank Farm\(^8\), a focused Site-specific Risk Assessment for a 40-acre tract in the Tank Farm area\(^9\), and a Site-Wide Human Health Risk Assessment (HHRA)\(^10\). The AHA Pit, lead impacted soils in the MPA, and SPA were not evaluated as part of the HHRA due to interim remedial measures (IRMs) conducted for these areas. A detailed summary of the findings and conclusions of the risk assessment activities is provided in the CAS report contained within the Administrative Record, and also briefly discussed further in Section 5.

### 3.1. Site Conditions

#### 3.1.1. Topography

The site is located in the Flint Hills Uplands physiographic province. The Flint Hills Uplands are characterized by rolling hills and rocky soil. Surface elevations range from approximately 1,339

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feet National Geodetic Vertical Datum (NGVD) to 1,287 feet NGVD. The overall site topography slopes from west to east, towards the Walnut River. Local variations include the Tank Farm where topography slopes towards an intermittent/perennial stream known as the South Tank Farm Creek (Tank Farm Creek).

3.1.2. Soil

Soils in the vicinity are comprised of valley sediments, which consist primarily of clay, silt, sand, and gravel, in which poorly developed paleo-soils are present a few feet below the modern surface. Sediments deposited along the Walnut River and its tributaries consist mainly of locally derived material, including pebbles of limestone and chert.

Alluvium and weathered bedrock from the surface to the top of bedrock are described in boring logs as predominantly silty clay with a thickness ranging from approximately 0 to 26 feet. Weathered bedrock is typically comprised of limestone fragments and/or clay.

3.1.3. Geology

The site is underlain by Lower Permian Age bedrock units of the Chase Group, which are comprised of layers of limestone, cherty limestone, dolomitic limestone, dolomite, and shale as shown on the general geologic cross-section in Highlight 3-1. The uplands around El Dorado consist of the Doyle Shale Formation and the Barnestone Limestone Formation. The Towanda Limestone and Holmesville Shale Members of the Doyle Shale Formation outcrop in the vicinity. Underlying the Doyle Shale Formation is the Barnestone Limestone Formation, which is comprised of the Fort Riley Limestone, Oketo Shale, and the Florence Limestone Members. Underlying the Barnestone Limestone Formation is the Blue Springs Shale Member of the Matfield Shale Formation. Depth to bedrock varies considerably across the site with bedrock units outcropping at the surface in various locations, and in other areas bedrock is encountered more than 20 feet below grade.

3.1.4. Surface Water

The Walnut River abuts the northeastern portion of the site. The river bed is composed of silt, sand, and gravel overlying bedrock, with an average bank height about 15 feet. The Tank Farm...
Creek flows into the Walnut River approximately 1,800 feet east of the Tank Farm. Two groundwater springs are present at the site, one associated with the asphalt handling area and the other within the Main Process Area.

The City of El Dorado currently obtains its public water supply from the El Dorado Reservoir, an 8,400-acre lake located approximately 1.5 miles east of the site.

### 3.1.5. Hydrogeology

Groundwater occurs under both confined and unconfined conditions as follows:

- **Alluvial**: An unconfined shallow groundwater-bearing zone encountered within alluvium, weathered/fractured Doyle Shale and the Fort Riley Limestone Member. The most transmissive groundwater-bearing zone is the highly fractured and weathered portions of the upper Fort Riley Limestone member.

- **Bedrock**: A confined to semi-confined groundwater-bearing zone is encountered within fractures at the base of the Fort Riley Limestone Member. A confined groundwater-bearing zone is also encountered within the deeper Florence Limestone Member.

Site investigations have found that where groundwater occurs in the shallow alluvium/weathered bedrock system, groundwater flow direction is predominantly easterly. However, local variations and influences exist as depicted on Figure 3-1.

### 3.2. Summary of Comprehensive Investigation Results

Numerous investigations, summarized in this section, have contributed to a site conceptual model for each main subarea. These models describe the nature and extent of sorbed-phase (soil), dissolved-phase (groundwater), and light non-aqueous phase liquid (LNAPL), as controlled by the local hydrogeology. For a more comprehensive data summary, refer to the CAS Report and investigation reports in the Administrative Record File.

#### 3.2.1. General Findings

COCs are primarily petroleum-related and include: benzene, naphthalene, total petroleum hydrocarbons (TPH), and select VOCs. Isolated metals (lead and arsenic) are also present, as well as methyl tert-butyl ether (MTBE) related to former activities at the site.

**Soil**: Petroleum impacted soil has been detected above the KDHE Tier 2 Non-Residential Risk-Based Screening Levels\(^{11}\) (RSK) in multiple locations within the site. The CI also identified metal impacts in soil above background levels; however, only lead and arsenic exceeded the regulatory threshold. Table 3-1 summarizes the maximum concentrations for select COCs in soil with comparisons to applicable screening standards.


-6-
**Groundwater:** Investigation activities found groundwater contaminated with petroleum-related compounds, VOCs, and metals above screening levels. Groundwater impacts are largely confined to the shallow system. The groundwater plume has migrated off the facility. Table 3-2 summarizes the maximum concentrations and current concentrations for select COCs in groundwater with comparisons to KDHE’s respective RSK Tier 2 Levels. Figures 3-2, 3-3, 3-4, and 3-5 show current contaminant plumes for benzene, MTBE, TPH-GRO, and TPH-DRO, and Figure 3-6 shows current measurements of apparent LNAPL thickness. Site investigation findings and site conceptual model details for main site subareas are discussed below.

**Wastes:** Waste-like materials in the form of asphalt, tank bottoms, sludge, etc. have been encountered in isolated areas within the facility. A majority of the waste materials have been addressed through IRM activities.

**Surface Water/Sediment:** Surface water samples have historically been collected from the Walnut River and Tank Farm Creek. Site related COCs have not been detected above respective Surface Water Quality standards at the time of sampling. Table 3-3 summarizes the surface water sampling results from select locations with comparisons to current Kansas Surface Water Quality standards. Sediment samples were compared to their respective threshold effect concentration and were below their respective background or screening level for all COCs.

**Vapor:** A portion of the groundwater plume is present beneath a house owned by El Paso Merchant located at 1800 North Topeka Street. To assess any potential vapor impacts to the residence, a vapor sampling port was installed in the basement. Concentrations for all VOCs analyzed indicate that the vapor pathway does not present an unacceptable risk under current conditions. The Sub-slab Vapor Investigation Report contains more information.

4. **Source Abatement and Interim Remedial Measure Implementation**

IRMs are actions or activities taken to quickly prevent, mitigate, or remedy unacceptable risk(s) posed to human health and/or the environment by an actual or potential release of a hazardous substance, pollutant, or contaminant. IRMs have facilitated closure of the site’s waste water treatment ponds and addressed impacted groundwater and soil. The following sections have a summary of the primary IRMs conducted to date. The Interim Measures Construction Completion Report describes IRMs conducted between 2010 and 2012. IRMs conducted to date have cost approximately $20,590,000.

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4.1 Main Process Area Demolition, Grading, and Landfarming

Demolition and GrADING: Demolition activities occurred in phases between 2004 through 2011 and included removal of all above-grade process equipment, piping, and above ground storage tanks; removing or properly abandoning remaining structures, underground storage tanks, and processing concrete and building debris, concrete crushing, and disposing of asphalt impacted materials at a KDHE-approved disposal facility. Approximately 13,650 cubic yards (cy) of concrete was crushed and re-used.

Grading activities established final grades for storm water management and to encourage runoff. Grading created terraces, channels, and a basin (discussed in Section 4.2) for sediment control and pollution prevention and to enhance long-term soil stability. The grading also provided a suitable base for landfarming petroleum-impacted soils. Main Process Area demolition and grading activities cost approximately $8,800,000.

Consolidation/Capping: To minimize the risk of spreading lead-impacted soils during grading activities, approximately 3,000 cy of soils from several areas in the northern portion of the Main Process Area were excavated and consolidated with other lead-impacted soil. The consolidated soils were then capped with clean soils. These activities cost approximately $150,000.

Landfarming: Landfarming activities between 2010 and 2012 included working impacted (approximately 28,632 cy) soil from various construction activities in lifts, with each landfarm cell disked until petroleum hydrocarbon concentrations were below applicable screening levels. In November 2012 KDHE – Bureau of Waste Management approved landfarm closure, and the landfarm was reseeded. Landfarming IRM activities cost approximately $180,000.

All Main Process Area soil management, demolition and grading, and landfarming activities cost approximately $9,130,000.

4.2 Storm Water Basin

Storm Water Basin: An approximately 800 feet by 150 feet basin was intentionally installed in the Main Process Area in a location of LNAPL impacts so soils could be removed and effectively remediated. The basin can store approximately 4.6 million gallons of water and is lined with an impermeable membrane to separate the water from the underlying groundwater. The water can also serve to provide beneficial future uses including but not limited to supplemental water to fill or maintain wetland water levels. An
approximate 1,900 foot long drainage partially rip rapped channel (aka, Main Process Area Channel) was constructed to convey surface water runoff to the basin.

### 4.3. Interceptor Trenches

Interceptor Trenches are a series of linear and vertical channels whereby soil was excavated and replaced with a highly permeable material, which allow groundwater to be collectively controlled through pumping.

- **Seep Interceptor Trench:** The first IRM constructed, a 1,650-foot Seep Interceptor Trench (Seep IT) located between the eastern waste water/storm water ponds and the Walnut River, is shown on the right. The Seep IT began operation in December 2006 and continues operating. The Seep IT captures impacted groundwater and LNAPL and prevents seepage into the Walnut River. The trench is constructed down to the weathered bedrock, and contains three extraction sumps. Extracted groundwater is treated through a wetlands-based treatment system. More than 70,000,000 gallons of water have been recovered and treated to date. Installation, operation, and maintenance of the Seep IT IRM has cost approximately $1,600,000.

- **Storm Water Basin Interceptor Trench:** Constructed directly beneath the Basin, this trench captures impacted groundwater and LNAPL in a primary source area. The trench extends beneath the ground through upper weathered bedrock to solid bedrock, and contains a perforated pipe and gravel backfill. Impacted groundwater and LNAPL gravity flow south through it until they enter an extraction sump and are pumped to the treatment system discussed in Section 4.4.

- **Channel Interceptor Trench:** Constructed directly beneath approximately 1,700 feet of the southern end of the Main Process Area Channel, it captures impacted perched groundwater and LNAPL north of the Basin. The Channel IT extends down to competent bedrock, and
contains a perforated pipe, gravel backfill, and an impermeable membrane cover. Impacted groundwater and LNAPL in the Channel IT gravity flow to the Storm Water Basin IT discussed above, then to an extraction sump and are pumped to the treatment system discussed in Section 4.4.

The IRM activities associated with the Storm Water Basin (Section 4.2), Storm Water Basin IT, and Channel IT cost approximately $750,000.

- **Main Process Area SpringInterceptor Trench:** A spring is located in the central portion of the Main Process Area. The spring is seasonally present and very responsive to storm events, increasing within hours of moderate rainfall due to the shallow soil and near-surface weathered rock to the west believed to be the source of water. Water from the spring was historically impacted by viscous residual asphaltic tar material. In response, a mitigation system was installed in 2012, as shown on the right to control the tar and prevent contaminated water from flowing into the site. Two trench laterals direct groundwater into a central groundwater sump, where the oil and water naturally separate, and then the water gravity flows through pipes to the MPA Storm Water Channel and the Storm Water Basin. In 2014, the system was modified to include a tar removal system, with an underground oil water separator and polishing filter media (e.g., granular activated carbon). This IRM cost approximately $360,000.

### 4.4. Groundwater Treatment System

A groundwater treatment system captures and treats all groundwater and subsequent LNAPL from the basin and interceptor trenches as shown on the right. Water is initially pretreated through a 2,000-gallon oil water separator (for the LNAPL), followed by a cascade aerator, and finally an 80,000-gallon capacity mineral precipitation and settling basin. This system came online in 2011. After being pretreated, the water flows through the wetlands system Stage 1, a vertical flow anaerobic wetlands system, approximately 1.2 acres in size. Effluent from Stage 1 enters Stage 2, approximately 2.2 acres in size, which is a lateral aerated/aerobic
wetlands to treat petroleum hydrocarbons. Water from Stage 2 then flows into Stage 3, approximately 2 acres in size, constructed as contingency non-aerated wetlands system to provide additional reserve treatment capacity. Water then discharges into the Walnut River through a National Pollutant Discharge Elimination System Outfall. Highlight 4-1 provides a schematic of the system. The Wetlands-based Groundwater Treatment System IRM cost approximately $2,200,000.

**4.5. Asphalt handling area excavation**

The asphalt handling area, which was formerly used to manage materials generated during refining operations was excavated in 2012. All petroleum-impacted materials that could be excavated (approximately 14,350 cy), other piles (approximately 15,000 cy), and asphalt-impacted soil discovered during the 2010 Main Process Area grading activities (approximately 700 cy) were transported and consolidated with other waste materials into the West Pond as described below in Section 4.6. The excavated area was back-filled, restored to grade, and seeded. Vegetation is well established and provides suitable surface stabilization. These IRM removal activities cost approximately $950,000.
4.6. Pond(s) Stabilization, Capping, and Closure

- **Former East Ponds (current Wetlands):** Clean closure of the East Ponds involved removing and consolidating all petroleum-impacted sediment (approximately 12,400 cy) in the West Pond for stabilization and capping. The East Ponds were then converted into a wetlands-based groundwater treatment system consisting of the three treatment stages discussed above (Section 4.4).

- **West Pond (current cap):** Full-scale stabilization of sediments/waste in the West Pond began in March 2012 and ended on June 29, 2012. Sediments and waste material from multiple site areas were transported and consolidated in the former West Oxidation Pond as shown to the right, including: 700 cy of asphaltic impacted soil from the Main Process Area; 5,300 cy of sediment from the former Marley and Spray Ponds; sediment and sludge from the Primary Pond; 12,400 cy of sediment from the East Ponds; 14,350 cy of stabilized AHA Pit material; and 15,000 cy of AHA Pile material (asphalt/soil), placed on top of previously stabilized pond sediments, and used as fill and to shape the slope of the subgrade. Grids ensured proper mixing ratios of sediment with blast furnace slag and Portland cement, resulting in approximately 55,000 cy of stabilized sediment/waste. Capping involved grading the surface to prevent ponding, then adding a 2-foot thick clay cover and six inches of organic soil mixed with cow manure to reduce infiltration and support vegetation. The cap was completed on October 24, 2012, and seeded with an approved KDOT seed mix on November 9, 2012. The West Pond Waste Stabilization and Capping IRM cost approximately $5,600,000.

- **Primary Pond (current cap):** The Primary Pond was also clean closed, filled with rubble and concrete fines, and capped at this time.

5. Site Risks

COCs for the Site are former refinery contaminants that generally include both petroleum products (VOCs and TPH) and select metals (arsenic and lead) in soil and groundwater, and VOCs in indoor air. COCs detected during the investigation phases were compared to their respective concentrations in the Tier 2 Risk-Based Summary Table in Appendix A of the KDHE RSK Manual.
to determine if the chemical- and media-specific concentrations are protective of human health and the environment. Additionally, a series of site-specific risk assessments (Ecological and Human Health) between 2008 and 2012 characterized the risk posed to human health and the environment.

5.1. Baseline Ecological Risk Assessment Conclusions

The Baseline Ecological Risk Assessment evaluated ecological risk factors, such as risk to invertivorous (insect-eating) mammals from surface soil contamination, and risk to macroinvertebrates (aquatic worms, insects, and crustaceans) in the Tank Farm Creek area from sediment contamination. The assessment identified no significant risks to ecological receptors in sediment or surface water. Soil consolidation and covering through the IRM reduced risk levels to invertivorous mammals from low to below levels of concern. Concentrations of benzene and xylene in sediments posed potential risks to macroinvertebrates in a localized area of the Tank Farm Creek. These contaminants likely came from impacted groundwater flowing into the creek. There were no significant risks to ecological receptors such as aquatic and terrestrial birds and mammals, or aquatic life exposed to surface water.

The Screening Level Ecological Risk Assessment indicated no significant risks to plants and invertebrates in the Tank Farm, and that risks associated with cumulative multi-site exposures over the other areas was low.

5.2. Human Health Risk Assessment Conclusions

For an exposure pathway to be complete, it must include four basic elements: a source, release mechanism from the source to media, transport through media to a receptor, and a point of exposure with a receptor. The contaminants identified in the investigation are transported through the environment via various mechanisms (e.g., advection, diffusion, dispersion, attenuation). Potential exposure pathways evaluated at the site included ingestion of soil/sediment, groundwater, or particulate dust; inhalation of vapors either indoors or outdoors from volatile contaminants in soil/sediment or groundwater; or dermal contact with contaminated soil or groundwater. Potential receptors evaluated included full-time/part time indoor/outdoor workers, excavation workers, trespassers, and hypothetical future residents.

From a toxicity standpoint, the COCs contain properties indicating that they are both carcinogens and present other potential adverse health effects with exposure. COCs that are carcinogens are often the driver for risk. In the event that a site specific risk assessment is performed, the acceptable range lies within $1 \times 10^{-4}$ (1 in 10,000) to $1 \times 10^{-6}$ (1 in 1,000,000). The risk-based screening levels adopted as the remedial action objectives fall within this risk range and are further identified in Section 6 below.

Soil: The soil pathway level addresses the impact to human health via ingestion of contaminated soil, inhalation of fugitive emissions or dusts, and dermal contact with contaminated soil. Results of the risk assessment indicated risks associated with surface soil and sediment fell within this acceptable range, indicating that there is no unacceptable human health or environmental exposure.
from contact with surface soil or sediment. However, contact with subsurface soil poses a potential threat, and also is a potential continuing source of contamination to groundwater as concentrations exceed the RSK Tier 2 Levels for the soil-to-groundwater pathway.

**Groundwater:** Groundwater contaminated with COCs poses the primary route for potential exposure. Groundwater impacted with COCs at concentrations exceeding their respective RSK Tier 2 Levels could present an unacceptable risk through inhalation, ingestion, or dermal contact with groundwater used for drinking or other household uses such as bathing. A water well survey was conducted as a component of the investigation phase to identify potential receptors that may be in contact with contaminated groundwater. A door-to-door water well survey was conducted in 2008 for residential properties located near the site. All properties and residents within the survey area are served by the City of El Dorado’s public water supply system, which obtains water from the El Dorado Reservoir. The survey also identified active and inactive wells used for lawn and garden purposes within the survey area; however, no wells were identified as providing drinking water. Private wells that are still in use present a potential exposure pathway to contaminated groundwater.

**Vapor:** For COCs that are both volatile and mobile vapor migration through the subsurface to homes is generally a concern. Potential routes of exposure to COCs through vapor intrusion were evaluated within the site specific conceptual model. Unsaturated utility trench backfill material and vadose zone soils are typical vapor migration paths. Underground utilities present potential conduit routes for vapors to migrate (e.g., storm sewer, electric, and water lines). Vapor intrusion exposure also can occur via the movement of contaminant vapors from soil gas within the unsaturated pore space of the vadose zone through the foundation into the interior air space of a structure. Elevated cancer and other potential non cancer adverse health effects were possible due to subsurface soil and groundwater for indoor workers or residents associated with breathing petroleum related volatiles from subsurface soil and groundwater.

### 6. REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) are media-specific goals for protecting human health and the environment. RAOs are developed by comparing applicable or relevant and appropriate requirements (ARARs) and To Be Considered standards with the findings of the CI and risk assessments. Based on this information, KDHE developed the following site-wide RAOs:

- Address wastes, including maintenance of the capped West Pond.
- Address practically recoverable LNAPL.
- Control migration of contaminants from soils that hinder achieving groundwater ARARs.
- Prevent off-site migration of dissolved-phase plumes or LNAPL.
- Prevent further degradation of the aquifer.
- Protect the surface water.
- Prevent exposure to all soil, soil vapors, and groundwater exceeding the KDHE RSK Tier 2 Levels as determined by KDHE.
- Restore groundwater to allow for its most beneficial use.
6.1. Cleanup Levels

Groundwater cleanup levels at sites with drinking water aquifers are set to the federally promulgated maximum contaminant levels (MCLs). For groundwater contaminants without MCLs, KDHE’s RSK Tier 2 Levels as specified in the KDHE RSK Manual\(^{14}\) are the final cleanup levels. For soil, KDHE’s RSK Tier 2 Levels are the final cleanup levels. KDHE will use Non-Residential standards for on-site soils because proposed institutional controls will prohibit on-site residents. Tables 3-1 and 3-2 summarize the MCLs and KDHE RSK Tier 2 Levels for contaminants in soil and groundwater.

7. SUMMARY OF REMEDIAL ACTION ALTERNATIVES EVALUATED

In accordance with KDHE’s CI/CAS scope of work, several remedial action alternatives were assembled and evaluated in detail during the CAS. Each remedial alternative was evaluated with respect to their ability to satisfy the following criteria as specified in the National Oil and Hazardous Substances Contingency Plan\(^{15}\) (NCP): overall protection of human health and the environment; compliance with federal and state ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility or volume through treatment; short-term effectiveness; implementability; and cost. The remedial action alternatives were then compared against one another to facilitate the identification of the preferred alternative. A detailed description of each remedial action alternative and the individual and comparative analyses is presented in the CAS. Each remedial alternative evaluated also includes the IRM already implemented at the site that is consistent with the technologies evaluated in the CAS.

The objective of the CAS is to identify remedial technologies and practices that can meet the site-specific remedial action objectives and then combine the technologies and practices into a suite of remedial alternatives for further evaluation. Evaluation of remedial alternatives in the CAS focused on technology types and practices potentially applicable to addressing impacted groundwater and soil. Brief summaries of the remedial action alternatives for each area (Main Process, Asphalt Handling, Tank Farm, and Storm Water Pond), including the preferred remedial action alternative for each, are provided below.

For each area discussed below, a “No Action” alternative was evaluated as a baseline for comparison to other remedial action alternatives evaluated. The “No Action” alternative generally assumes that the Site is left unchanged, and no further remedial actions are evaluated or taken; no further actions would be taken to reduce contaminant mass, address potential exposure pathways, or reduce the potential for contaminant migration. Since no remedial action is taken, risks to human health and environment may not be addressed. The present value cost of the “No-Action” alternative is $0, not including the IRMs already completed at the site.

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\(^{15}\) National Oil and Hazardous Substances Contingency Plan, 40 CFR 300 et seq.
In addition to the “No-Action” alternative (i.e., “Alternative 1”), each specific area within the site had two remedial action alternatives that were evaluated. Within the context of each specific alternative for all areas, several components were critical to the overall protectiveness of the site. To avoid repeated overlapping, the components included throughout each alternative evaluation consist of the following (referred to hereinafter as Critical Components): 1) Environmental Use Controls (EUCs) and a Soil-Waste Management Plan (SWMP), 2) long-term monitoring (LTM), 3) LNAPL recovery (separate and supplement to recovery from interceptor trenches), 4) monitored natural attenuation (MNA) and natural source-zone depletion (NSZD) (if confirmed to be viable through appropriate testing), 5) continued operation of the LNAPL and groundwater treatment system, 6) contingencies, and 7) closeout of the shared components (i.e., eventual removal of wells and equipment).

No data has been collected to confirm or quantify the presence of natural attenuation processes or support selection of a MNA remedial alternative. KDHE and El Paso Merchant have agreed that a detailed MNA evaluation assessment will be conducted in some areas to provide this data.

7.1. Main Process Area Alternatives

Remedial alternatives evaluated for the Main Process Area include: Interceptor Trenches and Phytoremediation and Seep Interceptor Trenches and Excavation.

7.1.1. Interceptor Trenches and Phytoremediation – Alternative 2

This alternative, in addition to the Critical Components listed above and IRMs already completed, consists of the following:

- Continuing to operate the three interceptor trenches, spring collection treatment system, and groundwater treatment system; and
- Design and installation of a phytoremediation system using trees (hybrid poplar, willow trees, oak and maple), grasses and shrubs to enhance hydraulic containment and contaminant mass removal and destruction.

Highlight 7-1 on the next page provides a summary of phytoremediation technologies. The phytoremediation system may use irrigation water from the MPA Basin and/or wetlands to ensure the trees are established. The total estimated cost of Alternative 2 is $3,475,199, not including IRMs already completed.

7.1.2. Seep Interceptor Trench and Excavation – Alternative 3

This alternative, in addition to the Critical Components above and IRMs already completed, consists of the following:
Continuing to operate only one interceptor trench (the Seep Interceptor Trench) and groundwater treatment system for 10 years;

- Excavating and landfarming all impacted soil and weathered rock down to bedrock with off-site disposal as needed, and remove the Basin, Basin Interceptor Trench, and Channel Interceptor Trench during excavation activities; and

- Installing and operating a new spring collection and treatment system for 20 years to be operated similarly to the existing system.

The primary differentiator of this alternative is excavation of most of the soil in the area and the weathered/excavatable rock down to fractured/unexcavatable bedrock. Removal of the weathered rock is essential to the success of this approach because it is the primary flow pathway for both groundwater and LNAPL, and hence contains a large amount of the overall contamination mass in this area. Weathered bedrock, buried concrete foundations, and associated structures that are excavated would be disposed at an off-site landfill. A new spring collection and treatment system would be constructed at the floor of the excavation to capture continued flow and migration of tar impacts through the fractured rock and would be constructed using the current system’s equipment. The total estimated cost of Alternative 3 is $55,302,195, not including IRMs already completed.

### 7.2. Asphalt Handling Area Alternatives

Remedial alternatives evaluated for the Asphalt Handling Area include: Main Process Area Spring and Basin Interceptor Trench and Additional Interceptor Trenches.

#### 7.2.1. Main Process Area Spring and Basin Interceptor Trench – Alternative 2

This alternative, in addition to the Critical Components above and IRMs already completed, consists of the following:

**Highlight 7-1: Phytoremediation**

Phytoremediation is the direct use of living green plants and their associated microorganisms to stabilize or reduce contamination in soils or shallow groundwater. Because it is a natural process, phytoremediation can be an effective remediation method at a variety of sites and on numerous contaminants. Phytoremediation technologies are attractive remedial components because these systems have relatively low capital costs, are energy efficient, and attractively preserve the natural environment.

Continuing to operate the Main Process Area spring collection treatment system, Main Process Area Basin Interceptor Trench, and groundwater treatment system for 20 years.

The pit, which is the source of the asphaltic tar, is upgradient of the Main Process Area spring, so this alternative includes the Main Process Area spring collection system and Basin Interceptor Trench components. Asphalt in rock fractures is either immobile, or it flows to the spring in a manner similar to groundwater, and impacted groundwater (if any exists) in this area is captured either by the spring collection system or by the Basin Interceptor Trench located in the Main Process Area. The total estimated cost of Alternative 2 is $203,410, not including IRMs already completed.

**7.2.2. Additional Interceptor Trenches – Alternative 3**

This alternative, in addition to the Critical Components above and IRMs already completed, consists of the following:

- Installing two 200-foot long interceptor trenches east of the pits to accelerate free product (tar) recovery; and
- Operating the new interceptor trenches, the Main Process Area spring collection and treatment system, Main Process Area Basin Interceptor Trench, and groundwater treatment system for 15 years.

Under this alternative two additional interceptor trenches would be installed to fractured bedrock and both would run north-south perpendicular to groundwater flow. Extracted groundwater and any entrained tar from the trenches would flow to the Main Process Area Basin Interceptor Trench and then to the groundwater treatment system. The total estimated cost of Alternative 3 is $965,210, not including IRMs already completed.

**7.3. Tank Farm Alternatives**

Remedial alternatives evaluated for the Tank Farm Area include: *Waste Excavation and Containment* and *Source Excavation, Large-Scale Containment, and Multi-Phase Extraction (MPE)*.

**7.3.1. Excavation and Containment – Alternative 2**

This alternative, in addition to the Critical Components above and IRMs already completed, consists of the following:

- Excavating approximately 400 cy of buried waste in an area containing elevated levels of lead and petroleum hydrocarbons, and stabilizing and disposing of this waste;
- Installing two 500-foot long interceptor trenches in the northeastern portion of the area on the east and south sides of property owned by El Paso Merchant for long-term hydraulic containment of the contaminant plumes;
Operating the two new interceptor trenches, the Main Process Area Basin Interceptor Trench, and the groundwater treatment system for 20 years to capture northern portions of the groundwater plume; and

Sampling surface water in the creek for three years with statistical and trend analysis to determine whether to install an interceptor trench (discussed below).

Extracted groundwater from the two new interceptor trenches would flow to the Main Process Area Basin Interceptor Trench and then to the groundwater treatment system. To assess the need for and/or size of the new trenches, a pre-design investigation would be conducted to define the depth to bedrock in the proposed construction area. Modeling may determine if there is sufficient hydraulic influence from the north-south trench, or if an east-west trench would be needed.

If groundwater concentrations remain above acceptable levels after the approximate 20 year timeframe, or off-site plume migration occurs at levels above cleanup levels, contingency measures such as continued operation of the interceptor trenches and/or delineation, excavation, and off-site disposal of the source area will be considered. The total estimated cost of Alternative 2 is $3,112,518, not including contingency implementation or IRMs already completed.

### 7.3.2. Excavation, Containment, and Multi-Phase Extraction – Alternative 3

This alternative includes the same remedial components as above (Section 7.3.1) with the following additions:

- Excavating an additional 26,000 bank cubic yards (bcy) of contaminated soil from four additional soil source areas down to bedrock and landfarming the soil in the Main Process Area;
- Installing an additional 1,200-foot long interceptor trench along the south side of the creek;
- Installing a 300-foot long interceptor trench along the east side of the area immediately west of and paralleling SE North Topeka Street;
- Installing Multi-Phase Extraction (MPE) systems in the four additional source areas after excavation in order to address any remaining source mass; and

#### Highlight 7-2: Multi-Phase Extraction

Multi-Phase Extraction (MPE) is an in-situ technology that uses a vacuum system, which can also be combined with a downhole pump (in a well), to remove various combinations of contaminated groundwater, separate-phase petroleum product, and vapors from the subsurface.

Operating the new interceptor trenches, the Main Process Area Basin Interceptor Trench, and groundwater treatment system for 20 years.

Under this alternative extracted groundwater/product from the interceptor trenches would flow to the Main Process Area Basin Interceptor Trench and then to the groundwater treatment system. Extracted vapors from the MPE systems would be directly discharged to the atmosphere. Highlight 7-2 provides a summary of MPE process technologies. The total estimated cost of Alternative 3 is $8,893,735, not including IRMs already completed.

7.4. Stormwater Pond Area Alternatives
Remedial alternatives evaluated for this area are Seep Interceptor Trench and Cap Maintenance and Seep Interceptor Trench, Cap Maintenance, and MPE.

7.4.1. Seep Interceptor Trench and Cap Maintenance – Alternative 2
This alternative, in addition to the Critical Components above and IRMs already completed, consists of the following:

- Continuing to operate the Seep Interceptor Trench and groundwater treatment system for 20 years; and
- Long-term inspections and maintenance of the existing cap.

The total estimated cost of Alternative 2 is $850,387, not including IRMs already completed.

7.4.2. Seep Interceptor Trench, Cap Maintenance, and MPE – Alternative 3
This alternative consists of the technologies similar to those presented above (Section 7.4.1) except that the Seep Interceptor Trench is converted to MPE and two additional trenches are installed using MPE/bioventing to accelerate contaminant mass removal. The additional components include the following:

- Installing two 1,400-foot long MPE/Biovent interceptor trenches with one trench between the wetlands system and the capped West Ponds, and the second trench between the capped West Ponds and the railroad corridor;
- Installing MPE systems in extraction sumps of the two new interceptor trenches and the existing Seep Interceptor Trench to accelerate remediation and enhance volatilization and biodegradation; and
- Operating the two new interceptor trenches and MPE systems and continue operating the existing interceptor trench and groundwater treatment system for 20 years.

The total estimated cost of Alternative 3 is $4,230,996, not including IRMs already completed.
8. Description of the Preferred Remedy
KDHE evaluated each remedial action alternative, individually and comparatively, while considering the threshold and balancing criteria discussed above in Section 7. On the basis of information available in the Administrative Record and summarized above, KDHE has selected Alternative 2 as the preferred remedy for each site specific area. The comparative analysis supports the preferred remedy outlined below and presented in Table 8-1. The preferred remedy as outlined below satisfies or meets Federal, State, and local requirements, and will be protective of human health and the environment. The total estimated combined cost of the preferred remedy is $7,600,000 as presented in Table 8-2.

8.1. Elements of the Preferred Remedy
This section describes the Critical Components, which are the common elements of the preferred remedy shared across all areas.

- **Environmental Use Controls and Soil-Waste Management Plan** – An EUC would be formally established through the EUC Program administered by KDHE. An EUC protects human health and the environment from risks posed by remaining contaminants by placing restrictions, prohibitions, and conditions on land use to reduce or eliminate potential human exposure. The EUC agreement runs with the property and is binding on the landowner and any other subsequent owners, lessees, and other property users. Figure 8-1 depicts the areas proposed to be covered by the EUC. An important component of the EUC is a SWMP that describes notification, planning, and field procedures for screening, sampling, handling, and disposal of any impacted soil or unknown waste encountered during soil disturbance activities within the EUC area. A SWMP for the site was submitted and approved by KDHE on May 5, 2014.

- **Long-term Monitoring** – Free-phase and groundwater fluid levels are currently measured in all 173 existing on-site monitoring wells. Groundwater samples are also currently collected semi-annually from 46 wells and the Main Process Area Spring; semi-annual seep inspections along the Walnut River are ongoing. The forthcoming Corrective Action Plan, once it has been submitted to and approved by KDHE, will determine the monitoring activities and other site reviews that will document the effectiveness of the existing and proposed remedial strategies. Groundwater monitoring will continue until the site meets closure criteria.

KDHE may require future changes to the monitoring network and/or sampling frequency if warranted by the data. Routine evaluation of remedial performance will demonstrate the overall protectiveness and effectiveness of the remedial strategies, and indicate whether contingency measures are necessary to achieve RAOs.

- **Receptor Management** - An annual water well survey will be conducted in an off-site area where benzene, MTBE, TPH concentrations are elevated above the RSK Tier 2 Levels
for groundwater. An annual water well survey will continue until samples from all off-site monitoring wells within the area display criteria following the KDHE Site Closure Policy BER-RS-024. As a contingency, if a new water well is found within the well survey area, 1) the groundwater extraction rates in the boundary interceptor trench in the northern residential area would be increased, if possible; and 2) granular activated carbon treatment of the well water, potential abandonment of the water well, EUCs, and/or additional remedial measures (i.e., injection of chemical oxidants, installation of an additional interceptor trench) in the area may be implemented in cooperation with KDHE and property owners, based upon actual risks.

Sub-slab vapor sampling may be conducted in residential structures where warranted based on plume characteristics. As a contingency, KDHE may require installing vapor abatement systems and accelerated implementation of hydraulic containment systems in the area.

- **LNAPL Recovery** – The existing interceptor trenches currently provide primary LNAPL containment and recovery. For wells containing LNAPL, manual LNAPL/product skimming using various recovery methods will enhance product recovery.

- **Monitored Natural Attenuation and Natural Source Zone Depletion** – As previously discussed, data supporting selection of these processes as remedial alternatives has not yet been collected. A detailed site-wide MNA evaluation assessment and LNAPL recovery, transmissivity, and NSZD assessment will be conducted to confirm the presence of natural processes. Specific areas and wells to be used during the assessments will be indicated in work plans to be submitted to and approved by KDHE. If MNA/NSZD are confirmed and mechanical treatment systems are eventually deactivated, they would be left in place for a period of time to be reactivated should MNA/NSZD prove inadequate.

- **Groundwater and LNAPL Treatment System** – As discussed in previous sections, the current and proposed treatment of LNAPL and groundwater treatment system will take place in the wetlands-based system. The operational timeframe of the groundwater treatment system is dependent on the operational timeframes of the associated interceptor trenches.

- **Closeout of the Shared Components** – The shared remedy components include the 173 existing monitoring wells and groundwater treatment system, which will eventually require removal. The Main Process Area Spring and Basin structures will likely be left in place to manage ongoing spring and storm water flow after site restoration is complete. The wetlands will be allowed to revert to natural wetlands, and the hydraulic control structures within the wetlands system could remain, but all other equipment will be removed, including all associated structures associated with the underground oil-water separator, cascade aerator, and precipitation and settling basin.
Area-specific KDHE preferred remedies, are summarized below.

- **Main Process Area:**
  - Hydraulic containment via continued operation of the Main Process Area Channel Interceptor Trench, Basin Interceptor Trench, Seep Interceptor Trench, and Spring Collection and Treatment System (Figure 8-2); and
  - Construction of a phytoremediation system (Figure 8-3) to enhance hydraulic containment and contaminant mass removal and destruction. Establishing a long-term tree stand would result in decreased groundwater infiltration and increased uptake and transpiration of groundwater. KDHE reviewed and approved a conceptual approach for phytoremediation in March 2016. An actual design would be submitted prior to implementation.

- **Asphalt Handling Area:**
  - Hydraulic containment via continued operation of the Main Process Area Spring Collection and Treatment System and Basin Interceptor Trench (Figure 8-2).

- **Tank Farm Area:**
  - Hydraulic containment via two new interceptor trenches, and continued operation of the Main Process Area Basin Interceptor Trench (Figures 8-2 and 8-4). KDHE would review and approve a Geotechnical Pre-design Investigation Work Plan to better define the depth to bedrock in the proposed construction area and to assess the need for and/or exact size of both trenches. If groundwater concentrations are not reduced to acceptable levels within the approximate 20-year proposed timeframe, or off-site plume migration occurs at levels above corrective action levels, contingency measures may include installing MPE systems, installing additional interceptor trenches; and/or excavation of the source area (Figures 8-5 and 8-6);
  - Excavation of approximately 400 cy of buried waste in the northeastern portion of the area, stabilization, and disposal of known waste (Figure 8-5); and
A portion of the refinery dissolved-phase plumes migrate onto an adjacent site known as the Union Tank Car Site, which is currently being addressed through KDHE’s Voluntary Cleanup and Property Redevelopment Program. The refinery groundwater plumes merge with a chlorinated plume originating from the Union Tank Car Site. The proposed interceptor trenches would stop off-site migration of the refinery plumes, and El Paso Merchant will coordinate operation of the interceptor trench with KDHE and Union Tank Car as appropriate.

- **Storm Water Pond Area:**
  - Hydraulic containment via continued operation of the Seep Interceptor Trench (Figure 8-2); and
  - Long-term inspections and maintenance of the existing cap.

- **Contingencies:**
  Groundwater flow contours induced by the Main Process Area interceptor trenches show that all impacted groundwater in the area is likely captured by the existing systems. However, should a portion of the refinery’s northern groundwater plume migrate onto the adjacent Pester Refinery Superfund Site, and that site’s current EUCs or hydraulic containment system are no longer active, additional remedial measures may be considered to prevent off-site migration, such as an extension of the Main Process Area Channel Interceptor Trench.

### 9. Community Involvement

A Public Relations Strategy for the site was developed by KDHE. Public input and comment has been encouraged by KDHE throughout the process. A public notice announcing the availability of the draft CAD and 30-day public comment period (July 12, 2016 to August 10, 2016) was published in *The Butler County Times-Gazette* on July 12, 2016. A webpage dedicated to the Site was also made available online during this period.
10. DOCUMENTATION OF SIGNIFICANT CHANGES

One written comment letter containing three specific comments were received by KDHE during the public comment period. In response to the comments received, KDHE has amended the draft CAD document as specified in Section 11.

11. RESPONSE TO COMMENTS SUMMARY

The purpose of this section is to review and provide responses to comments made by private citizens and other interested parties during the public comment period for the draft CAD. One comment letter was received. Comments and KDHE’s responses are included below.

Comment 1: Regarding the operation of the existing Seep Interceptor Trench system – Is Coastal performing continuous water level recording (i.e. via pressure transducers) in order to help determine and evaluate hydraulic radius of influence determinations that may be affecting groundwater elevations and flow on the adjacent Union Tank Car (UTLX) property to the south? If not, what O&M activities do they plan to perform and will these activities be presented in the Final CAD?

KDHE Response: KDHE is not requiring El Paso Merchant to perform continuous water level recording as part of the Seep Interceptor Trench (Seep IT) performance monitoring program. The existing Seep IT is installed to competent bedrock with continuous coverage across the full target petroleum plume of concern; therefore, radius of influence (ROI) is not considered relevant to the performance evaluation. A zone of influence does extend past the north and south edges of the Seep IT, based upon historical evaluation of off-site and on-site groundwater elevation data. In addition, chlorinated solvents have also been observed in the extraction groundwater from the Seep IT. Both of these observations indicate capture of some groundwater from the UTLX property. O&M activities are planned to continue at the Site with periodic gauging of nearby wells and piezometers to ensure capture of the refinery dissolved-phase plume. KDHE may request El Paso Merchant to reduce groundwater extraction rates should the hydraulic influence interfere with future UTLX Site remediation activities. No change to the CAD is required.

Comment 2: Regarding the design for the proposed interceptor trench south of the MPA and along the western common boundary of the UTLX property, has Coastal evaluated the radius of influence (hydraulic containment) and contaminant distribution of Methyl Tertiary-Butyl Ether (MTBE) utilizing appropriate groundwater and transient modeling scenarios? Similar to the comment 1) above, has Coastal considered continuous water level recording and analysis to evaluate hydraulic influences onto the UTLX property during the operation of the proposed interceptor trench?

KDHE Response: The MTBE plume is currently well-defined by on-site and off-site groundwater data. See KDHE Response to Comment 1 regarding the ROI and IT. Full cross-sectional coverage and hydraulic containment of the MTBE plume is the goal of the proposed ITs. Hydraulic containment will be confirmed by evaluation of nearby monitoring wells and in-trench piezometer groundwater elevation data and downgradient MTBE concentration trends. No continuous water
level recording is necessary or planned to confirm these performance objectives. The likely impact to the UTLX property will be lower groundwater elevations, reduced groundwater flow across the property, and reduced groundwater discharge to the river. Because of the resulting groundwater shadow behind the proposed ITs and the existing MPA Basin IT, a more northeasterly hydraulic gradient may also develop across the UTLX property with resulting increased capture of the UTLX Site chlorinated plume by the Seep IT. As discussed in Section 8.1 of the CAD and Section 10.7.3 of the CAS Report, El Paso Merchant will coordinate operation of the proposed ITs with KDHE and UTLX to facilitate implementation of the UTLX Site remedy. Similar to the Seep IT, KDHE may request El Paso Merchant to reduce groundwater extraction rates should the hydraulic influence interfere with future UTLX Site remediation activities. No change to the CAD is required.

Comment 3: MTBE is migrating onto the UTLX property along the Coastal eastern boundary (hydraulically downgradient of the proposed interceptor trench) as indicated by monitoring well MW-112 (3,170 micrograms per liter (µg/L) and MW-113 (1,070 µg/L). The KDHE Tier 2 Risk-Based Standards for Kansas (RSK) (Residential Scenario-Off-Site) level for MTBE is 262 µg/L. How will the Final CAD address this issue?

KDHE Response: As discussed in the CAS Report the primary objective of the proposed ITs is to control the flux of the mobile MTBE and TPH onto the UTLX property until on-site sources have been sufficiently reduced; thereby permitting natural attenuation of the off-site dissolved-phase plume. KDHE would like to clarify that the MTBE concentration data presented in Comment 3 is from October 2012, and the most recent data from sampling conducted in November 2015 show concentrations in MW-112 now at 2,600 µg/L and MW-113 at 440 µg/L. In addition, the current Tier 2 Risk-Based Standards for Kansas (RSK) groundwater values for the Non-residential scenario is 262 µg/L, and Residential scenario is 133 µg/L. As discussed in Section 6.1 of the CAD, and shown in Table 3-2, the Residential scenario Tier 2 RSK value of 133 µg/L will be the final cleanup level for off-site groundwater. Additionally, as discussed in Section 8.1 of the CAD, long-term groundwater monitoring will continue at the Site until closure criteria is met. Routine evaluation of remedial performance will demonstrate the overall protectiveness and effectiveness of the remedial strategies and indicate whether contingency measures (such as installing MPE systems, additional interceptor trenches, and/or excavation of the source area) are necessary to achieve the RAOs. No change to the CAD is required.
TABLES
### Table 3-1 – Maximum Soil Analytical Results Summary

<table>
<thead>
<tr>
<th>Compound</th>
<th>KDHE Tier 2 Level(^\text{2,3,4}) (Soil Non-Residential Pathway) mg/kg</th>
<th>KDHE Tier 2 Level(^\text{2,3,4}) (Soil-to-Groundwater Non-Residential Pathway) mg/kg</th>
<th>Historical/Current Maximum Concentration(^\text{1}) mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>28.2</td>
<td>0.168</td>
<td>500</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>145</td>
<td>65.6</td>
<td>84</td>
</tr>
<tr>
<td>Chloroform</td>
<td>7.14</td>
<td>0.85</td>
<td>1</td>
</tr>
<tr>
<td>MTBE</td>
<td>1,050</td>
<td>1.66</td>
<td>41</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>64.7</td>
<td>0.659</td>
<td>290</td>
</tr>
<tr>
<td>2-Methylnaphthalene</td>
<td>1,280</td>
<td>17.3</td>
<td>69</td>
</tr>
<tr>
<td>Arsenic</td>
<td>63.2</td>
<td>NE</td>
<td>243</td>
</tr>
<tr>
<td>Lead</td>
<td>1,000</td>
<td>NE</td>
<td>28,000</td>
</tr>
<tr>
<td>TPH-GRO</td>
<td>450</td>
<td>79.3</td>
<td>9,400</td>
</tr>
<tr>
<td>TPH-DRO</td>
<td>20,000</td>
<td>7,830</td>
<td>34,000</td>
</tr>
<tr>
<td>LRH (≥C5 - ≤C8)</td>
<td>950</td>
<td>150</td>
<td>No data</td>
</tr>
<tr>
<td>MRH (&gt;C8 - ≤C18)</td>
<td>350</td>
<td>150</td>
<td>No data</td>
</tr>
<tr>
<td>HRH (&gt;C18 - ≤C35)</td>
<td>27,500</td>
<td>13,000</td>
<td>No data</td>
</tr>
</tbody>
</table>

\(^1\)Current Soil Maximum Concentrations from the Phase III Investigation (2007-2009).


\(^3\)The Tier 2 Levels listed for TPH-GRO and TPH-DRO are from RSK Appendix A, March 2014 update, and were revised on September 1, 2015 to evaluate TPH using three different carbon ranges, low-, mid-, and high-range hydrocarbons (LRH, MRH, and HRH) under a new Kansas Modified Method 8015.

\(^4\)Revised Tier 2 Levels for TPH will be used for comparison to future TPH data collected. Bold font indicates concentrations above Tier 2 RSK Level.

NE – Tier 2 Level not established for the compound.

mg/kg – milligrams per kilogram
**Table 3-2 – Maximum Groundwater Analytical Results Summary**

<table>
<thead>
<tr>
<th>Compound</th>
<th>MCL or KDHE Tier 2 Level(^{2,3,4}) (Residential Scenario-Off-Site) µg/L</th>
<th>MCL or KDHE Tier 2 Level(^{2,3,4}) (Non-Residential Scenario-On-Site) µg/L</th>
<th>Historical Maximum Concentration µg/L</th>
<th>Current Maximum Concentration(^{3}) µg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>5</td>
<td>5</td>
<td>129,000</td>
<td>122,000</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>700</td>
<td>700</td>
<td>1,110</td>
<td>1,050</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>25</td>
<td>46.1</td>
<td>80.1</td>
<td>52</td>
</tr>
<tr>
<td>MTBE</td>
<td>133</td>
<td>262</td>
<td>38,000</td>
<td>19,000</td>
</tr>
<tr>
<td>2,4-Dimethylphenol</td>
<td>292</td>
<td>1,860</td>
<td>14,000</td>
<td>4,280</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>1.11</td>
<td>2.11</td>
<td>630</td>
<td>575</td>
</tr>
<tr>
<td>Arsenic</td>
<td>10</td>
<td>10</td>
<td>218</td>
<td>218</td>
</tr>
<tr>
<td>Barium</td>
<td>2,000</td>
<td>2,000</td>
<td>4,570</td>
<td>3,160</td>
</tr>
<tr>
<td>Manganese</td>
<td>50</td>
<td>50</td>
<td>12,900</td>
<td>12,900</td>
</tr>
<tr>
<td>TPH-GRO</td>
<td>500</td>
<td>500</td>
<td>270,000</td>
<td>244,000</td>
</tr>
<tr>
<td>TPH-DRO</td>
<td>500</td>
<td>720</td>
<td>1,200,000</td>
<td>920,000</td>
</tr>
<tr>
<td>LRH (≥C5 - ≤C8)</td>
<td>350</td>
<td>950</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>MRH (&gt;C8 - ≤C18)</td>
<td>150</td>
<td>400</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>HRH (&gt;C18 - ≤C35)</td>
<td>1,000</td>
<td>2,500</td>
<td>No data</td>
<td>No data</td>
</tr>
</tbody>
</table>

\(^1\)Current Groundwater Maximum Concentrations from four Semi-Annual Events – April 2012-October 2013.  
\(^3\)The Tier 2 Levels listed for TPH-GRO and TPH-DRO are from RSK Appendix A, March 2014 update, and were revised on September 1, 2015 to evaluate TPH using three different carbon ranges, low-, mid-, and high-range hydrocarbons (LRH, MRH, and HRH) under a new Kansas Modified Method 8015.  
\(^4\)Revised Tier 2 Levels for TPH will be used for comparison to future TPH data collected. Bold font indicates concentrations above MCL or Tier 2 RSK Level.  
µg/L – micrograms per Liter
### Table 3-3 – Surface Water Analytical Results Summary

<table>
<thead>
<tr>
<th>Compound</th>
<th>Kansas Surface Water Quality Standards (2015) µg/L</th>
<th>West Branch Walnut River(^1)</th>
<th>Tank Farm Creek</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Historical Maximum Concentration µg/L</td>
<td>Recent Maximum Concentration (2011) µg/L</td>
<td>Historical Maximum Concentration µg/L</td>
<td>Recent Maximum Concentration (2012) µg/L</td>
</tr>
<tr>
<td>Benzene</td>
<td>1.2(^2)</td>
<td>2.2</td>
<td>0.41 F</td>
<td>1.8</td>
</tr>
<tr>
<td>MTBE</td>
<td>NE</td>
<td>2.8 F</td>
<td>0.71 F</td>
<td>1.8</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>620</td>
<td>0.1</td>
<td>NA</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Arsenic</td>
<td>10</td>
<td>5</td>
<td>NA</td>
<td>&lt;4</td>
</tr>
<tr>
<td>Cyanide</td>
<td>5.2(^3)</td>
<td>13.2 F</td>
<td>NA</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.146</td>
<td>6.3 J</td>
<td>NA</td>
<td>&lt;0.07</td>
</tr>
<tr>
<td>TPH-GRO</td>
<td>NE</td>
<td>&lt;100</td>
<td>&lt;100</td>
<td>&lt;100</td>
</tr>
<tr>
<td>TPH-DRO</td>
<td>NE</td>
<td>120 F</td>
<td>120 F</td>
<td>290</td>
</tr>
</tbody>
</table>

\(^1\)Data compiled from CAS Report Historical Tables using maximum concentration data from either Transect #2, #3, or #4 surface water sample locations, whichever value is greatest.

\(^2\)The SWQS for benzene was 5 µg/L prior to 2015.

\(^3\)The mercury and cyanide detections are not site related based on investigation data and likely sourced from upgradient sources.

- Compound not detected above the laboratory reporting limit.
- NA – Compound not analyzed.
- NE – Surface Water Quality Standard (SWQS) not established for the compound.
- F – Reported concentration is estimated, and reported at a level less than the reporting limit, but greater than the method detection limit.
- J – Compound was positively identified, quantitation is estimated.

Bold font indicates concentrations above most current Kansas Surface Water Quality Standards.

µg/L – micrograms per Liter
Table 8-1 – Summary of the Preferred Alternative

<table>
<thead>
<tr>
<th>Preferred Alternative¹</th>
<th>Pre-Design Data Acquisition</th>
<th>Contingency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 2:</td>
<td>Soil fertility testing for</td>
<td>Additional soil excavation and MPE in</td>
</tr>
<tr>
<td></td>
<td>phytoremediation area;</td>
<td>Tank Farm Area; Tank Farm Creek ITs,</td>
</tr>
<tr>
<td></td>
<td>MNA and NSZD assessment;</td>
<td>Topeka Street IT; Rehabilitation or</td>
</tr>
<tr>
<td></td>
<td>Geotechnical Investigation</td>
<td>replacement of existing ITs; Short-term</td>
</tr>
<tr>
<td></td>
<td>in Tank Farm Area.</td>
<td>vapor abatement and accelerated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>implementation of hydraulic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>containment in Tank Farm Area.</td>
</tr>
</tbody>
</table>

¹Preferred Alternative includes completed IRMs, and the following Critical Components: EUCs and SWMP, LTM, Receptor Management, LNAPL Recovery, MNA and NSZD (if confirmed), and continued operation of the existing Groundwater and LNAPL Treatment Systems.

Table 8-2 – Estimated Cost of the Preferred Alternative

<table>
<thead>
<tr>
<th>Preferred Alternative</th>
<th>Estimated Cleanup Timeframe</th>
<th>Total Capital Cost</th>
<th>Total O&amp;M Cost</th>
<th>Total Estimated Cost¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 2</td>
<td>30 Years</td>
<td>$1,600,000</td>
<td>$6,000,000</td>
<td>$7,600,000</td>
</tr>
</tbody>
</table>

¹Costs are rounded and estimated by MWH Americas, Inc. Costs presented do not include contingency implementation or the $20,590,000 expended to date for IRMs already completed.
FIGURES
Figure 3-1 – Potentiometric Surface Map, November 2015

Figure prepared by MWH on behalf of EPME-PC, based on Figure 4-5 from the Second Half 2015 Semi-Annual Progress Report, March 2016.
Figure 3-2 – Site-Wide Benzene Concentrations in Groundwater, November 2015

Figure prepared by MWH on behalf of EPME-PC, based on Figure 4-1 from the Second Half 2015 Semi-Annual Progress Report, March 2016.
Figure 3-3 – Site-Wide MTBE Concentrations in Groundwater, November 2015

Figure prepared by MWH on behalf of EPME-PC, based on Figure 4-2 from the Second Half 2015 Semi-Annual Progress Report, March 2016.
Figure 3-4 – Site-Wide TPH-GRO Concentrations in Groundwater, November 2015

Figure prepared by MWH on behalf of EPME-PC, based on Figure 4-4 from the Second Half 2015 Semi-Annual Progress Report, March 2016.
Figure 3-5 – Site-Wide TPH-DRO Concentrations in Groundwater, November 2015

Figure prepared by MWH on behalf of EPME-PC, based on Figure 4-3 from the Second Half 2015 Semi-Annual Progress Report, March 2016.
Figure 3-6 – Site-Wide LNAPL Isopach Map, November 2015

Figure prepared by MWH on behalf of EPME-PC, based on Figure 4-6 from the Second Half 2015 Semi-Annual Progress Report, March 2016.
Figure 8-1 – Preferred Alternative for EUC Component

Figure prepared by MWH on behalf of EPME-PC, based on Figure 10-1 from the CAS Report, July 2014.
Figure 8-2 – Existing and Preferred Alternative Interceptor Trenches

Figure prepared by MWH on behalf of EPME-PC in May 2016.
Figure 8-3 – Preferred Alternative for Main Process Area Soil

Figure prepared by MWH on behalf of EPME-PC, based on Figure 10-2 from the CAS Report, July 2014.
Figure 8-4 – Preferred Alternative for Tank Farm Groundwater

Figure prepared by MWH on behalf of EPME-PC, based on Figure 10-6 from the CAS Report, July 2014.
Figure 8-5 – Preferred and Contingency Alternative for Tank Farm Waste and Soil

Figure prepared by MWH on behalf of EPME-PC, based on Figure 10-5 from the CAS Report, July 2014. The contingency alternative for additional soil excavations in Soil Areas 1, 2, 3, and 4 is also displayed on the Figure.
Figure 8-6 – Contingency Alternative for Tank Farm Groundwater and Surface Water

Figure prepared by MWH on behalf of EPME-PC, based on Figure 10-7 from the CAS Report, July 2014.
KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT
FINAL CORRECTIVE ACTION DECISION

DECLARATION OF CORRECTIVE ACTION DECISION

SITE NAME AND LOCATION
Former Coastal Refinery El Dorado Site
El Dorado, Butler County, Kansas

STATEMENT OF BASIS AND PURPOSE
The Former Coastal Refinery El Dorado Site (hereinafter "Site") is a former petroleum refining facility that was constructed and began operating in 1917. Refining operations were discontinued in 1993, and asphalt blending and terminal operations continued at the facility until 2004. Various stages of decommissioning and demolition of refinery structures occurred between 2004 and 2010. As a result of past facility operations petroleum-related compounds were released into the environment contaminating soil and groundwater, and contaminated groundwater has migrated to adjacent residential and industrial properties. Primary contaminants of concern for the Site are petroleum-related compounds that include benzene, naphthalene, total petroleum hydrocarbons, select volatile organic compounds, and isolated impacts from metals contamination. The Final Corrective Action Decision document presents the cleanup remedy selected by the Kansas Department of Health and Environment (KDHE) to address Site contamination. Pertinent documents leading to the remedy selection are contained in the Administrative Record file, which is located at the KDHE central office in Topeka, Kansas and is available for public review upon request. The public was provided opportunity to comment on the document during a public comment period.

DESCRIPTION OF THE SELECTED REMEDY
KDHE has determined that the selected remedy, described and evaluated in the Final Corrective Action Decision, meets the criteria established for selection and will be protective of human health and the environment. The selected remedy consists of hydraulic containment via operation of existing and proposed interceptor trenches, phytoremediation technologies, soil excavation and disposal, surface water sampling, and cap maintenance. The remedy also includes critical components such as environmental use controls, long-term monitoring, receptor management surveys, product recovery, monitored natural attenuation and natural source zone depletion (if confirmed through assessment), and continued operation of the existing groundwater and product treatment systems. Routine evaluation of remedial performance will demonstrate the overall protectiveness and effectiveness of the remedial strategies, and indicate whether contingency measures identified in the Final CAD, such as installation of multi-phase extraction systems, additional interceptor trenches, additional source area excavations, and receptor mitigation are necessary to achieve remedial action objectives.

DECLARATION
The selected remedy is protective of human health and the environment and attains State, Federal, and local requirements that are applicable or relevant and appropriate. In selecting and declaring this remedy, the KDHE believes implementation of this remedy will have a beneficial
effect on heath and the environment by reducing the toxicity, mobility, and volume of contaminants in the environment.

Susan Mosier, MD
Secretary of the Kansas Department of Health and Environment

Attachment: Final Corrective Action Decision