Flint Hills Resources Alaska, LLC

Final Onsite Cleanup Plan

North Pole Refinery
North Pole, Alaska

October 2014

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Tables (in text)

Tables (attached)

Figures

Appendices

Acronyms and Abbreviations

1,3,5-TMB	1,3,5-trimethylbenzene
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ARCADIS	ARCADIS U.S., Inc.
Barr	Barr Engineering Company
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
cfm	cubic feet per minute
CFR	Code of Federal Regulations
city	North Pole, Alaska
COC	constituent of concern
COPC	constituent of potential concern
CSM	Conceptual Site Model
CU #1 Wash Area	Crude Unit #1 Wash Area
CU #2 EU	Crude Unit #2 Extraction Unit
cy	cubic yards
DNR	Alaska Department of Natural Resources
Draft Final Onsite FS	Draft Final Onsite Feasibility Study
DRO	diesel range organics
Earth Resources	Earth Resources Corporation of Alaska
ECA	Energy Corporation of Alaska
FHRA	Flint Hills Resources Alaska, LLC
FTA	Fire Training Area
GAC	granular activated carbon

GRO	gasoline range organics
GRTS	Groundwater Remediation and Treatment System
GVEA	Golden Valley Electric Association
HHRA	Revised Draft Human Health Risk Assessment
HVAC	heating, ventilation, and air conditioning
IRAP	Interim Remedial Action Plan
LDR	land disposal restriction
LNAPL	light nonaqueous phase liquid
LTM	long-term monitoring
mg/kg	milligrams per kilogram
NGP	North Gravel Pit
NPR	North Pole Refinery
NSZD	natural source zone depletion
offsite	area located outside the property boundary, primarily in the downgradient north-northwest direction
OIT	Organic Incineration Technology, Inc.
OM&M Plan	Operation, Maintenance, and Monitoring Plan
onsite	area that is located within the property boundary of the FHRA NPR
OCP	Onsite Cleanup Plan
Onsite SCR	Onsite Site Characterization Report – 2013 Addendum
Onsite SMP	Onsite Soil Management Plan
OSHA	Occupational Safety and Health Administration
PFC	perfluorinated compound
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
power plant	electrical generating facility

RCRA	Resource Conservation and Recovery Act
Revised IRAPA	Revised Interim Remedial Action Plan Addendum
RRO	residual range organics
RSAP	Revised Sampling and Analysis Plan
SCR – 2011	Site Characterization Report – Through 2011
SGP	South Gravel Pit
site	Flint Hills Resources Alaska, LLC North Pole Refinery, an idled petroleum refinery located on H and H Lane in North Pole, Alaska
SVOC	semivolatile organic compound
SWA	Southwest Former Wash Area
TCLP	toxicity characteristic leaching procedure
TSDF	treatment, storage, and disposal facility
TWUP	temporary water use permit
UHC	underlying hazardous constituent
VI	vapor intrusion
VOC	volatile organic compound
VPT	vertical profiling transect
Williams	Williams Alaska Petroleum, Inc.
WWTP	wastewater treatment plant
µg/L	micrograms per liter

1. Introduction

On behalf of Flint Hills Resources Alaska, LLC (FHRA), ARCADIS U.S., Inc. (ARCADIS) prepared this Final Onsite Cleanup Plan (OCP) for the FHRA North Pole Refinery (NPR), an idled petroleum refinery located on H and H Lane in North Pole, Alaska (site). This OCP presents the proposed comprehensive remedial strategy for the onsite area of the NPR. Offsite issues are not within the scope of this strategy, including the alternative water supply plan.

1.1 Background

The NPR was built in 1976 and 1977 by Energy Corporation of Alaska (ECA) and refinery operations began in August 1977. ECA changed its name to Earth Resources Company of Alaska (Earth Resources) in 1977. Earth Resources leased the refinery property from the State of Alaska, which owned the refinery land. Since 1980, the name of the refinery operator has changed from time to time, including MAPCO Alaska, Inc. (1981-1983), MAPCO Petroleum, Inc. (1983-1987), MAPCO Alaska Petroleum, Inc. (1987-1998), and Williams Alaska Petroleum, Inc. (1998-2004) (Williams). Under these various names, Williams operated the NPR on state-owned land for more than 25 years, until 2004. FHRA purchased the refinery assets from Williams effective April 1, 2004, along with the refinery land, which Williams acquired from the State of Alaska shortly before the transaction with FHRA. FHRA has owned and operated the refinery since April 1, 2004.

It is acknowledged that in 18 Alaska Administrative Code (AAC) 75.990(115), the Alaska Department of Environmental Conservation (ADEC) defines the term “site” as an “area that is contaminated, including areas contaminated by the migration of hazardous substances from a source area, regardless of property ownership.” For this OCP, the term “onsite” is the area that is located within the property boundary of the FHRA NPR; the term “offsite” is the area located outside the property boundary, primarily in the downgradient north-northwest direction, based on the approximate extent of the dissolved-phase sulfolane plume detected at concentrations above the detection limit (approximately 3.1 micrograms per liter [µg/L]).

Because the onsite contamination is located in an industrial facility, the selected remedies focus on prevention of adverse impacts to human health, safety and welfare, and the environment via product recovery (light nonaqueous phase liquid [LNAPL]), containment (groundwater recovery system), and institutional controls (ICs) to limit future use to industrial operations and prevent use of groundwater for human consumption. Workers are currently protected onsite by numerous FHRA work practices and by FHRA compliance with Alaska and federal occupational health and safety laws and regulations.

The entire site has undergone significant characterization, as reflected in a series of site characterization reports. These collectively present a body of information that was gathered to ascertain the physical characteristics of the site, define the sources of contamination, and determine the nature and extent of contamination present at the site. The relevant site characterization reports are:

- Site Characterization Report – Through 2011 (SCR – 2011; Barr Engineering Company [Barr] 2012a), submitted in December 2012

- Site Characterization Report – 2012 Addendum (SCR – 2012; ARCADIS 2013a), submitted in January 2013

- Onsite Site Characterization Report – 2013 Addendum (Onsite SCR; ARCADIS 2013f)

Constituents of concern (COCs) for the site were identified by comparing detected concentrations with ADEC cleanup levels presented in 18 AAC 75.341 Tables B1 and B2 (soil) and 18 AAC 75.345 Table C (groundwater). Three COCs are not listed in those tables. Sulfolane is currently under ADEC review to determine a cleanup level for the site. Similarly, perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) have been found at the site but no cleanup number exists for those constituents. This OCP addresses petroleum constituents, sulfolane, PFOS, and PFOA.

1.2 Purpose and Scope

This OCP presents proposed cleanup actions for LNAPL, soil, and groundwater at the site. The proposed cleanup actions were designed to protect onsite workers and eliminate offsite migration of contaminants. The remedy includes a combination of active remediation (groundwater extraction and treatment, LNAPL recovery, and excavation of limited areas), establishment of an alternative point of compliance, and ICs. The cleanup actions presented in this OCP consider the limitations on cleanup associated with current and future industrial operations at the site.

The remedial strategy outlined in this OCP is consistent with ongoing activities at the site, under an existing Interim Remediation Action Plan (IRAP) (Barr 2010) and the Revised Interim Remedial Action Plan Addendum (Revised IRAPA: ARCADIS 2013c). This OCP supersedes the Revised IRAPA (ARCADIS 2013c). The LNAPL recovery and groundwater extraction and treatment remedy components described in the Revised IRAPA (ARCADIS 2013c) are ongoing at the NPR. Natural processes are also reducing LNAPL and petroleum constituents.

2. Site Setting and Background

2.1 Property Description

The 240-acre site is located inside the city limits of North Pole, Alaska (the city). The city is located approximately 13 miles southeast of Fairbanks, Alaska, within the Fairbanks North Star Borough (Figure 2-1). NPR is currently an idled petroleum refinery, operating as a fuels terminal. It is anticipated that the NPR will either restart under new ownership, or continue operations as fuel terminal. In either case, future land use of the NPR will remain consistent with an industrial manufacturing setting given its significant infrastructure and capabilities.

Three crude oil processing units are located in the southern portion of the site, making up the process area. The area where the processing units are located contains large refining equipment, extensive underground and aboveground piping and utilities, and other equipment (e.g., process tanks, large electric equipment). Tank farms are located in the central portion of the site. Truck-loading racks are located immediately north of the tank farms and a railcar-loading rack is located west of the tank farms. Wastewater treatment lagoons, storage areas, and two flooded gravel pits (North Gravel Pit [NGP] and South Gravel Pit [SGP]) are located in the western portion of the site. Rail lines and access roads are located in the northernmost portion of the site.

Along the southern site boundary, partially surrounded by the NPR, is an electrical generating facility (power plant) operated by Golden Valley Electric Association (GVEA). FHRA representatives indicated that the power plant burns heavy aromatic gas oil (diesel 4). The property south of the site and the GVEA power plant is occupied by the Petro Star, Inc. Refinery. Site features are presented on Figure 2-2.

North of the site are residential properties and the city’s wastewater treatment plant (WWTP). The North Pole High School is located immediately north and west of the WWTP and residential properties. An undeveloped parcel, owned by the Alaska Department of Natural Resources, lies between the site and the WWTP. The Tanana River is located to the south and west, flowing in a northwesterly direction toward Fairbanks. Surrounding the site is property that is residential or undeveloped. East of the site and crossing the offsite area running southeast to northwest are the Old Richardson Highway and the Alaska Railroad right-of-way. Current onsite features are presented on Figure 2-2. An onsite site plan is presented on Figure 2-3.

2.2 Physical Setting

The site and the surrounding North Pole area are located on a relatively flat-lying alluvial plain that is situated between the Tanana River and the Chena River. The site is located on the Tanana River Floodplain. Up to 2 feet of organic soil are typically found in the undeveloped portions of the site. Silt and silty sand layers varying in thickness from 0 to 10 feet typically occur beneath the organic soil. Alluvial sand and gravel associated with the Tanana River are present below the organic soil and silty layers. Depth to bedrock is estimated to be 400 to 600 feet below ground surface (bgs).

The city is located within an area of Alaska characterized by discontinuous permafrost (Ferrians 1965). Permafrost tends to act as a confining unit, impeding and redirecting the flow direction of groundwater (Glass et al. 1996). Based on regional information (Williams 1970, Miller et al. 1999), permafrost is assumed to be absent beneath the Tanana River.

The aquifer beneath the alluvial plain between the Tanana River and the Chena River generally consists of highly transmissive sand and gravel under water table conditions (Cederstrom 1963, Glass et al. 1996). The Tanana River has a drainage area of approximately 20,000 square miles upstream of Fairbanks (Glass et al. 1996). Near the site, this aquifer is reportedly greater than 600 feet thick (at least 616 feet thick near Moose Creek Dam) (Glass et al. 1996). Beyond the zones of influence of the site's historic groundwater remediation system, groundwater flow directions are controlled by discharge from the Tanana River to the aquifer and from the aquifer to the Chena River, as described by Glass et al. (1996). Variations in river stage through time are believed to be the primary cause of variations in groundwater flow direction in the aquifer between the rivers (Lilly et al. 1996, Nakanishi and Lilly 1998). Based on data from U.S. Geological Survey water table wells, the groundwater flow direction generally varies from a north-northwesterly direction to a few degrees east of north. The groundwater flow direction trends to the north-northwest in spring and more northerly in the summer and fall (Glass et al. 1996).

2.3 Constituents of Concern

Extensive sampling of groundwater and soil was completed for numerous constituents of potential concern (COPCs) to develop a list of COCs for the site. COCs were identified based on a comparison of site maximum concentrations to Method 2 cleanup levels for soil (Table B1 and B2 of 18 AAC 75.341(c)) and groundwater (Table C of 18 AAC 75.345(b)(1) for those constituents listed in Table 2-1.

Sulfolane is not regulated under the above-cited sections of the Alaska regulations, but is addressed as a COC in this OCP. Note that a Revised Draft Human Health Risk Assessment (HHRA; ARCADIS 2012a) was prepared for this site, but to date has not been approved by ADEC.

PFOS and PFOA are considered COPCs for the site, but have not been designated as COCs. Like sulfolane, PFOS and PFOA are not regulated under the above-cited sections of the Alaska regulations.

As reported in the 2011 Site Characterization Report, arsenic in groundwater was eliminated as a COC based on published background concentrations for the area of the site (USGS, 2001). Arsenic in soil was eliminated as a COC based on comparison of the 95% Upper Confidence Limit of the Mean (95%UCL) arsenic concentrations at NPR to an evaluation of background metals concentrations conducted by the U.S. Army Corps of Engineers (USACE) at Fort Wainwright, Alaska, located approximately 11 miles from the site. The NPR site-specific 95%UCL soil arsenic concentration of 7.3 milligrams per kilogram (mg/kg is less than half the Alaska mean (17.3 mg/kg) and less than the North Chena mean concentration (11 mg/kg) and South Chena mean concentration (8 mg/kg). These results indicate arsenic concentrations in soil at NPR are representative of background concentrations.

Dissolved phase iron exceeds a health based value calculated using methodology outlined in the Cleanup Levels Guidance (ADEC; June 9, 2008). However, remediation focused on iron is not considered necessary. Hydrocarbon contamination results in biological activity that consumes oxygen in the groundwater resulting in an anaerobic groundwater system. Iron minerals dissolve in anaerobic systems. The high iron concentrations are likely a consequence of the hydrocarbon contamination driving the groundwater system into an anaerobic state therefore, to effectively decrease the iron concentrations, hydrocarbons in the source area need to be addressed.

Table 2-1. Constituents of Concern in Soil and Groundwater

Soil COC	Maximum Concentration (mg/kg)	Soil Cleanup Level[1] (mg/kg)
1,2,4-	205	23
1,3,5-TMB	81.1	23
1,2,3	0.374	0.00053
Benzene	438	0.025
Ethylbenzene	392	6.9
Methylene chloride	0.188	0.016
n-Butylbenzene	107	15
sec-Butylbenzene	25.3	12
n-Propylbenzene	72.7	15
Toluene	1,330	6.5
Xylenes	2,510	63
1-Methylnaphthalene	88.5	6.2
2-Methylnaphthalene	240	6.1
Naphthalene	125	20
Sulfolane	1,620	TBD
GRO	7,730	300
DRO	32,000	250
RRO	64,700	11,000
Groundwater COC	**Maximum Concentration (µg/L)**	**Groundwater Cleanup Level[2] (µg/L)**
Benzene	52,700	5
Ethylbenzene	3,230	700
Toluene	63,000	1,000
Xylenes	16,800	10,000
Sulfolane	61,600	TBD
GRO	20,800	2,200
DRO	2,150	1,500

Notes:
1,3,5-TMB = 1,3,5-trimethylbenzene
DRO = diesel range organics
GRO = gasoline range organics
RRO = residual range organics

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[1] Soil cleanup level set at the minimum value of the direct contact, outdoor inhalation and migration to groundwater value in 18 AAC 75 Table B1 and B2 for the under 40-inch zone.

[2] Groundwater cleanup level set at 18 AAC 75 Table C value.

2.4 Conceptual Site Model – Distribution of Constituents of Concern

The Conceptual Site Model (CSM) was presented as Appendix A to the Onsite SCR (ARCADIS 2013f). The CSM summarizes COCs and sources, release mechanisms, impacted media, transport mechanisms, geology, permafrost, hydrogeology, exposure routes, and potential receptors.

Environmental impacts at the NPR and in areas downgradient from the NPR have been extensively characterized. A partial list of the environmental assessment activities is presented in Table 2-2.

Table 2-2. Summary of Environmental Assessment Activities as of December 2013

Assessment Technique	# Completed
Soil borings advanced	227
Monitoring wells installed	504
Soil samples collected and analyzed	1,032
Groundwater samples collected and analyzed	7,069

Notes:
Cumulative boring, monitoring well, and sample numbers are approximate since 2009. In addition to traditional soil and groundwater sampling, site characterization efforts have included investigations to assess LNAPL, soil gas, surface water, soil and aquifer characteristics, permafrost, and geophysical subsurface data. Other focused studies have included tracer tests, pumping tests, isotope studies, and biostudies.

Onsite soil, groundwater, and soil gas are impacted. Surface water samples collected from the NGP and SGP prior to 2013 and from the NGP in 2013 did not contain detectable concentrations of sulfolane. In addition, sulfolane does not bioaccumulate and no risk to ecological receptors was identified. The COCs impacting environmental media onsite are summarized in Section 2.3. Historical data tables are included in Appendix A.

2.4.1 Soil

The nature and extent of soil impacts onsite have been characterized through the collection of more than 1,000 soil samples during site characterization activities conducted in 2011 (Barr 2012a), 2012 (ARCADIS 2013a), and 2013 (ARCADIS 2013f).

2.4.1.1 Petroleum Hydrocarbons

Because of the shutdown of the refinery there are no ongoing, refinery operation-related petroleum hydrocarbon sources at the NPR. The extent of the historical soil contamination at the site has been delineated vertically and horizontally. Petroleum hydrocarbon COC impacts in soil are confined onsite. The highest concentrations of COCs are consistently found near the air-groundwater interface or the LNAPL smear zone. Petroleum hydrocarbon impacts have been reported above the Method 2 soil cleanup levels (Table B1 and B2 of 18 AAC 75.341(c)) at the Crude Unit #1 Wash Area (CU #1 Wash Area), Crude Unit #2 Extraction Unit (CU #2 EU), and Sump 908, and are collocated with LNAPL impacts in these areas. Benzene is an indicator of petroleum impacts and site-wide benzene concentrations are summarized on Figures 2-4 through 2-8.

2.4.1.2 Sulfolane

There are no ongoing operation-related sulfolane sources at the NPR. Sulfolane impacts to soil are confined onsite; sulfolane source areas are discussed in the Onsite SCR (ARCADIS 2013f). The most significant sulfolane impacts in onsite soil are found in Lagoon B, the Southwest Former Wash Area (SWA), Sump 908, CU #1 Wash Area, and CU #2 EU Area. These source areas are located coincident with systems that mitigate the risk to offsite receptors. Except for two source areas, most sulfolane-impacted soil is located under significant site infrastructure and/or at depths that make further removal and treatment impracticable.

However, as discussed below, two sulfolane source areas proposed for excavation in this OCP include onsite areas that are accessible and do not have operational constraints (i.e., Lagoon B and the SWA). Sulfolane concentrations detected in soil samples collected from Lagoon B are shown on Figure 2-9. Sulfolane concentrations detected in soil samples collected from the SWA are shown on Figures 2-10 through 2-13.

2.4.1.3 Perfluorooctane Sulfonate and Perfluorooctanoic Acid

PFOS and PFOA were detected in samples collected from soil in the Fire Training Area (FTA) on the southwest part of the NPR (Figure 2-14). The PFOS and PFOA impacts were found in soil above an impervious liner. Soil impacts, including other detected COCs within the FTA, are shown on Figures 2-14 and 2-15.

2.4.2 Groundwater

The nature and extent of groundwater impacts have been characterized through an immense amount of data collected, including more than 2,700 groundwater samples from 339 onsite wells since 2009. The lateral and vertical extents of petroleum hydrocarbons and sulfolane impacts are known. Data collected during the first quarter of 2014 is generally consistent with historical data.

Petroleum hydrocarbon COC concentrations in groundwater are generally collocated with LNAPL impacts. Sulfolane concentrations in groundwater are consistent with identified sulfolane source areas including Lagoon B, Sump 908, CU #2 EU, CU #1 Wash Area, and the SWA. Generally, onsite sulfolane concentrations in groundwater downgradient of the extraction wells are stable or decreasing, indicating that source mass is effectively captured by the historic groundwater remediation system.

2.4.2.1 Petroleum Hydrocarbons

The benzene plume is largely confined to the developed portion of the NPR and does not extend to the north property boundary. Benzene is an indicator of petroleum impacts and benzene concentrations above 5 micrograms per liter µg/L were most often detected in areas where LNAPL is present in soil. Wells with other petroleum COC detections are generally located within the footprint of the benzene plume. The benzene plume is delineated laterally and vertically to the water table and is currently captured by the historic groundwater remediation system that began operating in 1987 (see Section 2.5). Benzene concentrations detected in first quarter 2014 in onsite groundwater monitoring wells screened across the water table are shown on Figure 2-16.

2.4.2.2 Sulfolane

The most significant sulfolane source areas at the site are CU #2 EU, CU #1 Wash Area, the SWA, Sump 908, and Lagoon B. In first quarter 2014, detectable sulfolane concentrations in groundwater extended from the source areas to the north property boundary at a depth of up to 90 feet bgs (at well MW-364-90).

The majority of the sulfolane plume at the water table results from three of the identified source areas (CU #2 EU, CU #1 Wash Area, and Lagoon B [well MW-110-20]) and extends north to include the Sump 908 area (MW-176A-15). Optimization of the original groundwater remediation system, herein referred to as “Granular Activated

Carbon (GAC) East" has been ongoing since 2009, improving the overall performance of the system. However, groundwater modeling indicated that the western portion of the sulfolane plume was not being captured by the GAC East system (Barr 2012b). Thus, in June 2014, FHRA installed two additional recovery wells and an additional groundwater remediation system west of the current line of recovery wells to provide capture across the entire width of the plume. The additional groundwater remediation system is referred to as "GAC West." Together the GAC East system and the GAC West system is referred to as the "Groundwater Remediation and Treatment System" or "GRTS."

The bulk of the sulfolane plume will be captured by the combined groundwater remediation system. FHR believes that data to date indicate that the entire sulfolane plume with concentrations of more than 15 µg/L located upgradient of the groundwater extraction well transect is captured. This is referred to as hydraulic control and involves capturing the groundwater plume of contaminants to a specific depth and width. Note that in the event that the cleanup level for the site is instituted at a level different than the 15 µg/L, the system's performance will be adjusted to meet the cleanup level. Prior to any adjustment, a pre-scoping meeting will be held if FHRA deems it necessary. Upon request by FHRA to adjust the system's performance, ADEC will act upon the request within thirty days provided the submittal is complete.

Currently, detectable sulfolane concentrations are present downgradient of the GAC East system capture zone. However, results of groundwater capture evaluations conducted in 2013, combined with steadily decreasing groundwater concentration trends, indicate that the detectable sulfolane concentrations downgradient of the groundwater remediation system are the result of historical releases and are not the result of ongoing bypass of the system (ARCADIS 2013f). There are a limited number of wells where sulfolane concentrations have been noted to be stable, such as MW-304-15. These results are consistent with the CSM included in the 2013 On-site Site Characterization Report.

The Second Quarter 2014 Groundwater Monitoring Report (ARCADIS 2014c) presents a capture zone estimate for June 30, 2014 (that includes GAC West wells in operation) that indicates complete capture at the water table across the sulfolane plume. July and August data show similar results. These will be documented in the next quarterly report to ADEC. Additionally, capture zone testing for the GAC West system was performed as planned in August, 2014, and while all analysis and reporting is not complete, the preliminary evaluation indicates complete capture across the system at the water table and capture to similar or greater depths in cross-sections that have been estimated previously. Sulfolane concentrations in onsite groundwater are shown on Figures 2-17 through 2-20. Mann-Kendall trends calculated for onsite wells are shown on Figures 2-21 through 2-24.

Groundwater monitoring data collected during first quarter 2014 (ARCADIS 2014b) further defined the extent of the sulfolane plume. FHRA installed monitoring well nests (MW-186, MW-334, MW-344, MW-345, and MW-370) along the transect of currently operating remediation wells. The groundwater table is encountered at approximately 10 feet bgs, while the deepest monitoring wells in these nests were screened to approximately 75 or 85 feet bgs, which is the maximum depth of the onsite sulfolane plume with concentrations of more than 15 µg/L, as well as the depth of capture of the recovery wells. Except MW-154B-95 and MW-320-70, no other wells screened at a depth of 70 feet bgs or deeper onsite contained a concentration greater than 15 µg/L during first quarter 2014 (ARCADIS 2014b). Section 5.4.3 further discusses the groundwater remediation system performance monitoring.

Since installation of the well nests along the remediation well transect, sulfolane has not been detected in monitoring wells MW-334-85, MW-344-75, or MW-370-75, while detections in monitoring wells MW-345-75 and MW-351-75 have been near the analytical detection limit. Sulfolane concentrations in monitoring well MW-186E-75 have consistently decreased since the highest concentration was detected in November 2012. Except for well MW-186E-75, these wells have relatively short monitoring records because they were recently installed. However, downgradient monitoring wells have longer periods of record that support the data collected from monitoring wells along the recovery well transect. Section 5.4.3 further discusses the groundwater remediation system performance monitoring.

Sulfolane concentrations in well MW-154B-95, located downgradient of the remediation well transect, have generally decreased since August 1, 2012. Sulfolane concentrations at the vertical profiling transect (VPT) were detected to a maximum depth of 80 feet bgs in well MW-302-80 and concentrations in this monitoring well have been decreasing since June 2012 (ARCADIS 2014b). Sulfolane concentrations in this area are due to historical releases of sulfolane and the observed decreasing trends correlate to groundwater remediation system optimization and expansion implemented by FHRA since 2009. Sulfolane concentrations in onsite wells are shown on Figures 2-17 through 2-20.

Evaluations conducted in 2013 indicate that the GAC East system is capturing dissolved sulfolane concentrations greater than 15 µg/L, except at the western margin of the site, as shown in Appendix B. An evaluation of the GAC East system capture from the Fourth Quarter 2013 Groundwater Monitoring Report (ARCADIS 2014a) is included in Appendix C. Figures showing capture during third quarter 2013, as presented in the Third Quarter 2013 Groundwater Monitoring Report (ARCADIS 2013d), are included in Appendix D. Particle tracking figures, as generated by the FEFLOW numerical groundwater model prepared for the site and included in the Revised IRAPA (ARCADIS 2013c), are included in Appendix E.

The relatively limited concentrations of sulfolane detected at depths greater than 85 feet bgs are decreasing and there is no indication that the relatively higher concentration in one private well (709 µg/L at PW-1230 in March 2014), detected downgradient and offsite, is directly correlated to the onsite source areas which, based on FHRA's evaluations set out in Section 2.4.2.2 above, are under hydraulic control. This offsite concentration appears to be related to historical releases that occurred prior to expansion and optimization of the historic groundwater remediation system. A recent capture evaluation, included in the Fourth Quarter 2013 Groundwater Monitoring Report (ARCADIS 2014a), is provided as Appendix D.

2.4.2.3 Perfluorooctane Sulfonate and Perfluorooctanoic Acid

Groundwater monitoring for PFOS and PFOA show that detectable concentrations of PFOS and PFOA are present in groundwater at the site. The slightly elevated concentrations were limited to MW-321-15 (located adjacent to Lagoon A) and groundwater immediately adjacent to the FTA, as determined during the Phase II investigation (ARCADIS 2013b). Elevated perfluorinated compound (PFC) detections do not extend downgradient from these two locations.

2.4.3 Light Nonaqueous Phase Liquid

The nature and extent of LNAPL has been thoroughly characterized through 26 years of LNAPL recovery and data collection, along with intense efforts to assess LNAPL composition, mobility, and recoverability during the past 3 years.

The LNAPL present at the site has been characterized by forensic analysis as diesel #2, naphtha, Jet A, mixtures of these fuels, and mixtures with gasoline in some locations. In addition, the following information has been identified regarding LNAPL impacts at the site (ARCADIS 2013f):

- The extent of the LNAPL impact is known.

- LNAPL is not a significant source of sulfolane to groundwater.
- The LNAPL plume is stable with the GRTS operating.
- The dissolved-phase benzene and total xylene plumes are stable with the GRTS operating.
- LNAPL is readily recoverable in some areas of the site.
- Natural processes are depleting the LNAPL at a significant rate.

The extent of the LNAPL impact is shown on Figure 2-25. LNAPL transmissivity data from 2011 through 2014 are shown on Figure 2-26.

2.4.4 Vapor Intrusion

Compounds volatilize from source areas and move throughout the surrounding soil pore spaces as soil gas. Soil gas source areas may include shallow dissolved-phase volatile organic compounds (VOCs) in groundwater, impacted soil in the vadose zone, or LNAPL above or near the water table.

Soil gas samples were collected at the site in 2013 as part of remedial pilot testing. Results of soil gas analyses are summarized in the Onsite SCR (ARCADIS 2013f).

Indoor vapor intrusion (VI) may be a potentially complete exposure pathway and is discussed in Section 3.4.

2.5 Ongoing Remedial Measures

The ongoing remediation actions at the site include active groundwater recovery and treatment for benzene, toluene, ethylbenzene, and xylenes (BTEX) and sulfolane, active LNAPL recovery and recycling, and LNAPL natural source zone depletion (NSZD). The GAC East system is described in the Revised IRAPA (ARCADIS 2013c). Progress updates are provided in the quarterly groundwater monitoring reports (ARCADIS 2014b). Replacement wells described in the Revised IRAPA (ARCADIS 2013c) were installed during first quarter 2013 and extraction from the wells was initiated during second quarter 2013. The main components of the remediation systems during first quarter 2014 are described below:

- Groundwater recovery and treatment from nine recovery wells (R-21, R-35R, R-42, R-43, R-44, R-45, R-46. R-47, and R-48 commenced operation in June of 2014. The locations of the wells are shown on Figure 2-27.

- The recovered groundwater from the GAC East system passes through a prefilter for solids removal, a coalescer for LNAPL removal, and four air strippers for removal of VOCs, and then flows into the Gallery Pond. Groundwater from the Gallery Pond is pumped through sand filters and a four-vessel GAC system, which were added as part of the IRAP (Barr 2010) implementation in 2011. The sand filters were added to remove suspended solids, and the GAC system was added to remove sulfolane and other COCs. Treated groundwater is discharged to the SGP. The layout of the GAC East system is shown on Figure 2-27 and a process flow diagram of the system is shown on Figure 2-28.

- Pneumatic LNAPL recovery systems are operated seasonally or when recoverable LNAPL is present in wells MW-138, MW-334-15, R-20R, R-21, R-35R, R-40, R-45, and S-50. FHRA uses a hand-held LNAPL recovery pump or vacuum truck at other locations if LNAPL is present and recovery is possible. Recovery wells R-43, R-44, and R-46 also have the capability for pneumatic recovery system operation; however, enough LNAPL for operation of pneumatic recovery systems was not present at these locations during the first quarter 2014. LNAPL was also recovered from additional locations during baildown testing and manual skimming testing. Additional details about the LNAPL recovery program are summarized in Section 5.2.

2.5.1 Groundwater Recovery and Treatment

FHRA is currently remediating groundwater by extracting and treating groundwater onsite, as summarized in the First Quarter 2014 Groundwater Monitoring Report (ARCADIS, 2014b). In June 2014, the system was expanded. The GAC West System is located west of LNAPL impacts and does not need petroleum treatment measures. It uses a similar gallery pond, sand filter, and GAC treatment system to remove sulfolane prior to discharge to the NGP. The layout of the current extraction well network is shown on Figure 2-27.

Optimization and expansion of groundwater extraction operations has been ongoing since 2009. Groundwater recovery and treatment is currently ongoing at nine recovery wells (R-21, R-35R, R-42, R-43, R-44, R-45, R-46, R-47, and R-48).

Cumulative groundwater recovery and treatment for each year is summarized below:

- 2009: 69,200,000 gallons
- 2010: 107,100,000 gallons

- 2011: 136,900,000 gallons
- 2012: 188,300,000 gallons
- 2013: 200,815,291 gallons
- 2014: 91,136,491 gallons (through June 2014)

As shown in the groundwater recovery totals above, FHRA has continued to increase the total volume of recovered groundwater. Recovered groundwater is pumped to an onsite groundwater remediation system that removes LNAPL and dissolved-phase contaminants. The effectiveness of the groundwater remediation system is discussed below:

- The air stripper towers effectively remove the majority of dissolved-phase hydrocarbons from the recovered groundwater prior to discharge to the Gallery Pond.

- A GAC filter system removes sulfolane and any BTEX constituents that are not removed by the air strippers.

- Sulfolane reduction has been observed across the air strippers and between the air stripper outlets and the GAC vessel inlet. The remaining sulfolane is removed by the GAC system and is destroyed when the GAC is changed out and thermally treated for disposal.

FHRA recently implemented the interim remedial actions described in the IRAP (Barr 2010), SCR – 2011 (Barr 2012a), and Revised IRAPA (ARCADIS 2013c), including expansion of the GAC East system to the west of the current layout. This includes installation of the new GAC West treatment infrastructure and two additional wells (R-47 and R-48) described in Section 5.3.2. A process flow diagram for the GAC West system is included on Figure 2-29. These remedial actions have expanded and optimize the GAC East system to address remaining sulfolane source areas that were identified through completion of the site characterization process. The Second Quarter 2014 Groundwater Monitoring Report (ARCADIS 2014c) presents a capture zone estimate for June 30, 2014 (that includes GAC West wells in operation) that indicates complete capture at the water table across the sulfolane plume. July and August data show similar results.

2.5.2 Light Nonaqueous Phase Liquid Recovery

FHRA continues to perform LNAPL recovery via automated LNAPL skimmer systems when adequate LNAPL thickness is present in wells. Manual LNAPL recovery was completed during the first quarter 2014 using various mechanical and hand methods. The recovered LNAPL from the skimmer systems and manual recovery activities is either recycled or properly disposed at an offsite facility, depending on the site's operational capabilities.

From 1986 to present, approximately 395,400 gallons of LNAPL have been recovered (ARCADIS 2014b). Overall LNAPL recovery volumes are decreasing despite more aggressive recovery efforts, which indicates that the volume of recoverable LNAPL is decreasing.

2.5.3 Natural Source Zone Depletion

A qualitative evaluation of the chemical composition of groundwater and soil gas indicates that LNAPL is being depleted through natural processes, including dissolution, volatilization, and biodegradation in the saturated and unsaturated zones. As discussed in the Onsite SCR (ARCADIS 2013f), NSZD rates were quantified and the idealized total mass loss rate was estimated as high as 51,000 gallons per year in the saturated and unsaturated zones. This depletion rate may be biased high due to seasonal changes in soil diffusivity and biological activity. However, at a minimum, the natural LNAPL depletion rate at the site is on the order of tens of thousands of gallons per year (ARCADIS 2013f).

2.5.4 Offsite Area – Alternative Water Solutions Program

Upon the detection of sulfolane in an offsite monitoring well in October 2009, FHRA immediately began sampling private wells of residents and businesses near the NPR and providing alternative water solutions to those with impacted wells. As of September 20, 2013 and since monitoring began, 800 private wells have been sampled and 354 have yielded detectable concentrations of sulfolane. This work is ongoing; however, it is not in the scope of this OCP.

3. Cleanup Objectives

This section discusses cleanup objectives based on 18 AAC 75.325 -390 with the primary goal of protection of human health and the environment at an industrial facility with no onsite exposure concerns.

3.1 Institutional Controls

ICs are an essential part of this OCP to protect human health and environment per 18 AAC 75.375. ICs will be needed to limit, prohibit, or protect against activities that could result in human or environmental exposure to a hazardous substance; or that could interfere with the integrity of cleanup activities (18 AAC 75.990(54)), which meet some of the cleanup objectives described below for the impacted media. Protective ICs will be put in place for this site.

3.2 Soil

Cleanup objectives for soil are:

- Protect onsite workers from unacceptable exposure to COCs in impacted soil.
- Remove the highest concentration sulfolane-impacted soil from non-operational areas of the site to decrease sulfolane leaching to groundwater and reduce the operating life cycle of long-term remedial measures.
- Manage soil per ADEC regulations.

These objectives will be achieved through a combination of engineered cleanup actions and ICs. Cleanup actions will be focused outside the operational areas of the site with available access and where historical assessment activities have identified elevated concentrations in soil. Soil impacts in process areas and operating units cannot be effectively accessed for soil remediation because of large equipment and aboveground and underground utilities and infrastructure. These areas of the site will be addressed with ICs and engineering and administrative controls, and will be coupled with groundwater cleanup actions to prevent offsite migration of COCs.

3.3 Groundwater

Cleanup objectives for groundwater are:

- Protect onsite workers and future receptors from unacceptable exposure to COCs in impacted groundwater.

- Meet 18 AAC 75.345 Table C cleanup levels at an alternative point of compliance (VPT multilevel monitoring wells plus MW-141-30) established per 18 AAC 75.345(e).

- Meet the combined groundwater extraction and treatment system performance standard of 15 µg/L for sulfolane at the vertical profile transect wells plus MW-141-20. When ADEC determines a final cleanup level for sulfolane at the site, the 15 µg/L will be replaced with the ADEC final cleanup level.

- Manage contaminated groundwater consistent with 18 AAC 75.360.

- Prevent offsite migration of COCs at concentrations that would pose a risk to potential offsite receptors.

The proposed remedies to achieve these objectives are operation and performance monitoring of the groundwater extraction and treatment system, compliance monitoring, and implementation of ICs.

3.4 Light Nonaqueous Phase Liquid

The LNAPL cleanup objectives are:

- Remove LNAPL to the maximum extent practicable as presented in 18 AAC 75.325(f).

- Protect onsite workers from unacceptable exposure to COCs resulting from direct contact with LNAPL.

- Prevent offsite migration of the LNAPL plume.

Proposed remedies to achieve these objectives include continuation of the current program of hydraulic recovery, LNAPL NSZD, and ICs.

3.5 Vapor Intrusion

The soil gas cleanup objective is:

- Protect onsite workers from unacceptable exposure to COCs resulting from indoor VI into occupied buildings.

The proposed remedy to achieve these objectives is the implementation of ICs that include both engineering and administrative controls.

4. Facility Operational Constraints

The NPR is an idled refinery. It is anticipated that the refinery will either restart under new ownership, or continue operation as a fuel terminal. In either case, future land use of the property will remain consistent with an industrial manufacturing setting given its significant infrastructure and capabilities.

The site's infrastructure imposes constraints on the onsite remedial actions by restricting access to soil, groundwater, and LNAPL located near and under the existing infrastructure. Cleanup actions (discussed in Section 5) were designed considering these constraints, while still being protective of potential onsite receptors. Modifications to the scope of work proposed in Section 5 may be necessary based on conflicts with current operations identified during the internal FHRA construction management process.

5. Cleanup Actions

Various alternatives for onsite cleanup were established and reviewed in the Draft Final Onsite Feasibility Study (Draft Final Onsite FS; ARCADIS 2012b). Although this study has not been approved by ADEC, the Draft Final Onsite FS (ARCADIS 2012b) determinations were helpful to the development of this OCP. The Draft Final Onsite FS (ARCADIS 2012b) presents a detailed and comparative analysis of remedial alternatives. Twenty LNAPL, 18 soil, and 16 groundwater remedial alternatives were evaluated and between two and five potential remedial alternatives were selected for potential implementation in applicable site areas (ARCADIS 2012b).

The following cleanup actions were chosen from the selected remedial alternatives reviewed based on risk, practicability, implementability, and cost. This section discusses the following proposed cleanup actions for the onsite area:

- *LNAPL*. LNAPL recovery and implementation of administrative controls.
- *Soil*. Excavation and implementation of ICs.
- *Groundwater*. Groundwater extraction and treatment, establishment of an alternative point of compliance, and implementation of ICs.
- *Soil gas*. Implementation of ICs.

5.1 Institutional Controls

ICs will be developed consistent with ADEC's Guidance for Using Institutional Controls in Oil and Other Hazardous Substance Cleanups (ADEC 2011). Institutional controls will include:

- Limit the property use to industrial.
- Prohibition against use of groundwater for drinking water purposes.
- Fencing maintenance.
- Protective measures for excavation of soils in the defined contamination area. See the Map of Potentially Contaminated Soil attached to the Onsite Soil Management Health and Safety Plan (Attachment 1 to the Long-Term Monitoring Plan).

- Protective measures to limit groundwater vapor exposures in buildings currently used on site and requirements applicable to construction of new buildings on site to protect building occupants.

Documents (whether via deed restrictions, equitable servitudes or other forms consistent with ADEC's above referenced guidance) to memorialize the above institutional controls will be drafted and submitted to the Attorney General and ADEC for approval prior to implementation.

5.2 Light Nonaqueous Phase Liquid

The proposed cleanup actions to achieve the LNAPL cleanup objectives are:

- *Continue current LNAPL hydraulic recovery operations*. LNAPL recovery operations include skimming (through both the GAC East system and individual skimming systems) and intermittent mechanical (e.g., vacuum truck) or hand recovery (e.g., hand pumps). Continuous and seasonal ongoing LNAPL skimming will recover mobile LNAPL, reduce LNAPL mass, and support NSZD. Continuous operation of the GAC East system will sustain current conditions under which LNAPL is not migrating and will recover mobile LNAPL. NSZD is ongoing at the site, further remediating LNAPL through natural processes. Periodic LNAPL baildown tests will be conducted to evaluate transmissivity and recoverability of LNAPL in accessible areas of the site per the Revised Sampling and Analysis Plan ("RSAP"), which was included as Appendix A to the Fourth Quarter 2013 Groundwater Monitoring Report (ARCADIS 2014a).

- *Implement ICs.* The ICs will be an effective remedy to protect current and future onsite workers from potential exposure to soil gas. NSZD is ongoing at the site, further remediating LNAPL through natural processes.

Collectively, these are the proposed final remedies to address LNAPL impacts.

Hydraulic recovery remedial alternatives (e.g., skimming) comprise the majority of the LNAPL remedial alternatives identified for potential implementation of the LNAPL remedy. FHRA has successfully implemented hydraulic recovery operations at the NPR and proposes to continue the operations as discussed below. NSZD was also evaluated for implementation on a site-wide basis and scored well in the Draft Final Onsite FS (ARCADIS 2012b). Additional field data collected since the Draft Final Onsite FS (ARCADIS 2012b) was prepared indicate that tens of thousands of gallons of LNAPL are likely degraded each year. Thus, NSZD is identified as a cleanup action for the site.

5.2.1 Historical Operation

Active remediation is ongoing to recover LNAPL at the site. From 1986 through the first quarter 2014, approximately 395,638 gallons of LNAPL were recovered at the site. Annual recovery volumes have generally decreased as remediation has progressed and the volume of recoverable LNAPL has decreased.

5.2.2 Basis of Design

The proposed LNAPL cleanup action to continue current LNAPL hydraulic recovery operations is based on the following, as stated in Section 2.4.3.1:

- The extent of the LNAPL impact is known.
- LNAPL is not a significant source of sulfolane to groundwater.
- The LNAPL plume is stable with the GRTS operating.
- The dissolved-phase benzene and total xylene plumes are stable with the GRTS operating.
- LNAPL is readily recoverable in some areas of the site.
- Natural processes are depleting the LNAPL at a significant rate.

5.2.2.1 Skimming Well Selection and Operational Timeframes

To date, volumetric LNAPL recovery rates and LNAPL transmissivities indicate that LNAPL at the site is recoverable. LNAPL transmissivity was assessed at the site using multiple methods.

FHRA field staff currently perform LNAPL baildown testing semiannually, generally in March and late October to target hydrogeologic minima. The results are then evaluated and used to optimize recovery operations. If water levels indicate that the current testing timeframes are not achieving the intent of targeting hydrogeologic minima, then the timeframes will be modified.

5.2.2.2 Equipment and Implementation

A typical pneumatic skimmer consists of a submersible air-driven pump, with an intake located behind a hydrophobic filter. The intake and filter are located on a vertical slide apparatus; the density of the filter allows the intake to be placed at the LNAPL/water interface.

The typical operational configuration of a skimming system will include the following components:

- Two-inch-diameter monitoring well or 4-inch-diameter recovery well
- Compressed air supply for the skimmer pump
- Collection drums for the recovered product
- Well houses to insulate the skimmer systems for winter operations

Wells identified for continuous LNAPL recovery will be equipped with a pneumatic skimming unit with a floating, hydrophobic pump intake to target removal of LNAPL. LNAPL will be collected in a 55-gallon drum (or larger tank as needed) for recycling.

During periods of high water table elevation (generally during the summer months) when the LNAPL smear zone may be submerged, flow of LNAPL into recovery wells is expected to be minimal and skimming may be discontinued until groundwater elevations drop.

At locations where LNAPL transmissivity is low, or other restrictions prevent installation of a permanent skimmer pump, non-continuous or seasonal LNAPL skimming may be proposed.

5.2.2.3 Natural Source Zone Depletion

A quantitative evaluation of the chemical composition of groundwater and soil gas indicates that LNAPL is being depleted through ongoing natural processes, including dissolution, volatilization, and biodegradation in the saturated and unsaturated zones. LNAPL is not migrating and the LNAPL plume is further controlled by the groundwater extraction operations (discussed in Section 5.4.1). NSZD, in conjunction with the other LNAPL cleanup actions described above, will continue to reduce the volume and mobility of LNAPL at the site. Geochemical parameter data collected during the third quarter of each year will be qualitatively evaluated to observe conditions consistent with NSZD.

The process of volatilization during NSZD creates soil gas, which could potentially represent a risk for indoor VI. Currently, three buildings are located above the LNAPL plume: laboratory, fire house, and terminal building. Institutional controls (including administrative and engineering controls) to address potential VI are discussed in Section 5.2.4.

5.2.3 Light Nonaqueous Phase Liquid Performance Monitoring

LNAPL performance monitoring is described in the OM&M Plan (Barr 2014).

5.2.4 Institutional Controls

Implementation of administrative and engineering controls will protect receptors from potential risk from soil gas associated with the presence of LNAPL. FHRA stresses worker safety through implementation of the Safe Work Program. Currently, three buildings are located above the LNAPL plume: laboratory, terminal building, and fire training house. FHRA contracted Holaday-Parks Inc. to review the ventilation in the laboratory and the terminal building in 2008 (both buildings) and 2013 (laboratory only).

ICs will be used so that potential future construction of buildings over the LNAPL plume will be protective of workers (as required by the Occupational Safety and Health Administration [OSHA]).

5.2.4.1 Laboratory

A review of the ventilation reports indicates that the laboratory spaces were designed to be under negative pressure, as is standard for chemical laboratory construction. The calculated air exchange rate for the laboratory averaged 6.1 air exchanges per hour. This air exchange rate was based only on the mechanically supplied outside air and did not account for the influence of the laboratory hood system. The total building air exchange rate based on exhausting of the fume hoods is 18.3 air exchanges per hour.

In many evaluations of VI such as those based on the Johnson and Ettinger model, lower air exchange rates are used (e.g., 0.25) that are conservative even for residential buildings (Environmental Quality Management 2004). The fume hoods are an engineering control that serve as a protective measure for the daily work with petroleum samples conducted in the laboratory. While the negative pressurization could induce some VI, the majority of the makeup air for the hoods is likely delivered through the mechanically supplied air and leakage through the walls, doors, windows, and/or roof systems. The high rate of air exchange provides some protection against the potential effects of VI and will remain in place.

5.2.4.2 Terminal Building

A review of the ventilation report for the terminal building indicates that this building is positively pressurized as long as the heating, ventilation, and air conditioning (HVAC) is operating, because the mechanical flow is 960 cubic feet per minute (cfm) of air, of which 460 cfm is outside air. The total capacity of the exhaust systems in the utility room and bathroom is 215 cfm. Therefore, the supplied air considerably exceeds the exhausted air. This would be expected to provide protection against VI, per ADEC guidance (ADEC 2012).

5.2.4.3 Fire Training House

A ventilation audit was also conducted in the fire training house in 2008. The office space was provided with 1,725 cfm of outside air with an air handler. It is reasonable to conclude that the main portion of the fire training house is under positive pressure when the HVAC system is operating. If the HVAC system is operated continuously, it will provide a protective benefit with regard to VI.

Future office use at the fire training house is still under review. If a decision is made to occupy the building on a routine basis, additional controls will be implemented to ensure that the HVAC system is operated at a frequency that will maintain positive pressure and ventilation to mitigate a potential future exposure pathway. Daily monitoring of the terminal and fire training buildings will also be continued, as discussed in Section 5.5.

5.2.5 Cleanup Verification

When LNAPL recovery has been performed to the maximum extent practicable as defined in the OCP, FHRA will verify that cleanup objectives set out in the OCP have been met. This verification will include:

- A demonstration that the LNAPL cleanup objectives have been met.
- Show that the LNAPL footprint at low water conditions has declined over time and is maintained with the groundwater pumping system not operating
- Evaluate LNAPL recovery in the absence of groundwater pumping.
- Evaluate whether recoverable LNAPL exists pursuant to 18 AAC 75.325(f)(1)(B).

- Evaluate whether there are any unacceptable risks to human health or the environment due to remaining residual LNAPL or its constituent chemicals in groundwater, soil or soil gas.

- Establish a post active remediation monitoring program to demonstrate achievement of cleanup objectives. Monitoring will continue for five years after remediation activities are complete. At that time, assuming cleanup objectives are still being met, the work under this plan will be considered completed

- If cleanup objectives are not met, additional remedial efforts for LNAPL should be considered and evaluated.

5.3 Soil

The proposed cleanup actions to achieve the soil cleanup objectives are soil excavation and implementation of ICs. The proposed ICs will be an effective remedy to protect current and future onsite workers from unacceptable exposure to COCs in impacted soil. Soil excavation is an effective remedy to decrease sulfolane mass stored in soil moisture. Collectively, these are the proposed final remedies to address soil impacts.

Excavation with incineration was the only remedial alternative retained for the SWA in the Draft Final Onsite FS (ARCADIS 2012b). At the time of submittal of the Draft Final Onsite FS (ARCADIS 2012b), the SWA was referred to as the “Fire Training Area.” In subsequent documents, the area was renamed the SWA to more accurately depict the site layout and historical operations. In the Draft Final Onsite FS (ARCADIS 2012b), excavation with incineration was also retained for Lagoon B and remedial alternatives were not evaluated for the FTA.

The excavation sidewalls and base will be characterized in accordance with the ADEC Draft Field Sampling Guidance (May 2010) consistent with the descriptions below for each excavation area. Per Table 2B of the guidance, excavation base samples for laboratory analysis are to be collected at a frequency of 2 per 250 square feet plus one sample per additional 250 square feet of excavation area, and excavation sidewall samples for laboratory analysis are to be collected at a frequency of one per 20 linear feet. ADEC has discretion to approve different sample frequencies as appropriate; the sample frequencies proposed in this section are modified from the recommended frequency where appropriate to consider historical sample results. As there is no field screening method for sulfolane, only laboratory samples will be collected from the

Lagoon B and SWA excavations. Consistent with historical soil sampling, the soil samples will be collected from fine-grained soil layers to the extent possible from locations that are distributed relatively evenly across the excavation base and sidewalls. An after action report will be submitted to ADEC.

Soil planned for excavation will be characterized for treatment or disposal prior to excavation. The groundwater remediation systems will prevent offsite migration of dissolved-phase impacts from any soil left in place.

The proposed soil excavation cleanup actions are presented in Sections 5.3.1, 5.3.2, and 5.3.3. Proposed ICs and engineering and administrative controls are presented in Section 5.3.4.

5.3.1 Soil Excavation from Lagoon B

Lagoon B is located on the western portion of the site and was historically used to store wastewater. Soil sampling conducted in 2012 and 2013 indicated elevated concentrations of sulfolane in soil samples collected from the base of the lagoon. Dissolved-phase concentrations of sulfolane in groundwater downgradient of the lagoon are generally decreasing, and the groundwater remediation system will eliminate the potential for offsite migration of sulfolane from this source area.

5.3.1.1 Lagoon B Soil Excavation Specifications

Between 2012 and 2013, soil samples were collected from 36 locations to delineate the horizontal and vertical limits of impacted soil beneath Lagoon B. Soil sample locations were spatially located throughout the lagoon, with samples collected from each location at depth intervals between the surface and the water table. Generally, sample collection targeted fine-grained soil and soil at the groundwater surface.

Boring locations, as well as sulfolane concentration data for each location, are shown on Figure 2-9. The remedial excavation design is based on a focused removal of unsaturated soil containing the highest concentrations of sulfolane. Additional consideration was given to the implementability of the excavation. The planned extent of the excavation is shown on Figure 5-2.

The excavation will be advanced vertically through the unsaturated soil, terminating at a depth of approximately 3 feet bgs. Significant site characterization activities have delineated the extent of sulfolane in the excavation area. The intent of this excavation is removal of mass in unsaturated soil. While some residual concentrations of sulfolane will be left in place, this remedy will still be protective of potential offsite receptors. There is no mechanism for soil to migrate offsite and any residual effect on groundwater will be captured and remediated by the GAC West system, as discussed in Section 5.3.

The design excavation volume is approximately 416 cubic yards (cy). Due to the relatively shallow depth of groundwater beneath the bottom of the lagoon, no sloping is required. Figure 5-2 depicts the anticipated limits of excavation.

The design excavation volume is approximately 416 cy in three excavation areas. Figure 5-2 depicts the anticipated limits of excavation. Sulfolane is the primary COC at Lagoon B, and the excavation boundary samples will be analyzed for sulfolane, unless the pre-excavation sampling identifies additional COCs to be added to the excavation boundary sampling.

- The SB-263 excavation is approximately 440 square feet. Two samples will be collected from the base of the excavation and four from the excavation sidewalls.

- The SB-261/262 excavation can be easily separated from the remaining excavation area for purposes of soil characterization. This area is approximately 1000 square feet. Three samples will be collected from the base of the excavation and four from the excavation sidewalls.

- The third excavation area encompasses SB-253, SB-256, SB-216, and SB-259, is approximately 2200 square feet. Four samples will be collected from the base of the excavation, and excavation sidewall sampling will be performed at linear distances between approximately 20 feet and 50 feet, depending on the density of historical sampling locations.

Upon completion of the soil removal activities, the excavated area will be backfilled to the extent that site operations require.

5.3.1.2 Contaminated Soil Handling

The excavated soil will be handled in accordance with applicable requirements (as outlined in 18AAC 75.360, 18AAC 75.370, and 18 AAC 75.325(i)), including soil transport requirements outlined in 18 AAC 60.015. As soil is excavated, it will be loaded directly into roll-off bins or an equivalent container that will be covered and secured to ensure that contaminated soil does not come in contact with uncontaminated soil during the cleanup and transport process. Debris and other materials (i.e., steel piping and concrete) will be segregated from excavated soil and transported offsite for appropriate recycling or disposal.

5.3.1.3 Contaminated Soil Disposal

Waste characterization will be completed in Lagoon B soil prior to excavation. Waste characterization and disposal of soil generated during the Lagoon B excavation are described in the Waste Management Plan, which is presented in Section 6.

5.3.2 Soil Excavation from the Southwest Former Wash Area

The SWA is located on the western portion of the NPR, outside of the operational areas of the site. The SWA was previously used as a wash area where extraction unit heat exchanger bundles were pressure washed during turnarounds, generating sulfolane-laden wastewater. Additional information about historical usage of the SWA is presented in the Onsite SCR (ARCADIS 2013f).

Soil sampling conducted in the SWA indicated the presence of elevated concentrations of sulfolane. Dissolved-phase concentrations of sulfolane in groundwater downgradient of the SWA are generally decreasing, and the GAC West system will eliminate the potential for offsite migration of sulfolane from this source area.

5.3.2.1 Southwest Former Wash Area Soil Excavation Specifications

Between 2011 and 2013, soil samples were collected from 36 locations to delineate the horizontal and vertical limits of impacted soil at the SWA. Soil sample locations were spatially located throughout the SWA, with samples collected from each location at multiple depth intervals between the surface and the water table. The locations, as well as the highest detected concentration of sulfolane at each location, are shown on Figure 5-3. The remedial excavation design is based on a focused mass removal of unsaturated soil containing the highest concentrations of sulfolane to decrease potential migration to groundwater, thereby reducing the amount of time that the groundwater extraction system will be in operation. To maintain the structural integrity of existing infrastructure and the excavation, and to ensure the safety of field staff, the facility standard for a 2:1 (run:rise) slope has been added along the edge of the proposed excavation (the green dashed line on Figure 5-3).

As shown on Figure 5-3, in order to complete the excavation to the proposed limits, FHRA will remove a portion of the concrete pad at the Material Storage Area. The concrete material will be broken, segregated from underlying soil material, and transported offsite for disposal. The soil beneath the concrete pad is included in the slope material to be removed to provide structural stability of the excavation and will be managed along with the excavated soil.

The excavation will be advanced vertically through the unsaturated soil and will be terminated at the water table.

The design excavation volume is approximately 1,562 cy, which includes approximately 279 cy of material that lies outside of the footprint of the design excavation limits, but will be removed to allow adequate sloping of excavation sidewalls. Figure 5-3 depicts the anticipated limits of excavation. The excavation will be performed to the maximum depth possible considering the groundwater table elevation at the time of excavation; the anticipated depth of the excavation is 7 feet. Sulfolane is the only COC at the SWA, and the excavation boundary samples will be analyzed for sulfolane, unless the pre-excavation sampling identifies additional COCs to be added to the excavation boundary sampling. Previous sampling has confirmed the presence of high sulfolane concentrations in soil below the excavation depth. This characterization is considered adequate for characterization of soil remaining in-place at the base of the excavation, and no further excavation base sampling will be performed. Excavation sidewall sampling will be performed to characterize the remaining sulfolane concentrations. Excluding the sloped areas, the proposed excavation covers approximately 4,500 square feet. Excavation sidewall samples will be collected at linear distances between approximately 20 and 50 feet to characterize remaining contamination. Soil samples will be collected from more closely-spaced intervals in the portions of the excavation where historical sampling indicates higher concentrations of sulfolane in soil or where historical sampling is sparse. Upon completion of the soil removal activities, the excavated area will be backfilled and compacted to the extent necessary to meet the refinery operational requirements.

5.3.2.2 Contaminated Soil Handling

The excavated soil will be handled in accordance with applicable requirements (as outlined in 18AAC 75.360, 18AAC 75.370, and 18 AAC 75.325(i)), including soil transport requirements outlined in 18 AAC 60.015. As soil is excavated, it will be loaded directly into roll-off bins or an equivalent container that will be covered and secured to prevent contaminated soil from contacting uncontaminated soil during the cleanup and transport process. Debris and other materials (i.e., steel piping and concrete) will be segregated from excavated soil, cleaned, and transported offsite for appropriate recycling or disposal.

5.3.2.3 Contaminated Soil Disposal

Waste characterization will be completed on SWA soil prior to excavation. Waste characterization and disposal of soil generated during the Lagoon B excavation are described in the Waste Management Plan presented in Section 6.

5.3.3 Soil Excavation from the Fire Training Area

The FTA is located on the southwestern portion of the NPR, outside the operational areas of the site. The FTA was previously used for fire-fighting training exercises, but has not been used for these activities since 2009. Additional information about historical usage of the FTA is provided in the Perfluorinated Compounds Investigation Report (ARCADIS 2013b).

5.3.3.1 Fire Training Area Soil Excavation Specifications

As reported in the Onsite SCR (ARCADIS 2013f), seven soil samples were collected to identify impacts to soil within the FTA. Soil sample locations were positioned around steel structures in the area that was previously used for fire training activities, as well as at the low-lying south side of the FTA. Samples were collected from just above the concrete liner (approximately 1.5 feet bgs). The sample locations, as well as detected concentrations of PFCs and petroleum hydrocarbons at each location are shown on Figure 5-4. Based on the presence of detectable concentrations of PFOS and PFOA in the soil, ARCADIS designed the excavation to remove soil from within the limits of the FTA.

Soil in the lined footprint of the FTA, as shown on Figure 5-4, will be removed. Soil will be removed from the existing ground surface down to the concrete liner, which is expected to be 1.5 feet below existing grade, based on the depth encountered during 2013 site characterization activities. The horizontal limits of excavation will be defined by the berms that form the FTA liner. The in-situ design excavation volume is approximately 867 cy. Figure 5-4 depicts the anticipated limits of excavation. Post excavation sampling will be performed. Excavation boundary samples will be analyzed for PFCs and petroleum constituents.

Upon completion of the soil removal activities, the excavated area will be backfilled and compacted to the extent necessary to meet the NPR's operational requirements.

5.3.3.2 Contaminated Soil Handling

The excavated soil will be handled in accordance with applicable requirements (as outlined in 18AAC 75.360, 18AAC 75.370, and 18 AAC 75.325(i), including soil transport requirements outlined in 18 AAC 60.015. As soil is excavated, it will be loaded directly into roll-off bins or an equivalent container that will be covered and secured to prevent contaminated soil from contacting uncontaminated soil during the cleanup and transport process. Debris and other materials (i.e., steel piping and concrete) will be segregated from excavated soil and transported offsite for appropriate recycling or disposal.

5.3.3.3 Contaminated Soil Disposal

Waste characterization will be completed on FTA soil prior to excavation. Waste characterization and disposal of soil generated during the FTA excavation are described in the Waste Management Plan presented in Section 6.

5.3.4 Administrative Controls

The proposed soil excavations are planned for removal of sulfolane mass stored in soil moisture as well as removal of soil impacted with PFCs. Following the excavations, detectable concentrations may remain. Concentrations of COCs and sulfolane are also present in other areas of the site that are not accessible for excavation. Administrative controls will be used to protect onsite workers from potential exposure through direct contact with impacted soil and inhalation of volatile COCs.

An Onsite Soil Management Plan (Onsite SMP) was prepared for the site and is included Attachment 1 to the Long Term Monitoring Plan (ARCADIS 2014). The Onsite SMP serves as a guidance document to protect onsite workers from exposure to impacted soil encountered during any future ground-disturbing activities. The Onsite SMP will be used by the Property Owner or any other party performing work onsite to manage earth-moving activities.

To supplement the Onsite SMP, project-specific soil plans may be developed to describe roles, responsibilities, and procedures based on the scope and extent of a specific project. The Onsite SMP provides general guidance on roles and responsibilities for emergency, routine maintenance, or short lead-time projects that may arise. ICs will be put in place to assure compliance with the Onsite SMP.

The site is currently fenced and access is restricted. ICs will assure that this control will remain in place to prevent unauthorized entry to the site.

5.4 Groundwater

The proposed cleanup actions to achieve the groundwater cleanup objectives are groundwater extraction, establishment of an alternative point of compliance, and implementation of ICs. The ICs will be an effective remedy to prevent current and future onsite workers from unacceptable exposure to COCs in impacted groundwater. Groundwater extraction is an effective remedy to prevent further offsite migration of dissolved-phase COCs and sulfolane. Collectively, these are the proposed final remedies to address groundwater impacts.

The proposed groundwater extraction cleanup action is presented below.

5.4.1 Groundwater Extraction and Treatment Systems

A groundwater extraction system has operated at the site since 1987. As currently designed and operated, the extracted groundwater is treated by a groundwater remediation system to remove sulfolane and petroleum COCs from the groundwater before it is discharged to the SGP. The GAC East system was upgraded several times to increase the system effectiveness. Recent upgrades include:

- Installation of additional recovery wells R-43 and R-44.
- Installation of recovery wells R-45 and R-46 to replace existing wells R-39 and R-40 to improve performance.
- Rehabilitation of existing wells to improve performance.
- Addition of sulfolane treatment capabilities, including sand filters and a GAC filter system to the groundwater remediation system.
- Addition of recovery wells R-47 and R-48 and the GAC West system.

The Revised IRAPA (ARCADIS 2013c) proposed a GAC West system to expand the capture zone of the recovery system to achieve hydraulic control across the entire width and depth of the sulfolane plume where concentrations are greater than 15 µg/L. As described in the Technical Memorandum: Proposed Replacement Recovery Wells (Barr 2012b), groundwater modeling indicated that the western portion of the sulfolane plume was not being captured by the GAC East system. Thus, FHRA installed two additional recovery wells west of the current line of recovery wells to provide hydraulic control across the entire width and depth of the plume (Figure 2-27).

Construction of the GAC West system was completed in June 2014 and the system is operational.

5.4.2 Groundwater Extraction System Specifications

The GAC West system consists of two new recovery wells (R-47 and R-48), associated monitoring wells, a gallery pond, and a second GAC groundwater treatment system. Existing recovery well R-42 is connected to the GAC West system. Groundwater monitoring data at the new recovery well locations, as well as existing location R-42, show that treatment for hydrocarbons at these locations is not required. However, while the GAC West system is designed to treat for sulfolane, it also has the capacity to remove dissolved-phase petroleum hydrocarbons. Treated water from the GAC West system is discharged to the NGP.

Additional information regarding the GAC West system specifications is presented in the Technical Memorandum: Proposed Replacement Recovery Wells (Barr 2012b). With the recent upgrade to the GAC West system, groundwater is recovered from nine recovery wells (R-21, R-35R, R-42, R-43, R-44, R-45, R-46, R-47, and R-48). Operation of the nine-well recovery and treatment system prevents further migration (beyond the recovery zone) of sulfolane with concentrations greater than 15 µg/L. The concentrations of sulfolane beyond the recovery zone will continue to decrease, as documented through groundwater monitoring, until there is no further offsite migration of sulfolane with concentrations greater than 15 µg/L. In the event that a final determination of the sulfolane cleanup level is instituted at a level different than the 15 µg/L, the system's performance will be adjusted to meet the cleanup level. Prior to any adjustment, a pre-scoping meeting will be held if FHRA deems it necessary. Upon request by FHRA to adjust the system's performance, ADEC will act upon the request within 30 days provided the submittal is complete.

5.4.3 Performance Metrics and Monitoring

A comprehensive Operation, Maintenance, and Monitoring Plan (OM&M Plan) will be provided under separate cover to document operation, maintenance, and monitoring for the expanded recovery system. The OM&M Plan will include the following components:

- Maintenance plan and schedule for major components of the groundwater extraction and treatment systems.
- Factors and considerations for future modifications to the extraction and pumping system (e.g., number of extraction wells, pumping rate, treatment system components).
- Estimated duration of treatment system.
- Performance monitoring plan:
  - Performance monitoring program objectives and schedule
  - Performance monitoring description, with tables and maps of monitoring locations and monitoring frequency for the following types of monitoring:
    - ✓ Hydraulic control
    - ✓ Contaminant concentrations.
  - Sampling and analysis plan.
  - Factors for reducing sample frequency and/or number of sample locations in the future.

The performance monitoring component is an expansion of the current performance monitoring program, as described in the Revised IRAPA (ARCADIS 2013c). The expansion involves monitoring additional locations to document performance of the new extraction wells but is otherwise consistent with the current performance monitoring program. Additional long-term monitoring (LTM) will be performed for the alternative point of compliance (see Section 5.4.8).

The following activities have been conducted to evaluate performance of the historic groundwater remediation system and will continue to be conducted for the performance monitoring program:

- Evaluate hydraulic capture using field measurements of groundwater levels and the site groundwater flow model.
- Evaluate contaminant capture.
- Record groundwater pumping rates from recovery wells and groundwater remediation system up time.
- Monitor recovered groundwater quality.
- Monitor treated groundwater discharge quality per associated permits.

5.4.3.1 Hydraulic Capture Analysis

As proposed in the Revised IRAPA (ARCADIS 2013c) and presented by Barr (2013), FHRA will measure groundwater elevations in select monitoring wells and nests to evaluate the horizontal and vertical hydraulic capture of the GAC West system. The depth to groundwater will be measured and used to generate water table elevation contour plots and plots of hydraulic heads in cross section. The capture zone extent at the water table and in cross section will be estimated following the methods presented by Barr (2013). The groundwater model will also be used to evaluate capture. A technical memorandum detailing steps to evaluate capture by wells R-47 and R-48 upon startup of the GAC West system is provided in Appendix G. An ongoing evaluation of hydraulic capture of the historic groundwater remediation system is being implemented as proposed in the Revised IRAPA (ARCADIS 2013c).

The proposed hydraulic capture performance monitoring network for both the historic groundwater extraction system and the GAC West system includes monitoring wells summarized in Table 5-1 and shown on Figure 5-5.

Groundwater pressure sensors with data recording units are installed in several of the wells listed in Table 5-1. The pressure sensors provide continuous groundwater elevation data to evaluate variations in groundwater elevations between measurement events.

Hydraulic capture data have been collected and analyzed monthly since August 2013 (except November 2013). Hydraulic capture data is being collected and analyzed monthly for the first year of operation of the GAC West system. It is anticipated that frozen wells may prevent collection of the complete groundwater elevation data set during some months. The hydraulic capture data collection frequency will change to quarterly beginning in third quarter 2015. Additional information about the proposed plan to evaluate capture upon startup of the GAC West system is provided in Appendix G.

The Second Quarter 2014 Groundwater Monitoring Report (ARCADIS 2014c) presents a capture zone estimate for June 30, 2014 (that includes GAC West wells in operation) that indicates complete capture at the water table across the sulfolane plume. July and August data show similar results. Evaluation of hydraulic capture will be presented in quarterly groundwater monitoring reports. In the event that a final determination of the sulfolane cleanup level is instituted at a level different than the 15 µg/L, the system's performance will be adjusted to meet the cleanup level. Prior to any adjustment, a pre-scoping meeting will be held if FHRA deems it necessary. Upon request by FHRA to adjust the system's performance, ADEC will act upon the request within 30 days provided the submittal is complete.

5.4.3.2 Contaminant Capture

Upon completion of post-startup monitoring for the GAC West system, FHRA will collect quarterly and semiannual groundwater samples for sulfolane and BTEX, respectively, to evaluate contaminant capture. Monitoring wells shown on Figures 5-6 and 5-7 are categorized as upgradient, within the treatment zone, and downgradient as described below:

- *Upgradient locations:* O-6, O-19, O-19-55/90, MW-130-25, MW-175-90, MW-369-16/55/75, S-43, and S-51.

- *Within the treatment zone locations:* O-2, O-3, O-5, O-5-65, MW-113-15, MW-125-25, MW-186A-15/B-60/E-75, MW-199-150, MW-309-15/66, MW-334-15/65, MW-344-15/55/75, MW-345-15/55/75, and MW-370-15/55/75.

- *Downgradient locations:* MW-127-25, MW-129-40, MW-139-25, MW-142-20, MW-145-20, MW-154A-75/B-95, MW-351-15/55/75/150, MW-371-15/55/75/125, O-4, O-12, O-12-65, O-24, O-24-65, O-26, and O-26-65.

Performance monitoring wells identified for contaminant capture may be modified as necessary. The current monitoring well networks are summarized in Table 5-1. All groundwater samples will be collected in accordance with the RSAP.

In addition to the groundwater monitoring program, FHRA will collect groundwater samples monthly from recovery wells R-47 and R-48 during the first year of GAC West system operation. Groundwater samples from recovery wells will be submitted for BTEX and sulfolane analysis. Groundwater quality data from the recovery wells will provide another line of evidence that the GAC West system is capturing contaminants. Groundwater sample collection frequency for other recovery wells will change to quarterly beginning in first quarter 2015.

Evaluation of contaminant capture will be presented in quarterly groundwater monitoring reports and in the recovery system performance evaluation summary report described in Appendix G.

5.4.3.3 Groundwater Extraction Flow Rate and System Uptime

FHRA will operate the combined groundwater recovery system continuously. The expected groundwater recovery flow rates for the nine recovery wells are presented in Table 5-2. The collective groundwater remediation system flow rate will be approximately 540 to 670 gallons per minute as determined through a combination of hydraulic capture modeling and groundwater elevation measurements that demonstrate capture.

The recovery system uptime (number of hours of operation), individual well flow rates, and system flow rates will be automatically recorded by the facility real-time data collection system.

Groundwater recovery flow rates and system uptime will be presented in quarterly groundwater monitoring reports. The reports will discuss any significant deviation from typical groundwater recovery rates or system down time that is not related to routine maintenance activities.

5.4.3.4 Influent and Discharge Groundwater Quality

FHRA will collect water samples from the recovery systems influents and discharges on a monthly basis. The water samples will be analyzed for sulfolane and any additional parameters as required by the discharge permits.

The water quality data will be used to confirm that the systems are effectively treating sulfolane and to confirm compliance with the groundwater remediation system permits. Influent and discharge water quality will be presented in the quarterly groundwater monitoring reports.

FHRA will collect monthly samples for three consecutive months from the influent and effluent of the GRTS and analyze for PFOA and PFO. Data from this analysis will be submitted to ADEC as soon as reasonably practicable.

5.4.4 Results of Hydrogeologic Modeling to Assess Capture Zone

The FEFLOW numerical groundwater model prepared for the site will also be used to estimate the recovery and treatment system capture zones. Field data collected during the proposed startup testing (Appendix G) will initially be compared to modeled data using the current model construct. If the measured and modeled data show a reasonable fit, the model will be run with particle tracking to determine the three-dimensional capture zone of the combined system. If it is determined that any adjustments to the model are necessary, the adjustments will be documented and the updated version of the model will be used to determine the three-dimensional capture zone for multiple water-level scenarios.

5.4.5 Provisions for Minimizing Contaminant Migration to Unimpacted Areas

The capture zone at the water table of the GAC East system encompasses the sulfolane plume, except at its western limit. Since completion of the GAC West system in June 2014, hydraulic control is in place across the entire width and depth of the sulfolane plume with concentrations greater than 15 µg/L.

5.4.6 Disposal of Contaminated Media

Groundwater extracted from the recovery wells is treated through the groundwater remediation system. Soil generated during installation of new wells is managed per the RSAP. Spent carbon generated during operation of the groundwater remediation system will be managed in accordance with the Revised Updated Spent Carbon Management Plan (ARCADIS 2013e).

5.4.7 Permitting

Recovery well R-42 began operation upon issuance of an amended temporary water use permit (TWUP [A2011-48]) from the Alaska Department of Natural Resources (DNR). In addition to the TWUP for R-42, groundwater extraction from the historical recovery wells is conducted under DNR water use permit LAS24907.

On September 29, 2011, ADEC issued an indefinite administrative extension of Wastewater Disposal Permit 2005-DB0012. FHRA is currently reviewing proposed operational changes and an application for revisions to this permit is forthcoming. FHRA currently submits monthly discharge monitoring reports to ADEC.

For operation of the GAC West system, FHRA obtained temporary water use authorization (A2014-13) and an engineering plan review from ADEC. Monthly monitoring data will be submitted on a quarterly basis as required by ADEC.

FHRA acquired numerous other permits (e.g., zoning and building permits) to support expansion of the historic groundwater remediation system and for construction of the GAC West system.

5.4.8 Alternative Point of Compliance

Per 18 AAC 75. 345(e) an alternative point of compliance where groundwater levels must be attained can be approved if: (1) it is within the existing groundwater plume and (2) Table C cleanup levels are met at the property boundary where the current use of groundwater at the neighboring property is determined to be drinking water (unless an alternative source of water is provided to affected persons).

The line of VPT wells plus MW-141-20 have been selected for the alternative point of compliance. LTM will be performed for all COCs at all point of compliance wells on a schedule that will be based on historical sample results and current trends. In addition, upgradient and downgradient monitoring wells will be included in the LTM for trend analysis. Wells at the property boundary will also be included, as appropriate, in the LTM to document that applicable cleanup levels are met at the property boundary.

Monitoring details will be provided in the LTM Plan. The LTM Plan will be provided under separate cover and will include the following items:

- Description and maps showing the alternative point of compliance monitoring wells, along with major site features.

- Sampling program objectives and schedule.
- List and figures of all monitoring wells to be included in LTM (alternative point of compliance wells, plus selected upgradient and downgradient wells for trend analysis).
- Expected timeframe for attaining 15 µg/L sulfolane.
- A sampling and analysis plan that will include sampling for all COCs, on a frequency that is appropriate for the COC detection frequency and concentration.

5.4.9 Institutional Controls

The groundwater remediation system captures the full extent of the onsite sulfolane plume with concentrations greater than 15 µg/L. The groundwater remediation system also captures dissolved-phase concentrations of COCs, PFOS, and PFOA, and will be protective of potential offsite receptors. ICs will be put in place to protect onsite workers from unacceptable exposure to COCs. An Onsite SMP (Attachment 1 to the LTM Plan) will be implemented at the site. The Onsite SMP requires appropriate air monitoring during soil-disturbing activities. Air monitoring will protect workers from potential inhalation of volatile COCs from groundwater while working in a trench. ICs will be put in place consistent with 18 AAC 75.375.

5.4.10 Cleanup Verification

When groundwater extraction and treatment has been performed to the point that the cleanup performance standard set out in the OCP has been met, FHRA will verify that the cleanup objectives set out in the OCP have been met. The cleanup verification will include:

- A demonstration that groundwater cleanup objectives have been met.
- Show plume stability in the absence of groundwater pumping.
- Establish that sulfolane and petroleum hydrocarbons meet the cleanup level at the alternative point of compliance after the extraction system has been turned off.

- Evaluate the potential for contaminant rebound.
- Evaluate whether there are any unacceptable risks to human health or the environment due to COCs remaining in soil or groundwater.
- Establish a monitoring program to demonstrate attainment of cleanup levels at the alternative point of compliance. Monitoring will continue for five years after remediation activities are complete. At that time, assuming cleanup objectives are still being met, this work under this plan will be considered completed.
- If cleanup objectives are not met, additional remedial efforts should be considered and evaluated.

5.5 Soil Gas

The proposed cleanup actions to achieve the soil gas cleanup objectives are implementation of engineering and administrative controls. The remedies described above for LNAPL will also be used to achieve cleanup objectives for soil gas.

Currently, three buildings are located above the LNAPL plume: laboratory, fire training house, and terminal building. FHRA contracted Holaday-Parks Inc. to review ventilation of the laboratory and the terminal building in 2008 (both buildings) and 2013 (laboratory only).

5.5.1 Laboratory

A review of the ventilation reports indicates that the laboratory spaces were designed to be under negative pressure, as is standard for chemical laboratory construction. The calculated air exchange rate for the laboratory averaged 6.1 air exchanges per hour. This air exchange rate was based only on the mechanically supplied outside air and did not account for the influence of the laboratory hood system. The total building air exchange rate based on exhausting of the fume hoods is 18.3 air exchanges per hour. The fume hoods are an engineering control that serve as a protective measure for the daily work with petroleum samples conducted in the laboratory. While the negative pressurization could induce some VI, the majority of the makeup air for the hoods is likely delivered through the mechanically supplied air and leakage through the walls, doors, windows, and/or roof systems. The high rate of air exchange provides some protection against the potential effects of VI, and will remain in place.

5.5.2 Terminal Building

A review of the ventilation report for the terminal building indicates that this building is positively pressurized as long as the HVAC is operating, because the mechanical flow is 960 cfm of air, of which 460 cfm is outside air. The total capacity of the exhaust systems in the utility room and bathroom is 215 cfm. Therefore, the supplied air considerably exceeds the exhausted air. This would be expected to provide protection against VI, per ADEC guidance (ADEC 2012).

5.5.3 Fire Training House

A ventilation audit was also conducted in the fire training house in 2008. The office space was provided with 1,725 cfm of outside air with an air handler. It is reasonable to conclude that the main portion of the building is under positive pressure when the HVAC system is operating. If the HVAC system is operated continuously, it will provide a protective benefit with regard to VI.

Future office use at the fire training house is still under review. If a decision is made to occupy the building on a routine basis, additional controls will be implemented to ensure that the HVAC system is operated at a frequency to maintain positive pressure and ventilation to mitigate a potential future exposure pathway. FHRA has also instituted a daily monitoring program of indoor air for VOCs and percent lower explosive limit. Institutional controls will be used so that potential future construction of buildings over the LNAPL plume will be protective of workers (as required by OSHA).

6. Waste Management Plan

The proposed remedial actions will generate waste streams, including impacted soil, treated groundwater, LNAPL, and spent GAC.

6.1 Pre-Characterization Soil Sampling

FHRA will pre-characterize the three areas (Lagoon B, SWA, and FTA) proposed for remedial excavation. Soil samples were collected during site characterization activities completed between 2011 and 2013 (ARCADIS 2013f), but were not analyzed for all analytes required for appropriate waste characterization. Therefore, additional soil samples will be advanced to fully characterize the soil for waste profiling.

Soil boring locations will be evenly distributed within each of the excavation areas. Borings will be advanced using a hand auger within Lagoon B and the FTA per the RSAP. Due to the shallow target depth of the soil borings within Lagoon B and the FTA, only one soil sample will be collected for laboratory analysis using EPA approved analytical method from each boring. A direct-push drill rig will be used to collect subsurface soil samples from the borings in the SWA per the RSAP. This information, with a map of anticipated locations, analytical methods will be provided to ADEC in advance of field work. A copy of the sampling results will be forwarded to ADEC.

6.2 Required Analytical Data for Waste Characterization

Soil samples from each excavation area will be submitted for analysis to complete waste characterization. Laboratory analysis will be completed according to the methods described in the RSAP. Sections 6.2.1, 6.2.2, and 6.2.3 summarize the proposed analyte list for each excavation area.

6.2.1 Lagoon B

Soil beneath the Lagoon B liner may have come into contact with F037 waste from historical refinery operations. This waste includes petroleum refinery primary and secondary oil/water/soil separation sludge. The basis for the listing (40 Code of Federal Regulations [CFR] 261, Appendix VII) is: benzene, benzo(a)pyrene, chrysene, lead, and chromium. The land disposal restrictions (LDRs) (40 CFR 268.40) list the following COCs for F037 waste:

- Acenapthene

- Anthracene
- Benzene
- Benz(a)anthracene
- Benzo(a)pyrene
- Bi(2-ethylhexyl)phthalate
- Chrysene
- Di-n-butyl phthalate
- Ethylbenzene
- Fluorene
- Naphthalene
- Phenanthrene
- Phenol
- Pyrene
- Toluene
- Xylenes-mixed isomers (sum of o-, m-, and p-xylene concentrations)
- Chromium (total)
- Cyanides (total)
- Lead
- Nickel

Based on operations at the site, knowledge of the wastes generated, and LDRs for F037-listed waste, FHRA will submit Lagoon B waste characterization samples for the following analyses:

- VOCs
- Semivolatile organic compounds (SVOCs)
- Benzene by toxicity characteristic leaching procedure (TCLP)
- Cyanide
- Eight Resource Conservation and Recovery Act (RCRA) metals (arsenic, barium, cadmium, chromium, mercury, lead, selenium, and silver) plus nickel

6.2.2 Southwest Former Wash Area

Soil in the SWA may have come into contact with K050-listed wastes during historical refinery operations. This classification covers heat exchanger bundle cleaning sludge from the petroleum refining industry. The basis for the listing (40 CFR 261, Appendix VII) is hexavalent chromium. The Land Disposal Restriction (LDR) (40 CFR 268.40) lists the following COCs for K050 waste:

- Benzo(a)pyrene
- Phenol
- Cyanides (total)
- Chromium (total)
- Lead
- Nickel

Based on operations at the site, knowledge of the wastes generated, and LDRs for K050-listed waste, FHRA will submit SWA waste characterization samples for the following analyses:

- VOCs
- SVOCs
- Benzene by TCLP
- Cyanide
- Eight RCRA metals (arsenic, barium, cadmium, chromium, mercury, lead, selenium, and silver) plus nickel

6.2.3 Fire Training Area

Soil in the FTA has not come into contact with listed hazardous waste; therefore, the additional analytes are limited to those required by the incineration facility, Organic Incineration Technology, Inc. (OIT). The additional analytical data will supplement the data previously collected, which includes GRO, DRO, RRO, VOCs, and SVOCs. These additional analytes include the 8 RCRA metals. Appropriate steps will be taken to confirm that OIT is permitted to treat and dispose of this material. If treatment of perfluorinated compounds is not within the scope of OIT's permit, assure that appropriate transport, storage and disposal facilities will be used.

6.3 Excavated Soil

As described in Section 6.1, soil proposed for excavation will be pre-characterized for acceptance by an approved disposal facility. Soil excavated from the FTA is not considered a listed waste and is not expected to be characteristically hazardous. Soil from each of the three areas will be excavated and loaded directly into covered containers suitable for transport offsite.

6.3.1 Soil Disposal

Materials characterized as nonhazardous waste will be segregated for offsite transportation and disposal at OIT in Moose Creek, Alaska. These solid waste materials will require offsite transportation and disposal in accordance with applicable federal, state, and local regulations. Nonhazardous waste materials transported to OIT will be treated via incineration, which will be documented by a Certificate of Thermal Treatment. Treated ashes will be disposed of at the Fairbanks North Star Borough Landfill, pending treatment confirmation.

Appropriate steps will be taken to confirm that OIT is permitted to treat and dispose of this material. If treatment of perfluorinated compounds is not within the scope of OIT's permit, assure that appropriate transport, storage and disposal facilities will be used.

Nonhazardous Material Treatment Facility Information:

Organic Incineration Technology, Inc.
Old Richardson Highway
North Pole, Alaska 99705

Disposal Identification No.: AK0000094888

Post-treatment characterization of nonhazardous soil will be required. An analyte list for post-treatment characterization will be recommended and forwarded to ADEC with the request to transport soil to OIT for treatment. The proposed list will be based on the results of the pre-excavation disposal characterization.

Materials characterized as hazardous waste materials will be segregated for offsite transportation and disposal. These solid waste materials will require offsite transportation and disposal in accordance with applicable federal, state, and local regulations. Hazardous waste will be transported offsite to a properly permitted RCRA Subtitle C treatment, storage, and disposal facility (TSDF). The TSDF must be permitted to accept the specific hazardous waste streams. Disposal of the waste must meet the LDRs under 40 CFR 268.40 and all underlying hazardous constituents (UHCs) (40 CFR 268.48) or be treated by the TSDF to meet the LDRs and UHCs. It is anticipated that hazardous soil will be transported to Chemical Waste Management of the Northwest located in Arlington, Oregon for disposal via landfilling, which will be documented by a Certificate of Disposal.

Hazardous Material Disposal Facility Information:

Chemical Waste Management of the Northwest
17629 Cedar Springs Lane
Arlington, Oregon 97812

USEPA ID Number: ORD089452353

6.3.2 Transportation of Soil

The offsite transportation of nonhazardous waste materials will be performed by dump trailers that are permitted haulers. These dump trailers can each transport between 35 and 38 tons of waste material per trip and each dump trailer will be transported as a covered load in accordance with 18 AAC 60.015. Nonhazardous waste manifests will be completed and will accompany each load as it is transported to the disposal facility.

The offsite transportation of hazardous waste materials will be performed by loading waste materials into intermodal containers for transportation via rail, barge, and (potentially) truck. The soil will be transported by intermodal containers that can each transport between 21 and 24 tons of waste material. Each intermodal container will be transported as a covered load in accordance with 18 AAC 60.015. Once loaded, the intermodal containers are not expected to be unloaded until after receipt at the appropriate disposal facility. Uniform hazardous waste manifests will be completed and will accompany each load as it is transported to the disposal facility. Transport of the hazardous waste offsite will be conducted only by transporters that have valid United States Environmental Protection Agency identification numbers.

6.4 Groundwater

Extracted groundwater will be treated via the groundwater remediation system. Purge water generated during monitoring, LNAPL skimming, and other remedial or monitoring activities will be treated via the facility process wastewater or groundwater treatment systems or at an offsite disposal facility.

6.5 Light Nonaqueous Phase Liquid

LNAPL recovered via onsite recovery operations will either be recycled through the facility product refining systems or at an approved facility.

6.6 Granular Activated Carbon

Spent GAC generated by operation of the groundwater remediation system will be handled and disposed of at regular intervals per the Revised Updated Spent Carbon Management Plan (ARCADIS 2013e). The spent GAC will be transferred to super-sacks and transported to OIT for thermal treatment to destroy the sulfolane contained in the spent GAC.

7. Implementation Schedule

FHRA's proposed implementation schedule for the cleanup actions described in this Final OCP is included in Table 7-1. This schedule accounts for any facility planning and implementation (e.g., installation or excavation). OM&M summaries and progress reports will be included in semi-annual groundwater monitoring reports.

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Tables

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Figures

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Appendix **A**

Historical Data Tables

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Appendix **B**

Response to Comments – Capture Analysis

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Appendix C

Evaluation of Groundwater Remediation System Capture – Fourth Quarter 2013

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Appendix D

Evaluation of Groundwater Remediation System Capture Figures – Third Quarter 2013

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Appendix **E**

Modeled Groundwater Extraction
Particle Tracking Figures

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Appendix F

Expanded Groundwater Recovery and Treatment System Startup Aquifer Testing for Recovery System Hydraulic Capture Performance Evaluation