DEPARTMENT OF THE ARMY
INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS, U.S. ARMY GARRISON, FORT WAINWRIGHT
1046 MARKS ROAD
FORT WAINWRIGHT, ALASKA 99703

DEC 02 2016

Directorate of Public Works

SUBJECT: Submission of the US Army Garrison Fort Wainwright, Alaska's (USAG FWA) Fourth Five-Year Review Report

Ms. Shirley Bilbrey
Director, Region 10
US Environmental Protection Agency
Office of Environmental Clean-up
1200 Sixth Avenue
Seattle, WA 98101-3140

Dear Ms. Bilbrey,

Please find attached the USAG FWA Fourth Five-Year Review Report. The Army has made the necessary revisions to the USAG FWA Fourth Five-Year Review Report that incorporates the text changes and additional data analyses identified during the comment resolution telecoms with representatives from the U.S. Environmental Protection Agency Region 10 (EPA) and the Alaska Department of Environmental Conservation (ADEC).

Copies of this letter and the USAG FWA Fourth Five-Year Review Report will be furnished to the U.S. Army Environmental Command, the U.S. EPA Region 10 Alaska Operations Office Remedial Project Manager and the ADEC Remedial Project Manager.

The USAG FWA appreciates your support of our Environmental programs and looks forward to working with you in the future.

If you have any other questions or comments, please contact Mr. Joseph Malen, USAG FWA Remedial Project Manager at (907) 361-4512 or joseph.s.malen.civ@mail.mil.

Sincerely,

Sean C. Williams
Colonel, US Army
Commanding

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Fourth Five-Year Review Report for

FORT WAINWRIGHT
FAIRBANKS, ALASKA
USEPA ID AK6210022426

Prepared For:
U.S. Army Garrison, Fort Wainwright
1046 Marks Road #6000
Fort Wainwright, Alaska 99703-6000

November 2016

Prepared By:
U.S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

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Fourth Five-Year Review Report for

FORT WAINWRIGHT
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November 2016

Prepared for:

U.S. Army Garrison Fort Wainwright Alaska

Approved by: **Date:**

2 DEC 2016

Sean C. Williams
Colonel, U.S. Army
Commanding

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ATTACHMENTS

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ACRONYMS AND ABBREVIATIONS

2-PTY	Two-Party
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AOC	Area of Concern
ARAR	applicable or relevant and appropriate requirement
AS	air sparge
ASTs	above ground storage tanks
AWQS	Alaska Water Quality Standards
bgs	below ground surface
BHTF	Birch Hill Tank Farm
BTEX	benzene, toluene, ethylbenzene, and xylenes
CANOL	Canadian Oil Pipeline
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLOSES	Cleanup Operations and Site Exit Strategy
COCs	contaminants of concern
CRAAP	Chena River Aquatic Assessment Program
CRREL	U.S. Army Cold Regions Research and Engineering Laboratory
CY	cubic yard
DCA	dichloroethane
DCE	dichloroethene
DO	dissolved oxygen
DoD	Department of Defense
DPW	Directorate of Public Works
DRMO	Defense Reutilization Maintenance Operation
DRO	diesel range organics
EDB	dibromoethane
EQFS	East Quartermaster's Fueling System
ESD	Explanation of Significant Differences
E&E	Ecology and Environment, Inc.
FEP	Fairbanks-Eielson Pipeline
FES	Fairbanks Environmental Services, Inc.
FFA	Federal Facility Agreement between USEPA, FWA, and ADEC

FFCA	Federal Facility Compliance Agreement
FS	feasibility study
Ft	foot (feet)
FWA	Fort Wainwright Alaska
GIS	geographic information system
GRO	gasoline range organics
HLA	Hardy Lawson Associates
IC	institutional control
iRACR	interim remedial action completion report
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
ISCO	in-situ chemical oxidation
ISCR	in-situ chemical reduction
Jacobs	Jacobs Engineering Group, Inc.
LNAPL	light non-aqueous phase liquid
LTMO	long-term monitoring optimization
LUC	land use control
MAROS	Monitoring and Remediation Optimization System
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MEC	Munitions and Explosives of Concern
MNA	monitored natural attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	not detected
NFA	no further action
NPL	National Priorities List
OB/OD	open burning/open detonation
OM&M	operation, maintenance, and monitoring
ORC	oxygen releasing compound
ORP	oxidation reduction potential
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCA	tetrachloroethane

PCE	tetrachloroethene
PFC	perfluorooctane
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanoic sulfate
PMP	Performance Monitoring Plan
POL	petroleum, oil, lubricant
PSE	preliminary source evaluation
RAO	remedial action objective
RACR	remedial action completion report
RBC	risk-based concentration
RCRA	Resource, Conservation, Recovery Act
RFA	RCRA Facility Assessment
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROD	record of decision
ROLF	Railcar Off-Loading Facility
RPM	Remedial Project Manager
RRO	residual range organics
SDWA	Safe Drinking Water Act
SOP	standard operating procedure
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TAH	total aromatic hydrocarbons
TAqH	total aqueous hydrocarbons
TCA	trichloroethane
TCE	trichloroethene
TCP	trichloropropane
TMB	trimethylbenzenes
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Command
USEPA	US Environmental Protection Agency
UST	underground storage tank
UVOST	ultra violet light optical screening tool

UXO	unexploded ordnance
VISL	vapor intrusion screening level
VOC	volatile organic compound
WQFS	West Quartermaster's Fueling System
mV	millivolts
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
µg/L	micrograms per liter

EXECUTIVE SUMMARY

This is the fourth five-year review of remedial actions taken at operable units (OU) 1 through 5 on Fort Wainwright, Alaska (FWA):

- OU-1 801 Drum Burial Site
- OU-2 Building 1168 Leach Well
- OU-2 Defense Reutilization Maintenance Operation Yard
- OU-3 Remedial Area 1B (Birch Hill Tank Farm)
- OU-3 Remedial Area 2 (Valve Pits and Railcar Off-Loading Facility)
- OU-3 Remedial Area 3 (Fairbanks-Eielson Pipeline Mileposts 2.7 and 3.0)
- OU-4 Landfill
- OU-4 Coal Storage Yard
- OU-5 West Quartermaster's Fueling System
- OU-5 East Quartermaster's Fueling System
- OU-5 Remedial Area 1A (Birch Hill Tank Farm Above Ground Storage Tanks)

This is the first five-year review of remedial actions taken at OU-6 (Former Communications Site) on FWA.

The purpose of this review is to determine if remedial actions implemented at these sites are and will continue to be protective of human health and the environment.

The U.S. Army prepared this review consistent with applicable requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 for National Priority List sites and the National Oil and Hazardous Substances Pollution Contingency Plan. This five-year review is required because hazardous substances remain at the sites at levels that do not allow for unlimited use and unrestricted exposure. The methods, findings, and conclusions of the review, identified issues, and recommendations are documented in this report. The triggering action for this five-year review was the completion of the third five-year review report on September 29, 2011.

Fort Wainwright

As described in the Federal Facility Agreement (FFA), FWA is located within the Fairbanks North Star Borough in interior Alaska and occupies approximately 911,604 acres on the east side of Fairbanks. The Fairbanks North Star Borough is lightly populated with several scattered developments. The City of Fairbanks (population 35,000) is on the western boundary of FWA.

The installation consists of three primary areas:

- The main post two miles east of Fairbanks between the Chena and Tanana Rivers; it consists of a cantonment area, a small arms range complex, and a close in range complex.
- The Tanana Flats training area across the Tanana River from the main post.
- The Yukon Training Area 16 miles east-southeast of Fairbanks, adjacent to Eielson Air Force Base.

The U.S. Environmental Protection Agency (USEPA) placed FWA on the National Priorities List in August 1990. The USEPA, Alaska Department of Environmental Conservation (ADEC), and the U.S. Army negotiated a FFA in March 1992. It was amended in 2007 to add OU6 and provide a mechanism to add newly discovered source areas. The FFA ensures that environmental impacts associated with past practices at FWA are investigated and remedial actions are completed to protect human health and the environment. It sets deadlines, objectives, responsibilities, and procedural framework for implementing restoration activities at FWA.

OU-1 801 Drum Burial Site

The OU-1 801 Drum Burial site is an approximate 20 acre area that was used as a drum storage and disposal area. The drums contained diesel fuel, gasoline, jet fuel, solvents, asphalt, pesticides, and lubricants. Volatile organic compounds (VOCs), pesticides, and metals were present in soil, groundwater, and sediments of the Chena River. Metals were present in Chena River water samples.

The remedy consisted of drum and soil removal, natural attenuation of groundwater with long term monitoring/evaluation, institutional controls (ICs), and a contingent remedy consisting of air sparging/soil vapor extraction (AS/SVE). Soil and drum removal actions were conducted between 1992 and 1996. The contingent remedy was not implemented because contaminant concentrations in groundwater did not increase and the contaminant plume did not expand. ICs have been implemented and groundwater monitoring is ongoing. The ICs include restrictions on site access, construction, and well installation as long as hazardous substances remain at the site at levels that preclude unlimited use and unrestricted exposure.

OU-2 Building 1168 Leach Well

The OU-2 Building 1168 Leach Well was used from the 1950s to 1997. It received liquids collected in floor drains within Building 1168, which was for vehicle storage, as a vehicle shop, and as a petroleum, oil, and lubricant laboratory. Hydrocarbon and chlorinated solvent contamination was present in soil and groundwater.

The remedy consisted of operating an AS/SVE system, natural attenuation of groundwater with long term monitoring/evaluation, and ICs. The AS/SVE system was installed in 1994 and operated until 1998, when it was shut down. ICs have been implemented and groundwater monitoring is ongoing. The ICs include restrictions on site access, construction, and well installation as long as hazardous substances remain at the site at levels that preclude unlimited use and unrestricted exposure.

OU-2 Defense Reutilization Maintenance Operation Yard

The OU-2 Defense Reutilization Maintenance Operation (DRMO) Yard is a 25 acre site that was used to store obsolete, surplus, and unserviceable equipment. It was also used as a hazardous material transfer point for FWA and other Department of Defense facilities. It consists of six subareas. Two of these areas (DRMO-1 and DRMO-4) are being remediated under CERCLA and are included in this five-year review. Both subareas encompass different sections of the DRMO Yard. Petroleum hydrocarbons and chlorinated solvents were present in soil and groundwater.

The remedy consisted of operating an AS/SVE system at DRMO-1, natural attenuation of groundwater with long term monitoring/evaluation, and ICs at DRMO-1 and DRMO-4. The AS/SVE system was installed in 1997 and operated until 2005, when it was shut down. ICs have

been implemented and groundwater monitoring is ongoing. The ICs include restrictions on site access, construction, and well installation as long as hazardous substances remain at the sites at levels that preclude unlimited use and unrestricted exposure. Additional ICs include a limitation on refilling the DRMO Yard fire suppression water tank from the existing potable water supply well until state and federal maximum contaminant levels are met (except in emergency situations).

OU-3 Remedial Area 1B (Birch Hill Tank Farm)

OU-3 Remedial Area 1B consists of seven subareas, of which four are currently active: Former Building 1173, Truck Fill Stand, Thaw Channel, and Birch Hill Tank Farm (BHTF) Product Recovery System. The other three subareas were granted no further action status in 1996.

BHTF was constructed in 1943 as part of the Canadian Oil Pipeline project. It included fourteen 10,000 barrel and two 25,000 barrel above ground storage tanks (ASTs) that were used for JP-4, mogas, and diesel fuels. The site was contaminated with free product (weathered gasoline) on the water table, dissolved hydrocarbons and 1,2-dichloroethane (DCA) in groundwater, and VOCs and petroleum compounds in soil.

The remedy consisted of operating AS/SVE systems, a dual-phase product recovery system, natural attenuation of groundwater with long term monitoring/evaluation, and ICs. The AS/SVE systems operated between 1996 and 2005. The dual phase recovery system was installed in 1998 and operated until 2003. ICs have been implemented and groundwater monitoring is ongoing. The ICs include restrictions on site access, construction, and well installation as long as hazardous substances remain at the sites at levels that preclude unlimited use and unrestricted exposure.

OU-3 Remedial Area 2 (Valve Pits and Railcar Off-Loading Facility)

OU-3 Remedial Area 2 occupies 40 acres. It was used as a rail car off-loading and fuel distribution facility. It consists of six subareas: Valve Pit A, Valve Pit B, Valve Pit C, a Central Header, Former Building 1144, and an Eight Car Header. Groundwater and soil contamination were caused by fuel and fuel additive storage, handling, and transfer activities. Soil and groundwater at the sites were contaminated with petroleum hydrocarbons.

The remedy consisted of operating AS/SVE systems, natural attenuation of groundwater with long term monitoring/evaluation, and ICs. The AS/SVE systems were installed in 1996 and operated until 2012. ICs have been implemented and groundwater monitoring is ongoing. The ICs include restrictions on site access, construction, and well installation as long as hazardous substances remain at the sites at levels that preclude unlimited use and unrestricted exposure.

OU-3 Remedial Area 3 (Fairbanks-Eielson Pipeline Mileposts 2.7 and 3.0)

OU-3 Remedial Area 3 consists of two source areas along the Fairbanks-Eielson Pipeline (FEP) at Milepost 2.7 and Milepost 3.0. A third site, Milepost 15.75, was granted no further action status in 2012 and is not included in this five-year review. Petroleum hydrocarbon contamination of soil and groundwater was identified at Milepost 2.7 and Milepost 3.0.

The remedy consisted of operating AS/SVE systems at each site, injecting an oxygen-releasing compound into groundwater during a treatability study, natural attenuation of groundwater with long term monitoring/evaluation, and ICs. AS/SVE and oxygen releasing compound treatability studies were performed in 1996. Both technologies were not considered viable due to low soil

permeability. An Explanation of Significant Differences was prepared in 2002 to change the remedial strategy to excavation of contaminated soil, *ex situ* treatment via AS/SVE and additional monitoring requirements. A data gap analysis is planned for these areas to verify the source of groundwater contamination and to recommend future actions. ICs have been implemented and groundwater monitoring is ongoing. The ICs include restrictions on site access, construction, and well installation as long as hazardous substances remain at the sites at levels that preclude unlimited use and unrestricted exposure.

OU-4 Landfill

The OU-4 Landfill Source Area occupies approximately 14 acres. It was used for disposal of domestic and commercial refuse, ash, asbestos, incinerator residue, and construction and demolition waste from the early 1950s to the early 1960s. A limited area of petroleum contaminated surface soil was present at one location. Groundwater was contaminated by petroleum hydrocarbons and chlorinated solvents.

The remedy consisted of installing a landfill cap, natural attenuation of groundwater with long term monitoring/evaluation, and ICs. A contingent remedy, consisting of a methane gas collection system, was also identified in the Record of Decision (ROD). It was subsequently determined to be unnecessary and not installed. ICs have been implemented and groundwater monitoring is ongoing. The ICs include restrictions on site access, construction, and well installation as long as hazardous substances remain at the site at levels that preclude unlimited use and unrestricted exposure.

OU-4 Coal Storage Yard

The OU-4 Coal Storage Yard is an approximately 800 feet by 300 feet (ft) area that was used for coal storage for a FWA cogeneration power plant. The pile was sprayed with waste petroleum products and waste solvents from the 1960s to 1993 to increase the thermal content of the coal. The site is still used for coal storage. Groundwater was contaminated by petroleum hydrocarbons, chlorinated solvents, and bis(2-ethylhexyl)phthalate.

The remedy consisted of operating an AS/SVE system, natural attenuation of groundwater with long term monitoring/evaluation, and ICs. The AS/SVE system was installed in 1997 and operated until 2000. Groundwater monitoring has been discontinued because COCs were not detected in groundwater above the cleanup goals. ICs have been implemented, they include restrictions on site access, construction, and well installation as long as hazardous substances remain at the site at levels that preclude unlimited use and unrestricted exposure.

OU-5 West Quartermaster's Fueling System

The OU-5 West Quartermaster's Fueling System (WQFS) consists of four subareas, WQFS1, WQFS2, WQFS3, and WQFS4 that encompass approximately 50 acres. It was used for vehicle and aircraft maintenance operations that involved the use and disposal of solvents and other cleaning compounds. The site also included storage tanks (underground and above ground), a pump house, fueling islands, and fuel piping (above ground and underground). Buried drums were encountered at the site. Groundwater, surface water in the Chena River, and soil were contaminated by petroleum hydrocarbons. 1,2-DCA was also identified in groundwater.

The remedy consisted of operating AS/SVE systems, natural attenuation of groundwater with long term monitoring/evaluation, and ICs. Three AS/SVE systems were installed in 1997 and 1998 and decommissioned in 2011 and 2013. A fourth AS/SVE system was operated between

2001 and 2003. A boom was installed in the Chena River in 1998 to remove sheen from the water. It is deployed annually from May to October. Abandoned and buried fuel lines were cleaned, emptied, and abandoned in 2000. Groundwater monitoring is ongoing and ICs have been implemented. The ICs include restrictions on site access, construction, and well installation as long as hazardous substances remain at the sites at levels that preclude unlimited use and unrestricted exposure.

OU-5 East Quartermaster's Fueling System

The OU-5 East Quartermasters Fueling System (EQFS) covers approximately 40 acres. It was used for vehicle storage and maintenance, dry cleaning, fuels testing, refueling, pesticide storage and mixing, and waste storage. The site included storage tanks (underground and above ground), a pump house, fueling islands, and a fuel pipeline. Groundwater, surface water in the Chena River, and soil were contaminated by petroleum hydrocarbons. 1,2-Dichloroethane and bis(2-chlorethyl)ether were identified in groundwater.

The remedy consisted of operating an AS/SVE system, natural attenuation of groundwater with long term monitoring/evaluation, and ICs. The AS/SVE system was operated from 1994 to 2005. ICs have been implemented and groundwater monitoring is ongoing. The ICs include restrictions on site access, construction, and well installation as long as hazardous substances remain at the site at levels that preclude unlimited use and unrestricted exposure.

OU-5 Remedial Area 1A (Birch Hill Tank Farm Above Ground Storage Tanks)

OU-5 Remedial Area 1A consists of petroleum and lead-contaminated soil surrounding above ground storage tanks on the BHTF. The site contained fourteen 10,000 barrel and two 25,000 barrel ASTs, underground pipes, pump houses, a manifold building, and a truck fill stand. The facility was used for storage of diesel fuel, jet fuel, and gasoline (leaded and unleaded). It covers approximately 110 acres.

Petroleum and lead-contaminated soil was caused by sludge in the bottom of the tanks, thread lubricant, and leaded paint chips from the tanks. The remedy consists of ICs to restrict access and land use. The ASTs were removed in 2015 and excavation of contaminated soil is planned for 2016 pursuant to a 2-Party Agreement between the U.S. Army and ADEC (not under the OU-5 CERCLA remedy). ICs have been implemented. They include restrictions on site access, construction, and well installation as long as hazardous substances remain at the site at levels that preclude unlimited use and unrestricted exposure.

OU-5 Open Burn Open Detonation (OB/OD) Area

The OB/OD Area was used historically for open burning and open detonation of explosives on FWA from as early as the mid-1960s until as late as the mid-1980s. It is located within an active small-arms impact range on FWA, approximately 1,000 ft north of the Tanana River and 1,500 ft south of a flood control dike. The site is situated along the east side of a gravel water-filled borrow pit. It is bounded to the north and east by gravel berms. The bermed area comprising the OB/OD site measures approximately 150 ft by 450 ft. An OB/OD pad reportedly was used by the U.S. Army and the U.S. Air Force for disposing of unexploded ordnance (UXO), unused propellants (black powder), rocket motors, small-arms ammunition, and other hazardous materials.

The OB/OD was included in OU-5 under the FFA, was also designated as a RCRA-regulated unit, and was granted deferred closure under Title 40, part 265 of the Code of Federal

Regulations (CFR) since this site is located within the active small-arms impact range on FWA. As described in the ROD, final closure will occur under a 1991 Federal Facility Compliance Agreement (FFCA) and RCRA, but evaluation of the decision to delay closure will be reviewed during each five year review.

The ecological and human health risk assessments completed during a remedial investigation indicated that the risks associated with the site are very low, and therefore, the site was determined to require no further action under CERCLA and RCRA Corrective Action. However, because of concerns about potential human exposure to unexploded ordnance associated with the operational range and the deferred RCRA closure, the U.S. Army's ICs that provide monitoring and control of access to the site were required to remain in place.

OU-6 Former Communications Site

The OU-6 Former Communications Site covers approximately 54 acres and contains military housing units known as the Tanana Trails Family Housing Development (formerly known as Taku Gardens Family Housing Development). It previously contained or was used for barracks, company headquarters, communications and radar systems, a salvage/reclamation yard, debris disposal, drum stockpiles, firefighter training, a Post Exchange Service Station (gas station), a concrete batch plant, and possible ammunition storage. Previous site activities included the dumping of solid waste and debris into a former meander channel of the Chena River (Hoppe's Slough).

Soil and groundwater contamination were identified during construction of the housing development and remedial investigation activities. Soil contamination consisted of petroleum, oil, and lubricants, polychlorinated biphenyls (PCBs), volatile organic, semi-volatile organic, and explosive compounds, pesticides, and herbicides. Groundwater was contaminated by petroleum, oil, and lubricants and VOCs. Five groundwater contaminant plumes were identified. Several removal actions were conducted after the risk assessment was completed and prior to the OU-6 ROD. They resulted in the removal and off-site disposal of PCB-contaminated soil (3,368 cubic yards [CY]), pesticide-contaminated soil (66 CY), petroleum/solvent-contaminated soil (3,354 CY), 2,934 items classified as munitions-related debris, and 1,061 drums (all but eight were empty and crushed).

The ROD was signed in January 2014. The remedy consists of: 1) implementing ICs that prohibit soil disturbing activities greater than 6 inches without prior approval, prohibit the use of or access to groundwater beneath the site, and prohibit damage or defacement of monitoring wells, and 2) groundwater monitoring to assess the progress of natural attenuation of the contaminants and to ensure that contamination is not migrating towards FWA drinking water supply wells. A land use control/IC site inspection has been conducted since the ROD was signed.

Site Inspections, Interviews, and Public Notice

Five-year review site inspections were performed on August 11, 2015. Interviews were conducted with FWA Directorate of Public Works personnel and U.S. Army Corps of Engineers, Alaska District personnel. Interviews with USEPA and ADEC personnel were completed in July, 2016. A public notice announcing the five-year review was published in the Alaska Post on April 8, 2016 and in the Fairbanks Daily Miner on June 14, 2016.

Protectiveness Statements, Issues, and Recommendations

OU-1

The remedy at OU-1 currently protects human health and the environment because:

- Contaminant source removal (drums and contaminated soil) was completed.
- Migration of contaminants of concern (COCs) in groundwater to the Chena River and downgradient drinking water wells is not occurring based on sampling results that indicate the plume is stable.
- Based on groundwater data and a comparison of groundwater quality to calculated USEPA vapor intrusion screening levels (VISLs), the vapor intrusion exposure pathway is incomplete at the 801 Drum Burial Site.
- ICs are in place to ensure that groundwater will not be used until cleanup goals are attained and to assure that exposure to any contaminated soil at the site will not occur.

However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness:

- Collect groundwater samples from monitoring wells AP-6326, AP-6327, AP-7162, and AP-10042 for analysis for VOCs and complete a vapor intrusion assessment.
- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the 801 Drum Burial Site. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-2

The remedies at OU-2 currently protect human health and the environment because:

- All cleanup goals have been attained at the Building 1168 Leach Well site, although petroleum contamination persists at the site.
- Migration of COCs in groundwater from the DRMO-1 and DRMO-4 source areas has been reduced by the remedial actions.
- ICs are in place to ensure that groundwater containing COCs will not be used.

However, in order for the remedy to be protective in the long-term, the following action needs to be taken to ensure protectiveness:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Building 1168 Leach Well site and DRMO Yard. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-3

The remedies at OU-3 currently protect human health and the environment because:

- Further migration of contaminated groundwater has been reduced by the remedial actions and natural attenuation.
- ICs are in place to ensure that groundwater containing COCs will not be used.
- Off-post risks associated with the consumption of contaminated groundwater at Remedial Area 1B are mitigated by attenuation of COCs in the alluvial aquifer.

However, in order for the remedies to be protective in the long-term, the following actions need to be taken:

- Re-establish the cleanup goals for 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene in groundwater using either of the following methods: 1) update the risk-based concentrations by including the inhalation pathway and using information from a new USEPA Integrated Risk Information System toxicity assessment, or 2) adopt the cleanup goals established in 18 AAC 75.
- Perform a data gap investigation at Remedial Area 1B and the Mileposts 2.7 and 3.0 sites and recommend a future course of action for the sites. (This activity is currently under contract with the U.S. Army.).
- Conduct an investigation to evaluate if there are any previously undiscovered source areas at the Remedial Area 2 (Valve Pits and ROLF).

OU-4

The remedies at OU-4 currently protect human health and the environment because:

- All RAOs have been attained at the Coal Storage Yard.
- Further migration of contaminated groundwater from the Landfill Source Area has been reduced by the implemented remedy and natural attenuation.
- ICs are in place at the Landfill Source Area to ensure that contaminated groundwater will not be used until the cleanup goals are attained.

However, in order for the remedies to be protective in the future, the following action needs to be taken to ensure protectiveness:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Landfill. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-5

The remedies at OU-5 currently protect human health and the environment because:

- Initial remedial responses were performed at WQFS/EQFS and AS/SVE systems were installed and operated in accordance with the ROD. The treatment systems have recovered significant mass and reduced or prevented further migration of contaminated groundwater to downgradient areas and the Chena River.
- Natural attenuation is an active process that has reduced or prevented further migration of contaminated groundwater to downgradient areas and the Chena River from the WQFS/EQFS.
- The Chena River Aquatic Assessment Program did not identify adverse impacts associated with the WQFS/EQFS to benthic communities in the river.
- Occurrences of sheen in the Chena River have decreased.
- ICs are in place at the WQFS/EQFS to ensure that groundwater containing contaminants above Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs), non-zero maximum contaminant level goals (MCLGs), or relevant Alaska Water Quality Standards (AWQS) (fresh water use criteria) will not be used until the cleanup goals are attained.

- ICs are in place at Remedial Area 1A to limit human and terrestrial receptor exposure to lead contaminated soil.
- The OB/OD IC components have been improved since trespassers were identified on a site located 1,000 ft from the OB/OD. Improvements include increased frequency of inspections and access controls.
- There is no evidence of unauthorized installation or use of groundwater wells, no soil disturbing activities, and warning signs are intact at Remedial Area 1A and the OB/OD Area.

However, in order for the remedies to be protective in the long-term, the following actions need to be taken to ensure protectiveness:

- Conduct an investigation and determine if there are any previously undiscovered source areas at the WQFS.
- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the OU-5 WQFS or EQFS. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-6

The remedy at OU-6 is protective of human health and the environment because:

- ICs are in place to ensure that human exposure to contaminated soil and groundwater will not occur.
- There is no evidence of unauthorized installation or use of groundwater wells.
- Groundwater quality data will be used to assess the performance of the OU-6 remedy in the future.

Issues and Recommendations

Issues that affect protectiveness of the remedies and recommendations to address them are identified in Section 6, Table 6-1.

Several concerns have been identified that do not affect the protectiveness of the remedies. These concerns and corresponding recommendations are provided in Section 6, Table 6-2.

FIVE YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Fort Wainwright Alaska (FWA)		
EPA ID: AK6210022426		
Region: X	**State:** AK	**City/County:** Fairbanks/Fairbanks North Star Borough

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes OU-1 801 Drum Burial Site OU-2 Building 1168 Leach Well OU-2 DRMO Yard OU-3 Remedial Area 1B (BHTF) OU-3 Remedial Area 2 (Valve Pits and Rail Off Loading Facility [ROLF]) OU-3 Remedial Area 3 (FEP Mileposts 2.7 and 3.0) OU-4 Landfill OU-4 Coal Storage Yard OU-5 WQFS OU-5 EQFS OU-5 Remedial Area 1A (BHTF ASTs) OU-5 OB/OD Area OU-6 Former Communications Site	**Has the site achieved construction completion?** No

REVIEW STATUS
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** U.S. Army
Author name (Federal or State Project Manager): Prepared by U.S. Army Corps of Engineers for U.S. Army Environmental Command and USAG - FWA
Author affiliation: U.S. Army Corps of Engineers
Review Period: August 2015 – November 2016
Date of site inspection: August 11, 2015
Type of review: Statutory
Review number: 4
Triggering action date: September 29, 2011

Due date *(five years after triggering action date):* September 29, 2016				
Issues/Recommendations				
AOC(s) without Issues/Recommendations Identified in the Five-Year Review:				
OU-4 Coal Storage Yard, OU-5 Remedial Area 1A (BHTF ASTs), OU-5 OB/OD Area, and OU-6 Former Communications Site				
Issues and Recommendations Identified in the Five-Year Review:				
AOC(s): OU-1 (Drum Burial Site)	**Issue Category:** Monitoring			
	Issue: Under agreement among the remedial project managers (RPMs), data was not collected from monitoring wells located between currently monitored points and the 801 Military Housing Area for inclusion in the five-year review. Data from these wells was not available for use in the vapor intrusion assessment at OU-1.			
	Recommendation: Collect groundwater samples from monitoring wells AP-6326, AP-6327, AP-7162, and AP-10042 for analysis for VOCs and complete a vapor intrusion assessment.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	USEPA	September 2018
AOC(s): OU-1 (Drum Burial Site)	**Issue Category:** Monitoring			
	Issue: An assessment for 1,4-dioxane has not been performed at the 801 Drum Burial Site.			
	Recommendation: Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the 801 Drum Burial Site. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	USEPA	September 2018
AOC(s): OU-2 (Building 1168 Leach Well and DRMO Yard)	**Issue Category:** Monitoring			
	Issue: An assessment for 1,4-dioxane has not been performed at the 1168 Leach Well site and DRMO Yard.			
	Recommendation: Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Building 1168 Leach Well site and DRMO sites. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.			

Affect Current Protectiveness	Affect Future Protectiveness	Implementing Party	Oversight Party	Milestone Date
No	Yes	Federal Facility	USEPA	September 2018
AOC(s): OU-3 Remedial Area 1B (BHTF), Remedial Area 2 (Valve Pits and ROLF), and Remedial Area 3 (FEP Mileposts 2.7 and 3.0)	**Issue Category:** Cleanup goals			
	Issue: The risk-based cleanup goals for trimethylbenzenes (TMBs) presented in the 2002 Explanation of Significant Differences are no longer valid.			
	Recommendation: Re-evaluate and update the cleanup goals for 1,2,4-TMB and 1,3,5-TMB in groundwater.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	USEPA	September 2018
OU-3 Remedial Area 1B (BHTF - GW)	**Issue Category:** Remedy Performance			
	Issue: The benzene and 1,2-DCA concentrations continue to exceed cleanup goals and exhibit increasing trends in some monitoring locations.			
	Recommendation: Perform a data gap investigation and recommend a future course of action for Remedial Area 1B.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	USEPA	September 2018
OU-3 Remedial Area 2 (Valve Pits and ROLF)	**Issue Category:** Remedy Performance			
	Issue: The historical decommissioning of infrastructure may have resulted in the abandonment of pipeline with impacts at Remedial Area 2.			
	Recommendation: Conduct an investigation to evaluate whether there are any previously undiscovered source areas at the Remedial Area 2 (Valve Pits and ROLF).			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	USEPA	September 2018
OU-3 Remedial Area 3 (FEP Mileposts 2.7 & 3.0)	**Issue Category:** Remedy Performance			
	Issue: The concentrations of benzene remain high and exhibit increasing trends in several wells. Analysis has shown that groundwater cleanup goals will not be achieved for these areas within a reasonable period of time.			

	Recommendation: Perform a data gap investigation (currently under contract and being performed) and recommend a future course of action for the FEP Milepost sites.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	USEPA	September 2018
OU-4 Landfill	**Issue Category:** Monitoring			
	Issue: An assessment for 1,4-dioxane has not been performed at the Landfill.			
	Recommendation: Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Landfill. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	USEPA	September 2018
OU-5 WQFS	**Issue Category:** Remedy Performance			
	Issue: The historical decommissioning of infrastructure may have resulted in the abandonment of pipeline with impacts at the WQFS.			
	Recommendation: Conduct an investigation to evaluate if there are any previously undiscovered source areas at the WQFS.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	USEPA	September 2018
OU-5 WQFS and EQFS	**Issue Category:** Monitoring			
	Issue: An assessment for 1,4-dioxane has not been performed at OU-5 WQFS or EQFS.			
	Recommendation: Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the OU-5 WQFS or EQFS. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	USEPA	September 2018

Protectiveness Statement(s)		
AOC: OU-4 Coal Storage Yard, OU-5 Remedial Area 1A (BHTF ASTs), OU-5 OB/OD, and OU-6 Former Communications Site	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*
AOC: OU-1 801 Drum Burial Site, OU-2 Building 1168 Leach Well, OU-2 DRMO Yard, OU-3 Remedial Area 1B (BHTF – GW), OU-3 Remedial Area 2 (Valve Pits and ROLF), OU-3 Remedial Area 3 (FEP Mileposts 2.7 & 3.0), OU-4 Landfill, OU-5 WQFS, and OU-5 EQFS	*Protectiveness Determination:* Short-Term Protective	*Addendum Due Date (if applicable):*

Protectiveness Statements:

OU-1

The remedy at OU-1 currently protects human health and the environment because:

- Contaminant source removal (drums and contaminated soil) was completed.
- Migration of COCs in groundwater to the Chena River and downgradient drinking water wells is not occurring.
- Based on groundwater data and a comparison of groundwater quality to the calculated USEPA VISLs, the vapor intrusion exposure pathway is incomplete at the 801 Drum Burial Site.
- ICs are in place to ensure that groundwater will not be used until cleanup goals are attained and to assure that exposure to any contaminated soil at the site will not occur.

However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness:

- Collect groundwater samples from monitoring wells AP-6326, AP-6327, AP-7162, and AP-10042 for analysis for VOCs and complete a vapor intrusion assessment.
- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the 801 Drum Burial Site. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-2

The remedies at OU-2 currently protect human health and the environment because:

- All cleanup goals have been attained at the Building 1168 Leach Well site, although petroleum contamination persists at the site.
- Migration of COCs in groundwater from the DRMO-1 and DRMO-4 source areas has been reduced by the remedial actions.
- ICs are in place to ensure that groundwater containing COCs will not be used.

However, in order for the remedies to be protective in the long-term, the following action needs to be taken to ensure protectiveness:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Building 1168 Leach Well site and DRMO Yard. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-3

The remedies at OU-3 currently protect human health and the environment because:

- Further migration of contaminated groundwater has been reduced by the remedial actions and natural attenuation.
- ICs are in place to ensure that groundwater containing COCs will not be used.
- Off-post risks associated with the consumption of contaminated groundwater at Remedial Area 1B are mitigated by attenuation of COCs in the alluvial aquifer.

However, in order for the remedies to be protective in the long-term, the following actions need to be taken:

- Re-establish the cleanup goals for 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene in groundwater using either of the following methods: 1) update the risk-based concentrations by including the inhalation pathway and using information from the 2016 USEPA Integrated Risk Information System toxicity assessment or 2) adopt the cleanup goals established in 18 AAC 75.
- Perform a data gap investigation at Remedial Area 1B and the FEP Mileposts 2.7 and 3.0 sites and recommend a future course of action for the sites. (This activity is currently under contract with the U.S. Army for the Milepost sites).
- Conduct an investigation to evaluate if there are any previously undiscovered source areas at the Remedial Area 2 (Valve Pits and ROLF).

OU-4

The remedies at OU-4 currently protect human health and the environment because:

- All RAOs have been attained at the Coal Storage Yard.
- Further migration of contaminated groundwater from the Landfill Source Area has been reduced by the implemented remedy and natural attenuation.
- ICs are in place at the Landfill Source Area to ensure that contaminated groundwater will not be used until the cleanup goals are attained.

However, in order for the remedies to be protective in the future, the following actions needs to be taken to ensure protectiveness:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Landfill. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-5

The remedies at OU-5 currently protect human health and the environment because:

- Initial remedial responses were performed at WQFS/EQFS and AS/SVE systems were installed and operated in accordance with the ROD. The treatment systems have

recovered significant mass and reduced or prevented further migration of contaminated groundwater to downgradient areas and the Chena River.

- Natural attenuation is an active process that has reduced or prevented further migration of contaminated groundwater to downgradient areas and the Chena River from the WQFS/EQFS.
- The Chena River Aquatic Assessment Program did not identify adverse impacts associated with the WQFS/EQFS to benthic communities in the river.
- Occurrences of sheen in the Chena River have decreased.
- ICs are in place at the WQFS/EQFS to ensure that groundwater containing contaminants above SDWA MCLs, non-zero MCLGs, or relevant AWQS (fresh water use criteria) will not be used until the cleanup goals are attained.
- ICs are in place at Remedial Area 1A to limit human and terrestrial receptor exposure to lead contaminated soil.
- The OB/OD IC components have been improved since trespassers were identified on a site located 1,000 ft from the OB/OD. Improvements include increased frequency of inspections and access controls.
- There is no evidence of unauthorized installation or use of groundwater wells or evidence of soil disturbing activities, and warning signs are intact at Remedial Area 1A and the OB/OD area.

However, in order for the remedies to be protective in the future, the following action needs to be taken to ensure protectiveness:

- Conduct an investigation and determine if there are any previously undiscovered source areas at the WQFS.
- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the OU-5 WQFS or EQFS. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-6

The remedy at OU-6 is protective of human health and the environment because:

- ICs are in-place to ensure that human exposure to contaminated soil and groundwater will not occur.
- There is no evidence of unauthorized installation or use of groundwater wells.
- Groundwater quality data will be used to assess the performance of the OU-6 remedy in the future.

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1.0 INTRODUCTION

This review was conducted to determine whether previous remedial actions at six operable units (OUs) on Fort Wainwright Alaska (FWA) are, and will continue to be, protective of human health and the environment. The methods, findings, and conclusions of the review are documented in this report. Also identified are issues found during the review and recommendations to address them.

The U.S. Army has prepared this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The U.S. Environmental Protection Agency (USEPA) interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

The location of FWA is illustrated on Figure 1-1. The U.S. Army conducted a review of remedial actions implemented at the following OUs, which were generally grouped by similar contaminants of concern (COCs).

OU-1 - 801 Drum Burial Site

OU-2

- Former Building 1168 Leach Well
- Defense Reutilization Maintenance Operation (DRMO) Yard

OU-3

- Remedial Area 1B Birch Hill Tank Farm (BHTF)
- Remedial Area 2 Valve Pits and Railcar Off-Loading Facility (ROLF)
- Remedial Area 3 Fairbanks-Eielson Pipeline (FEP) Mileposts 2.7 and 3.0

OU-4

- Landfill
- Coal Storage Yard

OU-5

- West Quartermaster's Fueling System (WQFS)
- East Quartermaster's Fueling System (EQFS)
- Remedial Area 1A Birch Hill Tank Farm Aboveground Storage Tanks (ASTs)
- Open Burning/Open Detonation (OB/OD) Area (no remedy selected – review of institutional controls required for unexploded ordnance)

OU-6 - Former Communications Site

This is the fourth five-year review for OU-1, OU-2, OU-3, OU-4, and OU-5, which was triggered by the completion date of the third *Five-Year Review Report for US Army Garrison, Fort Wainwright, Alaska* (U.S. Army 2011). This is the first five-year review for OU-6. The review was conducted from July 2015 to November 2016 by personnel from the U.S. Army Corps of Engineers (USACE) Buffalo District.

Previous five-year reviews of CERCLA activities at FWA were conducted in 2001 (U.S. Army 2001), 2006 (U.S. Army 2006), and 2011 (U.S. Army 2011). Updates since the last five-year review are provided on a site-by-site basis in report sections *Progress Since the Last Five-Year Review*. Table 1-1, below, lists all sites at FWA currently subject to restoration activities and whether or not they meet the requirements for inclusion in this five-year review. Review is required for OU-1 through OU-6 because the selected remedies leave hazardous substances, pollutants, or contaminants in place at levels that do not allow unlimited use and unrestricted exposure after the remedial actions are or were completed. No other five-year reviews are currently required for sites located at the FWA.

Table 1-1 Summary of Active Restoration Activities at FWA

Site ID	OU	Description	Status	Evaluated in the five-year review? (Y/N)
Installation Restoration Program Sites				
FTWW-011	4	Power Plant Coal Storage Yard (Building 3595)	1996 ROD – Remedy Implemented	Y
FTWW-038	4	Landfill Plume	1996 ROD – Remedy Implemented	Y
FTWW-047	2	DRMO Salvage Yard	1997 ROD – Remedy Implemented	Y
FTWW-055	3	Fairbanks Fuel Terminal	ROD/ESD – Remedy Selected	Y
FTWW-067	1	801 Drum Burial Site	1997 ROD, Remedy Implemented	Y
FTWW-068	5	Open Burning/Open Detonation Area	Delayed RCRA Closure	Y
FTWW-072	2	Oil Water Separator at Bldg 1168	1997 ROD – Remedy Implemented	Y
FTWW-083	3	Railroad Off Loading Facility	ROD/ESD – Remedy Implemented	Y
FTWW-084	3	FEP Milepost 2.7 and 3.0	ROD/ESD – Remedy Selected	Y
FTWW-094	5	Former Quartermaster's Fueling System – East/West	1999 ROD –Remedy Implemented	Y
FTWW-096	5	Birch Hill Above Ground Storage Tanks	1999 ROD –Remedy Implemented	Y
FTWW-102	6	Former Communication Site/Taku Gardens	2014 ROD – Remedy Implemented	Y
N/A	7	Tanana River Site	Under Investigation	N
Petroleum Contaminated Groundwater Sites				
FTWW-050	N/A	North Post Site	2-PTY Monitoring	N
FTWW-085	N/A	UST, Bldg 5110	2-PTY Monitoring	N
FTWW-086	N/A	UST, Bldg 3562	2-PTY Under Investigation	N
FTWW-087	N/A	UST, Bldg 2111 & 2112	2-PTY Monitoring	N
FTWW-099	N/A	UST, Bldg 3564	2-PTY Monitoring	N

Site ID	OU	Description	Status	Evaluated in the five-year review? (Y/N)
FTWW-100	N/A	Building 2250 Residual POL Contamination	2-PTY Monitoring	N
FTWW-101	N/A	Neely Road POL Point Building 3570	2-PTY Monitoring	N
CC-FTRS-04	N/A	Seward Recreation Camp UST/AST Site	2-PTY Monitoring	N
CC-FTWW-02	N/A	Forward Air Refueling Point	2-PTY Monitoring	N
CC-FTWW-103	N/A	Aviation Task Force & Building 3004	2-PTY Under Investigation	N
CC-FTWW-104	N/A	Spill area south of Building 3485	2-PTY Under Investigation	N
CC-FTWW-105	N/A	336B Barracks	2-PTY Under Investigation	N
CC-FTWW-106	N/A	Pipeline Breaks	2-PTY Under Investigation	N
CC-FTWW-107	N/A	Motor Pool Building s 3492, 3494, 3496	2-PTY Under Investigation	N
CC-FTWW-108	N/A	Building 3498	2-PTY Under Investigation	N
CC-FTWW-109	N/A	Building 1054	2-PTY Under Investigation	N
CC-FTWW-110	N/A	Building 3014	2-PTY Under Investigation	N
CC-FTWW-111	N/A	Montgomery Road Extension	2-PTY Under Investigation	N
CC-FTWW-112	N/A	Sage Hill	2-PTY Under Investigation	N
CC-FTWW-113	N/A	Northern Lights Housing Area	2-PTY Under Investigation	
Military Munitions Response Program Sites				
FTWW-001-R-01	N/A	TA-105	Remedy Selection Pending	N
FTWW-002-R-01	N/A	TA-101	Remedy Selection Pending	N
FTWW-004-R-01	N/A	Arctic Survival Area – Ski Slope	Remedy Selection Pending	N
FTWW-008-R-01	N/A	Bombing From Wainwright to Greely	Under Investigation	N

2.0 SITE CHRONOLOGY

FWA was established in 1938 as a cold weather testing station. Originally known as Ladd Army Airfield, the post was used to test aircraft operations in arctic conditions. It served as supply transfer point for the United States Lend-Lease Program to the Soviet Union during World War II. In 1947 the newly formed U.S. Air Force assumed control of Ladd Army Airfield, which was redesignated as Ladd Air Force Base and became a resupply and maintenance base for Distant Early Warning sites and an experimental station in the Arctic Ocean. During the Korean conflict, the base served as part of the defense network that included Nike Hercules missile sites. FWA became the home of the 171st Infantry Brigade in 1963 and has housed various U.S. Army brigades and divisions over the years.

FWA was proposed for placement on the CERCLA National Priorities List (NPL) in July 1989 due to releases of hazardous substances, pollutants, and contaminants into the environment. The U.S. Army's investigation of contaminated sites at FWA began in 1989 under the Installation Restoration Program (IRP) and the installation was added to the CERCLA National Priorities List in 1990.

The USEPA (Region 10) and the Alaska Department of Environmental Conservation (ADEC) began working closely with the U.S. Army to better understand the nature and extent of contamination at FWA and its threat to human health and the environment. The three parties negotiated the FWA NPL Site Federal Facility Agreement, (FFA), which was signed in March 1992. The FFA ensures that environmental impacts associated with past practices at FWA are investigated and remedial actions are completed to protect human health and the environment. This agreement sets deadlines, objectives, responsibilities, and procedural framework for implementing the IRP at FWA. The FFA establishes and describes the CERCLA process as applied to FWA.

An additional goal of the FFA was to integrate the U.S. Army's CERCLA response obligations and Resource Conservation and Recovery Act (RCRA) corrective action obligations at FWA. The FFA states that remedial actions implemented under the agreement will be protective of human health and the environment such that remediation of releases shall obviate the need for further corrective actions under RCRA.

Each of the parties to the FWA FFA is represented by a Remedial Project Manager (RPM). They meet regularly in accordance with the FFA to discuss the U.S. Army's progress regarding remedial actions selected in Record of Decision (ROD) documents and to address related issues as they arise during the course of remedial actions. The RPMs meet when needed and routinely make themselves available to each other for purposes of FWA remediation (e.g., for technical reviews, modifying monitoring programs, etc.) and to meet the intent and commitments of the FFA.

Site locations evaluated in this five-year review are illustrated on Figure 2-1. Table 2-1 lists the dates of important events for FWA and OU-1 through OU-6.

Table 2-1 Chronology of Site Events

Event	Date
Site-Wide	
FWA listed on the NPL	August 1990
FFA signed	1992
2-PTY Agreement signed[1]	1992
First FWA Five-Year Review Report finalized	September 2001
FWA Construction Complete concurrence received from the USEPA[2]	2002
Second FWA Five-Year Review Report finalized	September 2006
Third FWA Five-Year Review Report finalized	September 2011
OU-1 801 Drum Burial Site	
Drum storage and disposal activities	1950s and 1960s
Preliminary source evaluation (PSE) conducted	1991
Buried drums discovered during construction; geophysical survey conducted with two anomalies found.	1992
Second PSE conducted; 92 drums excavated and removed from site, 18 contained product.	1992 and 1993
Excavation of 34 drums (8 containing product); additional monitoring wells installed and sampled.	1995
Initial response conducted that included geophysical surveys, removal of drums, removal of contaminated soil, and installation of monitoring wells.	September 1996
Final remedial investigation (RI) report issued (Site N-4, 801 Drum Burial Site, Building 1599, Chemical Agent Dump Site, and Building 2077).	September 13,1996
Final Feasibility Study (FS) report issued	February 1997
Proposed Plan for remedial action issued	February 1997
Stockpiled soils removed from site	1997
ROD signed	June 1997
Additional excavations performed, no additional drums found	October 1997
Final Operation, Maintenance and Monitoring (OM&M) report issued	December 2000
Interim Remedial Action Report (RACR) issued	May 2001

[1] The 2-PTY agreement deferred source areas limited to potential petroleum contamination to investigation and clean up under Alaska State regulation. The 2-PTY sites are CERCLA-exempt and have been excluded from this review.

[2] Although construction completion was recorded in 2002, remedial actions are still in progress at FWA. The USEPA considers construction completion for sites meeting the following criteria: 1) Any necessary physical construction is complete, whether or not final cleanup levels or other requirements have been achieved; or 2) USEPA has determined that the response action should be limited in measure that do not involve construction; or 3) The site qualifies for deletion from the NPL. (https://www.epa.gov/superfund/superfund-remedial-action-project-completion-and-construction-completions) FWA does not currently meet this criteria.

Table 2-1 Chronology of Site Events

Event	Date
Cleanup Operations and Site Exit Strategy (CLOSES) Evaluation issued	April 2004
OU-2 Former Building 1168 Leach Well	
Lube oil and vehicle storage facility operations	1949 to 1962
Site converted into a petroleum test laboratory	1962
Groundwater survey conducted; USEPA recommends further investigation	1990
PSE conducted	1992 and 1993
Source area pilot-scale air sparge/soil vapor extraction (AS/SVE) remediation system installed.	November 1994
Final RI report issued	January 25, 1996
Proposed Plan for remedial action issued	April 1996
Final FS report issued	April 29, 1996
ROD signed	January 1997
Building 1168 demolished	1997
Active AS/SVE treatment completed	1998
RACR completed for Former Building 1168 AS/SVE system.	May 1999
Final OM&M plan issued	December 2000
AS/SVE system decommissioned	2003
In-situ chemical oxidation (ISCO) treatability study injection at the Former Building 1168 Three Party (Leach Well) Site.	October 2010
OU-2 DRMO Yard	
Vehicle storage and vehicle maintenance shop activities	1945 to 1961
Site converted to salvage yard and drum storage	1961
Diesel spill near Building 5001	Early 1980s
Removal of eight underground storage tanks (USTs)	1988 to 1996
Installation and semiannual sampling of monitoring wells	1990 to 1993
Soil and groundwater contamination discovered north of building 5001	July 1992
PSE conducted to assess extent of soil contamination	September 1992
RI conducted	1993
Proposed Plan for remedial action issued	April 1996
Final FS report issued	April 29, 1996
ROD signed	January 1997
RACR completed for OU-2	August 1999
Final OM&M plan issued	December 2000

Table 2-1 Chronology of Site Events

Event	Date
CLOSES evaluation completed	March 2004
DRMO-1 Three-Party treatment system decommissioned	October 2008
In-situ chemical reduction (ISCR) treatability study injection at the DRMO-1 and DRMO-4 Three-Party Sites.	August 2009
Supplemental ISCR injection at the DRMO-1 Three-Party Site	August 2010
OU-3 Remedial Area 1B – Birch Hill Tank Farm	
Tank farm constructed with fourteen 10,000 barrel bolted steel ASTs	1943
Two 25,00 barrel ASTs added to the tank farm	1956
Two 2,250 barrel ASTs added to the Truck Fill Stand	1956
Soil gas survey conducted	1988
Picket wells installed	1992
RI fieldwork conducted	September/October 1994
RI and Risk Assessment reports submitted to USEPA	October 1994
FS submitted to USEPA	April 1995
Proposed Plan for remedial action issued	April 1995
ROD signed	January 1996
AS/SVE systems installed at Former Building 1173 and Lazelle Road	1996
Remedial Design/Remedial Action Statement of Work issued	April 1996
Lazelle Road system relocated to the Truck Fill Stand and the Former Building 1173 system expanded to cover Lazelle Road source area	1997
Product recovery treatability studies initiated at the BHTF	1998
Thaw Channel treatment system installed	1999
Explanation of Significant Differences (ESD) signed	September 2002
Interim RACR completed	September 2002
OU-3 Valve Pits and ROLF	
ROLF constructed	1939
Three 1,100 barrel ASTS added	1943
Soil-gas survey conducted	1988
Monitoring wells installed	1989
RI fieldwork conducted	September/October 1994
RI and Risk Assessment reports submitted to USEPA	October 1994
FS submitted to USEPA	April 1995
Proposed Plan for remedial action issued	April 1995

Table 2-1 Chronology of Site Events

Event	Date
ROD signed	January 1996
AS/SVE treatment systems installed at Valve Pits A, B, and C; Central Header; and Former Building 1144	July and August 1996
Remedial Design/Remedial Action Statement of Work issued	April 1996
AS/SVE systems expanded	1997
AS/SVE treatment system installed at the Eight Car Header sub-source area; Central Header and Former Building 1144 treatment systems further expanded	1998
ESD signed	September 2002
Interim RACR completed	September 2002
AS/SVE treatment system at Eight-Car Header expanded to include upgradient area; Central Header and Former Building 1144 treatment systems also expanded.	2004
AS/SVE systems at Valve Pits B and C decommissioned	2005
Valve Pit A *in-situ* injection treatability study performed	October 2010
OU-3 Remedial Area 3 – FEP Mileposts 2.7 and 3.0	
Soil-gas survey conducted along FEP	1989
Monitoring wells installed	1991
RI fieldwork conducted	September/October 1994
RI and Risk Assessment reports submitted to USEPA	October 1994
FS submitted to USEPA	April 1995
Proposed Plan for remedial action issued	April 1995
ROD signed	January 1996
AS treatability study conducted at Milepost 2.7 source area	1996
Remedial Design/Remedial Action (RD/RA) Statement of Work issued	April 1996
Oxygen releasing compound (ORC) treatability study completed at Milepost 3.0 source area.	1997
Approximately 1,500 cubic yards (CY) of soil removed from the Milepost 2.7 source area for *ex-situ* remediation treatability study.	1998
Approximately 6,000 CY of soil removed from the Milepost 3.0 source area for *ex-situ* remediation treatability study.	2000
ESD signed	September 2002
Interim RACR completed	September 2002
Ex-situ soil treatment systems decommissioned	2003
CLOSES evaluation conducted	2004
In-situ treatability studies began at Mileposts 2.7 and 3.0	October 2009

Table 2-1 Chronology of Site Events

Event	Date
OU-4 Landfill and Coal Storage Yard	
Landfill activities begin	Early 1950s
Soil and groundwater study conducted	1990
Groundwater monitoring performed	1991 and 1992
RI conducted	1993 and 1994
RI report issued	November 1994
Proposed Plan for remedial action issued	October 1995
Final FS report issued	November 1995
Area of petroleum hydrocarbon and lead contaminated soil covered with approximately 8 feet (ft) of construction debris and ash.	Prior to 1996
ROD signed	August 1996
Landfill Project Site Plan completed	July 1997
Cap constructed over inactive portion of landfill	1997
AS/SVE treatment system installed at coal storage yard	1997
RACR finalized	March 1999
AS/SVE system shut down to evaluate rebound	2004
OM&M plan issued	January 2001
Building 1191 (Landfill Caterpillar Shed) preliminary investigation conducted.	October 2012
OU-5 West Quartermaster's Fueling System	
Industrial maintenance activities involving solvents, petroleum, oil, and lubricants (POLs), pesticides, and other hazardous activities.	1930s to 1960s
Approximately 30,000 gallons of diesel fuel leaked	1971
16,000 gallons of gasoline spilled	1971
Fuel leak of unknown origin into the Chena River	1980
North Airfield groundwater investigation	1994
Initiation of WQFS1 Horizontal Well AS/SVE with treatability study	Spring 1997
Initial Chena River Aquatic Assessment Program (CRAAP) investigations conducted	1997 and 1998
RI report issued	November 1996
FS report issued	1998
Proposed Plan for remedial action issued	June 1998
OU-5 bench-scale column study initiated	January 1998
Initiation of soil heating AS/SVE treatability study at WQFS1	Spring 1998

Table 2-1 Chronology of Site Events

Event	Date
Initiation of WQFS1 source area AS/SVE treatability study at WQFS1	August and September 1998
WQFS2 Sparge Curtain Treatability Study initiated	August 1998
ROD signed	May 1999
WQFS3 AS/SVE Treatability Study initiated	August 2000
Draft 2000 RACR completed	September 2001
Additional CRAAP investigation performed	2002
WQFS2 SVE system and catalytic oxidizer shut down	January 2004
CRAAP investigations terminated by RPMs	2005
WQFS 1, 3, and 4 AS/SVE systems shut down and rebound study initiated	November 2005
OU-5 East Quartermaster's Fueling System	
Vehicle storage and maintenance, dry cleaning, fuels testing, refueling, pesticide storage and mixing, and waste storage take place on site.	1970s
Natural Attenuation Treatability Study initiated	September 1997
AS/SVE Treatability Study initiated at Building 1060 East	June 1994
ROD signed	May 1999
AS/SVE Treatability Study at Building 1060 East completed	September 2000
AS/SVE system installed at Building 1060 West site	August to December 2000
Final Intrinsic Remediation Evaluation report submitted	November 2000
Draft 2000 RACR issued	April 2001
Building 1060 West AS/SVE system shut down and Contaminant Rebound Study initiated	October 2005
Building 1060 West AS/SVE system decommissioned	August 2009
OU-5 Remedial Area 1A – Birch Hill Tank Farm ASTs	
Tank farm constructed with fourteen 10,000 barrel bolted steel ASTs	1943
Two 25,00 barrel ASTs added to the tank farm	1956
Tank farm permanently closed; tanks, facility piping, and fuel handing equipment purged of fuel and cleaned and piping disconnected, flanged off, and filled with nitrogen.	January 1994
RI and Risk Assessment report submitted	October 1994
FS issued	April 1995
Proposed Plan submitted	April 1995
ROD signed	January 1996
Remedial Design/Remedial Action Scope of Work issued	February 1996
AS/SVE remediation systems installed at Building 1173 and Lazelle Road	1996

Table 2-1 Chronology of Site Events

Event	Date
Remedial Design/Remedial Action Statement of Work issued	April 1996
Lazelle Road system relocated to the Truck Fill Stand and the Former Building 1173 system expanded to cover Lazelle Road source area	1997
Product recovery treatability studies initiated at the Birch Hill Tank Farm	1998
Thaw Channel treatment system installed	1999
Product Recovery treatment system installed	2000
ESD signed	September 2002
Interim RACR completed	September 2002
OU-5 OB/OD Area	
OB/OD of munitions conducted	Mid 1960s to mid-1980s
USEPA and ADEC conduct site visit for RCRA Facility Assessment	1990
US Army Environmental Hygiene Agency conducted evaluation of the OB/OD Area	1990
Federal Facility Compliance Agreement (FFCA) signed by the U.S. Army and the USEPA identified the OB/OD as a regulated unit	1991
Field investigation and soil sampling conducted at the OB/OD Area	September 1994
Additional site visit and soil sampling conducted	1995
RI/FS Final report issued	1996
ROD signed	1996
Site visit conducted	1999
Interim Closure Plan issued	August 1999
RCRA Permit effective	November 2013
Safety Clearance visual and geophysical survey including the OB/OD area conducted	June 2015
OU-6 Former Communications Site	
Site areas cleared for the construction of troop billets, motor pools, dining halls, and other essential facilities.	Late 1940s to late 1950s
Site used for equipment and vehicle disposal, salvage, and maintenance activities, as well as staging area for railroad construction activities and a concrete batch plant.	Late 1940s to 1960s
Communications and radar systems structure constructed.	Prior to 1956
Site selected for military family housing	2002 and 2003
Geotechnical and environmental investigations conducted; contaminated soil removal actions performed.	2003 to 2005
Site cleared for construction of the Taku Gardens Family Housing Development; excavations for building foundations, utilities, and other	2005

Table 2-1 Chronology of Site Events

Event	Date
infrastructure started.	
PCB-contaminated soil and buried debris uncovered.	July 2005
Time-critical removal action of PCB-contaminated soil performed.	September 2005
PSE (first phase) investigation conducted	Winter of 2005 to 2006
PSE (second phase) investigation conducted.	Summer and fall of 2006
PCB-contaminated soil removed.	2007 and 2008
Eight-ft high chain-link fence with three-stranded barbed wire installed around the site perimeter.	Spring of 2007
RI field work conducted	2007 through 2010
Preliminary Source Evaluation II report issued	May 2007
Action Memorandum issued; it established interim land use controls (LUCs) for the site and documented the time-critical removal action.	November 19, 2007
RI report issued	December 2010
Second time-critical soil removal action performed.	2010 and 2011
FS issued	May 2011
Proposed Plan issued	January 2, 2013
ROD signed	January 29, 2014
Remedial Design (RD)/Remedial Action (RA) report finalized	June 2015

3.0 BACKGROUND

This section provides general information applicable to FWA. OU-specific information is provided in Section 5.0.

3.1 Physical Characteristics

As described in the FFA, FWA is located within the Fairbanks North Star Borough in interior Alaska and occupies approximately 911,604 acres on the east side of Fairbanks (Figure 1-1 and Figure 3-1). The Fairbanks North Star Borough is lightly populated with several scattered developments. The City of Fairbanks (population 35,000) is on the western boundary of FWA. The installation consists of three primary areas:

- The main post two miles east of Fairbanks between the Chena and Tanana Rivers consisting of a cantonment area, a small arms range complex, and a close-in-range complex.
- The Tanana Flats training area across the Tanana River from the main post.
- The Yukon Training Area 16 miles east-southeast of Fairbanks, adjacent to Eielson Air Force Base.

3.1.1 Geology

FWA is underlain by soil and sediment that consist of silt, sand and gravel that ranges in thickness from 10 ft to more than 400 ft before encountering bedrock. A 5 ft thick surficial soil layer of fine-grained soil overlies deeper alluvial deposits that consist of varying amounts of sand and gravel that are commonly layered. Where present, permafrost forms discontinuous confining layers that influence groundwater movement and distribution. The depth to permafrost, when present, ranges from 2 to 40 ft below ground surface (bgs). The greater depths are found on cleared and developed land surfaces, where thermal degradation of underlying permafrost occurs.

3.1.2 Hydrology

The Chena River flows through FWA, the City of Fairbanks, and eventually into the Tanana River. The Tanana River borders the southern portion of FWA. The main aquifer in this area is the Tanana Basin alluvial aquifer, which is a buried river valley. The aquifer ranges from a few ft thick at the base of Birch hill to at least 300 ft thick under the installation's main cantonment area. The aquifer may reach a thickness of 700 ft in the Tanana River Valley. Groundwater in the Tanana-Chena floodplain generally is considered to be unconfined in permafrost-free areas. A confined aquifer may develop seasonally where the depth to the water table is less than the depth of the seasonal frost penetration.

Groundwater movement between the Tanana and Chena Rivers generally follows a northwest regional direction, similar to flow direction of the rivers. Seasonal changes in groundwater flow directions of up to 180 degrees are not uncommon in the area due to the effects of changing river stages in the Tanana River and, to a lesser extent, the Chena River. Groundwater levels near the Chena River fluctuate greatly because of river stage and interactions with the Tanana River. Typically, groundwater levels rise during spring ice breakup and late summer runoff, and drop during fall and winter when rainfall decreases and precipitation becomes snow.

3.2 Land and Resource Use

The current and future mission of FWA is to remain as an operational base; there is no expectation of closure in the near future. Primary missions at FWA have included training of infantry soldiers in the arctic environment, testing of equipment in arctic conditions, preparation of troops for defense of the Pacific Rim, and rapid deployment of troops worldwide. On-site activities include the operation, maintenance, and repair of fixed-wing aircraft, helicopters, tactical and non-tactical vehicles, weapon systems, and general support activities.

Industrial activities at FWA include power generation, steam heat production, drinking water production, treatment, and distribution, standby power and water production, maintenance operations, landfill operations, and grounds maintenance. Also present is the Haines/Eielson Pipeline Extension.

Groundwater is the only source of potable water used at FWA and the Fairbanks area. Approximately 95 percent of FWA's potable water is supplied through a single distribution system fed by two large-capacity wells located in Building 3559, near the Post Power Plant. These wells are completed at a depth of approximately 80 ft bgs and provide between 1.5 million and 2.5 million gallons of water per day to the Post Water Treatment Plant for processing and distribution. The other five percent of potable water comes from three individual wells, one class C well at the DRMO Yard and two wells at a Golf Course. In addition to the main drinking water supply wells, there are five emergency standby supply wells located around the cantonment area. They were completed between 80 and 120 ft bgs and are capable of pumping approximately 250,000 gallons per day per well.

Golden Heart Utilities has four water supply wells located 1¼ miles downgradient of the installation's boundaries, on the banks of the Chena River (see Figure 3-1). All municipal water users are currently supplied from these wells. At one time, College Utilities also supplied water from three water wells located along the Chena River, but they have not been used since 2002.

3.3 History of Contamination

Beginning in 1938, fuels, waste solvents, and pesticides were disposed of on the ground. Spills associated with fuel management, storage, transportation, and handling were common. Waste oils, solvents, and contaminated fuels were also incinerated at the installation's power plant and fire training areas, a practice that was discontinued in 1993. Waste oils commonly were used for dust control. USTs for waste oil, fuel, lubricants, and solvents were installed at most maintenance facilities. A majority of these tanks eventually leaked and released contaminants to soil and groundwater. All existing USTs were removed and/or replaced with double walled, cathodically protected tanks with leak detection systems.

Pesticides (insecticides, herbicides, fungicides, avicides and rodenticides) have been used over the years to maintain grounds and structures and to prevent pest-related health problems. Pesticides were reported to have been mixed on inadequate surfaces and/or stored in such a way to allow releases to the soil.

4.0 FIVE-YEAR REVIEW PROCESS

4.1 Administrative Components

The following activities were performed for this five-year review:

- Potentially interested parties and the local community were notified of the start of the five-year review.
- Documents and site data were reviewed.
- Site inspections were performed.
- Interviews were conducted with FWA Directorate of Public Works (DPW) staff and USACE Alaska District staff with insight on decisions made and activities completed at the sites.

This five-year review report was conducted and written by staff of the USACE Buffalo District.

- Michelle Barker, FE, PMP, HTRW Regional Technical Specialist
- William Frederick, Hydrogeologist
- Karen Keil, PhD, Environmental Toxicologist
- Holly Akers, PE, Project Manager
- Jane Staten, Project Engineer
- James Stachowski, PE, Project Engineer

Staff from FWA also provided assistance.

4.2 Community Notification and Involvement

A public notice has been published in the Fairbanks Daily News Miner, a Fairbanks, Alaska newspaper, and in the Alaska Post, the FWA newspaper, stating that the five-year review process had begun.

The five-year review report will be made available to the public once it has been finalized. A copy of the document will be placed in the following repositories:

Noel Wien Public Library
1215 Cowles Street
Fairbanks, Alaska 99701
(907) 459-1020

Fort Wainwright CERCLA Library
Building 3023
Fort Wainwright, Alaska 99703
(907) 361-9687

Fort Wainwright Post Library
3700 Santiago Avenue
Fort Wainwright, Alaska 99703
(907) 353-2642

Upon completion of the five-year review report, a public notice will be placed in the Fairbanks Daily News Miner and the Alaska Post to announce the availability of the final five-year review report in the document repositories.

4.3 Document Review

Relevant, site-related documents were reviewed, including the RODs, previous five-year review reports, remedial action work plans, remedial action completion reports, RCRA permit documents, and recent monitoring/sampling data. A complete list of documents reviewed is provided in Attachment 2. Documents reviewed for the risk assessment and toxicology review are listed in Attachment 8. The documents were obtained from the FWA staff, from the administrative record file, and from public repositories at Noel Wien Library in Fairbanks and the FWA Post Library.

4.4 Data Review

Data reviewed for each OU are documented in Section 5, Attachment 10, Attachment 11, and Attachment 12.

4.5 Site Inspections

Site inspections were conducted by USACE on August 11, 2015. They were attended by USACE staff Karen Keil (Risk Assessor) and Holly Akers (Project Manager) and lead by Brian Adams, FWA Restoration Project Manager.

Observations for each OU are described in Section 5. Site inspection checklists are included in Attachment 4. Photographs are included in Attachment 5.

4.6 Interviews

Three interviews were conducted in support of the five-year review. USACE Buffalo interviewed FWA staff Joseph Malen (Remedial Program Manager) and Brian Adams (Remedial Project Manager) from August 10 to 13, 2015. USACE (Anchorage District) representative Bob Hazlett responded in writing to a five-year interview questionnaire on February 26, 2016.

U.S. Army Environmental Command (USAEC) representative Michael Kipp, Environmental Restoration Manager, was also present during this period, but was not interviewed.

A meeting was held with Fairbanks Environmental Services (FES), a FWA contractor, on August 12, 2015. It was attended by:

- USACE Buffalo District staff
  - Karen Keil
  - Holly Akers
- FWA DPW staff
  - Joseph Malen
  - Brian Adams
- FES
  - Craig Martin
  - supporting staff

A meeting was held at the ADEC offices in Anchorage on August 13, 2015 to discuss the five-year review process. It was attended by:

- ADEC
  - Guy Warren, Remedial Project Manager
- USEPA
  - Sandra Halstead, Remedial Project Manager
- USAEC
  - Michael Kipp, Environmental Restoration Manager
- Fort Wainwright, DPW
  - Joseph Malen
  - Brian Adams
- USACE Buffalo District
  - Karen Keil
  - Holly Akers
- USACE Anchorage
  - Bob Hazlett

ADEC and USEPA requested written interview questionnaires at the meeting. Interview questionnaires were provided to ADEC and USEPA representatives on February 10, 2016. A completed questionnaire was received from the USEPA on July 27, 2016 and a completed questionnaire was received from ADEC on July 21, 2016. They are included in Attachment 6. A Restoration Advisory Board is currently not active at FWA.

5.0 OPERABLE UNIT SITES

5.1 OU-1 801 Drum Burial Site

5.1.1 Background Information

5.1.1.1 Physical Characteristics

The 801 Drum Burial Site is located between the west bank of the Chena River and River Road and south of the Alaska railroad bridge (Figures 2-1 and 5-1). It covers approximately 20 acres, is currently undeveloped, and vegetated with grass, brush and trees. No endangered or threatened species reside in the area.

The depth to groundwater varies from about 5 to 15 ft bgs across the site. Monitoring of groundwater levels has shown groundwater flow to be generally consistent with the regional west-northwesterly flow direction. However, because the site is located close to the Chena River, the groundwater flow direction and gradient can fluctuate seasonally in response to the water level and flow of the river. During periods of high water in the Chena River, the flow direction on site is generally to the west, away from the river. During low water, usually in the winter and early spring, the groundwater flow direction is eastward, toward the river.

5.1.1.2 Land and Resource Use

Land use at OU-1 is recreational and is expected to remain recreational due to its location adjacent to the Chena River. Military housing known as the Birchwood Estates is situated across River Road, immediately west of the OU.

Drinking water for Birchwood Estates (as well as the City of Fairbanks) is supplied water wells operated by Golden Heart Utilities. The wells are approximately 1¼ miles downgradient and in the same unconfined aquifer as the contaminant source area for this site. Because of this, groundwater use at OU-1 is considered residential.

5.1.1.3 History of Contamination

The 801 Drum Burial Site was used as a drum storage and disposal area. The drums contained diesel fuel, gasoline, jet fuel, solvents, asphalt, pesticides, and lubricants. Aerial photographs from the 1950s and 1960s show a pit on the southwest corner of the storage area. Subsequent aerial photographs (1974) indicate that the pit was filled. In 1992, buried drums were found during the construction of a storm sewer that runs west-east through the source area and outfalls in the Chena River. Numerous drums were removed during these construction activities.

5.1.1.4 Initial Response

Geophysical surveys and three separate removal actions were conducted between 1992 and 1997. At least 244 drums and 850 CY of contaminated soil were removed from the site. Drum contents included fuels, solvents, pesticides and lubricants. The removed soil was contaminated with pesticides and diesel range organics (DRO). It was stockpiled for later use in a phytoremediation treatability study that was designed and implemented to evaluate the performance of phytoremediation for reducing pesticide (aldrin and dieldrin) concentrations in soil. Five treatment cells were constructed for the study. Several plant types were evaluated and both drained and saturated conditions were maintained. After four years of monitoring, overall results showed that the aldrin concentrations decreased significantly whereas dieldrin concentrations

increased slightly. This soil was ultimately disposed of in a lined cell in the FWA landfill in 2003 and 2004.

5.1.1.5 Basis for Taking Action

Sampling conducted prior to and during the RI detected petroleum hydrocarbons, VOCs, pesticides, and metals in surface soil, subsurface soil, and groundwater; metals in Chena River water samples; and VOCs, pesticides, and metals in Chena River sediments. Preliminary data suggested that contaminant plumes in the groundwater were migrating from the known source areas; however, migration rates were undetermined due to the complexity of groundwater movement in the area. Results of the RI also suggested a high potential for the contaminants to migrate to the Chena River and affect downgradient groundwater users if not controlled.

Site COCs were documented in the ROD (U.S. Army 1997b) and listed in Table 5-1. They were based on the results of a baseline risk assessment that assumed residential use of groundwater and recreational use of soil.

Table 5-1 OU-1 801 Drum Burial Site COCs

Media	COC
Groundwater	Aldrin
	Benzene
	cis 1,2-DCE[1]
	1,1-DCE
	Dieldrin
	DRO[1, 2]
	Vinyl chloride
Surface and Subsurface Soil	Aldrin
	Dieldrin
	DRO[2]

Notes:

1 Footnote a to ROD Table 7-1, *"Monitoring and sampling will follow EPA protocols and will not be limited to the specific contaminants of concern"*

2 Footnote to ROD Table 7-1, *"diesel range organics will be cleaned up to levels consistent with the proposed State of Alaska regulations (18 AAC 75)"*

DCE dichloroethene

5.1.2 Remedial Actions

5.1.2.1 Remedy Selection

Remedial action objectives (RAOs) established in the June 1997 ROD for the 801 Drum Burial Site are listed below.

Groundwater

- Ensure that groundwater quality at the 801 Drum Burial Site meets federal and state standards.
- Minimize potential migration of contaminated groundwater to the Chena River and downgradient drinking water wells.

- Establish and maintain institutional controls (ICs) to ensure that the groundwater will not be used until federal and state maximum contaminant levels (MCLs) are attained, except for activities undertaken to initiate the selected remedies.

Soil

- Prevent further leaching of contaminants from soil to groundwater.
- Reduce risks associated with exposure to contaminated soil and drums.
- Prevent migration of soil contaminants to groundwater which could result in groundwater contamination and exceedances of federal MCLs and Alaska Water Quality Standards (AWQS) (18 Alaska Administrative Code [AAC] 70).

The cleanup goals for COCs in groundwater and soil identified in the ROD are presented in Table 5-2.

Table 5-2 OU-1 801 Drum Burial Site COC Cleanup Goals

Media	COC	Cleanup Goal	Basis [1]
Groundwater	Aldrin	0.0042 µg/L	RBC
	Dieldrin	0.004 µg/L	RBC
	Benzene	5 µg/L	MCL
	1-1-DCE	7 µg/L	MCL
	cis-1,2-DCE	70 µg/L	MCL
	Vinyl chloride	2 µg/L	MCL
	DRO	15 µg/L	ARAR
Surface Soils (direct contact)	Aldrin	3.8 mg/kg	RBC
	Dieldrin	4.0 mg/kg	RBC
Subsurface and subsurface soils (direct contact and migration to groundwater, respectively)	Aldrin	3.8 mg/kg	RBC
	Dieldrin	4.0 mg/kg	RBC
	DRO	200 mg/kg	ARAR

Notes:

1 Groundwater cleanup levels were based on federal or state drinking water MCLs or an excess lifetime cancer risk of $1x10^{-6}$ for a residential exposure scenario. Risk for soil was based on a residential exposure scenario associated with an excess lifetime cancer risk of $1x10^{-4}$.

2 The DRO groundwater cleanup level can be found in Table C of 18 AAC 75, and the current State of Alaska DRO soil cleanup level for migration-to-groundwater in the under 40-inch zone can be found in Table B2 of 18 AAC 75 (revised as of January 1, 2016).

ARAR applicable or relevant and appropriate requirement
RBC risk-based concentration
mg/kg milligrams per kilogram

µg/L micrograms per liter

The selected remedy consisted of:

- Locating and removing potential buried drums at the site.
- Establishing and maintaining ICs to ensure that groundwater would not be used until federal and state MCLs were attained, except for activities undertaken to initiate the selected remedy. The ICs would include restrictions governing site access, construction, and well development or placement as long as hazardous substances remained on site at levels that preclude unrestricted use.
- Natural attenuation of groundwater with long-term monitoring.
- A contingent remedy that included an AS/SVE system to treat VOCs. It would be implemented when either: 1) the concentrations of contaminants in the groundwater plume show an increasing trend over any three consecutive sampling events or 2) the designated monitoring points around the plume indicate that contaminants are migrating away from the source area.

The estimated timeframe to reach the cleanup goals was 10 years (VOCs) and 100 years (pesticides) (U.S. Army 1997b).

5.1.2.2 Remedy Implementation

Groundwater Monitoring

Groundwater monitoring began in September 1997, after the ROD was signed. The monitoring network included 16 wells screened across the water table; they varied in depth from 20 to 40 ft bgs. Over the years, the number of wells monitored and the sampling frequency changed several times. Currently, eight of the 16 monitoring wells are monitored once every five years for ROD COCs (aldrin, dieldrin, benzene, 1,1-DCE, cis-1,2-DCE, vinyl chloride, and DRO) as well as gasoline-range organics (GRO). Five OU-1 monitoring wells were recommended for decommissioning in the 2015 groundwater monitoring report (FES, 2016d). Figure 5-1 in Attachment 1 depicts the remaining 11 monitoring wells.

Institutional Controls

ICs at the 801 Drum Burial site include restrictions on site access, construction, and well installation as long as hazardous substances remain onsite at levels that preclude unrestricted use. ICs ensure that the groundwater will not be used until federal and state MCLs are attained. An informational sign describing these ICs was posted at the site in 2001. It was repaired and updated several years later. Since there is no surface contamination at the site, access for non-intrusive activities is unrestricted. Excavation and groundwater intrusion at the site is restricted and subject to approval by FWA DPW Environmental Department.

ICs at each OU are inspected annually and a complete summary of the survey and corrective actions taken are presented in an annual IC report. The first annual report was prepared for 2012 (FES 2013h) and prior inspection results were included in the OU-specific monitoring reports. IC inspections evaluate potential land use changes, site security (monitoring wells, etc., as applicable), or unauthorized groundwater use. In addition, reviews of a FWA IC geographic information system (GIS) layer and the site-specific information in an ADEC contaminated sites database are conducted.

5.1.2.3 Operation, Maintenance, and Monitoring

No active remediation systems are operating at the site and maintenance activities are limited to monitoring well inspections. During the groundwater sampling events, monitoring wells are inspected to ensure that they are accessible, locked and in good condition. Results of the inspections are presented in the monitoring reports. The 2015 OU-1 Monitoring Report stated that the all wells were in satisfactory condition for continued use as monitoring wells (FES 2016).

Currently, eight of the 16 monitoring wells are included in the monitoring program. Since 2010, the monitoring frequency was reduced to once every five years to coincide with the five-year review process. Groundwater is monitored for ROD COCs (aldrin, dieldrin, benzene, 1,1-DCE, cis-1,2-DCE, vinyl chloride and DRO) and for GRO.

5.1.3 Progress Since the Last Five-Year Review

The Third Five-Year Review Report (U.S. Army 2011) provided the following protectiveness statement for the OU-1 801 Drum Burial Site:

> *"The remedy at OU1 has been implemented and is protective of human health and the environment. The remedy is relying upon Monitored Natural Attenuation (MNA) to achieve final cleanup goals in groundwater over time, and in the interim, exposure pathways that could result in unacceptable risks are being controlled and Institutional Controls are preventing exposure to, or ingestion of, contaminated groundwater."*

The following recommendations were provided in the Third Five-Year Review Report:

- Continue groundwater monitoring of the eight wells every five years, prior to the five-year review, to ensure that no off-site migration of contaminants is occurring.
- Perform post-wide IC inspection and evaluate protectiveness. Update restricted use boundaries in GIS as new information becomes available.
- Develop the parameters for an Annual Report of IC effectiveness and corrective actions taken (spring 2012 milestone date).
- Update the database of LUC/IC summary documents (October 2013 milestone date), which consists of tables that describes in greater detail the ICs, the objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms.

The status of these recommendations and actions taken to address them are discussed below.

- Groundwater samples were collected from eight monitoring wells in May 2015. The data allows for an evaluation of natural attenuation of groundwater contaminants and assessment of off-site migration.
- A post-wide IC inspection is performed and results have been documented in annual IC reports for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).
- Parameters for an annual report of IC effectiveness and corrective actions taken have been developed; they are used in the annual IC reports.
- Tables that describe in detail the ICs, objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms were updated and documented in annual IC reports for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

5.1.4 Site Inspection

The 801 Drum Burial Site was inspected by USACE on August 11, 2015 to examine the remediated area and assess protectiveness of the remedy. The site was forested, all wells appeared to be in good condition, and the informational sign was in good condition. A completed site inspection checklist is provided in Attachment 4 and site photographs are provided in Attachment 5.

FWA staff indicated that LUCs/ICs are maintained as required by the ROD. Review of ICs for the 801 Drum Burial site documented in the draft 2014 IC report (FES 2015f) concluded:

- ICs at the site are in place and no unauthorized well installation or use of groundwater wells was observed.
- No soil disturbing activities were observed.
- Site vegetation is well maintained.
- An informational sign is intact and exhibits signs of water damage.
- Wells currently at the site are easily accessible and secured.
- Site land use and adjacent land use have not changed.

The five-year review site inspection confirmed these conclusions.

5.1.5 Data Review

The most recent groundwater analytical results from May 2015 (Attachment 10) are similar to the previous round of sampling performed in 2010.

- Dieldrin exceeded the ROD risk-based cleanup goal in four of the wells sampled, AP-6326, AP-6331, AP-7284, and AP-10042 (replacement well for AP-7163). Dieldrin was not detected in wells AP-6630, AP-6327, and AP-7279, although the detection limit (0.0045 µg/L) exceeded the cleanup goal (0.004 µg/L).
- Benzene and DRO exceeded their respective cleanup goals in well AP-6327.
- cis-1,2-DCE exceeded the cleanup goal in well AP-6326.

The remaining COCs were below their cleanup goals.

The ROD estimated timeframe to reach the cleanup goals for VOCs (10 years or by 2007) has passed. The ROD estimated timeframe to reach the cleanup goals for pesticides is 100 years, or by 2097.

Trend analysis was performed on available groundwater analytical data using linear regression and the Mann-Kendall test for dieldrin in wells AP-6326, AP-6327, AP-6331 and AP-7282. Wells AP-6630, AP-7284, and AP-7279 were not evaluated because most of the data were censored (i.e., concentrations are predominantly non-detectable) and the Mann-Kendall test loses significant statistical power if most of the data are censored. Well AP-10042 was not evaluated because there were only two data points. Trend analysis was also performed for benzene in wells AP-6326 and AP-6327. Results of the evaluation (at a confidence level of 95%) are provided in Attachment 10 and summarized below. Wells with COCs exceeding the cleanup goals are identified in bold text.

- Dieldrin
    - No trend is identified in wells AP-6327, **AP-6326, AP-6331** and AP-7282.
- Benzene
    - An overall downward trend is identified for well **AP-6327**, however concentrations remained constant between 2010 and 2015.
    - No trend is identified for well AP-6326, although a downward trend is suggested.
- cis-1,2-DCE
    - An overall downward trend is identified for well **AP-6326**.
- DRO
    - No trend is identified in well **AP-6327**.

The dieldrin plume is currently undefined to the west with exceedances of the cleanup goal detected in monitoring well AP-10042. The dieldrin concentrations were detected at 0.029 and 0.022 µg/L above the cleanup goal of 0.004 µg/L. Spatial moment analysis, conducted in the OU-1 2010 and 2015 monitoring reports, indicates that the dissolved dieldrin mass has been stable and no trend has been identified for the location of the center of mass.

Piezometric surface maps indicate that a groundwater divide, trending north-south, is present at the site. Groundwater in the eastern portion of the site discharges to the Chena River, while groundwater in the western portion of the site flows west/northwest. The location of the divide varies with river stage.

The OU-1 COCs are persistent, which may be due to seasonal variation of the groundwater flow direction that is caused by river level fluctuations. The variation of flow direction contributes to minimal off-site migration and appears to cause long natural attenuation response periods (i.e., the contaminants do not experience downgradient dispersion and attenuation). The absence of increasing trends indicates that past source removal actions positively affected site conditions. Although the RAO to meet groundwater cleanup goals has not been attained for benzene, DRO, and cis-1,2-DCE, the data demonstrate that the RAOs are being met.

The 2015 monitoring report provides geochemical data (dissolved oxygen (DO), oxidation-reduction potential (ORP), dissolved iron, dissolved manganese, and sulfate) (FES,2016e). The results indicate that relatively low DO concentrations and relative low ORP are present, which suggest that the aquifer is anaerobic and moderately reduced. A small area surrounding well AP-6327 exhibits significantly reduced conditions. The monitoring report asserts that these conditions may be favorable for attenuation of dieldrin based on prior phytoremediation study treatability study findings for OU-1. Groundwater geochemistry returns to background conditions within approximately 50 ft downgradient of AP-6327.

The 2015 monitoring report made the following recommendations to optimize the long term monitoring program at OU-1:

- Continue groundwater monitoring on a five-year basis from eight monitoring wells including the addition of pesticide samples from monitoring wells AP-6330 and AP-6631.
- Collect biennial (2017 and 2019) samples from monitoring well AP-10042 to establish a dataset for trend analysis.

- Continue VOC analysis for monitoring well AP-6326 to monitor cis-1,2-DCE as recommended in the 2004 CLOSES evaluation.
- Decommission five monitoring wells previously removed from the sampling program (AP-6629, AP-7162, AP-7280, AP-7281, AP-7283).

The monitoring wells proposed for decommissioning are depicted on Figure 4-1, *OU1 Monitoring Wells Recommended for Decommissioning*, in Attachment 10.

The five-year review concurs with these recommendations except for the decommissioning of monitoring well AP-7162, which has been included in a recommendation for monitoring to evaluate vapor intrusion (see Section 5.1.6).

The Risk Assessment and Toxicology Evaluation included in Attachment 8 assessed the OU-1 Drum Burial Site for vapor intrusion risks. The 801 Military Housing Area is located directly across River Road from the site and groundwater flows toward the housing area at least some times during the year (groundwater flow direction is affected seasonally by the river stage). The vapor intrusion assessment compared the USEPA vapor intrusion screening levels (VISLs) to VOC concentrations in the nearest sampled monitoring well, AP-6326. In 2015, the only detected VOCs at AP-6326 included benzene, toluene, TCE, and trans- and cis-1,2-DCE. No exceedances of the USEPA VISLs were identified. Concentrations of 1,2,4-TMB exceeded the VISLs are two monitoring wells (AP-6327 and AP-1010); however this compound was not detected in wells closer to the housing development.

Based on a 2004 CLOSES evaluation and subsequent decision of the RPMs, groundwater monitoring was not performed for VOCs in 2015 at monitoring well AP-10042 or AP-7162 located on the west side of River Road adjacent to the 801 Military Housing Area. AP-10042 was installed in 2010 on-post to replace off-post well AP-7163 and was not sampled for VOCs. Historical data collected from monitoring wells AP-7162 and AP-7163 (replaced with AP-10042 in 2010) was reviewed to make further assessment on the potential risk of vapor intrusion. The most recent sampling events with VOC analyses were conducted in 2005 (AP-7162) and 2010 (AP-7163):

Table 5-3 OU-1 Historical VOC Results for AP-7162 and AP-7163

Compound	Sampling Location	USEPA VISL	ADEC VISL	AP-7162	AP-7163
	Date			2005	2010
cis-1,2-DCE		--	44	<0.12	0.8 J
trans-1,2-DCE		--	380	<0.15	0.14 J
Benzene		370	14	<0.14	<0.15
TCE		15	5.2	<0.14	0.42 J
Toluene		59,000	19,200	1.1	<1.0

No exceedances of the USEPA or ADEC VISLs were identified. No VISLs are available for trans- and cis-1,2-DCE (see Attachment 8 for more details).

5.1.6 Technical Assessment

5.1.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

Yes, the remedy is functioning as intended by the ROD. This assessment is supported by the following information:

- Removal of buried drums and contaminated soil have prevented further leaching of contaminants from soil to groundwater and reduced the risk of exposure.
- Analytical data indicates that groundwater contamination due to benzene and cis-1,2-DCE is attenuating, albeit at a slow rate, and the plumes are stable. The concentrations of dieldrin remain stable and exhibit no trend. The remaining groundwater VOCs, aldrin, 1,1-DCE, and vinyl chloride, are below their cleanup goals.
- LUC/ICs have been implemented and are functioning as intended. No violations have been reported since the previous five-year review.
- The ROD-estimated time frame to reach the cleanup goal is 10 years (VOCs) and 100 years (pesticides). The remedy, MNA, was implemented in 1997. Benzene, cis-1,2-DCE, and dieldrin exceeded their cleanup goals in the most recent monitoring event (May 2015). The estimated time frame to reach the cleanup goals has passed for benzene and 1,2-DCE. However, since the plume remains stable and there are no complete exposure pathways, there is no increased risk to human health and the environment.

The five-year review did not identify opportunities for optimizing the monitoring program other than those currently included in the long term monitoring program reports.

No early indicators of potential problems were identified.

5.1.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy are still valid. The current exposures and major exposure assumptions for future potential land use at the site have not changed. The toxicity criteria used to develop risk-based cleanup goals are reviewed in Attachment 8. That attachment also evaluates the potential for vapor intrusion at the site, since it was not previously evaluated. The 801 Military Housing Area is located west across River Road. The Housing Area was constructed in 1986-1987 according to City of Fairbanks records and was in place at the time the remedy was selected for the 801 Drum Burial Site; however a vapor intrusion assessment was not completed. USEPA and ADEC guidance on vapor intrusion was either developed or significantly updated within the last five years. The following information was used to make an assessment of the vapor intrusion pathway:

- Based on the RI, soil at the site varies from silty sand and gravel to clean sand and gravel.
- Groundwater is shallow (5 to 15 ft bgs) and groundwater flow direction and gradient at the site fluctuates seasonally and with the flow stage of the Chena River.
- The hydraulic gradient at the site is relatively flat (3 ft per mile) and highly variable.

- One preferential groundwater flow pathway was identified at the site: an underground storm sewer that traverses the 801 Drum Burial Site east-west from the Chena River across River Road south of monitoring well AP-6328 to the 801 Housing Area (see Figure 5-1 in Attachment 1).
- The only compound exceeding the USEPA VISLs was 1,2,4-TMB in monitoring wells AP-6327 and AP-1010. Wells located across River Road closer to the 801 Housing Area including those wells located adjacent to the storm sewer did not contain exceedances of the USEPA VISLs.

Based on this information, the vapor intrusion exposure pathway is incomplete.

There are no newly promulgated or modified requirements of federal or state environmental laws for the COCs that have MCL-based cleanup goals (benzene, 1,1-DCE, cis-1,2-DCE, and vinyl chloride) that would change the protectiveness of the groundwater and soil remedies implemented at the site.

For COCs that have risk-based cleanup goals (aldrin, dieldrin, and DRO), the exposure assumptions, toxicity criteria, and RAOs used at the time of the remedy are still valid.

5.1.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No information has come to light that could call into question the protectiveness of the remedy for the intended use of the property as described in the ROD; however, the USEPA has identified 1,4-dioxane as an emerging contaminant.

An assessment has not been performed at the OU-1 801 Drum Burial Site to evaluate whether a release of the stabilizer 1,4-dioxane occurred. A recommendation to perform sampling is included below; however, this issue is not anticipated to affect protectiveness based on the following information:

- LUCs/ICs have been implemented preventing receptors from direct contact with subsurface contaminants at the Drum Burial Site.
- A hypothetical USEPA VISL was calculated for 1,4-dioxane (530,000 µg/L). This value is over four orders of magnitude greater than a VISL calculated for TCE under the same conditions (15 µg/L). ADEC does not have a VISL for 1,4-dioxane (VISL for TCE in groundwater is 5.2 µg/L). Based on this information, 1,4-dioxane should not pose a risk via vapor intrusion where no risk is identified for TCE.
- Groundwater contaminant concentrations at the Drum Burial Site are relatively low and perimeter monitoring wells do not indicate that contaminants are migrating from the source area to the Chena River or 801 Military Housing Area.
- The closest drinking water supplies include:
    - The Golden Heart Utilities has four water supply wells (AK2310730 - community) located 2.4 miles from the Drum Burial Site on the banks of the Chena River. These wells are unlikely to be influenced by the Drum Burial Site due to the presence of a hydrogeologic divide (Chena River). The system operator was contacted on 27 October 2016 to request monitoring data for 1,4-dioxane as required for this system under the Unregulated Contaminant

Monitoring Rule 3 (UCMR3). The operator indicated that the system was sampled for 1,4-dioxane twice in 2013 (February and August), however, the sampling point was at the entry point to the distribution system (post-treatment). The results indicate that no 1,4-dioxane was detected in the water samples at concentrations above the laboratory's minimum reporting limit of <0.07 µg/L. No raw water quality data was available for 1,4-dioxane.

- Pioneer drinking water wells (AK2310714 - community) for the Hamilton Subdivision are located approximately 1.0 mile from the Drum Burial Site (see Figure 3-1). These wells are unlikely to be influenced by the Drum Burial Site based on the distance of separation and low levels of impacts at the Drum Burial Site.
- The system operator was contacted on 27 October 2016 to request monitoring data for 1,4-dioxane, if available. As of the date of this report, no response has been received.
- FWA has eight on-post wells (AK2310918 - community) and one well servicing the golf course (AK2311095 - non-community). In addition to those wells identified by the State, an emergency water supply well is located within the OU-2 DRMO Yard (see Section 5.3). The well locations are depicted on Figure 3-1. Only one well located on FWA is currently designated as a drinking water source (Building 3559 Water Well). This well is separated from the OU-1 Drum Burial Site by a hydrogeologic divide (Chena River).

- The OU-1 Drum Burial Site is located adjacent to the Chena River. The historical remedial actions at site greatly reduced the magnitude of contaminants left in place and, due to the hydrogeology of the site, have limited mobility. Adverse impacts to the Chena River from 1,4-dioxane at the OU-1 Drum Burial Site are unlikely.
- No other sensitive receptors were identified.

5.1.6.4 Technical Assessment Summary

The 801 Drum Burial Site remedy is functioning as intended by the ROD. Removal actions completed from 1992 to 1997 addressed source drums and impacted soil. ICs have since been established and are maintained to prevent groundwater use. Groundwater monitoring demonstrates that the groundwater plume is stable and attenuating. Groundwater quality has not achieved the VOC cleanup goals in the timeframe estimated in the ROD (2007); however, no risk is currently posed by the groundwater contamination. Contaminant concentrations are decreasing or exhibit no trend. In the last five years, there have been no physical changes to the site that would affect the protectiveness of the remedy. An abbreviated screening of vapor intrusion risk was performed with the calculation of VISLs and comparison to the most recently available groundwater quality data. No exceedances of the VISLs were identified. No changes to the ARARs or risk assessment and toxicology evaluation were identified that would affect the protectiveness of the remedy.

5.1.7 Issues

The following issues were identified that may affect the future protectiveness of the 801 Drum Burial site remedy:

- Under agreement among the RPMs, data was not collected from monitoring wells located between currently monitored points and the 801 Military Housing Area for inclusion in the five-year review. Data from these wells was not available for use in the vapor intrusion assessment at OU-1.
- An assessment for 1,4-dioxane has not been performed at OU-1.

The following concerns were identified that do not affect protectiveness of the remedy:

- The detection limit for dieldrin in groundwater in 2015 exceeded the cleanup goal.
- Insufficient groundwater quality data is available for determining attainment of cleanup levels at monitoring wells AP-10042 and AP-7163.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide standard operating procedure (SOP) does not include documentation and information regarding all LUCs required throughout FWA.

5.1.8 Recommendations for Follow-up Actions

The following recommendations for follow-up actions were identified at the OU-1 Drum Burial site that may affect the future protectiveness of the remedy:

- Collect groundwater samples from monitoring wells AP-6326, AP-6327, AP-7162, and AP-10042 for analysis for VOCs and complete a vapor intrusion assessment.
- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the 801 Drum Burial Site. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

Recommendations for a follow-up actions that do not affect protectiveness of the remedy are provided below:

- Provide greater scrutiny of groundwater analytical detection limits during future monitoring events.
- Increase monitoring frequency in wells AP-10042 and AP-7163 from once every five years to biennial (2017 and 2019) until the next five-year review.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. This will be initiated in November 2016 with a planned completion date of September 2018.

5.1.9 Protectiveness Statement

The remedy at OU-1 801 currently protects human health and the environment because:

- Contaminant source removal (drums and contaminated soil) was completed.
- Migration of COCs in groundwater to the Chena River and downgradient drinking water wells is not occurring based on sampling results that indicate the plume is stable.

- Based on groundwater data and a comparison of groundwater quality to the calculated USEPA VISLs, the vapor intrusion exposure pathway is incomplete at the 801 Drum Burial Site.
- ICs are in-place to ensure that groundwater will not be used until cleanup goals are attained and to assure that exposure to any contaminated soil at the site will not occur.

However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness:

- Collect groundwater samples from monitoring wells AP-6326, AP-6327, AP-7162, and AP-10042 for analysis for VOCs and complete a vapor intrusion assessment.
- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the 801 Drum Burial Site. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

5.2 OU-2 Building 1168 Leach Well

5.2.1 Background Information

5.2.1.1 Physical Characteristics

The Former Building 1168 Leach Well source area is located on the northwestern side of FWA, north of Trainor Gate Road and adjacent to the Trainor gate entrance (Figures 2-1 and 5-2). The nearest surface water body, the Chena River, is approximately 1,800 ft to the southeast. No surface water drainage pathways are evident. No endangered or threatened species reside in the area.

Subsurface soil at the site consists of lenses of interlayered silt, silty sand and poorly graded sand and gravel. Groundwater occurs at 12 to 17 ft bgs. The predominant groundwater flow is to the west-northwest following the trend of the Tanana River Valley. However seasonal changes in flow direction may occur due to the influences of water level changes in the Chena River.

5.2.1.2 Land and Resource Use

Building 1168 was demolished during the summer of 1997 and the site is now a flat, graded gravel lot. The area around the former Building 1168 site was used to stage construction materials for a Sitku Basin military housing project. This project was started in 2006 and completed in 2008, and the former building area remains a flat gravel lot. Groundwater use is considered residential because water supply wells for the City of Fairbanks are located in the same unconfined aquifer as groundwater contamination at the source area.

Surrounding land use includes a Fairbanks public school located approximately 1,000 ft northwest of this site, the Birchwood Estates housing area (formerly the 801 military housing area) approximately 300 ft southwest (upgradient) of the site, and the newly completed Sitku Basin military housing area located along the north side of the site.

5.2.1.3 History of Contamination

Contamination originated from a leach well that received liquids collected in floor drains within Building 1168. From the 1950s to 1997, Building 1168 was used as a lubrication oil and vehicle storage/shop facility, and as a POL laboratory. Floor drains in the building formerly discharged into an oil/water separator designed to allow POL to flow into a storage tank and wastewater to flow through a 4-inch diameter buried waste line to a leach well approximately 100 ft southwest of the former building. The oil/water separator system was decommissioned in 1993. Because of system malfunctions during the 40 years of service, some products entering the oil/water separator were inadvertently conveyed directly to the leach well, subsurface soil, and groundwater. Products suspected to have entered the leach well include oil from engines and transmissions, gasoline, diesel, jet fuel, and solvents.

5.2.1.4 Initial Response

In 1994, a pilot scale AS/SVE system was installed around the leach well to determine whether an *in-situ* treatment system was technically feasible in source area soil and groundwater. The system was modified and expanded in 1996 and 1997 to optimize its effectiveness. The treatment system was designed to operate during May through October. It was operated for four years.

5.2.1.5 Basis for Taking Action

Contaminated soil associated with the former leach well appeared to be the source of groundwater contamination. Initial site investigations discovered a zone of hydrocarbon contamination approximately 4 to 5 ft thick in subsurface soils near the groundwater interface that extended approximately 50 ft radially from the leach well. Contamination from these subsurface soils created commingling benzene and trichloroethene (TCE) plumes in the groundwater 20 to 50 ft bgs.

Based on the results of a risk assessment that assumed industrial use for soil and residential use for groundwater, the following COCs associated with Former Building 1168 Leach Well were established:

Table 5-4 OU-2 Building 1168 Leach Well COCs

Medium	COC
Subsurface Soil	DRO
	GRO
	Benzene
	Toluene
	Ethylbenzene
	Xylenes
Groundwater	Benzene
	PCE
	TCE
	1,1-DCE
	cis-1,2-DCE
	Vinyl chloride

Notes:
PCE tetrachloroethene

5.2.2 Remedial Actions

5.2.2.1 Remedy Selection

Based on the findings of a Human Health and Ecological Risk Assessment, RAOs were established in the January 1997 ROD for OU-2.

Groundwater

- Restore groundwater to its beneficial use of drinking water quality within a reasonable time frame through source control.
- Reduce or prevent further migration of contaminated groundwater from the source areas.
- Prevent use of groundwater containing contaminants at levels above Safe Drinking Water Act (SDWA) and State of Alaska Drinking Water Standard MCLs and AWQS.
- Use natural attenuation to attain AWQS (18 AAC 70) after reaching state and federal MCLs.

Soil

- Prevent migration of soil contaminants to groundwater, which could result in groundwater contamination and exceedances of state and federal MCLs and AWQS (18 AAC 70).

In order to achieve these RAOs, the following remedy was selected.

AS/SVE

- *In-situ* treatment of groundwater via AS to remove VOCs and attain state and federal MCLs.
- *In-situ* treatment of soil via SVE to prevent contaminated soil from acting as an ongoing source of contamination to groundwater.
- Treatment system evaluation and modification as necessary to optimize effectiveness.
- Periodic monitoring and evaluation of air emissions from the AS/SVE treatment system to meet air emission requirements.
- Periodic groundwater monitoring and off-gas measurements to determine attainment of RAOs.

Natural Attenuation and Groundwater Monitoring

- Achieve AWQS through natural attenuation after active treatment attains state and federal MCLs.

Institutional Controls

- Maintain ICs, including restricted access and well development restrictions, as long as hazardous substances remain on site at levels that preclude unrestricted use.

The cleanup goals for COCs in groundwater identified in the 1997 ROD are presented in Table 5-5.

Table 5-5 OU-2 Building 1168 Leach Well COC Cleanup Goals

Medium	COC	Cleanup Goal	Basis [1,2]
Subsurface Soil	DRO	100 mg/kg	ADEC 18 AAC 78
	GRO	50 mg/kg	ADEC 18 AAC 78
	Benzene	0.1 mg/kg	ADEC 18 AAC 78
	BTEX[3]	10 mg/kg	ADEC 18 AAC 78
Groundwater	Benzene	5 µg/L	MCL
	PCE	5 µg/L	MCL
	TCE	5 µg/L	MCL
	1-1-DCE	7 µg/L	MCL
	cis-1,2-DCE	70 µg/L	MCL
	Vinyl chloride	2 µg/L	MCL

Notes:

1 Groundwater cleanup levels are based on federal and state drinking water MCLs.
2 Soil cleanup goals are based on the ADEC soil cleanup matrix to be used as a guidance for treatment of in situ soils.
3 BTEX = sum of benzene, toluene, ethylbenzene, and total xylene concentrations

The ROD estimated timeframe to reach the cleanup goals was 15 years, or by 2012 (U.S. Army 1997a).

5.2.2.2 Remedy Implementation

AS/SVE System

In 1994, a pilot scale AS/SVE system was installed around the leach well to determine whether an *in-situ* treatment system was technically feasible. The system was modified and expanded in 1996 and 1997 to optimize its effectiveness based on an evaluation of monitoring data. The treatment system was operated seasonally (May through October) for four years. It was shut down in December 1998 after the RAOs were achieved. The system was decommissioned in 2003 in accordance with recommendations provided in a 2003 CLOSES report (CH2M HILL 2003b).

During the period of operation, the system removed 2,680 pounds of hydrocarbons through volatilization and an estimated 1,900 pounds of hydrocarbons through aerobic biodegradation. Annual soil sampling during operation of the AS/SVE system indicated that the system was *"beneficial at reducing soil contaminant concentrations in the source area"* (CH2M HILL 2003b).

Groundwater Monitoring and In-situ Chemical Oxidation Treatability Study

When the groundwater cleanup goals identified in the ROD were attained in 1998, the AS/SVE system was shut down and the monitoring frequency was decreased from quarterly to annually. Within a few years following system shut down, minor rebound in contaminant concentrations was observed and the RPMs agreed to increase the frequency of groundwater monitoring to semi-annually through 2004.

In 2009, a Long Term Monitoring Optimization (LTMO) analysis of the groundwater data was performed and the results showed that attenuation was occurring at this site and there was no evidence of contaminant migration. Stable and decreasing trends for benzene and DRO in individual wells were identified and a first-order attenuation rate analysis indicated that the benzene contamination would likely persist at the site for a significant period of time. Based on these results, a treatability study using ISCO was conducted in October 2010 as an attempt to reduce the residual benzene concentrations. Several rounds of groundwater monitoring were conducted between November 2010 and September 2011 to evaluate the effectiveness of the treatability study.

Currently, three monitoring wells located along the southern boundary of the site are sampled annually.

Institutional Controls

ICs at the site include restrictions on well installations until state and federal MCLs are met. Since there is no surface contamination at the Building 1168 Leach Well site, access to the area for non-intrusive activities is unrestricted.

ICs are inspected annually and a summary of the survey and corrective actions taken are presented in an annual IC report. The first annual report was prepared for 2012 (FES 2013h) and prior IC inspections were included in the OU-specific annual monitoring reports. IC inspections evaluate potential land use changes, site security (monitoring wells, etc., as applicable), or unauthorized groundwater use. Reviews of the FWA IC GIS layer and the site-specific information in the ADEC Contaminated Sites database are also conducted.

5.2.2.3 Operation, Maintenance and Monitoring

The AS/SVE system was decommissioned in 2003. Since that time, groundwater sampling has been conducted annually. Currently, three wells (AP-5751, AP-6809, and AP-10037) are sampled for ROD COCs, as well as GRO, DRO, residual range organics (RRO), and geochemistry parameters.

5.2.3 Progress Since Last Five-Year Review

The Third Five-Year Review Report (U.S. Army 2011) provided the following protectiveness statement for the OU-2 Building 1168 Leach Well Site:

> *"The remedy at OU2 has been implemented and is protective of human health and the environment. The remedy is relying upon Monitored Natural Attenuation (MNA) to achieve final cleanup goals in groundwater over time, and in the interim, exposure pathways that could result in unacceptable risks are being controlled and Institutional Controls are preventing exposure to, or ingestion of, contaminated groundwater."*

The following recommendations were provided in the Third Five-Year Review Report:

- The current site model indicates that contamination does not appear to be migrating off-site and continued groundwater monitoring should be sufficient to ensure protectiveness.
- Continue evaluation of the ISCO treatability study and conduct additional injections if necessary.
- Perform post-wide IC inspection and evaluate protectiveness. Update restricted use boundaries in GIS as new information becomes available.
- Develop the parameters for an Annual Report of IC effectiveness and corrective actions taken (spring 2012 milestone date).
- Update the database of LUC/IC summary documents (October 2013 milestone date), which consists of tables that describes in greater detail the ICs, the objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms.

The status of these recommendations and actions taken to address them are discussed below.

- Groundwater samples have been collected from the site annually since the previous five-year review. During each annual monitoring event, groundwater data from three monitoring wells was presented in annual monitoring reports and used to perform LTMO analysis, which included evaluations of contaminant trends, plume stability, monitoring well redundancy, and sampling frequency using Monitoring and Remediation Optimization System (MAROS) software. Beginning in 2014, the sampling data was analyzed using a groundwater statistics tool developed by the USEPA.
- A post-wide IC inspections have been performed and results were documented in annual IC reports for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

- Parameters for an annual report of IC effectiveness and corrective actions taken have been developed; they are used in the annual IC reports.
- Tables that describe in detail the ICs, objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms have been updated and are documented in annual IC reports for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

5.2.4 Site Inspection

The site was inspected by USACE on August 11, 2015 to examine the remediated areas and assess the protectiveness of the remedy. The site was forested with both mature and young trees. All wells appeared to be in good condition. A damaged bollard was observed adjacent to monitoring well AP-7143; it did not appear to affect access to the monitoring well. Site access is controlled by the installation and interior fencing was in good condition. A small amount of cardboard boxes and other household refuse were observed on the site. A completed site inspection checklist is provided in Attachment 4. Photographs are provided in Attachment 5.

FWA staff indicated that LUCs/ICs are maintained as required by the ROD. The most recent IC review of the Former Building 1168 Leach Well site documented in the preliminary draft 2014 IC report (FES 2015f) concluded:

- There was no evidence of unauthorized installation or use of groundwater wells.
- No soil disturbing activities were observed.
- Wells currently at the site are easily assessable and secured.
- Site land use and adjacent land use have not changed.

The five-year review site inspection confirmed these conclusions.

5.2.5 Data Review

Annual groundwater data collected between 2012 and 2015 was available for this five-year review. The 2015 Monitoring Report for OU-2 presents 2015 and historical groundwater analytical results and demonstrates through statistical evaluation that groundwater cleanup goals have been achieved for ROD COCs, although petroleum contamination (as DRO) persists (FES 2016e). Groundwater analytical data collected between 2010 and 2015 is provided in Attachment 10. Monitoring well locations are shown on Figure 5-2.

Annual groundwater monitoring data for the Former Building 1168 Leach Well site shows that benzene concentrations, the target of the ISCO treatability study injections, have been consistently below the site cleanup goal. Consequently, additional ISCO injections are not recommended. PCE, TCE, 1,1-DCE, cis-1,2-DCE, and vinyl chloride have also been consistently below the site cleanup goals. The 2015 monitoring report recommended eliminating VOC analyses from the monitoring program and transferring the site to the 2-PTY Program, which has been approved by the USEPA. The five-year review concurs with this recommendation.

5.2.6 Technical Assessment

5.2.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

Yes, the remedy is functioning as intended by the ROD. The estimated time frame to achieve the cleanup goals was 15 years. Groundwater cleanup goals for ROD COCs were achieved after four years of AS/SVE system operation. Groundwater monitoring following completion of the active remediation showed that benzene concentrations had rebounded, triggering an ISCO treatability study in 2010. Annual groundwater data collected since the ISCO treatability study indicate that the benzene concentrations, as well as other COCs, have been consistently below the cleanup goals.

ICs are in effect and no violations have been reported since the previous five-year review. The five-year review concurs with the recommendation to eliminate VOC analyses and transfer the site to the 2-PTY Program.

No early indicators of potential problems were identified.

5.2.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy are still valid. The current exposures and major exposure assumptions for future potential land use at the site have not changed. Attachment 8 evaluates the potential for vapor intrusion at the site, since it was not previously evaluated. USEPA and ADEC guidance on vapor intrusion has either been developed or has been significantly updated within the last five years.

None of the cleanup goals are risk-based. There are no new or newly promulgated requirements of federal and state environmental laws that would change the protectiveness of the remedy implemented at the site.

The exposure assumptions used at the time of the remedy for protection of human health remain valid. The vapor intrusion pathway was not explicitly evaluated at OU-2 at the time of the ROD. The current VOC concentrations in groundwater do not exceed VISLs and vapor intrusion should not be a concern at the neighboring residential housing units.

A screening level ecological risk assessment indicated that no complete ecological exposure pathways existed at the Building 1168 Leach Well site. Nothing has changed at the site that would change this assessment.

5.2.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No information has come to light that could call into question the protectiveness of the remedy for the intended use of the property as described in the ROD; however, the USEPA has identified 1,4-dioxane as an emerging contaminant.

An assessment has not been performed at the OU-2 Building 1168 Leach Well site to evaluate whether a release of the stabilizer 1,4-dioxane occurred. A recommendation to perform sampling is included below; however, this issue is not anticipated to affect protectiveness based on the following information:

- LUCs/ICs have been implemented preventing receptors from direct contact with subsurface contaminants at the OU-2 Building 1168 Leach Well site.
- A hypothetical USEPA VISL was calculated for 1,4-dioxane (530,000 µg/L). This value is over four orders of magnitude greater than a VISL calculated for TCE under the same conditions (15 µg/L). ADEC does not have a VISL for 1,4-dioxane (VISL for TCE in groundwater is 5.2 µg/L). Based on this information, 1,4-dioxane should not pose a risk via vapor intrusion where no risk is identified for TCE.
- Groundwater contaminant concentrations at the site are relatively low.
- The closest drinking water supplies include:
    - The Golden Heart Utilities has four water supply wells (AK2310730 - community) located 2.1 miles from the OU-2 Building 1168 Leach Well on the banks of the Chena River. These wells are separated from the OU-2 Building 1168 Leach Well by a hydrogeologic divide (Chena River).
    - The system operator was contacted on 27 October 2016 to request monitoring data for 1,4-dioxane as required for this system under the Unregulated Contaminant Monitoring Rule 3 (UCMR3). The operator indicated that the system was sampled for 1,4-dioxane twice in 2013 (February and August), however, the sampling point was at the entry point to the distribution system (post-treatment). The results indicate that no 1,4-dioxane was detected in the water samples at concentrations above the laboratory's minimum reporting limit of <0.07 µg/L. No raw water quality data was available for 1,4-dioxane.
    - Pioneer drinking water wells (AK2310730 - community) for the Hamilton Subdivision are located approximately 0.7 miles from the OU-2 Building 1168 Leach Well (see Figure 3-1). These wells are unlikely to be influenced by the OU-2 Building 1168 Leach Well due to the distance of separation and low contaminant concentrations.
    - FWA has eight on-post wells (AK2310918 - community) and one well servicing the golf course (AK2311095 - non-community). In addition to those wells identified by the State, an emergency water supply well is located within the OU-2 DRMO Yard (see Section 5.3). The well locations are depicted on Figure 3-1. Only one well located on FWA is currently designated as a drinking water source (Building 3559 Water Well). This well is separated from the OU-2 Building 1168 Leach Well by a hydrogeologic divide (Chena River).
- The OU-2 Building 1168 Leach Well is located approximately 0.4 mile west of the Chena River. Based on the distance of separation and low contaminant concentrations, it is unlikely that impacts associated with the Leach Well would impact the Chena River.
- No other sensitive receptors were identified.

5.2.6.4 Technical Assessment Summary

The remedy at the Building 1168 Leach Well site was fully implemented in 1997. Monitoring data indicates that the cleanup goals have been attained. No changes in ARARs or the risk assessment were identified that would affect the protectiveness of the remedy. No sampling for 1,4-dioxane has been completed at the Building 1168 Leach Well site. This issue is discussed below with a corresponding recommendation.

5.2.7 Issues

The following issue was identified at the Building 1168 Leach Well site that may affect the long-term protectiveness of the remedy:

- An assessment for 1,4-dioxane has not been performed at the Building 1168 Leach Well site and DRMO Yard.

The following issue was identified that does not affect the protectiveness of the Building 1168 Leach Well site:

- All cleanup goals identified in the OU-2 ROD have been attained, although petroleum contamination persists at the site.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.

5.2.8 Recommendations for Follow-up Actions

The following recommendation is made for the issue that affects protectiveness at FWA:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Building 1168 Leach Well and DRMO sites. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

The following recommendation is made for the issue that does not affect protectiveness at the Building 1168 Leach Well site:

- An iRACR should be completed to document remedial action complete under CERCLA.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. This will be initiated in November 2016 with a planned completion date of September 2018.

5.2.9 Protectiveness Statement

The remedy at the OU-2 Building 1168 Leach Well site currently protects human health and the environment because:

- All cleanup goals identified in the ROD have been attained, although petroleum contamination persists at the site.

- ICs are in-place to ensure that groundwater containing petroleum contaminants will not be used.

However, in order for the remedy to be protective in the long-term, the following action needs to be taken to ensure protectiveness:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Building 1168 Leach Well site. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

5.3 OU-2 DRMO Yard

5.3.1 Background Information

The DRMO Yard is composed of six subareas. Two subareas, a portion of DRMO-1 and DRMO-4, are being remediated under CERCLA and included in this five-year review. The remaining subareas are managed under the 2-PTY agreement between the U.S. Army and ADEC and are exempt from CERCLA; one subarea was granted no further action. The location of the DRMO Yard is shown on Figure 2-1 and subareas are illustrated on Figure 5-3.

The DRMO-1 subarea covers the central and northwest portions of the DRMO Yard, including Building 5008, a Water Supply Well House, and a large area to the northwest. The DRMO-4 subarea encompasses the southwest section of the DRMO Yard, which includes an Alaska Railroad spur line that enters the yard and an associated loading ramp. A portion of the Alaska Railroad line and the Old Richardson Highway are south of the DRMO Yard.

5.3.1.1 Physical Characteristics

The DRMO Yard is approximately 25 acres and located along the eastern border of FWA. The yard is bordered by the Alaska Railroad to the south, a man-made channel (Channel B) of the Chena River Flood Control Project to the west, and Badger Road to the east. Fencing surrounds the yard. No endangered or threatened species reside in the area.

Surface soil is characterized as fill material, 3 ft to 6 ft deep, consisting of silt, silty sands, and gravels. Subsurface soil is variable and consists of layers of silty sand, gravel, silt, and alluvial deposits of sand and gravel.

Groundwater is encountered at approximately 7½ ft bgs in an unconfined aquifer consisting of poorly graded, coarse-grained sand and gravel. Groundwater flow is generally toward the northwest following the regional flow of the Tanana River Valley. At the western boundary of the DRMO Yard there may be some minor short term influences by water level fluctuations in Channel B, which was constructed as part of the Chena River flood control project that connects the Chena and Tanana Rivers.

5.3.1.2 Land and Resource Use

The DRMO Yard was used to store obsolete, surplus, and unserviceable equipment and supplies for transfer to another authorized user, for public auctions, or for destruction and disposal. The yard contained numerous aisles of surplus appliances, tires, transformers, and wire. It formerly served as the hazardous material transfer point for FWA, Fort Greely, and Eielson Air Force Base. A portion of the DRMO Yard is presently used to store vehicles and equipment for troop mobilization and connexes for left-behind equipment. The land use is currently industrial and is expected to remain industrial for the foreseeable future.

Residential areas are located near the DRMO Yard approximately 1,000 ft to the northeast and 400 ft to the southeast. Residents in these subdivisions use groundwater as a drinking water source. Private wells are located upgradient of the DRMO Yard in the same unconfined aquifer as contaminated groundwater. Although groundwater generally flows west to northwest, away from these residential areas, fluctuations in flow direction occur.

In 1996, a potable water supply (Class C)/fire suppression well was installed to a depth of 102 ft in the DRMO Yard. It was located 50 ft upgradient of a defined solvent plume and 100 ft downgradient of a defined petroleum plume. Groundwater pumped from this well is treated with

activated carbon, potassium permanganate addition, filtration, and chlorination prior to distribution to users. The water supply well system is housed in Building 5009 and has been sampled as part of a DRMO-1 2-PTY annual monitoring program. It is sampled six times a year for VOCs (CH2M HILL 2004b). In accordance with the ROD, the water supply well is limited to a pumping rate of 60 gallons per minute, until MCLs are achieved, to reduce the chance of drawing the plume into well's cone of influence. Use of the water supply well to fill a fire suppression storage tank is prohibited except for emergencies. The tank was initially filled by a water supply truck. Groundwater use is considered to be residential.

5.3.1.3 History of Contamination

DRMO-1

No discrete sources of contamination were identified for petroleum hydrocarbons and chlorinated solvents that have been detected in soil and groundwater at the site. The sources of contamination are believed to have been spills and releases from waste oil drums and transformers previously stored in this area, as well as former diesel USTs. A chlorinated solvent spill area is located generally north of a petroleum source area.

DRMO-4

Transformer and asphalt drum storage areas were located in DRMO-4. Near-surface contamination may have resulted from miscellaneous releases associated with the Alaska Railroad rail spur. Subsurface contamination near the water table at locations where surface contaminant levels are minimal suggests possible releases from an unidentified UST or fuel line or an undetected surface release adjacent to the area.

5.3.1.4 Initial Response

No pre-ROD cleanup activities or response actions were performed at the OU-2 DRMO Yard.

5.3.1.5 Basis for Taking Action

DRMO-1

The RI performed in 1995 concluded that petroleum hydrocarbons detected in soil at 6 to 11 ft bgs had impacted groundwater. A dissolved petroleum hydrocarbon plume was found to have migrated in the direction of groundwater flow (northwest) and extended from the suspected source area to beyond the northwest corner of the DRMO Yard. The RI also reported a chlorinated VOC plume that extended from approximately 7 ft bgs (depth to groundwater) to 30 to 40 ft bgs.

DRMO-4

Petroleum and chlorinated VOCs were detected in the groundwater at DRMO-4, although the plume was smaller and contaminant concentrations lower than at DRMO-1.

Based on the results of a baseline risk assessment, COCs for both DRMO-1 and DRMO-4 were identified in the ROD. They are presented in Table 5-6.

Table 5-6 OU-2 Former DRMO Yard COCs

Medium	COC
Groundwater	Benzene
	PCE
	TCE
	1,1-DCE
	cis-1,2-DCE
	Vinyl chloride
Soil	DRO

5.3.2 Remedial Actions

5.3.2.1 Remedy Selection

RAOs established in the January 1997 ROD (U.S. Army 1997a) are listed below.

Groundwater

- Restore groundwater to its beneficial use of drinking water quality within a reasonable time frame through source control.
- Reduce or prevent further migration of contaminated groundwater from the source areas.
- Prevent use of groundwater containing contaminants at levels above SDWA and State of Alaska Drinking Water Standard MCLs and AWQS.
- Use natural attenuation to attain AWQS (18 AAC 70) after reaching state and federal MCLs.

Soil

The RAO for soil at DRMO-1 and DRMO-4 is to prevent migration of soil contaminants to groundwater, which could result in groundwater contamination and exceedances of state and federal MCLs and AWQS (18 AAC 70).

The cleanup goals identified in the ROD for COCs in groundwater and soil are presented in Table 5-7.

Table 5-7 OU-2 Former DRMO Yard COC Cleanup Goals

Media	COC	Cleanup Goal	Basis [1]
Groundwater	Benzene	5 µg/L	MCL
	PCE	5 µg/L	MCL
	TCE	5 µg/L	MCL
	1-1-DCE	7 µg/L	MCL
	cis-1,2-DCE	70 µg/L	MCL
	Vinyl chloride	2 µg/L	MCL
Soil	DRO	100 mg/kg	ADEC 18 AAC 78

Notes:

1 Groundwater cleanup goals are based on federal and state drinking water MCLs

2 ADEC soil matrix concentrations will be considered as a guidance for in situ treatment of soils

In order to achieve these RAOs, the following remedies were selected:

DRMO-1

- *In-situ* treatment of groundwater via AS to remove VOCs.
- *In-situ* treatment of soil via SVE to prevent contaminated soil from acting as an ongoing source of contamination to groundwater.
- Evaluation and modification of the AS/SVE system, as necessary, to optimize effectiveness.
- Periodic monitoring and evaluation of air emissions from the AS/SVE system to meet air emission requirements.
- Periodic groundwater monitoring and off-gas measurements to determine attainment of RAOs.
- Achieve AWQS through natural attenuation after active treatment attains state and federal MCLs.
- Maintain ICs, including restricted access, well development restrictions and prohibition against refilling fire suppression water tank from the on-site well, as long as hazardous substances remain onsite at levels that preclude unlimited use and unrestricted exposure.

DRMO-4

- Natural attenuation
- Groundwater monitoring
- Maintain ICs, including restricted access, well development restrictions and prohibition against refilling fire suppression water tank from the on-site well, as long as hazardous substances remain onsite at levels that preclude unlimited use and unrestricted exposure.

The ROD assumed that groundwater would be restored to its beneficial use within 15 years from implementation of the remedy (U.S. Army 1997a).

5.3.2.2 Remedy Implementation

DRMO-1

The AS/SVE system was installed at the DRMO-1 source area in the summer of 1997. It was designed to operate seasonally (May through October) and was operated from 1997 to 2005. The AS system was operated continuously in 2004 and 2005. In 2005, the AS wells were rehabilitated to improve air flow through the soil but PCE removal rates remained low. As a result of declining PCE removal rates and concerns that operation of the system may have been inhibiting anaerobic biodegradation of chlorinated compounds, the RPMs decided to shut down the AS/SVE system in 2005. Between 2006 and 2008, contaminant concentrations in groundwater were slightly above the cleanup goals. It was determined that the increase in contaminant concentrations did not reflect rebound conditions that can occur following the shutdown of the treatment system. The system was decommissioned in October 2008.

A LTMO analysis completed in 2008 included an evaluation of contaminant trends, plume stability, monitoring well redundancy, and sampling frequency. Results indicated that the

contaminant plumes were either stable or decreasing, thereby allowing for reductions in the monitoring program. Sampling frequency was reduced from semi-annual to annual and several wells were eliminated from the monitoring network in 2009.

The LTMO analysis also indicated that COC concentrations could exceed cleanup goals for a significant period of time. Consequently, a treatability study was conducted to stimulate reductive dechlorination and achieve remedial goals in a shorter timeframe. The treatability study was completed during 2009 and consisted of the injection of an ISCR compound, zero valent iron with a fibrous organic material. Ten months following injection, contaminant concentrations were observed to decrease to their lowest levels; however, groundwater geochemistry indicated that groundwater conditions were returning to pre-injection conditions. Consequently, a second injection was completed in 2010.

DRMO-4

Groundwater monitoring is performed at DRMO-4 to assess the progress of natural attenuation. Monitoring data collected through 2009 showed that PCE concentrations remained above the cleanup goal and a decision was made to conduct a treatability study using the same ISCR product applied at DRMO-1. The first injection was completed in 2009. PCE concentrations immediately following the injection increased to their highest concentration since the fall 2007. Following this initial increase, the concentrations decreased and remained below the cleanup goal through the October 2010 sampling event. A second injection was performed in 2011.

DRMO-1 and DRMO-4

ICs at DRMO-1 and DRMO-4 include restrictions on groundwater well installations, site access restrictions, and maintenance of fencing at the DRMO Yard until state and federal MCLs are met. Controlled access on the east side of the DRMO Yard is maintained by the operators of the DRMO facility, and controlled access from the west side of the site is maintained by the "Left-Behind Equipment" Group. Additional ICs include a limitation on refilling the DRMO Yard fire suppression water tank from the existing potable water supply well until state and federal MCLs are met (except in emergency situations).

ICs at each OU are inspected annually and a complete summary of the survey and corrective actions taken are presented in an annual IC report. The first annual report was prepared for 2012 (FES 2013h) and prior inspections were included in OU-specific annual monitoring reports. IC inspections evaluate potential land use changes, site security (monitoring wells, etc., as applicable), and unauthorized groundwater use. In addition, reviews of the FWA IC GIS layer and the site-specific information in the ADEC Contaminated Sites database are conducted.

5.3.2.3 Operation, Maintenance and Monitoring

There are no active remediation systems operating at the site and maintenance activities are limited to monitoring well inspections. During the annual groundwater sampling events, monitoring wells are inspected to ensure that they are accessible, locked, and in good condition. Results of the inspections are presented in the annual monitoring reports. Over the last several years, maintenance activities have included replacing well locks and adjusting well risers that were impacted by frost.

Currently, seven wells at DRMO-1 (AP-7559, AP-7560, AP-8914R, AP-10015, AP-10016, AP-10017, and AP-10018) and three wells at DRMO-4 (AP-8916, Probe B, and PO5) are monitored annually for ROD groundwater COCs as well as DRO, RRO, and geochemistry parameters.

5.3.3 Progress Since the Last Five-Year Review

The Third Five-Year Review Report (U.S. Army 2011) provided the following protectiveness statement for the OU-2 Former DRMO Yard:

> *"Remedies at OU3 are currently protective of human health and the environment; however, in order for the remedies to remain protective in the long-term, the Army will initiate appropriate responses in cooperation with the EPA and State of Alaska if future monitoring indicate significant changes from the current status of the contaminant plumes that would adversely affect human health and the environment. In the interim, exposure pathways that could result in unacceptable risks are being controlled and Institutional Controls are preventing exposure to, or ingestion of, contaminated groundwater."*

The following recommendations were provided in the Third Five-Year Review Report:

- The current site model indicates that contamination does not appear to be migrating off-site and continued groundwater monitoring should be sufficient to ensure protectiveness.
- Continue evaluation of the ISCR treatability study and conduct additional injections if necessary.
- Perform post-wide IC inspection and evaluate protectiveness. Update restricted use boundaries in GIS as new information becomes available.
- Develop the parameters for an Annual Report of IC effectiveness and corrective actions taken (spring 2012 milestone date).
- Update the database of LUC/IC summary documents (October 2013 milestone date), which consists of tables that describe in greater detail the ICs, the objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms.

The status of these recommendations and actions taken to address them are discussed below.

- Groundwater samples have been collected from the site annually since the previous five-year review. Groundwater analytical data from 2012, 2013, 2014, and 2015 were available for this five-year review.
- Following each annual monitoring event, groundwater data were presented in annual monitoring reports and used to perform a LTMO analysis, which included evaluation of contaminant trends, plume stability, monitoring well redundancy, and sampling frequency using MAROS software. As a result of this evaluation, a second ISCR injection was completed in 2011 in the DRMO-4 subarea as part of the treatability study initiated in 2009. In addition, beginning in 2014, the sampling data was analyzed using a Groundwater Statistics Tool developed by the USEPA.
- Post-wide IC inspections have been performed and results were documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013h, 2015a, 2015f).
- Parameters for an annual report of IC effectiveness and corrective actions taken have been developed; they are used in the annual IC reports.

- Tables that describe in detail the ICs, objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms were updated and documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

5.3.4 Site Inspection

The DRMO Yard was inspected by USACE on August 11, 2015 to examine the remediated areas and assess protectiveness of the remedy. The site appeared to be used as a staging area with some structures, paved, gravel covered, and vegetated areas. Some of the probe points appeared to be frost-jacked; however, installation staff noted that sampled wells were not affected. Monitoring wells were locked and in good condition. Site access is controlled by the installation perimeter fence and fencing around the DRMO Yard. Both fences were in good condition. Completed site inspection checklists are provided in Attachment 4 and site photographs are provided in Attachment 5. FWA staff indicated that LUCs/ICs are maintained as required by the ROD.

The most recent IC review of the OU-2 DRMO Yard is documented in the 2014 IC report (FES 2015e), which concluded that:

- There was no evidence of unauthorized installation or use of groundwater wells.
- No soil disturbing activities were observed.
- A portion of the fence (northwest of the site, toward the center) appeared to be dented but was not breached.
- Wells currently at the site are easily assessable and secured.
- Land use at the site and adjacent areas has not changed.

The five-year review site inspection confirmed these conclusions. The 2012 Monitoring Report (FES 2013d) indicated that a fire suppression tank was refilled in August 2012 using the DRMO Yard potable water supply well, which is sampled for benzene and DRO as part of the 2-PTY DRMO Yard monitoring program. Since sampling began in 1998, benzene has not been detected above the ROD cleanup goal and DRO has not been detected above the 2-PTY Agreement cleanup goal.

5.3.5 Data Review

The 2015 Monitoring Report for OU-2 (FES 2016d) evaluated the latest groundwater analytical results and presented the following conclusions and recommendations:

- Overall groundwater flow direction was northwest, consistent with the regional groundwater flow pattern.
- PCE concentrations exceeded the cleanup goals in two wells, one located in DRMO-1 source area (AP-10016) and one in DRMO-4 (PO5). The exceedances at AP-10016 were attributed to high water levels that may have caused contaminants on the soil to desorb to groundwater. The high water levels correlate with above average precipitation in July and August 2015 and do not appear to be a trend at the DRMO Yard.
- The presence of PCE degradation products was interpreted to indicate that biodegradation was occurring at the sites. Reduced total organic carbon concentrations, an indicator of the injected substrate, to near background levels was interpreted to indicate that the substrate had been exhausted.

- LTMO analysis concluded that annual sampling should continue to evaluate groundwater geochemistry and contaminant concentration trends.

Groundwater analytical data collected between 2010 and 2015 is provided in Attachment 10. Monitoring well locations are shown on Figure 5-3.

DRMO-1

Eight years of AS/SVE system operation followed by two rounds of ISCR treatability study injections have reduced the COC concentrations in groundwater. The most recent groundwater data collected in 2015 showed PCE exceeding the cleanup goal in one well (AP-10016) at the DRMO-1 injection area. No other COCs exceed the cleanup goals at DRMO-1. Statistical trend analysis results presented in the 2015 Monitoring Report for OU-2 (FES 2016d) are summarized below (wells with exceedances are bolded):

- PCE
  - Increasing trend in well AP-10017 (upgradient)
  - Stable trend in well AP-7559 (downgradient)
  - No trend in wells **AP-10016** (source area), AP-7560 (downgradient), and AP-10015 (downgradient)
  - Decreasing trend in wells AP-8914R and AP-10018 (both source area)
- TCE
  - Increasing trend in wells AP-10017 (upgradient), AP-8914R (source area), and AP-10016 (source area)
  - No trend in wells AP-7559 and AP-10015 (both downgradient)
  - Stable trend in AP-10018 (source area)
  - Potentially decreasing trend in AP-7560 (downgradient)

A spatial moment analysis was performed for the PCE plume at DRMO-1 in the 2015 groundwater monitoring report. The analysis determined the following:

- The PCE dissolved mass has been variable and exhibited no trend. However, the dissolved mass estimate decreased by one third since 2014.
- The center of mass of PCE exhibited an increasing trend, and appears to have shifted downgradient of the source in recent sampling events. These results do not indicate that the plume is migrating, but are significant source area concentration decreases resulting from the treatability study and table, low-level downgradient concentrations.
- PCE trends were stable in the direction of groundwater flow, and no trend perpendicular to groundwater flow.
- There were no cleanup goal exceedances for TCE in 2015, but PCE exceeded the cleanup goal in one well near the source area. These results show there is no evidence of plume spread with concentrations above the cleanup goal in DRMO-1.

Benzene, PCE, 1,1-DCE, cis 1,2-DCE, and vinyl chloride concentrations in wells downgradient of the source area (AP-7559 and AP-7560) have remained below the cleanup goals, indicating that the plumes are not expanding. Increasing trends were identified for PCE and TCE at well AP-10017 located upgradient to the plume center (just 60 ft east of AP-10016). The PCE and TCE concentrations have been below cleanup goals for the last five years of sampling. The PCE

concentration was 1.3 µg/L in August 2015 and the TCE concentration was non-detect. Increasing TCE concentrations were also detected at source area well AP-8914R, also below cleanup goals. Given how low the PCE concentrations are at AP-10016 (equal to or less than 2.0 µg/L since 2011), and that increasing TCE concentrations may be expected with reductive dechlorination, these increasing trends do not present cause for concern over remedy performance or upgradient source area(s).

Petroleum contamination (evidenced by elevated DRO concentrations) were also detected in DRMO-1 (specifically in monitoring well AP-7560); however, DRO was not selected as a groundwater COC in the OU-2 DRMO Yard ROD.

Geochemical data indicates that iron and sulfate-reducing conditions were present during the August 2015 monitoring event. Reducing conditions were stimulated by the ISCR treatability study injections. The greatest reducing conditions were observed at wells AP-8914R and AP-10018, which correspond to the highest density of injection points. Iron and sulfate reducing areas mapped in the 2015 monitoring report and are presented in Attachment 10 (Figure 3-2, *Approximate Regions of Reduced Groundwater Geochemistry*). Total organic carbon and alkalinity data indicate that the ISCR substrate was exhausted when the 2015 monitoring event was performed.

DRMO-4

Natural attenuation and two rounds of ISCR treatability study injections have caused the PCE concentrations to fluctuate above and below the cleanup goal in two of the three wells monitored. Statistical trend analysis results presented in the 2015 Monitoring Report for OU-2 (FES 2015m) are summarized below (wells with exceedances are bolded):

- PCE
    - No trend in well **PO5** (source area)
    - Stable trend in wells AP-8916 (source area) and Probe B (downgradient)
- TCE
    - Potentially increasing in well PO5 (source area)
    - Stable in well Probe B (downgradient)
    - Potentially decreasing in well AP-8916 (source area)

All COC concentrations in downgradient well Probe B have remained below the cleanup goals, indicating that the plumes are not expanding. Geochemical data indicates that reducing conditions were present in the source area and mildly reducing at downgradient well Probe B during the August 2015 monitoring event. A potentially increasing trend in TCE was identified in source area well PO5. The concentrations of TCE remain below the cleanup goal and may increase with reductive dechlorination. This potentially increasing trend does not adversely affect the remedy performance evaluation.

The five-year review reviewed the data and analysis presented in the 2015 monitoring report and agrees with the conclusions provided in the report.

5.3.6 Technical Assessment

5.3.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

Yes, the remedy is functioning as intended by the ROD.

Although the remedy is taking longer than the 15 years assumed in the ROD, groundwater data indicates that the COC plumes in the DRMO Yard are stable or decreasing. The 2015 groundwater monitoring data identified exceedances of cleanup goals at only two monitoring wells, AP-10016 in DRMO-1 (PCE at 7.2 µg/L) and PO5 at DRMO-4 (PCE at 8.56 µg/L). Groundwater geochemistry and analytical results indicate that biodegradation is occurring and will require additional time to achieve the cleanup goals. The remedial actions have prevented further migration of contaminated groundwater from the source areas. LUCs prevent the use of groundwater containing COCs above the cleanup goals.

The OU-2 ROD prohibits the refilling of the DRMO Yard fire suppression water tank from the existing DRMO Yard potable water supply until state and federal MCLs are met within the contaminant plume. The potable well was used in the past to fill the fire suppression water tank and is tested routinely to confirm that the water meets state and federal MCLs. The U.S. Army will restrict future use of the DRMO Yard potable water supply to ensure that the remedy continues to function as intended by the ROD.

LUC/ICs have been implemented and are functioning as intended. Opportunities for optimization were not identified.

No early indicators of potential problems were identified.

5.3.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy are still valid. The current exposures and major exposure assumptions for future potential land use at the site have not changed.

None of the cleanup goals are risk-based. There are no newly promulgated or modified requirements of federal and state environmental laws that would change the protectiveness of the groundwater and soil remedies implemented at the OU-2 DRMO Yard.

The vapor intrusion pathway was not explicitly evaluated at OU-2 at the time of the ROD. USEPA and ADEC guidance on vapor intrusion has either been developed or significantly updated within the last five years. Attachment 8 evaluates the potential for vapor intrusion at the site. The current VOC concentrations in groundwater do not exceed their VISLs and vapor intrusion should not be a concern at commercial buildings in the DMRO Yard or at the neighboring residential housing units.

A screening level ecological risk assessment was performed for OU-2; it concluded that there did not appear to be unacceptable potential ecological risks associated with the DRMO Yard source area. Nothing has changed at OU-2 that would invalidate these conclusions.

5.3.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No information has come to light that could call into question the protectiveness of the remedy for the intended use of the property as described in the ROD. However, the USEPA has identified 1,4-dioxane as an emerging contaminant.

An assessment has not been performed at the OU-2 DRMO Yard to evaluate whether a release of the stabilizer 1,4-dioxane occurred. A recommendation to perform sampling is included below; however, this issue is not anticipated to affect protectiveness based on the following information:

- LUCs/ICs have been implemented preventing receptors from direct contact with subsurface contaminants at the OU-2 DRMO Yard.
- A hypothetical USEPA VISL was calculated for 1,4-dioxane (530,000 µg/L). This value is over four orders of magnitude greater than a VISL calculated for TCE under the same conditions (15 µg/L). ADEC does not have a VISL for 1,4-dioxane (VISL for TCE in groundwater is 5.2 µg/L). Based on this information, 1,4-dioxane should not pose a risk via vapor intrusion where no risk is identified for TCE.
- Groundwater contaminant concentrations at the OU-2 DRMO Yard are relatively low.
- The closest drinking water supplies include:
    - The Golden Heart Utilities has four water supply wells (AK2310730 - community) located 5.1 miles from the OU-2 DRMO Yard on the banks of the Chena River. These wells are unlikely to be influenced by the OU-2 DRMO Yard due to the distance of separation and low contaminant concentrations. The system operator was contacted on 27 October 2016 to request monitoring data for 1,4-dioxane as required for this system under the Unregulated Contaminant Monitoring Rule 3 (UCMR3). The operator indicated that the system was sampled for 1,4-dioxane twice in 2013 (February and August). However, the sampling point was at the entry point to the distribution system (post-treatment). The results indicate that no 1,4-dioxane was detected in the water samples at concentrations above the laboratory's minimum reporting limit of <0.07 µg/L. No raw water quality data was available for 1,4-dioxane.
    - Pioneer drinking water wells (AK2310714 - community) for the Hamilton Subdivision are located approximately 4.0 miles from the OU-2 DRMO Yard (see Figure 3-1). These wells are separated from the DRMO Yard by a hydrogeologic divide (Chena River). FWA has eight on-post wells (AK2310918 - community) and one well servicing the golf course (AK2311095 - non-community). In addition to those wells identified by the State, an emergency water supply well is located within the OU-2 DRMO Yard (see Section 5.3). The well locations are depicted on Figure 3-1. Only one well located on FWA is currently designated as a drinking water source (Building 3559 Water Well). This well is located approximately two miles west of the DRMO Yard. Based on the distance of separation and low contaminant levels at the DRMO Yard, the drinking water supply is unlikely to be influenced by impacts at the DRMO Yard.
- The OU-2 DRMO Yard is located approximately 1 mile south of the Chena River. Based on the distance of separation, groundwater flow direction, and low contaminant concentrations, it is unlikely that impacts associated with the DRMO Yard would impact the Chena River.
- No other sensitive receptors were identified.

5.3.6.4 Technical Assessment Summary

DRMO-1

The AS/SVE remedy at DRMO-1 was implemented in 1997 and shut down in 2005. The estimated timeframe to achieve the groundwater cleanup goals has passed; however, only one ROD-listed COC (PCE) exceeded the cleanup goal in 2015 at one sampling location (source area well AP-10016). All other COCs have been below the cleanup goals. Increasing trends in PCE and TCE were observed in well AP-10017. The PCE and TCE concentrations have been below the cleanup goals at this location, and do not affect the protectiveness of the remedy. The concentrations of PCE at monitoring well AP-10016 (where an exceedance of the cleanup goal was detected in 2015) demonstrated no trend. ICs were implemented and are maintained at DRMO-1 mitigating risk posed by receptors exposure to groundwater. No changes in ARARs or the risk assessment were identified that would affect the protectiveness of the remedy.

DRMO-4

Groundwater monitoring has been performed at DRMO-4 since the ROD was issued in 1997 (i.e. start of the remedial action). PCE concentrations have fluctuated above and below the site cleanup goals in two of three wells sampled; the estimated time frame to achieve the groundwater cleanup goals has passed. Increasing trends are not identified for PCE. Potentially increasing trends in TCE concentrations were identified in PO5; however, the TCE concentrations remain below the cleanup goal. The increasing trends therefore would not affect protectiveness. All other COCs have been below the site cleanup goals. ICs were implemented and are maintained at DRMO-1 mitigating risk posed by receptors exposure to groundwater. No changes in ARARs or the risk assessment were identified that would affect the protectiveness of the remedy.

5.3.7 Issues

The following issue was identified that may affect the future protectiveness of the remedy at the OU-2 DRMO Yard:

- An assessment for 1,4-dioxane has not been performed at the DRMO Yard.

The following concerns were identified that do not affect protectiveness of the remedy:

- The OU-2 ROD prohibits the refilling of the DRMO Yard fire suppression water tank from the existing DRMO Yard potable water supply until state and federal MCLs are met within the contaminant plume. The potable well was used in the past to fill the fire suppression water tank and is tested routinely to confirm that the water meets state and federal MCLs.
- Frost-jacked monitoring points were observed on site at the time of the site inspection.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.

5.3.8 Recommendations for Follow-up Actions

The following recommendation is made for follow-up actions that may affect protectiveness of the remedy:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the DRMO Yard. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

The following recommendation for a follow-up action was identified that does not affect the protectiveness of the remedy:

- The U.S. Army will restrict future use of the DRMO Yard potable water supply in accordance with the ROD.
- Frost-jacked points should be evaluated for repair or replacement in the OU-2 DRMO Yard.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. This will be initiated in November 2016 with a planned completion date of September 2018.

5.3.9 Protectiveness Statement

The remedy at the OU-2 DRMO Yard currently protects human health and the environment because:

- Migration of COCs in groundwater from the DRMO-1 and DRMO-4 source areas has been prevented by implementation of the remedial actions.
- ICs are in place to ensure that groundwater containing COCs will not be used.

However, in order for the remedy to remain protective in the long-term, the following action needs to be taken to ensure protectiveness:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the DRMO Yard. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

5.4 OU-3 Remedial Area 1B Birch Hill Tank Farm

5.4.1 Background Information

OU-3 Remedial Area 1B extends south from the base of Birch Hill to the Truck Fill Stand, west toward Lazelle Road, and east toward the Canadian Oil Pipeline (CANOL) service road. Remedial Area 1B is divided into seven subareas based on geographic location and differing physical characteristics. There are currently four active subareas known as:

- Former Building 1173
- Truck Fill Stand
- Thaw Channel
- BHTF Product Recovery System

The remaining subareas include Shannon Park Subdivision and CANOL Service Road, which were granted NFA RODs in 1996. The Lazelle Road sites were incorporated into the Former Building 1173 subarea in 1997. Figure 2-1 shows the location of OU-3 Remedial Area 1B and Figure 5-4 illustrates site features.

5.4.1.1 Physical Characteristics

Remedial Area 1B is located in the Chena River floodplain, which gently slopes southward and then westward at about 1.8 ft per mile. The subsurface contains discontinuous permafrost and poorly drained soils covered by thick organic mats. Surface water ponding is common throughout the area during spring melt-off, after which mid-summer conditions dry the land surface. Wetlands are scattered throughout the area and shrub and forested wetlands border the southern portion of the site. No endangered or threatened species reside in the area.

The BHTF was constructed on the southwest slope of Birch Hill, between elevations 530 ft and 725 ft, which are above the surrounding river plain and cantonment area that are approximately 450 ft in elevation. Two distinct hydrostratigraphic zones underlie the tank farm and nearby properties: 1) the Birch Creek schist bedrock aquifer located from the top of the hill to the base of the hill, which includes the area beneath the ASTs on Birch Hill; and 2) an alluvial sediment aquifer that thickens to the south and west and contains discontinuous permafrost. The alluvial aquifer underlies Former Building 1173 and the Truck Fill Stand along with the Lazelle Estates and church properties.

Birch Hill consists of loess blanketing the Birch Creek schist and deeper bedrock units. Groundwater flow in the bedrock aquifer at the BHTF occurs in secondary porosity features, such as fractures and joints. The presence, location, and extent of permafrost from the base of Birch Hill southward to the Chena River significantly affects the groundwater flow direction in this area. Groundwater occurs in two zones above and below the permafrost in the alluvial aquifer. The supra-permafrost groundwater zone is a saturated zone above permafrost, whereas sub-permafrost groundwater is a saturated zone beneath permafrost. This deeper zone is the source for most local drinking water wells.

The approximate location of permafrost is shown on Figure 5-4. Additional information, including a November 2014 groundwater contour map, is provided in Attachment 10. It shows a steep hydraulic gradient within the bedrock aquifer at Birch Hill that flattens at the base of the hill. Groundwater in the bedrock aquifer flows generally to the southwest following surface topography and changes to a more westerly direction at the base of Birch Hill. The alluvial

aquifer exhibits 1) very low gradients in a southwesterly flow direction, 2) shallow groundwater flow deviations around blocks of permafrost, and 3) groundwater depths varying between 20 ft and 22 ft bgs. Development of the property to the west of BHTF may result in additional thawing of permafrost, which could cause changes in shallow groundwater flow. This condition is exemplified by a Thaw Channel area where land use changes have promoted seasonal soil heating that has permanently thawed the permafrost and created a preferential flow pathway for shallow groundwater. The flow direction arrows on a groundwater contour figure in Attachment 10 show the routing of groundwater through the Thaw Channel area.

5.4.1.2 Land and Resource Use

The current land use is considered light industrial in the remedial area and light industrial, recreational, and residential in surrounding areas. Groundwater below Remedial Area 1B is not currently a source of drinking water. The Shannon Park Baptist Church and Steese Chapel on Lazelle Road are approximately ¼ mile west and have groundwater wells; although neither of these wells are currently used for drinking water purposes. The U.S. Army currently fills a water holding tank at Shannon Park Baptist Church once a month. Bottled water was supplied to the Steese Chapel, which has been discontinued at their verbal request (exact date of this request is unknown). A reverse osmosis treatment system was installed on the Chapel supply well. The treatment system is operated and maintained by the Chapel.

Fifty-two (52) acres adjacent to the BHTF was sold in early 2006 for the Lazelle Estates residential housing development. According to the third five-year review, the development included 220 lots and 91 housing units by 2007. The most recent tax maps (accessed 27 September 2016) and Google Earth™ imagery (dated September 6, 2015) include 123 property records with 72 lots developed. The developed lots contain a mixture of single family homes and duplexes; therefore, the number of housing units is greater than the number of developed lots. The current equivalent number of housing units was not available in the public records. A portion of the Lazelle Estates originally planned for development was never completed which may account for the discrepancy between the total number of lots noted in 2007 and in 2016. The development shares a property line with FWA and housing construction is concentrated along the Steese Highway, approximately 1,000 ft from the FWA boundary. All of the housing units are on city water and volatile contaminants from the BHTF do not extend under the residential area.

5.4.1.3 History of Contamination

The BHTF was originally constructed as part of the 1943 CANOL Project that included a 3-inch pipeline from Whitehorse to Fairbanks. It originally consisted of 14 10,000-barrel, bolted-steel ASTs that contained JP-4, mogas, and diesel fuels. These tanks were connected by an 8-inch pipeline to a Railcar Off-Loading Facility (OU-3 Remedial Area 2) and the East Birch Hill UST Tank Farm near the Milepost sites (OU-3 Remedial Area 3). In 1955, as part of oil pipeline expansions, two 25,000 barrel tanks, the Truck Fill Stand, and a new pump house and manifold building were built.

Contamination in Subarea 1B was initially discovered during a 1988 soil gas survey. Subsequent investigations indicated that subsurface soils and groundwater were impacted by petroleum compounds. Fuel spills at the Truck Fill Stand, tank leaks, and operational processes employed at the Former Building 1173 subarea caused this contamination. USTs located at the base of the hill also appeared to be a contributing fuel source via spills or leaks.

The BHTF was permanently closed in January 1994. Characterization of soil and groundwater contamination at the tank farm was complicated by permafrost, which led to initially underestimating the nature and extent of contamination in this area.

In 1995, 1,2-dichloroethane (DCA) was detected in the Shannon Park Baptist Church drinking water well at concentrations slightly above the MCL. The U.S. Army began supplying drinking water to two churches, Shannon Park Baptist Church and Steese Chapel, both located downgradient of Remedial Area 1B. Concentrations of DCA in the Baptist Church well have been consistently below the MCL since 1999 and DCA concentrations in the Steese Chapel well have been consistently insignificant.

The OU-3 ROD was signed in April 1996 and subsequent studies better delineated the permafrost configuration and groundwater flow characteristics. The extent of contamination was also redefined and showed both the bedrock and alluvial aquifers were more impacted than previously estimated. Free product (weathered aviation gasoline known as AVGAS) and elevated groundwater concentrations of fuel additives DCA and 1,2-dibromoethane (EDB) indicated the presence of persistent sources in the Birch Hill bedrock aquifer.

A series of investigations indicated that dissolved contaminants measured off post were migrating in the alluvial aquifer groundwater that comes in contact with free product in bedrock fractures underlying Birch Hill. The detection of free product led to the addition of a subarea known as the Birch Hill Product Recovery System, which was documented in the 2002 ROD ESD.

5.4.1.4 Initial Response

The U.S. Army began supplying drinking water to the Shannon Park Baptist Church and Steese Chapel in 1995 due to MCL exceedances at the Baptist Church.

5.4.1.5 Basis for Taking Action

A remedy for Remedial Area 1B was necessary for the following reasons:

- Benzene was detected above SDWA levels in groundwater.
- The site was near the FWA boundary, residential drinking water wells, and a Class A public water-supply system.
- Contaminant migration from soil to groundwater was occurring.

Based on the results of a baseline risk assessment, CERCLA COCs were identified for Remedial Area 1B groundwater and presented in the 2002 ROD ESD (U.S. Army 2002). They represent fuel-related compounds and are presented in Table 5-8.

Table 5-8 OU-3 Remedial Area 1B COCs

Medium	COC
Groundwater	Benzene
	Toluene
	Ethylbenzene
	1,2-EDB
	1,2-DCA
	1,2,4-TMB
	1,3,5-TMB

Notes:
TMB trimethylbenzene

5.4.2 Remedial Actions

5.4.2.1 Remedy Selection

The following RAOs were established in the January 1996 ROD:

- Restore groundwater to drinking water quality within a reasonable time frame.
- Reduce further migration of contaminated groundwater.
- Prevent use of groundwater with contaminants at levels above SDWA standards.

A RAO for petroleum contaminated soil was established to prevent migration of contaminants from soil into groundwater that would result in groundwater contamination and exceedance of SDWA standards.

The cleanup goals identified in the ROD are presented in Table 5-9.

Table 5-9 OU-3 Remedial Area 1B COC Cleanup Goals

Media	COC	Cleanup Goal (µg/L)	Basis
Groundwater	Benzene	5	1
	Toluene	1,000	1
	Ethylbenzene	700	1
	1,2-EDB	0.05	1
	1,2-DCA	5	1
	1,2,4-TMB	1,850	2,3
	1,3,5-TMB	1,850	2,3
Soil	Soils contaminated with VOCs and petroleum-related compounds	Active remediation until contaminant levels in groundwater are consistently below state and federal MCLs	

Notes:
1 Groundwater cleanup goal based on federal and state drinking water MCLs.
2 Groundwater cleanup goal based on a RBC equivalent to a non-cancer hazard quotient of 1 using residential groundwater exposure assumptions.

3 The 2002 ESD clarified the cleanup goals for 1,2,4-TMB and 1,3,5-TMB to 1.85 milligrams per liter (mg/L). The ROD listed cleanup goals for these constituents at 0.014 mg/L and 0.012 mg/L, respectively.

The selected remedy consisted of SVE for contaminated soil and AS for contaminated groundwater in permafrost free areas to achieve SDWA levels and natural attenuation to meet AWQS.

The ROD estimated timeframe to reach the cleanup goals was no more than 30 years, or by 2026 (U.S. Army 1996b).

5.4.2.2 Remedy Implementation

AS/SVE Systems

Two AS/SVE systems were installed at OU-3: 1) near Former Building 1173 and 2) at the Truck Fill Stand. An AS system was also installed at the Thaw Channel (refer to Attachment 10, Figure 1-1). The systems were operated between 1996 and 2005 and decommissioned in 2012. Combined, they removed approximately 87,000 pounds of VOCs (82,000 pounds from Former Building 1173 and 5,300 pounds from the Truck Fill Stand) or a weight equivalent of about 14,000 gallons of gasoline. *In-situ* equipment, piping, and supporting infrastructure were removed, recycled, and disposed according to ADEC agreements and guidance. Select groundwater monitoring wells not included in the monitoring program were also decommissioned. All of the sites, besides the BHTF proper, were restored to native field conditions and hydroseeded.

These remedial actions were followed by rebound studies and performance monitoring for natural attenuation processes.

Dual-phase Free-Product Recovery System

To address the significant amounts of floating fuel product discovered at the BHTF during the 1998 field season, active and passive skimmers were installed in 1998 in various bedrock wells located on the hill (refer to Attachment 10, Figure 1-1). They were expanded in 1999 in several new wells. Between 2000 and 2003, a product recovery system operated on Birch Hill that ultimately removed approximately 5,500 gallons of fuel product from over 13 million gallons of groundwater. This source depletion decreased dissolved benzene within the bedrock aquifer and limited migration to the alluvial aquifer, thereby reducing the potential for contamination in off-post wells. In 2003, the system's efficiency declined as free-product layers thinned, so the system was shutdown. Free product is still known to exist in the fractured bedrock below BHTF area and appears to be a low-concentration source to nearby monitoring wells screened in the alluvial aquifer. The recovery system was placed in storage in 2009 and can be re-initiated if required.

Groundwater Monitoring

All treatment systems in OU-3 Remedial Area 1B have been shut down and the sites are currently undergoing natural attenuation and long-term groundwater monitoring.

Institutional Controls

ICs for OU-3 were established in the 2002 ESD, which asserted that a facility-wide IC policy established in the OU-5 ROD, U.S. Army Alaska Institutional Controls Standard Operating

Procedures (APVR-RPW [200-1]), and a February 2002 Memorandum on ICs (APVR-RPW-EV-[200-1c]) from Major General James J. Lovelace, Fort Richardson, Alaska would be used to develop, implement, and monitor site-specific IC requirements at the site (U.S. Army 2002). Since that time, FWA Garrison Policy #38 was issued (November 9, 2011), which updated and disseminated the LUC/IC Policy for FWA.

ICs are maintained to ensure that groundwater will not be used until cleanup goals are attained. They include restrictions governing site access, construction, and water supply well installation as long as hazardous substances remain on site at levels that preclude unrestricted use. Informational signs have been installed to inform the public of restrictions in this area.

Installation-wide ICs are annually inspected and any violations are corrected. Results of these activities are documented annual IC reports. The first annual report was prepared for 2012 (FES 2013h) and prior IC inspection results were included in the OU-specific annual monitoring reports.

5.4.2.3 Operation, Maintenance and Monitoring

There are no active remediation systems in Remedial Area 1B and maintenance activities are limited to monitoring well inspections. During the annual monitoring events, monitoring wells are inspected to ensure that they are accessible, locked, and in good condition. Inspection results are presented in the annual monitoring reports. Over the last several years, activities have included replacing well locks and adjusting well risers that are impacted by frost.

Groundwater monitoring throughout OU-3 occurs annually (normally in June), with some additional sampling at the Remedial Area 1B to assess contaminant trends in bedrock wells and select alluvium wells downgradient of the BHTF. A total of 27 bedrock wells and 18 alluvium wells were sampled in 2014. Groundwater samples are analyzed for ROD COCs, DRO, and geochemistry parameters. Wells are located on Birch Hill, in an area south of Birch Hill, and off-post areas (refer to Figure 5-4).

5.4.3 Progress Since the Last Five-Year Review

The Third Five-Year Review (U.S. Army 2011) provided the following protectiveness statement for OU-3:

> *"Remedies at OU3 are currently protective of human health and the environment; however, in order for the remedies to remain protective in the long-term, the Army will initiate appropriate responses in cooperation with the EPA and State of Alaska if future monitoring indicate significant changes from the current status of the contaminant plumes that would adversely affect human health and the environment. In the interim, exposure pathways that could result in unacceptable risks are being controlled and Institutional Controls are preventing exposure to, or ingestion of, contaminated groundwater."*

The following recommendations were provided in the Third Five-Year Review Report:

- Decommission AS/SVE treatment systems at Former Building 1173 and the Truck Fill Stand.
- Continue annual monitoring of Birch Hill alluvial and bedrock wells to evaluate natural attenuation. Continue to optimize the sampling frequency, location, and analysis required to achieve remedial goals by conducting LTMO analysis.

- Perform a post-wide IC inspection and evaluate protectiveness; update restricted use boundaries in GIS as new information becomes available.
- Develop the parameters for an Annual Report of IC effectiveness and corrective actions taken (spring 2012 milestone date).
- Update the database of LUC/IC summary documents (October 2013 milestone date), which consist of tables that describe in greater detail the ICs, the objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms.

The status of these recommendations and actions taken to address them are discussed below.

- The AS/SVE systems at the Former Building 1173 and the Truck Fill Stand were decommissioned in 2012.
- Groundwater sampling has been conducted annually between 2011 and 2015 and LTMO analysis has been performed on the data.
- Post-wide IC inspections have been performed and results were documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).
- Parameters for an annual report of IC effectiveness and corrective actions taken have been developed; they are used in the annual IC reports.
- Tables that describe in detail the ICs, objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms were updated and documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

5.4.4 Site Inspection

The site was inspected by USACE on August 11, 2015 to examine the remediated areas and assess the protectiveness of the remedy. The site was forested and includes staging areas for remedial activities occurring on 2-PTY sites and other construction activities. All wells appeared locked and in good condition. Fuel piping was observed in the area; FWA staff noted that the piping was associated with the pipeline and not the tank farm. The AS/SVE treatment systems at Former Building 1173 and the Truck Fill Stand were decommissioned.

Evidence of historical trespassing including fencing damage (repaired) and graffiti was observed. A former product recovery building was locked and decommissioned. FWA staff noted that the removal of ASTs and fencing repairs were completed to deter trespassing. The community information sign was in good condition. Site inspection checklists are provided in Attachment 4 and site photographs are provided in Attachment 5.

FWA staff indicated that LUCs/ICs are maintained as required by the ROD.

The most recent IC review of OU-3 Remedial Area 1B is documented in the 2014 IC report (FES 2015e), which concluded that:

- There was no evidence of unauthorized installation or use of groundwater wells.
- No soil disturbing activities were observed.
- Information signs are intact.
- Wells currently at the sites are easily accessible and secured.
- Site land uses and adjacent land use have not changed.
- IC boundaries are clearly marked on the IC map and the IC database is up to date.

The five-year review site inspection confirmed these conclusions.

The IC summary presented in the preliminary draft 2015 OU-3 Monitoring Report (FES 2016b) identified several maintenance issues associated with the BHTF survey conducted in September 2015. They included one inoperable well lock (AP-7855), unsecured gates, and a breach that was present on the west side of the fence near Tank 315. According to FES, breaches are repaired as soon as they are found, may be mitigated by the removal of the ASTs formerly located at the BHTF, and AP-7855 was secured with a new lock.

5.4.5 Data Review

The 2015 sampling event detected three COCs (benzene, 1,2-DCA, and 1,2-EDB) above their cleanup goals in the bedrock aquifer. No adjacent alluvium wells exhibited contaminant concentrations exceeding the ROD cleanup goals in 2015. Groundwater data for the last five years is presented in Attachment 10. Highlights include:

- All COCs have attenuated to below the cleanup goals in the alluvial aquifer except for the following:
    - AP-10227MW: This well is located near the base of Birch Hill (Building 1173) and may reflect low level impacts from bedrock dispersion. 1,2-DCA concentrations have exceeded the cleanup goal at this location six times since 2011.
    - AP-10230MW: This well is located within the Truck Fill Stand area. EDB concentrations have exceeded the cleanup goal at this location twice since 2011 (October 2014 and April 2015).
- Six bedrock monitoring wells (including one multi-level well) located in either the Thaw Channel area or along CANOL Road exhibited benzene concentrations below the cleanup goal. Benzene was not detected in any alluvial aquifer wells or in off-post bedrock wells in the Thaw Channel. DCA has reached its cleanup goal in the Thaw Channel subarea.
- Benzene has not been detected above the MCL at the Shannon Park Baptist Church since 2007.
- The predominant area of bedrock groundwater impacts is located within the AST 316 tank berm (wells AP-7596 and AP-8783) and extends south across the Building 1182 Pump House (AP-7600) and west to the vicinity of wells AP-7594 and AP-8890. This plume includes benzene, 1,2-DCA, and 1,2-EDB cleanup goal exceedances and comingles with the free product also detected in bedrock groundwater.
- Measureable product (fuel) layers were detected in two bedrock wells. AP-7848 contained a 0.42-ft thick layer; it is located near the base of Birch Hill (generally downgradient of former tanks 302 and 316) in the Birch Hill Product Recovery area. AP-7816 contained a 0.07-ft thick layer. Free product has not been seen in the alluvial aquifer since 1997.
- The bedrock aquifer monitoring program at Birch Hill indicates the presence of significant source volume, bedrock COCs are still prevalent above the cleanup goals.
- DRO was not identified as a groundwater COC for the BHTF, but was detected at elevated concentrations in April 2015 in five alluvial wells (AP-10227MW, AP-10228MW, AP-10230MW, AP-10231MW, and AP-10234MW).

The natural attenuation of COCs in OU-3 Remedial Area 1B is progressing at slow to moderate rates. The alluvial aquifer in this area is anaerobic and exhibits elevated ferrous iron and depleted sulfate concentrations where fuel-related contamination exists or existed (refer to Attachment 10, Table 5-12). The sampling data trends, in concert with these geochemical signatures, indicate COCs are stabilizing and attenuating in the groundwater environment, albeit at a slow rate in the bedrock aquifer.

The following monitoring wells historically contained elevated concentrations of COCs above the cleanup goals but are no longer sampled:

- AP-7813: the 2014 OU-3 monitoring report recommended the sampling of well AP-8424 in lieu of AP-7813. It is located within 10 ft of AP-7528.
- AP-7528: The 2012 OU-3 monitoring program recommended that AP-7528 be removed from the sampling program due to poor recharge.

Statistical trend analysis (Mann-Kendall test) and spatial plume analysis was performed on groundwater analytical data collected through 2015 for benzene and DCA in 25 bedrock wells and 18 alluvial aquifer wells located within the Birch Hill Product Recovery area and at the base of Birch Hill (FES 2016b). This analysis was also performed for 1,2-EDB in 26 bedrock wells. Trend analysis for 1,2-EDB analysis was not performed on the alluvium wells. The results are discussed below.

Benzene

A dissolved benzene plume within the bedrock aquifer covers an estimated 126,000 square ft from the sources on Birch Hill to the base of Birch Hill. The plume continues to exhibit mass depletion and natural attenuation that is reflected in low concentrations in the alluvial aquifer (Refer to Attachment 10, Figure 2-6). Anticipated remedial timeframes vary up to 100 years according to linear data regressions. The trend and spatial plume analysis indicate the following:

- Increasing trend: two bedrock wells (AP-10226MW [1173MP] and AP-8422). These wells are located near the base of Birch Hill east of Former Building 1173.
- All remaining sampled wells with benzene concentrations exceeding ½ the cleanup goal had no trend or a decreasing benzene trend.
- The bedrock aquifer spatial moment analysis showed decreasing trends in plume mass and distance to source, but increasing trends in the plume spread (likely due to decreasing concentrations in the source areas and variable concentrations in downgradient wells).

1,2-DCA

1,2-DCA concentrations remain elevated within the bedrock aquifer and several wells exhibit increasing concentrations near the base of Birch Hill, although only one well exceeded the cleanup goal in 2015. These data indicate that dissolution of 1,2-DCA from the bedrock appears to be a low-strength source to the alluvium, where dispersion is decreasing the center mass and concentrations of the plume (Refer to Attachment 10, Figure 2-7). The trend and spatial plume analysis indicate the following:

- Increasing trend Identified in four bedrock wells with concentrations of at least ½ the cleanup goal (AP-7530, AP-10226MW [1173-MP1], AP-8422, and AP-7855 [extraction well]). Short term trends (since 2010) in three of these wells exhibit stable DCA conditions.

- The bedrock aquifer spatial moment analysis showed increasing trends in plume mass and distance to source, and increasing trends in the plume spread indicative of downgradient plume migration of DCA. However, the rate of expansion appears to be relatively slow and increasing DCA concentrations have not been recently observed in the alluvial aquifer.

1,2-EDB

1,2-EDB concentrations have generally declined in bedrock wells within the Birch Hill Product Recovery area and at the base of Birch Hill (Refer to Attachment 10, Figure 2-8). Similar to 1,2-DCA, the 1,2-EDB concentrations in some wells at the eastern base of the hill have increased, suggesting possible contaminant migration in that direction. However, except for in one well, 1,2-EDB has not been recently detected above the cleanup goal in the alluvial aquifer. The trend and spatial plume analysis indicate the following:

- Increasing trend: one bedrock well (AP-7852)
- All other wells containing 1,2-EDB concentrations of at least ½ the cleanup goal had decreasing trends.
- The 1,2-EDB concentration in source well AP-7596 increased to the highest level observed since April 2006.
- The bedrock aquifer spatial moment analysis showed decreasing and stable trends in plume mass and distance to source, respectively; but increasing trends in the plume spread (likely due to increasing concentrations in the downgradient well).

The preliminary draft of the 2015 monitoring report (final draft was not available for review) recommended the completion of a data gap analysis to evaluate contamination within the bedrock aquifer at the BHTF and to identify potential sources. The data gap analysis will be completed under the 3-PTY framework and the recommendation has been added to this five-year review. The monitoring report also recommends future actions to further characterize the area within the former AST 316 tank berm. This area was identified as the location of a "major" spill of JP-4 in the RI. Based on the contaminants identified in groundwater monitoring in this area, a release of leaded gasoline is also suspected. This recommendation will be addressed under the 2-PTY framework.

5.4.6 Technical Assessment

5.4.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

Yes, the remedy is functioning as intended by the 1996 ROD and 2002 ESD. The AS/SVE remedy was implemented in 1996 and terminated in 2005. A dual-phase product recovery system was installed in 1998. The ROD estimated 30 years to achieve the groundwater cleanup goals. This period has not lapsed (2026). Groundwater monitoring data indicate that prior remedial system operations and subsequent natural attenuation has reduced contaminant mass and reduced the migration of contaminated groundwater from source areas. Free product has been detected in two bedrock wells located near the base of Birch Hill and increasing trends in benzene and 1,2-DCA have been detected in this area. ICs are in place to prevent the use of contaminated groundwater on FWA and off-post consumption risks are mitigating via the attenuation of COCs in the alluvial aquifer.

Opportunities to improve performance and/or reduce costs of the monitoring were not identified. The MAROS sampling periodicity analysis should be used as a basis for any potential programmatic changes.

An early indicator of a potential problems may have been identified in groundwater quality including the persistence of free product and increasing trends in benzene and 1,2-DCE concentrations in bedrock monitoring wells.

5.4.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

No, not all of the exposure assumptions, toxicity data, cleanup levels, and RAOs established at the time of the remedy remain valid. A review of the exposure assessment and toxicity criteria changes is provided in Attachment 8. The major exposure assumptions for current and future potential land use have not changed. Although potential vapor intrusion risks were not evaluated to off-site residents at the time of the remedy, groundwater concentrations at OU-3 Remedial Area 1B remain below very conservative vapor intrusion levels and vapor intrusion is not a concern.

As explained in Attachment 8, the toxicity criteria used to develop RBCs for 1,2,4-TMB and 1,3,5-TMB have been updated since the cleanup goals were identified in the 1996 ROD and then changed in the 2002 ESD. These toxicity changes do not indicate that the TMBs are more toxic now than previously assumed, so the toxicity changes do not affect the protectiveness of the remedy. However, TMBs were eliminated from the inhalation pathway during the development of the TMB cleanup goals, which was an error. The 1994 baseline risk assessment clearly considered residential inhalation of VOCs from tap water to be a complete exposure pathway, which was quantified in characterizing the baseline risk from exposure to site contaminants. Therefore, the change in risk-based cleanup goals for TMBs in the ESD was not justified; they should not have been increased by over a factor of 100. As LUCs are in place to prevent ingestion of groundwater, the remedy remains protective in the short term, but if the water is used as a source of tap water for residents, the cleanup goals may not be fully protective.

Any potential risk to ecological receptors that may occur from exposure to surface soil concentrations of lead at Remedial Area 1B are considered as part of the discussion of OU-5.

5.4.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

5.4.6.4 Technical Assessment Summary

The AS/SVE remedy was implemented in 1996 and terminated in 2005. A dual-phase product recovery system was installed in 1998. Groundwater monitoring has been performed since the ROD was signed in 1996. All COCs have attenuated to below the cleanup goals in the alluvial aquifer with the exception of two monitoring wells. COCs are still present in the bedrock aquifer above the site cleanup goals and measurable NAPL was detected in two bedrock monitoring

wells. Benzene, 1,2-DCA, and 1,2-EDB exhibit increasing trends in some of the bedrock wells. These increasing trends do not affect the protectiveness of the remedy because:

- The benzene and 1,2-EDB plume analyses showed decreasing trends in plume masses and distance to source.
- The rate of expansion of the 1,2-DCA plume appears to be slow and increasing trends in 1,2-DCA have not recently been observed in the alluvial aquifer.

These increasing trends may be an early indicator of a potential problem.

ICs have been implemented and are maintained to prevent receptor exposure to risks posed by impacted groundwater. No changes to ARARs were identified that would affect the protectiveness of the remedy. One issue was identified in the development of the TMB cleanup goal in the ESD. This issue is summarized below with a corresponding recommendation for follow-up action.

5.4.7 Issues

The following issues were identified at OU-3 Remedial Area 1B that may affect future protectiveness of the remedy:

- The inhalation pathway should not have been eliminated during development of the TMB cleanup goals in the ESD. The 1994 baseline risk assessment clearly considered residential inhalation of VOCs from tap water to be a complete exposure pathway, which was quantified in characterizing the baseline risk from exposure to site contaminants.
- The benzene and 1,2-DCA concentrations continue to exceed cleanup goals and exhibit increasing trends in some monitoring locations.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.

5.4.8 Recommendations for Follow-up Actions

The following recommendation is provided for a follow-up action at OU-3 Remedial Area 1B:

- Re-establish the cleanup goals for 1,2,4-TMB and 1,4,5-TMB in groundwater using either of the following methods:
    - Update the RBCs by including the inhalation pathway and using information from a 2016 USEPA IRIS toxicity assessment, or
    - Adopt the cleanup goals established in 18 AAC 75.
- Perform a data gap investigation and recommend a future course of action for Remedial Area 1B.

A recommendation for follow-up action that does not affect protectiveness of the remedy is provided below:

- Groundwater monitoring should be re-evaluated after remedial work under the 2-PTY Agreement is completed (petroleum and other contaminant removal). The well inventory should be incorporated, where appropriate, into the attenuation monitoring program for the bedrock aquifer at Birch Hill. An optimized alluvium and bedrock well array should

be selected to monitor the attenuation of recalcitrant COCs so a remedy completion strategy can be defined. The MAROS sampling periodicity analysis presented in the 2015 monitoring report (FES 2016b) should continue to be used as a basis for other potential changes to the groundwater sampling program.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. This will be initiated in November 2016 with a planned completion date of September 2018.

5.4.9 Protectiveness Statement

The remedy at OU-3 Remedial Area 1B (BHTF) currently protects human health and the environment because:

- Further migration of contaminated groundwater has been reduced by the remedial actions and natural attenuation.
- ICs are in place to ensure that groundwater containing COCs will not be used.
- Off-post risks associated with consumption of contaminated groundwater are mitigated by attenuation of COCs in the alluvial aquifer.

However, in order for the remedy to be protective in the long-term, the following action needs to be taken to ensure protectiveness:

- Re-establish the cleanup goals for 1,2,4-TMB and 1,3,5-TMB in groundwater using either of the following methods: 1) update the RBCs by including the inhalation pathway and using information from the 2016 USEPA IRIS toxicity assessment or 2) adopt the cleanup goals established in 18 AAC 75.
- Perform a data gap investigation and recommend a future course of action for the OU-3 Remedial Area 1B (BHTF).

5.5 OU-3 Remedial Area 2 Valve Pits and ROLF

5.5.1 Background Information

Remedial Area 2 is located south of the BHTF, across the Chena River and north of Gaffney Road (Figures 1-2, 5-5, and 5-6). It contained a ROLF that was built in 1939 to extract fuel from tanker cars and distribute it to airfield refueling points, the quartermaster fuel system, and the BHTF. The distribution system included three valve pits. Valve Pit A was on the west side of the Chena River (pipeline to the BHTF), whereas Valve Pits B and C were located on the east side of the Chena River. Fuel was also stored in USTs in this area until they were removed in 1990. Remedial Area 2 covers 40 acres and was divided into the following six subareas based on geographic location and differing physical characteristics:

- Valve Pit A
- Valve Pit B
- Valve Pit C
- Central Header
- Former Building 1144
- Eight-car Header

5.5.1.1 Physical Characteristics

The ROLF area and Valve Pits A, B, and C are located in the floodplain and on the banks of the Chena River, within a meander bend immediately north of the FWA airstrip. A scrub-shrub wetland borders the northeast edge of the ROLF; no endangered or threatened species reside in the area.

Groundwater flow in a shallow alluvial aquifer is consistent with the westerly regional groundwater flow pattern. It is subject to seasonal variations due to influences from the Chena River stage. During the high-water season (spring melt off), the groundwater gradient can reverse or flatten due to bank storage from the surrounding river (i.e., the river contributes to the groundwater). During the balance of the year when river levels decline, groundwater flows into the river (base flow). Consequently, depth to groundwater in the vicinity of the ROLF varies between 10 and 20 ft bgs, depending on river stage.

5.5.1.2 Land and Resource Use

The area around Remedial Area 2 is used for recreational sport fishing, boating and hiking. Numerous private residential wells are located on the north bank of the Chena River, less than ½ mile downstream. The Golden Heart Utilities wells are located on the south side of the Chena River, approximately 3 miles west (down river) of OU-3 Remedial Area 2. The river separates the sites (Valve Pits and Rail Off-Loading Facility) from the Golden Heart Utilities wells. Four FWA drinking water supply wells are located approximately 1 mile south and Pioneer Class A drinking water wells for the Hamilton Subdivision are located approximately 1 mile west of the ROLF. Future land use is considered to be residential and recreational.

5.5.1.3 History of Contamination

The primary sources for contamination at Remedial Area 2 are associated with fuel and fuel additives from the storage, transfer, and handling activities at Valve Pit A, Valve Pit B, Valve Pit

C, the Central Header, Former Building 1144, and the Eight-Car Header at the ROLF. Recorded fuel spills and leaks indicate JP-4 fuel was released occasionally from the headers and tanks.

Subsurface petroleum compounds were first identified in soil gas probes installed at the ROLF in 1988. A 1992 investigation identified petroleum compounds and free product. An RI/FS was conducted in 1993 and determined that petroleum hydrocarbons and related VOCs were present in soil and groundwater (E&E 1994c, 1995a). Contamination was found near the infrastructure and pipeline transfer points (valve pits). Subsequent investigations located hot spots near the valve pits and along pipelines in the ROLF area.

5.5.1.4 Initial Response

No pre-ROD cleanup activities or response actions were performed at OU-3 Remedial Area 2.

5.5.1.5 Basis for Taking Action

COCs identified for Remedial Area 2 groundwater were developed on the basis of a baseline risk assessment. They are identified in Table 5-10 and represent fuel compounds and associated additives.

Table 5-10 OU-3 Remedial Area 2 COCs

Medium	COC
Groundwater	Benzene
	Toluene
	Ethylbenzene
	1,2-EDB
	1,2-DCA
	1,2,4-TMB
	1,3,5-TMB

5.5.2 Remedial Actions

The following RAOs were established in the September 2002 ROD for groundwater at OU-3:

- Restore groundwater to drinking water quality within a reasonable time frame.
- Reduce further migration of contaminated groundwater.
- Prevent use of groundwater with contaminants at levels above Safe Drinking Water Act standards.

A RAO was established for petroleum contaminated soil to prevent the migration of contaminants from soil to groundwater that would result in groundwater contamination above SDWA standards.

Cleanup goals identified in the 2002 ESD (U.S. Army 2002) for COCs in groundwater and soil at OU-3 are presented in Table 5-11.

Table 5-11 OU-3 Remedial Area 2 COC Cleanup Goals

Media	COC	Cleanup Goal (µg/L)	Basis
Groundwater	Benzene	5	1
	Toluene	1,000	1
	Ethylbenzene	700	1
	1,2-EDB	0.05	1
	1,2-DCA	5	1
	1,2,4-TMB	1,850	2,3
	1,3,5-TMB	1,850	2,3
Soil	Soils contaminated with VOCs and petroleum-related compounds	Active remediation until contaminant levels in groundwater are consistently below state and federal MCLs	

Notes:

1 Groundwater cleanup goal based on federal and state drinking water MCLs.
2 Groundwater cleanup goal based on a risk-based concentration equivalent to a non-cancer hazard quotient of 1 using residential groundwater exposure assumptions.
3 The 2002 ESD corrected the cleanup goals for 1,2,4-TMB and 1,3,5-TMB to 1.85 mg/L. The ROD listed cleanup goals for these constituents at 0.014 mg/L and 0.012 mg/L, respectively.

5.5.2.1 Remedy Selection

The selected remedy consisted of (U.S. Army 1996a):

- AS/SVE at known contaminant sources ("hot spots") and locations with groundwater impacts above the MCLs.
- ICs restricting access to and development at the site as long as hazardous substances remain.
- Groundwater monitoring to evaluate achievement of SDWA standards and natural attenuation to meet AWQS.

Based on the assumption that land use was not anticipated to change in the foreseeable future, the reasonable time frame for remediation at each source area was set at no more than 30 years, or by 2026 (U.S. Army 1996b).

5.5.2.2 Remedy Implementation

AS/SVE Systems

AS/SVE systems were installed in 1996 at six hot-spots throughout Remedial Area 2. They were designed to treat contaminated soil and groundwater within the alluvial aquifer and were expanded in 1997 and 1998 to capture additional impacts in the Central Header, Former Building 1144, and Eight-Car Header areas.

The systems were terminated individually through 2009 and fully decommissioned in 2012 and 2013. These actions were followed by performance monitoring and natural attenuation evaluations for groundwater COCs.

Mass balance analysis estimated that approximately 760,000 pounds of VOCs (weight equivalency of about 123,000 gallons of gasoline) were removed by the individual AS/SVE treatment systems, as follows:

- Valve Pit A – 23,411 pounds
- Valve Pit B – 31,432 pounds
- Valve Pit C – 10,450 pounds
- Central Header – 289,411 pounds
- Former Building 1144 – 248,840 pounds
- Eight-Car Header – 157,887 pounds

The extent of groundwater exceeding the benzene cleanup goal in Remedial Area 2 had decreased by more than 90 percent in 2012 (FES 2013f).

Groundwater Monitoring and ISCO Treatability Study

The current groundwater monitoring program is focused on the natural attenuation of CERCLA COCs and DRO and GRO constituents. In addition to sampling for COCs, the OU-3 ROD stated, *"...for the long-term groundwater monitoring program, lead in groundwater will also be sampled and compared to an MCL of 15 µg/L."* Monitoring for lead in groundwater was initiated in 2002 and terminated in 2011, upon agreement among the RPMs, since lead did not exceed the MCL in the wells monitored between 2008 and 2011 (a lone well exhibited lead exceedances but was damaged and not replaced).

In 2009 the AS/SVE system at Valve Pit A was shut down. An ISCO treatability study was conducted in 2010 to augment the natural attenuation of remaining contamination. Subsequent sampling data were input to a program optimization analysis performed with the MAROS software, which indicated few changes to the program based upon temporal and spatial analyses.

Institutional Controls

ICs for OU-3 were established in the 2002 ESD, which asserted that a facility-wide IC policy established in the OU-5 ROD, U.S. Army Alaska Institutional Controls Standard Operating Procedures (APVR-RPW [200-1]), and a February 2002 Memorandum on ICs (APVR-RPW-EV-[200-1c]) from Major General James J. Lovelace, Fort Richardson, Alaska would be used to develop, implement, and monitor site-specific IC requirements at the site (U.S. Army 2002). Since that time, FWA Garrison Policy #38 was issued (November 9, 2011), which updated and disseminated the LUC/ICs Policy for FWA.

ICs are maintained to ensure that groundwater will not be used until MCLs are attained. They include restrictions governing site access, construction, and water supply well installation, as long as hazardous substances remain on site at levels that preclude unrestricted use. Signs have been installed to inform the public of restrictions in this area.

Installation-wide ICs are annually inspected, summarized, and violations corrected in an annual IC report. The first annual report was prepared for 2012 (FES 2013h) and prior inspection results were included in the OU-specific monitoring reports.

5.5.2.3 Operation, Maintenance and Monitoring

There are no active remediation systems operating in Remedial Area 2. Maintenance activities are limited to monitoring well inspections and maintenance. During the annual groundwater sampling events, monitoring wells are inspected to ensure that they are accessible, locked, and in good condition. The results are presented in annual monitoring reports. Over the last several years, maintenance activities have included replacing well locks, adjusting well risers that were impacted by frost, and replacing monitoring wells observed in poor condition.

Currently, annual groundwater monitoring is performed using 31 wells within the Remedial Area 2 sites.

- Valve Pit A - five wells
- Valve Pit B - two wells
- Valve Pit C - one well
- Central Header - nine wells
- Building 1144 - eight wells
- Eight Car Header - six wells

Well locations are illustrated in Figure 5-5 (Valve Pits A, B, and C) and Figure 5-6 (ROLF).

In 2015, two monitoring wells and 21 groundwater sampling points were decommissioned and replaced with permanent PVC monitoring wells. The replacement monitoring well locations are shown on Figure 3-1, *2015 Replacement Well Locations*, in Attachment 10.

Groundwater samples are analyzed for ROD COCs and geochemistry parameters (dissolved iron and sulfate); non-ROD parameters include GRO and DRO. Wells near the Chena River also are analyzed for total aromatic hydrocarbons (TAH).

5.5.3 Progress Since the Last Five-Year Review

The Third Five-Year Review Report (U.S. Army 2011) provided the following protectiveness statement for OU-3:

> *"Remedies at OU3 are currently protective of human health and the environment; however, in order for the remedies to remain protective in the long-term, the Army will initiate appropriate responses in cooperation with the EPA and State of Alaska if future monitoring indicate significant changes from the current status of the contaminant plumes that would adversely affect human health and the environment. In the interim, exposure pathways that could result in unacceptable risks are being controlled and Institutional Controls are preventing exposure to, or ingestion of, contaminated groundwater."*

The following recommendations were provided in the Third Five-Year Review Report:

- Decommission non-operating AS/SVE systems at Valve Pit A, Central Header, Former Building 1144, and Eight Car Header.
- Continue to monitor groundwater at all of the ROLF source areas to evaluate natural attenuation.
- Continue to evaluate the *in-situ* injection treatability study at Valve Pit A.

- Perform post-wide IC inspection and evaluate protectiveness. Update restricted use boundaries in GIS as new information becomes available.
- Develop the parameters for an Annual Report of IC effectiveness and corrective actions taken (spring 2012 milestone date).
- Update the database of LUC/IC summary documents (October 2013 milestone date), which consist of tables that describes in greater detail the ICs, the objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms.

The status of these recommendations and actions taken to address them are discussed below.

- All AS/SVE systems in OU-3 Remedial Area 2 were decommissioned in 2012 and 2013.
- Groundwater has been monitored annually (reduced from a semi-annual program in 2012) at 31 wells.
- The results of the *in-situ* ISCO injection treatability study at Valve Pit A in 2010 are discussed in the annual groundwater monitoring reports.
- A post-wide IC inspection is performed and results have been documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).
- Parameters for an annual report of IC effectiveness and corrective actions taken have been developed; they are used in the annual IC reports.
- Tables that describe in detail the ICs, objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms were updated and documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

5.5.4 Site Inspection

USACE inspected the sites on August 11, 2015 to examine the remediated areas and assess the protectiveness of the remedy. The sites were forested. Underground piping associated with former fueling infrastructure was observed in the ROLF area. FWA staff noted that contracts to remove former fuel systems did not include any subsurface piping or infrastructure. AS/SVE systems at Valve Pit A, Central Header, Former Building 1144 and Eight Car Header were decommissioned.

A bird habitat was under construction at the time of the site inspection. FWA staff noted that the construction was not intrusive. Concrete construction materials were staged within the ROLF area. All monitoring wells appeared to be in good condition. Community information signs appeared to be unchanged from the 2014 IC inspection (i.e., damaged but legible). Completed site inspection checklists are provided in Attachment 4 and site photographs are provided in Attachment 5.

FWA staff indicated that LUCs/ICs are maintained as required by the ROD.

The most recent IC review of OU-3 Remedial Area 2 presented in the draft 2014 report (FES 2015l) concluded:

- There was no evidence of unauthorized installation or use of groundwater wells.
- No soil disturbing activities were observed.
- Wells currently at the sites are easily accessible and secured.
- Site land uses and adjacent land use have not changed.

The five-year review site inspection confirmed these conclusions.

5.5.5 Data Review

Annual monitoring data from 2010 to 2015 indicates the past source control remedies were effective at reducing contaminant mass, which advanced the natural attenuation of COCs in Remedial Area 2. Details are provided below. Data is provided in Attachment 10 and well locations are shown on Figure 5-5 and Figure 5-6.

Valve Pit A

Groundwater under the Valve Pit A site diverges to the west, southwest and east due to influences from regional flow and proximate river levels. Five wells sampled in April/May 2015 including three groundwater probes replaced with PVC monitoring wells in 2015 (AP-10294MW, AP-10295MW, and AP-10296MW). Currently, benzene is the only COC to exceed its cleanup goal at Valve Pit A. The other COCs are below their cleanup goals. Benzene concentrations were decreasing at Valve Pit A since the 2010 ISCO treatability study until a spike in 2014 when benzene concentrations exceeded the cleanup goal in all five monitoring wells. The higher benzene concentrations were attributed to record rainfalls in June and July 2014, which elevated the water table approximately 4 ft. This recharge pulse and nearby river influences likely mobilized residual benzene from the soil and the capillary fringe, which caused elevated groundwater concentrations (such residual COC impacts in soil are described in the RI report).

The benzene concentrations generally decreased in 2015 when compared to the 2014 data except for monitoring well AP-6064, which showed an increase in concentration from 9 µg/L in 2014 to 36 µg/L in 2015. Only one other well exceeded the cleanup goal in 2015, AP-10296MW (former VPA-MP1), with a benzene concentration of 7.2 µg/L (down from 140 µg/L detected in 2014). A trend chart of benzene concentrations in select Valve Pit A wells is included as Graph 3-1 in Attachment 10.

Groundwater geochemistry data for 2015 indicates highly reduced conditions in contaminated areas, while non-impacted areas exhibit less reduced conditions (lower ferrous iron and higher sulfate concentrations). The ISCO treatability study injections in 2010 indicated that reoxygenation of the groundwater below Valve Pit A would promote additional benzene depletion, although the legacy plume shows continued degradation (refer to Attachment 10, Figure 3-3).

Valve Pit B

Three Valve Pit B wells were sampled in April/May 2015 including two groundwater probes (VPB-MP1 and VPB-MP3) that were decommissioned and replaced with PVC monitoring wells in 2015. The 2015 analytical data continue to verify that all COCs have achieved the cleanup goals since April 2001.

Valve Pit C

Well VPC-MP2 is currently monitored annually in the Valve Pit C area; a second well, VPC-MP6, was damaged before 2011 and could not be sampled. It was decommissioned in October 2011. The 2015 analytical data for well VPC-MP2 found no COCs exceeding their cleanup goals. COCs have not exceeded the cleanup goals in former well VPC-MP6 or well VPC-MP2 since 2005 and 2000, respectively.

Central Header

Nine Central Header monitoring wells are sampled annually. Five groundwater probes (AP-10274MW, AP-10275MW, AP-10276MW, AP-10277MW, and AP-10279MW) were decommissioned and were replaced with PVC monitoring wells in 2015. One COC exceeded the cleanup goals at one monitoring location, AP-10274MW (former CH-MP6), in 2015. The benzene concentration was 7.3 µg/L. Monitoring well AP-10274MW was installed in 2007 to monitor the effectiveness of the Central Header Hot Spot treatment area. The initial benzene concentration in 2007 was 20 µg/L and was below the cleanup goal for ten sampling events until 2015.

Groundwater geochemistry in the Central Header area varies significantly with pockets of moderately reduced groundwater in areas of impacts. Sulfate and dissolved iron reductions occur within different areas of the site. The sulfate and dissolved iron concentrations are included on Table 5-16, *Groundwater Sample Field Screening and Analytical Results,* in Attachment 10.

Former Building 1144

Ten wells are sampled annually at the Former Building 1144 including two monitoring wells (AP-10027 and AP-10032) and seven groundwater probes (AP-10278MW, AP-10280MW, AP-10282MW, AP-10283MW, AP-10285MW, AP-10286MW, and AP-10287MW) that were replaced in 2015. All COC concentrations in groundwater were below the cleanup goals at all ten wells sampled in 2015.

Eight Car Header

Six wells are currently monitored at the Eight Car Header site and upgradient area. All have shown COC concentrations below the cleanup goals for over five years.

Natural Attenuation Analysis

The compliment of sample datasets were evaluated in the 2015 sampling report developed by FES (FES 2016b). The report contains constituent summary tables, graphical trends, maps, and a geostatistical analysis that indicate COC reductions (mass depletion) are occurring in the alluvial aquifer. The attenuation is not uniform throughout the OU-3 sub areas due to the different source strengths, hydrostratigraphic units, permafrost, and geochemistry. The 2015 evaluation also employed Mann-Kendall trend analyses that was cross-checked by this five-year review without discrepancy.

COCs that have attenuated to meet the cleanup goals throughout OU-3 Remedial Area 2 include toluene, 1,2-EDB, 1,2-DCA, 1,2,4-TMB, and 1,3,5-TMB.

Benzene plumes within the alluvial aquifer have reduced from about 36 acres in 1996 to less than 1,000 square ft (0.2 acre) in 2015, with only the former hot spot treatment area of the Central Header being recalcitrant (refer to Attachment 10, Figure 3-4, *Benzene Plume Reduction at the Railcar Offloading Facility*). All other COCs in the ROLF subareas have reached the cleanup goals, although minor seasonal variability is apparent in the data.

Mann-Kendall statistical trend analysis and spatial plume analysis of the benzene data was completed for four of the six alluvial aquifer wells based on exceedances of the benzene cleanup level since treatment system shutdown. The analysis identified the following:

- Increasing Trend: 2 wells
- No Trend: 1 well (reflects highly variable data)
- Stable Trend: 0 wells (not increasing nor decreasing)
- Decreasing Trend: 1 well
- Non-detectable Conditions: 0 wells
- Spatial Moment Analysis: Not enough wells to definitively describe

The benzene plumes in the ROLF areas continue to exhibit mass depletion and natural attenuation that is reflected in area-wide concentration reductions.

5.5.6 Technical Assessment

5.5.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

Yes, the remedy is functioning as intended by the ROD and ESD.

The AS/SVE remedy at Remedial Area 2 was implemented in 1996 across six areas and expanded in 1997 and 1998. The systems were terminated from 2009-2012. The estimated timeframe to reach the cleanup goal at OU-3 is no more than 30 years. This period has not lapsed (2026). The AS/SVE systems have been effective in removing COCs from the subsurface and substantially reducing groundwater contaminant source areas. Toluene, 1,2-EDB, 1,2-DCA, 1,2,4-TMB, and 1,3,5-TMB have attenuated to below the cleanup goals. In 2015, benzene cleanup goal exceedances were identified at two wells within Valve Pit A (AP-10296 [VPA-MP1] and AP-6064) and one well within the central header (AP-10274 [CH-MP6]). The 2015 exceedance of the benzene cleanup goal at AP-10274 is the first exceedance at this location for at least the last five years. No COC exceedances were identified at Valve Pit B, Valve Pit C, the Eight Car Header, and at Former Building 1144 in samples collected in 2015. The 2015 draft monitoring report included Mann-Kendall trend analyses for benzene. Increasing trends were identified at the following locations:

- AP-10274 (Central Header)

  The 2015 benzene concentration is the highest concentration detected at AP-10274 over the last five years and the only exceedance of the benzene cleanup goal at AP-10274. Further monitoring is required to assess why the concentration increased from 1.7 µg/L in 2014 to 7.3 µg/L in 2015. Based on the available information, the increasing benzene trend at this location is not expected to affect remedy protectiveness.

- AP-10283 (Former Building 1144)

  Although an increasing trend was identified at this location, the short term benzene concentrations have remained fairly consistent fluctuating from 3.5 J µg/L to 5.1 µg/L over the last five years. The 2015 sampling results were just below the cleanup goal at a concentration of 4.3 µg/L. Based on this information, the increasing benzene trend at this well is not expected to affect remedy protectiveness.

LUC/ICs have been implemented and are functioning as intended.

The following areas of potential optimization for the Remedial Area 2 remedy were identified:

- The historical decommissioning of infrastructure may have resulted in the abandonment of pipeline with impacts at Remedial Area 2. The U.S. Army will conduct an investigation and determine if there are any previously undiscovered source areas at Remedial Area 2.
- An ISCO treatability study was conducted at Valve Pit A. The U.S. Army will continue to evaluate whether ISCO injections of excavation of contaminated soil at Valve Pit A would enhance natural attenuation in groundwater.

The MAROS sampling periodicity analysis should be used as a basis for any potential programmatic changes.

One early indicator of potential problems was identified at the OU-3 Valve Pit A: increasing concentrations of benzene were identified.

5.5.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

No, not all of the exposure assumptions, toxicity data, cleanup levels, and RAOs established at the time of the remedy remain valid. A review of the exposure assessment and toxicity criteria changes is provided in Attachment 8. The major exposure assumptions for current and future potential land uses have not changed. Although potential vapor intrusion risks were not evaluated to off-site residents at the time of the remedy, groundwater concentrations at OU-3 Remedial Area 2 remain below very conservative vapor intrusion levels and vapor intrusion is not a concern at OU-3.

As explained in Attachment 8, the toxicity criteria used to develop risk-based concentrations for 1,2,4-TMB and 1,3,5-TMB have been updated since the cleanup goals were identified in the 1996 ROD and then changed in the 2002 ESD. These toxicity changes do not indicate that the TMBs are more toxic now than previously assumed, so the toxicity changes do not affect the protectiveness of the remedy. However, TMBs were eliminated from the inhalation pathway during the development of TMB cleanup goals, which was an error. The 1994 baseline risk assessment clearly considered residential inhalation of VOCs from tap water to be a complete exposure pathway, which was quantified in characterizing the baseline risk from exposure to site contaminants. Therefore, the change in risk-based cleanup goals for TMBs in the ESD was not justified; they should not have been increased by over a factor of 100. As LUCs are in place to prevent ingestion of groundwater, the remedy remains protective in the short term, but if the water to be used as a source of tap water for residents, the cleanup goals may not be fully protective.

5.5.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

5.5.6.4 Technical Assessment Summary

The AS/SVE remedy was implemented in 1996 (six areas) and expanded in 1997 and 1998. The systems were terminated during 2009 to 2012. In 2015, benzene was the only COC detected

above cleanup goals in the Valve Pit A and Central Header areas. Toluene, ethylbenzene, 1,2-EDB, 1,2-DCA, 1,2,4-TMB, and 1,3,5-TMB have attenuated to the cleanup goals. ICs were implemented and are maintained to prevent adverse exposures of receptors to groundwater impacts. No changes to ARARs were identified that would affect the protectiveness of the remedy. One issue was identified that is attributed to the development of the TMB cleanup goal in the ESD. This issue is summarized below with a corresponding recommendation for follow-up action.

5.5.7 Issues

The following issues were identified that may affect future protectiveness of the remedy at OU-3 Remedial Area 2:

- The inhalation pathway should not have been eliminated during development of the TMB cleanup goals in the ESD. The 1994 baseline risk assessment clearly considered residential inhalation of volatiles from tap water to be a complete exposure pathway, which was quantified in characterizing the baseline risk from exposure to site contaminants.
- The historical decommissioning of infrastructure may have resulted in the abandonment of pipeline with impacts at Remedial Area 2.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.

5.5.8 Recommendations for Follow-up Actions

The following recommendations for follow-up actions at OU-3 Remedial Area 2 are provided:

- Re-establish the cleanup goals for 1,2,4-TMB and 1,4,5-TMB in groundwater using either of the following methods:
    - Update the RBCs by including the inhalation pathway and using information from a 2016 USEPA IRIS toxicity assessment, or
    - Adopt the cleanup goals established in 18 AAC 75.
- Conduct an investigation and determine if there are any previously undiscovered source areas at Remedial Area 2.

The following recommendation is provided for a follow-up action that does not affect protectiveness of the remedy:

- Continue to evaluate whether ISCO injections or excavation of contaminated soil at Valve Pit A would enhance natural attenuation in groundwater.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. This will be initiated in November 2016 with a planned completion date of September 2018.

5.5.9 Protectiveness Statement

The remedy at OU-3 Remedial Area 2 (Valve Pits and ROLF) currently protects human health and the environment because:

- Further migration of contaminated groundwater has been reduced by the remedial actions and natural attenuation.
- ICs are in place to ensure that groundwater containing COCs will not be used.

However, in order for the remedy to be protective in the long-term, the following action needs to be taken to ensure protectiveness:

- Re-establish the cleanup goals for 1,2,4-TMB and 1,3,5-TMB in groundwater using either of the following methods: 1) update the RBCs by including the inhalation pathway and using information from the 2016 USEPA IRIS toxicity assessment or 2) adopt the cleanup goals established in 18 AAC 75.
- Conduct an investigation and determine if there are any previously undiscovered source areas at Remedial Area 2.

5.6 OU-3 Remedial Area 3 FEP Mileposts 2.7 and 3.0

5.6.1 Background Information

Remedial Area 3 consists of two source areas along the Fairbanks-Eielson Pipeline at Milepost 2.7 and Milepost 3.0 (Figures 2-1 and 5-7). The sites are located in the East Birch Hill Tank Farm area and the milepost designations indicate distances along the Fairbanks-Eielson Pipeline from the BHTF (e.g., Milepost 2.7 is located approximately 2.7 miles east of the BHTF).

A third area, Milepost 15.75, was located in an off-post residential setting. It was granted NFA status on January 30, 2012 and is not discussed further. Monitoring wells at the Milepost 15.75 site have been decommissioned (FES 2013f).

5.6.1.1 Physical Characteristics

Milepost 2.7 and Milepost 3.0 source areas both have a moderate to steep south-facing slopes to the north and a shallow, south-facing slope to the south. The shallow alluvial aquifer in this area is covered with poorly drained sediments and ponded surface water is common from spring until mid-summer. Discontinuous permafrost is typical in the subsurface soil. A black spruce-scrub-shrub wetland borders the south side of the source areas, while the surrounding area is densely vegetated. Groundwater is encountered at depths between 3 and 12 ft bgs and flows to the southwest.

5.6.1.2 Land and Resource Use

The Milepost 2.7 and 3.0 sites are located within a military training area north of the Chena River approximately 1 mile from the nearest residential development. Both areas are used recreationally. The Birch Hill Ski area is 1 mile to the east and has a drinking-water well completed in bedrock. It is not hydraulically connected to the alluvial aquifer under these sites.

5.6.1.3 History of Contamination

Historic (1989) soil gas analyses along the Fairbanks-Eielson Pipeline identified elevated levels of benzene, toluene, ethylbenzene, and xylenes (BTEX) in the milepost areas. Subsequent investigations detected petroleum hydrocarbons (gasoline products and additives) contamination in surface and subsurface soils and groundwater (specifically benzene). These impacts are postulated as pipe leakage and spills.

5.6.1.4 Initial Response

No pre-ROD cleanup activities or response actions were performed at OU-3 Remedial Area 3.

5.6.1.5 Basis for Taking Action

COCs identified for OU-3 Remedial Area 3 groundwater were developed on the basis of a baseline risk assessment. They are identified in Table 5-12 and represent fuel compounds and associated additives.

Table 5-12 OU-3 Remedial Area 3 COCs

Medium	COC
Groundwater	Benzene
	Toluene
	Ethylbenzene
	1,2-EDB
	1,2-DCA
	1,2,4-TMB
	1,3,5-TMB

5.6.2 Remedial Actions

5.6.2.1 Remedy Selection

The following RAOs were established for groundwater in OU-3 groundwater in the January 1996 ROD:

- Restore groundwater to drinking water quality within a reasonable time frame.
- Reduce further migration of contaminated groundwater.
- Prevent use of groundwater with contaminants at levels above SDWA standards.

A RAO was also established in the ROD for petroleum contaminated soil; to prevent migration of contaminants from soil into groundwater that would result in groundwater contamination and exceedance of SDWA standards.

Cleanup goals identified in the 1996 ROD and 2002 ESD for COCs in groundwater are presented in Table 5-13.

Table 5-13 OU-3 Remedial Area 3 COC Cleanup Goals

Media	COC	Cleanup Goal (µg/L)	Basis
Groundwater	Benzene	5	1
	Toluene	1,000	1
	Ethylbenzene	700	1
	1,2-EDB	0.05	1
	1,2-DCA	5	1
	1,2,4-TMB	1,850	2,3
	1,3,5-TMB	1,850	2,3
Soil	Soils contaminated with VOCs and petroleum-related compounds	Active remediation until contaminant levels in groundwater are consistently below state and federal MCLs	

Notes:

1 Groundwater cleanup goal based on federal and state drinking water MCLs.
2 Groundwater cleanup goal based on a risk-based concentration equivalent to a non-cancer hazard quotient of 1 using residential groundwater exposure assumptions.

3 The 2002 ESD corrected the cleanup goals for 1,2,4-TMB and 1,3,5-TMB to 1.85 mg/L. The ROD listed cleanup goals for these constituents at 0.014 mg/L and 0.012 mg/L, respectively.

The selected remedy consisted of (U.S. Army 1996b):

- SVE of petroleum contaminated soils and AS of petroleum contaminated groundwater in permafrost free areas at Milepost 2.7 and 3.0, and known source areas where MCLs were exceeded at Milepost 15.75 to achieve SDWA levels and natural attenuation to meet AWQS[3].
- ICs that restrict access to and development at the site as long as hazardous substances remain.
- Groundwater monitoring

5.6.2.2 Remedy Implementation

Air Sparge Treatability Study, Excavation and Ex-situ Treatment of Soil, and Injection of Oxygen-Releasing Compounds into Groundwater

An AS treatability study was conducted at Milepost 2.7 in 1996. A study involving ORCs injected into the groundwater was also evaluated that same year. These *in-situ* technologies were not considered viable for the site due to low soil permeability. A treatability study was performed during 1998 to evaluate the feasibility of excavation and *ex-situ* soil treatment. This involved the excavation of approximately 1,500 CY of contaminated soil that were placed in a treatment cell constructed adjacent to the Truck Fill Stand. The AS/SVE blowers were utilized to treat the petroleum contaminated soil *ex-situ* and soil contaminant concentrations decreased significantly. In 2003, the Milepost 2.7 soil treatment cell was decommissioned.

A pilot study was conducted at Milepost 3.0 in 1996 involving the use of ORC injected as a slurry below the water table. As with Milepost 2.7, analytical results of groundwater samples indicated that injection of the ORC slurry was ineffective. Despite the positive results of the Milepost 2.7 treatability study for excavation and *ex-situ* treatment of soils, it was not clear if the same technology would be effective for Milepost 3.0 due to potential differences in soil or contaminant concentrations between the two sites. Therefore, in April 2000, a pilot-study excavation and subsequent *ex-situ* soil treatment was performed. This involved the excavation of approximately 6,000 CY of petroleum contaminated soil that was mixed with gravel and placed in an 8,000 CY treatment cell constructed at the base of Birch Hill. The Building 1173 AS/SVE blowers were utilized to treat the contaminated soil *ex-situ*. This treatment cell operated for two field seasons, with the main contaminants being GRO and benzene. Contaminant concentrations in the treatment cell decreased rapidly and the cell was decommissioned in 2003.

Through implementation of the ROD remedial actions and additional historical research, a better understanding of the sources and volumes of contamination, groundwater movements, and geology led to a re-evaluation of the remedial actions. It concluded that the remedies selected in the ROD for Milepost 2.7 and Milepost 3.0 would not fully achieve the RAOs without significant changes to the remedial method.

[3] Milepost 15.75 was granted NFA status on January 30, 2012.

The 2002 ESD documented the recommended changes in remedial strategy. Based on additional sampling conducted post-ROD, it was found that the soils in both locations contained high fractions of tight silt and clay, thus limiting the movement of air within the vadose zone, which is necessary for effective contaminant reduction. Therefore, the selected remedial action in the selected in the ROD for this area, AS/SVE *in-situ* treatment, could not be effectively implemented. However, pilot studies conducted after the ROD showed that *ex-situ* treatment of soil would be effective in meeting soil cleanup goals.

The following actions that were not anticipated at the time of the ROD were implemented in accordance with the 2002 ESD for Remedial Area 3 (i.e., some actions like excavation and *ex-situ* treatment of soil were completed prior to development of the ESD):

- Excavation of contaminated soils from Milepost 2.7 (1,500 CY) and Milepost 3.0 (6,000 CY) for *ex-situ* AS/SVE.
- Treatment of the excavated soil in *ex situ* cells to achieve soil disposal criteria.
- Monitoring of soil and groundwater contamination remaining in the vicinity of Remedial Area 3 until RAOs have been achieved, as determined by concurrence of the RPMs.
- Installation of additional monitoring wells and site characterization at Mileposts 2.7 and 3.0 to gain a better understanding of local hydrology, impacts of permafrost, and contaminant migration.

A limited soil excavation and bioaugmentation treatability study was conducted during regrading of a road in 2009. At Milepost 2.7, an ORC and microorganism solution was added to a trench perpendicular to the road. At the Milepost 3.0 site, ORC alone, microorganisms alone, and ORC and microorganisms were added to three trenches perpendicular to the road to treat groundwater migrating along the road. The excavated soils from the trenches were treated in an *ex-situ* treatment cell using ORC and microorganisms.

Institutional Controls

ICs for OU-3 were established in the 2002 ESD, which asserted that a facility-wide IC policy established in the OU-5 ROD, U.S. Army Alaska Institutional Controls Standard Operating Procedures (APVR-RPW [200-1]), and a February 2002 Memorandum on ICs (APVR-RPW-EV-[200-1c]) from Major General James J. Lovelace, Fort Richardson, Alaska would be used to develop, implement, and monitor site-specific IC requirements at the site (U.S. Army 2002). Since that time, FWA Garrison Policy #38 was issued (November 9, 2011), which updated and disseminated the LUC/ICs Policy for FWA.

ICs are maintained to ensure that groundwater will not be used until MCLs are attained. They include restrictions governing site access, construction, and water supply well installation as long as hazardous substances remain on site at levels that preclude unrestricted use.

ICs at each OU are inspected annually and a complete summary of the survey and corrective actions taken are presented in an annual IC report. The first annual report was prepared for 2012 (FES 2013h) and prior IC inspections were included in the OU-specific annual monitoring reports. IC inspections evaluate potential land use changes, site security (monitoring wells, etc., as applicable), or unauthorized groundwater use. In addition, reviews of the FWA IC GIS layer and the site-specific information in the ADEC contaminated sites database are conducted.

Groundwater Monitoring

Groundwater monitoring at the Milepost 2.7 and 3.0 source areas for natural attenuation is currently ongoing for ROD COCs, GRO, and geochemistry parameters.

5.6.2.3 Operation, Maintenance and Monitoring

There are no active remediation systems operating in Remedial Area 3. Maintenance activities are limited to monitoring well inspections. During the groundwater sampling events and IC survey, monitoring wells are inspected to ensure that they are accessible, locked, and in good condition. The results of the inspections are presented in annual IC reports. Over the last several years, maintenance activities have included replacing well locks and adjusting well risers that were impacted by frost.

Following the 2011 sampling event, the sampling frequency at Milepost 2.7 and Milepost 3.0 was reduced from annually to once every five years and was scheduled to coincide with the five-year reviews. Two rounds of groundwater data (2011 and 2015) have been collected since the last five-year review. Samples were collected from 22 wells in 2011 and 20 wells in 2015. Well locations are illustrated in Figure 5-7. Groundwater samples from both events were analyzed for ROD COCs, GRO, and geochemistry parameters (e.g., iron and sulfate).

5.6.3 Progress Since the Last Five-Year Review

The Third Five-Year Review Report (U.S. Army 2011) provided the following protectiveness statement for OU-3:

> *"Remedies at OU3 are currently protective of human health and the environment; however, in order for the remedies to remain protective in the long-term, the Army will initiate appropriate responses in cooperation with the EPA and State of Alaska if future monitoring indicate significant changes from the current status of the contaminant plumes that would adversely affect human health and the environment. In the interim, exposure pathways that could result in unacceptable risks are being controlled and Institutional Controls are preventing exposure to, or ingestion of, contaminated groundwater."*

The Third Five-Year Review provided the following recommendations:

- The current site model indicates that contamination does not appear to be migrating off site and continued groundwater monitoring should be sufficient to ensure protectiveness. After the 2011 sampling event, groundwater monitoring at both the Milepost 2.7 and Milepost 3.0 sites should be conducted every five years.
- Perform post-wide IC inspections and evaluate protectiveness. Update restricted use boundaries in GIS as new information becomes available.
- Develop the parameters for an Annual Report of IC effectiveness and corrective actions taken (spring 2012 milestone date).
- Update the database of LUC/IC summary documents (October 2013 milestone date), which consist of tables that describe in greater detail the ICs, the objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms.

The status of these recommendations and actions taken are discussed below.

- Following the 2011 sampling event, groundwater monitoring frequency at the Milepost 2.7 and Milepost 3.0 sites was reduced to every five years to coincide with the five-year review recommendation.
- A post-wide IC inspection is performed and results are documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013h, 2015a, 2015f).
- Parameters for an annual report of IC effectiveness and corrective actions taken have been developed; they are used in the annual IC reports.
- Tables that describe in detail the ICs, objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms were updated and documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

5.6.4 Site Inspection

The Milepost 2.7 and Milepost 3.0 sites were inspected by USACE on August 11, 2015 to examine the remediated areas and assess the protectiveness of the remedies. The areas were relatively remote and forested. The areas were used for improvised explosive device discovery and disarming training. Frost heaving was observed in several monitoring wells. FWA staff indicated that the well construction (long screened intervals) allowed the wells to continue to be sampled despite the frost heaving. An information sign was in good condition. Completed site inspection checklists are provided in Attachment 4 and site photographs are provided in Attachment 5.

FWA staff indicated that LUCs/ICs are maintained as required by the ROD. The most recent IC review of OU-3 Remedial Area 3 is documented in the draft 2014 IC report (FES 2015f), which concluded:

- There was no evidence of unauthorized installation or use of groundwater wells.
- No soil disturbing activities were observed.
- Wells currently at the sites are easily accessible and secured.
- Site land uses and adjacent land use have not changed.

The five-year review site inspection confirmed these conclusions.

5.6.5 Data Review

Groundwater analytical data from 2011 and 2015 are similar to historical data and indicate that past source control remedies were somewhat effective at reducing contaminant mass. Generally, benzene, toluene, 1,2-EDB, and 1,2-DCA continue to exceed the cleanup goals, although some wells are exhibiting decreasing trends. Elevated GRO concentrations were detected at OU-3 Remedial Area 3; however, GRO was not selected as a COC in the ROD. A linear regression analysis presented in the 2011 OU-3 Monitoring Report estimated the timeframes to reach the benzene cleanup goal in those wells with decreasing trends. The results ranged from three to 46 years at Milepost 2.7 and 32 years at Milepost 3.0. Several wells are exhibiting increasing benzene trends over time. The latest (2015) groundwater analytical data are provided in Attachment 10. Monitoring well locations are shown on Figure 5-7.

Due to damage caused by frost heaving, three new wells were installed in each milepost site. AP-6034, AP-8707, and AP-9084 were replaced by AP-10300MW, AP-10302MW, and AP-

10301MW at Milepost 2.7. AP-5850, AP-6039, and AP-8712 were replaced by AP-10298MW, AP-10297MW, and AP-10299MW at Milepost 3.0.

Due to the increasing extent and magnitude of groundwater contamination at the two milepost source areas, a data gap analysis is planned (Marsh Creek 2015b). The purpose of the data gap analysis is to determine the source of the groundwater contamination and to recommend future actions. The scheduled data-gap analysis will provide additional source characterization to establish the extent of contamination and identify potential transport pathways. It will support the assessment of exposure risks and selection of any associated remedial measures. Additional soil and groundwater sampling will be performed in the area of the former underground storage tanks at the BHTF, as well as at points along the Fairbanks-Eielson Pipeline.

5.6.6 Technical Assessment

5.6.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

No, the remedy is not functioning as intended by the ROD.

Active remedial measures (AS treatability study, ORC injection, and excavation with *ex situ* treatment) have not met the RAOs (restore groundwater to drinking water quality within a reasonable timeframe and reduce further migration of contaminated groundwater). The ROD-estimated time frames to achieve the cleanup goals were estimated at 46 years (Milepost 2.7) and 32 years (Milepost 3.0). The estimated time frames were updated in the 2011 groundwater monitoring report using linear regression on a contaminant-by-contaminant basis to three to 46 years. The benzene and EDB concentrations remain above cleanup goals and show increasing trends in at least one well. Analysis has shown that groundwater cleanup goals will not be achieved within a reasonable period of time. To better understand site conditions, a data gap analysis will be performed. Following the collection of additional soil and groundwater data, a future course of action will be recommended.

LUC/ICs have been implemented and are functioning as intended. Opportunities for optimization have not been identified. Consistent with the information provided above, the data reviewed for Remedial Area 3 suggest future problems with the selected remedy. No other early indicators of potential problems were identified.

5.6.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

No, not all of the exposure assumptions, toxicity data, cleanup levels, and RAOs established at the time of the remedy remain valid. The major exposure assumptions for current and future potential land use have not changed. Although potential vapor intrusion risks were not evaluated to off-site residents at the time of the remedy, groundwater concentrations at OU-3 remain below very conservative vapor intrusion levels and vapor intrusion is not a concern.

As explained in Attachment 8, the toxicity criteria used to develop RBCs for 1,2,4-TMB and 1,3,5-TMB have been updated since the cleanup goals were identified in the 1996 ROD and then changed in the 2002 ESD. These toxicity changes do not indicate that the TMBs are more toxic now than previously assumed, so the toxicity changes do not affect the protectiveness of the remedy. However, TMBs were eliminated from the inhalation pathway during the development

of the TMB Cleanup goals, which was an error. The 1994 baseline risk assessment clearly considered residential inhalation of volatiles from tap water to be a complete exposure pathway, which was quantified in characterizing the baseline risk from exposure to site contaminants. Therefore, the change in risk-based cleanup goals for TMBs in the ESD was not justified; they should not have been increased by over a factor of 100. As LUCs are in place to prevent ingestion of groundwater, the remedy remains protective in the short term, but if the water to be used as a source of tap water for residents, the cleanup goals may not be fully protective.

5.6.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

5.6.6.4 Technical Assessment Summary

The AS/SVE remedy was not fully implemented due to low soil permeabilities at the FEP Milepost 2.7 and 3.0 sites. Benzene, toluene, 1,2-EDB, and 1,2-DCA exceeded the cleanup goals. The estimated timeframes to reach the cleanup goals were revisited in a 2011 monitoring report. The results ranged from 46 years at Milepost 2.7 and 32 years at Milepost 3.0. A data gap analysis will be performed at these sites to determine the source of groundwater contamination and to recommend future actions. Increasing concentrations of COCs were identified in groundwater monitoring at Remedial Area 3; however, components of the remedy have been implemented to prevent adverse exposures. Specifically, ICs have been implemented and are maintained to ensure that no risk is posed to receptors due to exposures to impacted groundwater. No changes to ARARs were identified that would affect the protectiveness of the remedy. One issue was identified in the development of the TMB cleanup goal in the ESD. This issue is summarized below with a corresponding recommendation for follow-up action.

5.6.7 Issues

The following issues were identified the OU-3 Remedial Area 3 (FEP Mileposts 2.7 and 3.0) that affect protectiveness of the remedy:

- The concentrations of benzene remain high and exhibit increasing trends in several wells. Analysis has shown that groundwater cleanup goals will not be achieved for these areas within a reasonable period of time.
- The inhalation pathway should not have been eliminated during development of cleanup goals for TMBs in the ESD. The 1994 baseline risk assessment clearly considered residential inhalation of volatiles from tap water to be a complete exposure pathway which was quantified in characterizing the baseline risk from exposure to site contaminants.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.

5.6.8 Recommendations for Follow-up Actions

The following recommendations are provided for follow-up action at OU-3 Remedial Area 3 that affect protectiveness of the remedy.

- Perform a data gap investigation and recommend a future course of action for the milepost sites. (This activity is currently under contract with the U.S. Army).
- Re-establish the cleanup goals for 1,2,4-TMB and 1,4,5-TMB in groundwater using either of the following methods:
    - Update the RBCs by including the inhalation pathway and using information from a 2016 USEPA IRIS toxicity assessment, or
    - Adopt the cleanup goals established in 18 AAC 75.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. This will be initiated in November 2016 with a planned completion date of September 2018.

5.6.9 Protectiveness Statement

The remedy at OU-3 Remedial Area 3 (FEP Mileposts 2.7 and 3.0) currently protects human health and the environment because:

- Permafrost and low permeability soils inhibit groundwater flow and the migration of contaminants from the sites.
- There are no complete pathways for human exposure to groundwater. ICs are in-place to ensure that contaminated groundwater will not be used until cleanup goals are attained.

However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness:

- Perform a data gap investigation and recommend a future course of action at the milepost sites (This activity is currently under contract with the U.S. Army).
- Re-establish the cleanup goals for 1,2,4-TMB and 1,3,5-TMB in groundwater using either of the following methods: 1) update the RBCs by including the inhalation pathway and using information from a 2016 USEPA IRIS toxicity assessment, or 2) adopt the cleanup goals established in 18 AAC 75.

5.7 OU-4 Landfill

OU-4 consisted of three source areas: a Landfill (containing active and inactive portions), a Coal Storage Yard, and Fire Training Pits.

A Landfill Caterpillar shed (Building 1191), located south of the active landfill, was investigated in 2010 to assess the potential for groundwater contamination at this area (FES 2011a). The shed was added to OU-4 as part of a Consent Order Agreement and Final Order (USEPA Region 10 and U.S. Army Garrison, Fort Wainwright Alaska 2011). Three monitoring wells were installed that are currently being sampled as part of the long term monitoring of the OU-4 Landfill.

Locations of the OU-4 Landfill and Coal Storage Yard are illustrated on Figure 2-1.

5.7.1 Background Information

5.7.1.1 Physical Characteristics

The OU-4 Landfill (Landfill Source Area) occupies approximately 14 acres north of River Road. It is immediately adjacent to FWA's active landfill (Figure 5-8). The Landfill Source Area is an inactive portion of the landfill that was addressed in the ROD for OU-4 (U.S. Army 1996b).

The entire FWA Landfill (i.e. active and inactive areas) encompasses approximately 60 acres; approximately 40 acres are north of River Road and a 20 acre area, known as the former trench area, is south of River Road. The FWA Landfill is bordered by wetlands to the north and east and by black spruce forest elsewhere except for areas that have been cleared for access to the landfill (U.S. Army 2011).

FWA is underlain by soil and sediment that consists of silt, sand, and gravel that ranges from 10 ft to 400 ft thick. At the landfill, soil types are coarser grained. Discontinuous permafrost occurs at depths of 3 ft to more than 50 ft and is more prevalent north of the Chena River (U.S. Army 1996b).

The landfill is located within a 500 year floodplain. It is surrounded by discontinuous permafrost that is part of a complex hydrogeologic regime. The landfill is believed to be situated in a permafrost-free zone. Where permafrost is present, the aquifer may exhibit shallow (suprapermafrost) and deep (subpermafrost) water-bearing zones. Where permafrost is absent, a single unconfined aquifer is present (U.S. Army 1996b). Three groundwater zones are monitored at the site; a shallow zone, an intermediate zone, and a deep zone. Potentiometric surface measurements indicate that groundwater in all three zones generally flows to the west/southwest at low hydraulic gradient. The flow directions are subject to seasonal variations and may be interrupted or redirected by permafrost in some locations (U.S. Army 2011). Depth to groundwater in the vicinity of the landfill is approximately 15 to 20 ft bgs. Groundwater flow velocities were estimated to range from 100 to 5,600 ft per year in the shallow zone and from 1,000 to 1,400 ft per year in the deep zone (U.S. Army 1996b).

No endangered or threatened species reside in the landfill area (U.S. Army 2011).

5.7.1.2 Land and Resource Use

The Landfill Source Area and the Former Trench Area are inactive. The active landfill is used for disposal of construction and demolition debris. It currently operates under an ADEC solid waste permit as an unlined Class 1 Solid Waste Facility. It is permitted through 2020 (FES

2015h). Current and future land use is light industrial. Groundwater use is considered residential because water supply wells for the City of Fairbanks are located in the same aquifer.

5.7.1.3 History of Contamination

Landfilling activities began in the early 1950s. The Landfill Source Area was permitted to accept domestic and commercial refuse, ash, asbestos, incinerator residue, and construction and demolition waste. Wastes were initially dumped into gravel pits, burned and covered. In the early 1960s, trenching and burning ceased and the waste was spread by bulldozer and covered with coal ash from a power plant on FWA.

Materials that may have been disposed in the Landfill Source Area include human wastes, household refuse, POLs, hazardous waste, solvents, pesticides, asbestos, construction debris, and inert munitions (U.S. Army 2011). Investigations have identified other suspected wastes that may have been disposed, which include: dry cleaning waste and filters (reportedly distilled to remove PCE), vehicle paint, asbestos, small arms and explosives, triple-rinsed, punctured, and crushed pesticide cans, rags, and soil from small pesticide spills of less than one gallon, empty drums, and paint debris (U.S. Army 2011).

The Landfill Caterpillar shed (Building 1191) was previously used for vehicle storage and repair. An injection well at the shed contained a septic tank and leach pit that previously served as a bathroom and a floor drain in a vehicle storage area of the shed. The septic system was an injection well that received motor vehicle fluids.

5.7.1.4 Initial Response

An area petroleum hydrocarbon and lead contaminated surface soil in the inactive portion of the landfill was covered with approximately 8 ft of construction debris and native soils prior to the OU-4 ROD (U.S. Army 2011). This was done to eliminate the potential for dermal exposure to lead.

5.7.1.5 Basis for Taking Action

The primary sources of contamination at the Landfill Source Area are wastes that were placed in the landfill and coal ash from the power plant. Investigations determined that soil and groundwater were contaminated.

Soil

Petroleum hydrocarbons and lead, from a spill, were present at one surface soil location. The area was permanently covered prior to the ROD.

Groundwater

VOCs (1,1,2,2-tetrachloroethane [PCA], 1,1,2-TCA, TCE, cis-1,2 DCE, vinyl chloride, and benzene) and a semi-volatile organic compound (SVOC) (bis(2-ethylhexyl)phthalate) were detected in groundwater downgradient of the landfill at concentrations that exceeded federal drinking water MCLs and USEPA Region 3 RBCs used for screening contaminants of potential concern (U.S. Army 2011). Excess lifetime cancer risks associated with the consumption of contaminated groundwater downgradient of the Landfill Source Area exceeded the acceptable risk range for 1,1,2,2-PCA and bis(2-ethylhexyl)phthalate.

5.7.2 Remedial Actions

5.7.2.1 Remedy Selection

The following RAOs were established for groundwater in the August 1996 ROD:

- Restore groundwater to its beneficial use of drinking water quality within a reasonable time frame (defined as 70 years).
- Reduce further migration of contaminated groundwater from the source area.
- Prevent use of groundwater containing contaminants at levels above federal MCLs and AWQS (18 AAC 70).
- Use natural attenuation to attain AWQS (18 AAC 70).

COCs and site cleanup goals for groundwater are identified in Table 5-14; they represent USEPA and State of Alaska MCLs.

Table 5-14 OU-4 Landfill Groundwater COCs and Cleanup Goals

COC	Cleanup Level (µg/L)	Basis
VOCs		
Benzene	5	USEPA MCL
cis-1,2-DCE	70	USEPA MCL
1,1,2,2-PCA	5.2	USEPA Region 3 RBC [1, 2]
1,1,2-TCA	5	USEPA MCL
TCE	5	USEPA MCL
Vinyl chloride	2	USEPA MCL
SVOCs		
bis(2-Ethylhexyl)phthalate	6	USEPA MCL

Notes:

1 USEPA Region 3 RBC at the 1 x 10^{-4} incremental cancer risk level.
2 This constituent now has a State of Alaska MCL (4.3 µg/L) in 18 AAC 75, Table C.

The selected remedy included a phased approach intended to restore groundwater to its beneficial use as a potential drinking water aquifer. It included the following elements:

Landfill Cap

- Cap the inactive portion of the landfill with a minimum of 2 ft of native soil to achieve a permeability no greater than 1 x 10^{-5} centimeters per second.
- Vegetate the cap with native plants.
- Promote drainage to prevent ponding and erosion.

Groundwater

- Achieve the RAO for groundwater through natural attenuation.
- Monitor groundwater downgradient of the landfill and evaluate the results to determine the effectiveness of the capping and natural attenuation.

Contingent Remedy

- Evaluate the need for a methane gas collection system during the remedial design.

- Consider an active remediation system if natural attenuation of groundwater did not progress as projected or did not result in a significant reduction in leachate.

Institutional Controls

- Maintain ICs that restrict access to and development of the site as long as hazardous substances remain on site at levels that preclude unlimited use and unrestricted exposure.

5.7.2.2 Remedy Implementation

The cap was installed in September 1997, it covered 14 acres of the closed landfill. The former trench area was not capped because contaminants were not found in soil at levels that posed an unacceptable risk to human health or the environment.

The landfill cap included the following components (from bottom to top):

- Unclassified subgrade material (6 inches thick) for the base of the cap (unclassified material is inorganic soil free if trash, peat, debris, or frozen clods that is capable of being compacted in accordance with the design plans).
- Low permeability soil layer (18 inches thick) compacted to achieve a maximum permeability of 5×10^{-5} centimeters per second or less.
- Sand drainage layer (6 inches thick).
- Woven geotextile fabric.
- Top soil layer at least 6 inches thick.
- Surface vegetation consisting of grass and wildflower mixture.

A methane gas collection system was evaluated during the remedial design and determined to be unnecessary. It was not installed.

ICs have been implemented. They include access restrictions (posted signs, fencing around the inactive portion of the landfill), deed restrictions on future land use if land is transferred out of federal ownership, restrictions on groundwater well installation, restrictions on the use of wells, and well use advisories. Significant elements of the FWA base-wide IC policy include project planning procedures, dig clearance requirements, standard operating procedures associated with LUC/ICs, and incorporation of LUC/IC details in a FWA GIS database. LUC/ICs are still in effect at the Landfill Source Area. Excavation and groundwater intrusion are restricted and may only be authorized by FWA Directorate of Public Works, Environmental Department (U.S. Army 1996b).

5.7.2.3 Maintenance and Monitoring

Maintenance and monitoring consist of the following activities:

- Semi-annual monitoring of groundwater (spring and fall)
- Annual inspection of the landfill cap

Groundwater Monitoring

Post remedial action groundwater monitoring began in December 1998. Groundwater monitoring wells sampled are identified in Attachment 10 and their locations are illustrated on Figure 5-8. In general, sampling has been performed semi-annually except in 2012 and 2014 when annual sampling was performed. Groundwater monitoring has been conducted for COCs

and other parameters (VOCs, SVOCs, total metals, dissolved iron, sulfate, and methane) required in a Memorandum of Understanding between the U.S. Army and ADEC (FES 2015h). Field measurements taken at the time of sampling include depth to water, temperature, specific conductance, DO, pH, ORP, and turbidity. Since the start of long-term monitoring in 1998, some changes to the well network have been made as a result of low yielding wells, damaged wells, and new wells that were installed from additional delineation activities. Currently, 13 wells are sampled.

Landfill Cap Inspection

An engineering evaluation of the landfill cap was conducted in 2009. It was determined to be in good condition except for a soil stockpile that was placed on the cap and a small amount of water that was pooling on the east side of an access road near the entrance gate (U.S. Army 2011).

5.7.3 Progress Since the Last Five-Year Review

The Third Five-Year Review Report (U.S. Army 2011) provided the following protectiveness statement for OU-4:

> *"The remedy at OU4 has been implemented and is protective of human health and the environment. The remedy is relying upon Monitored Natural Attenuation to achieve final cleanup goals in groundwater over time, and in the interim, exposure pathways that could result in unacceptable risks are being controlled and Institutional Controls are preventing exposure to, or ingestion of, contaminated groundwater."*

The following recommendations were provided in the Third Five-Year Review Report:

- Continue the semi-annual monitoring program to evaluate natural attenuation at the Landfill Source Area.
- Perform post-wide IC inspection and evaluate protectiveness. Update restricted use boundaries in GIS as new information becomes available.
- Develop the parameters for an Annual Report of IC effectiveness and corrective actions taken (spring 2012 milestone date).
- Update the database of LUC/IC summary documents (October 2013 milestone date), which consist of tables that describe in greater detail the ICs, the objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms.

The status of these recommendations and actions taken are discussed below.

- Semi-annual monitoring at the Landfill Source Area has been continued.
- A post-wide IC inspection is performed and results are documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).
- Parameters for an annual report of IC effectiveness and corrective actions taken have been developed; they are used in the annual IC reports.
- Tables that describe in detail the ICs, objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms were updated and documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

5.7.4 Site Inspection

A site inspection was conducted by USACE on August 11, 2015 to obtain familiarity with the site, review records, examine the remedial action area, and assess protectiveness of the remedy. A completed site inspection checklist is provided in Attachment 4. Photographs are provided in Attachment 5.

Access to the landfill source area is restricted by a perimeter fence that was observed to be in good condition. Interview records and documentation indicate that the fence was damaged by vandalism in 2014 and has since been repaired. No settlement, cracking, bulges, erosion, or holes in the cap were evident. The landfill cap is vegetated with no signs of stress. Wet areas and unstable slopes were not identified. All monitoring wells were locked and appeared to be in good condition.

FWA staff indicated that LUCs/ICs are maintained as required by the ROD. The most recent IC review of the OU-4 Landfill is documented in the draft 2014 IC report (FES 2015f), which concluded:

- There was no evidence of unauthorized installation or use of groundwater wells.
- No soil disturbing activities were observed.
- Wells currently at the site are easily assessable and secured.
- Site land use and adjacent land use have not changed.

The five-year review site inspection confirmed these conclusions.

The IC report also provides an IC summary table for the site and a map (Fort Wainwright IC Boundary Map) that identifies IC boundaries.

5.7.5 Data Review

Groundwater monitoring results for site COCs since the completion of the remedial action in September 1997 are summarized in Attachment 10. They were reviewed to evaluate progress towards attaining the RAOs. Monitoring records inspected for the five-year review were available from annual sampling reports for 2012, 2013, and 2014 (FES 2013g, 2014g, and 2015h). A 2015 monitoring report was not available for review.

The monitoring well network includes six shallow wells (AP-5588, AP-8061, AP-10257, AP-10258, AP-10259, and FWLF-4), three intermediate wells (AP-5589, AP-6136, and AP-6138), and four deep wells (AP-6530, AP-6532, AP-6535, and AP-8063).

Groundwater flow in the vicinity of the landfill is affected by discontinuous permafrost regions. Mapping of October 2014 water level data provided in the 2014 monitoring report (FES 2015h) shows overall groundwater flow to the west/southwest (refer to Attachment 10, Figure 3-2).

Seven of the 13 monitoring wells contained one or more COC above the cleanup goals during the October 2014 sampling event:

- AP-5588 – cis-1,2-DCE, PCA, 1,1,2-TCA, and TCE
- AP-8063 – cis-1,2-DCE, PCA, and TCE
- AP-8061 – TCE
- AP-6530 – bis(2-ethylhexy)phthalate
- AP-6532, AP-10257, and AP-10258 – Benzene

Trend analysis was performed in this five-year review to augment and verify assessments provided in the annual sampling reports. Trend plots and trend analysis using the Mann-Kendall test are provided in Attachment 10. Results are discussed below.

Trend Analysis - Shallow Zone Wells

The highest COC concentrations and most frequent detections occur in AP-5588, which is immediately downgradient of the capped Landfill Source Area. COC concentrations decrease with distance downgradient. Decreasing trends are observed for TCE, cis 1,2-DCE in both downgradient wells (AP-5588 and AP-8061) and benzene is decreasing in AP-5588. No trend was identified in benzene data collected from AP-8061.

Data presented in the 2014 annual sampling report indicate that DO in the downgradient shallow wells was typically below 1 mg/L and ORP varied from approximately 50 millivolts (mV) to -60 mV (FES 2015h). Dissolved iron and sulfate in the downgradient wells were elevated relative to background. Geochemical conditions in the shallow zone are anoxic and suggest that manganese reducing to iron reducing conditions may be present. These conditions are suitable for reductive dechlorination of PCA, TCA, TCE, and DCE.

Trend Analysis - Intermediate Zone Wells

The highest concentrations of chlorinated VOCs and the most frequent detections occur in AP-5589, which is immediately downgradient of the capped Landfill Source Area. The concentrations decrease with distance downgradient. TCE and cis-1,2-DCE concentrations are increasing in AP-5589, while vinyl chloride and benzene are decreasing. Benzene concentrations are also decreasing in AP-6138. Bis(2-ethylhexyl)phthalate occurs most frequently and at the highest relative concentrations in AP-6136 and AP-6138.

Data presented in the 2014 annual sampling report indicate that DO in the downgradient intermediate wells was typically below 1 mg/L and ORP varied from approximately 50 mV to -72 mV (FES 2015h). Dissolved iron and sulfate in downgradient wells were elevated relative to background. Geochemical conditions in the intermediate zone are anoxic and suggest that manganese reducing to iron reducing conditions may be present. These conditions are suitable for anaerobic reductive dechlorination of TCE to cis-1,2-DCE, which may explain the increasing concentrations at AP-5589. The increasing TCE concentrations at this location may be a result of abiotic transformation of 1,1,2,2-PCA or a residual TCE plume from beneath the landfill.

Trend Analysis - Deep Zone Wells

The highest concentrations of chlorinated VOCs and the most frequent detections occur in AP-8063, which is the closest downgradient well to the capped landfill. The concentrations decrease with distance downgradient. At this well, TCE and cis-1,2-DCE concentrations are increasing, 1,1,2,2-PCA exhibits no trend, and vinyl chloride and benzene are decreasing. Benzene occurs most frequently and at the highest relative concentrations in AP-6532; where the concentrations are increasing. Benzene concentrations in AP-6530 and AP-6535, which are downgradient of AP-6532, exhibit no trend.

Data presented in the 2014 annual sampling report indicate that DO in the downgradient deep wells was typically below 1 mg/L and ORP varied from approximately 20 mV to -71 mV (FES 2015h). Dissolved iron and sulfate in downgradient wells were elevated relative to background. Geochemical conditions in the deep zone are anoxic and suggest that manganese reducing to iron reducing conditions may be present. These conditions are suitable for anaerobic reductive

dechlorination of TCE to cis-1,2-DCE, which may explain the increasing concentrations at AP-8063.

Progress Towards Attaining the RAOs

The data review conducted in this five-year review has determined:

- It is too early to ascertain whether the remedy will restore groundwater to its beneficial use of drinking water quality.
- Migration of contaminants from the Landfill Source Area has been reduced.
- Reductive dechlorination, a natural attenuation process, is occurring in site groundwater.

The 2014 Annual Sampling Report provided the following long-term monitoring recommendations that were established by the RPMs during a February 2015 Federal Facility Agreement meeting (FES 2015b):

Shallow Zone Wells

- AP-5588 – conduct annual monitoring during the spring season because results do not vary significantly between the spring and fall sampling events.
- FWLF-4 – conduct annual monitoring during the spring season because COCs have not exceeded the cleanup levels since 2003.
- AP-8061 – conduct annual monitoring during the spring and fall seasons.
- AP-10257 – conduct annual monitoring during the spring and fall seasons to evaluate the presence of benzene in groundwater upgradient of the landfill.
- AP-10258 – conduct annual monitoring during the spring and fall seasons to evaluate the presence of benzene upgradient of the landfill.
- AP-10259 – discontinuing monitoring because no COCs have been detected for four consecutive sampling events.

This five-year review agrees with these recommendations; no other opportunities for optimization were identified.

Intermediate Zone Wells

- AP-5589 – conduct annual monitoring during the spring season to evaluate bis(2-ethylhexyl)phthalate that was detected above the cleanup level in June 2013.
- AP-6136 – discontinue monitoring because COCs have not been detected or detected at low concentrations below the cleanup levels since 2006.
- AP-6138 – discontinue monitoring because COCs have not been detected or detected at low concentrations below the cleanup levels since 2006.

This five-year review agrees with these recommendations; no other opportunities for optimization were identified.

Deep Zone Wells

- AP-8063 – conduct annual monitoring during the spring season because results do not vary significantly between the spring and fall sampling events.
- AP-6530 – conduct annual monitoring during the spring and fall seasons.

- AP-6532 – conduct annual monitoring during the spring and fall seasons.
- AP-6535 – conduct annual monitoring during the spring and fall seasons.

This five-year review agrees with these recommendations; no other opportunities for optimization were identified.

5.7.6 Technical Assessment

5.7.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

Yes, the remedy is functioning as intended by the ROD.

The landfill cap was installed in 1997 in accordance with the ROD; it covered 14 acres of the closed landfill. Groundwater monitoring has been performed since the cap was installed. The data indicate that COC concentrations decrease downgradient in all monitored zones and plume extents have not increased. The RAO to reduce further migration of contaminated groundwater from the source area is being met. The data also indicates that reductive dechlorination, a natural attenuation process, is occurring in site groundwater.

LUC/ICs have been implemented and maintained in accordance with the ROD. They prevent the use of groundwater containing contaminants at levels above federal MCLs and AWQS.

The ROD-estimated time frame to reach the cleanup goals are 70 years. It is too early to determine whether the RAOs to restore groundwater to its beneficial use of drinking water within a reasonable time frame and to attain AWQS via natural attenuation are being met. Increasing concentrations in TCE were identified in two wells; however, increasing concentrations of cis-1,2-DCE were also detected. The post remedial action monitoring period has spanned 16 years. Trend analysis indicates that downward trends are observed in 11 of the data sets and no trends are observed in 11 of the data sets. There are no increasing COC trends in shallow zone wells. One intermediate zone well, AP-5589, exhibits increasing trends for TCE and cis 1,2-DCE but at concentrations below the cleanup goals. Increasing trends are also observed for deep zone wells AP-8063 (TCE and cis 1,2-DCE) and AP-6532 (benzene). Reductive dechlorination and/or a residual plume beneath the landfill may be causing the increasing TCE and cis-1,2-DCE trends in AP-5589 and AP-8063. These increasing trends are not anticipated to affect remedy protectiveness because the LUC/ICs are in place. The deep plume of TCE is bound by three downgradient wells, AP-6530, AP-6532, and AP-6535. The deep plume of benzene is bound by two downgradient wells, AP-6530 and AP-6535.

No opportunities for optimization were identified other than those recommendations outlined in the 2014 groundwater monitoring report discussed above.

No early indicators of potential problems were identified.

5.7.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

Yes, the RAOs and exposure assumptions used at the time of the remedy selection for protection of human health remain valid. The current exposures and major exposure assumptions for future potential land use at the site have not changed. The toxicity criteria used to develop risk-based

cleanup goals are reviewed in Attachment 8. That attachment also evaluates the potential for vapor intrusion at the site, since it was not previously evaluated. USEPA and ADEC guidance on vapor intrusion was either developed or significantly updated within the last five years. The change in toxicity criteria for 1,1,2,2-PCA, which occurred in 2010, does not affect the protectiveness of the remedy. This constituent now has a State of Alaska MCL (4.3 µg/L) pursuant to 18 AAC 75, Table C.

Although the vapor intrusion pathway was not explicitly evaluated at this OU at the time of the ROD, there are no currently occupied buildings in the vicinity of the landfill that would warrant an evaluation for vapor intrusion concerns. The exposure assumptions established at the time of the ROD are still valid.

High quality, undisturbed ecological habitat is lacking in OU-4. The lack of complete ecological exposure pathways indicates that no further evaluation of ecological risk is needed in this OU.

5.7.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No information has come to light that could call into question the protectiveness of the remedy for the intended use of the property as described in the ROD; however, the USEPA has identified 1,4-dioxane as an emerging contaminant.

An assessment has not been performed at OU-4 to evaluate whether a release of the stabilizer 1,4-dioxane occurred. A recommendation to perform sampling is included below; however, this issue is not anticipated to affect protectiveness based on the following information:

- LUCs/ICs have been implemented preventing receptors from direct contact with subsurface contaminants at OU-4.
- A hypothetical USEPA VISL was calculated for 1,4-dioxane (530,000 µg/L). This value is over four orders of magnitude greater than a VISL calculated for TCE under the same conditions (15 µg/L). ADEC does not have a VISL for 1,4-dioxane (VISL for TCE in groundwater is 5.2 µg/L). Based on this information, 1,4-dioxane should not pose a risk via vapor intrusion where no risk is identified for TCE.
- Groundwater flow in the vicinity of the Landfill is influenced significantly by a thick, continuous permafrost west of the Landfill, and highly variable permafrost south of the Landfill. The near-surface permafrost retards groundwater movement within the shallow subsurface. Shallow/intermediate groundwater flow above the permafrost is to the west while deep groundwater flow (subpermafrost aquifer) is to the southwest.
- Groundwater contaminant concentrations at the Landfill are relatively low.
- The closest drinking water supplies include:
    - The Golden Heart Utilities has four water supply wells (AK2310730 - community) located 3.25 miles from the OU-4 Landfill on the banks of the Chena River. These wells are separated from the OU-4 Landfill via hydrogeologic divide (Chena River).
    - The system operator was contacted on 27 October 2016 to request monitoring data for 1,4-dioxane as required for this system under the Unregulated Contaminant Monitoring Rule 3 (UCMR3). The operator indicated that the

system was sampled for 1,4-dioxane twice in 2013 (February and August), however, the sampling point was at the entry point to the distribution system (post-treatment). The results indicate that no 1,4-dioxane was detected in the water samples at concentrations above the laboratory's minimum reporting limit of <0.07 µg/L. No raw water quality data was available for 1,4-dioxane.

  - Pioneer drinking water wells (AK2310714 - community) for the Hamilton Subdivision are located approximately 1.6 miles from the OU-4 Landfill (see Figure 3-1). Given the current plume extents and magnitude as well as the location of permafrost, migration of groundwater contaminants from the vicinity of the Landfill 1.6 miles to the Pioneer wells is highly unlikely.
  - The installation has eight on-post wells (AK2310918 - community) and one well servicing the golf course (AK2311095 - non-community). In addition to those wells identified by the State, an emergency water supply well is located within the OU-2 DRMO Yard (see Section 5.3). The well locations are depicted on Figure 3-1. Only one well located on FWA is currently designated as a drinking water source (Building 3559 Water Well). This well is separated from the OU-4 Landfill via hydrogeologic divide (Chena River).

- The Chena River is located approximately 1,800 feet southwest of the OU-4 Landfill. Based on the site conceptual model, impacts associated with the Landfill are not anticipated to impact the Chena River.
- No other sensitive receptors were identified.

5.7.6.4 Technical Assessment Summary

The OU-4 landfill cap was installed in 1997, groundwater monitoring is performed on a routine basis, and ICs have been implemented and are maintained as required by the ROD. The landfill cap and ICs prevent the exposure of receptors to groundwater impacts. Groundwater monitoring indicates that the remedy has effectively reduced migration of groundwater impacts and that reductive dechlorination is taking place. It is too early to assess whether the remedy will achieve the groundwater cleanup goals. No changes in the ARARs or risk assessment were identified that would affect the protectiveness of the remedy.

5.7.7 Issues

The following issue was identified at the OU-4 Landfill that may affect the future protectiveness of the remedy:

- An assessment for 1,4-dioxane has not been performed at the Landfill.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.

5.7.8 Recommendations for Follow-up Actions

The following recommendation for follow-up action was identified that may affect the future protectiveness of the remedy:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Landfill. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. This will be initiated in November 2016 with a planned completion date of September 2018.

5.7.9 Protectiveness Statement

The remedy at OU-4 Landfill currently protects human health and the environment because:

- Further migration of contaminated groundwater from the source area has been reduced by the implemented remedy and natural attenuation.
- ICs are in-place to ensure that contaminated groundwater will not be used until the cleanup goals are attained.

However, in order for the remedy to be protective in the long-term, the following action needs to be taken to ensure protectiveness:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Landfill. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

5.8 OU-4 Coal Storage Yard

5.8.1 Background Information

5.8.1.1 Physical Characteristics

The OU-4 Coal Storage Yard is situated south of a coal fired cogeneration power plant that was used as the sole source of heat and electricity for FWA (U.S. Army 1996). The area of concern was approximately 800 ft by 300 ft and located between a cooling pond and embankment. Coal was stored directly on the ground since the 1950s. From the 1960s to 1993 the pile was sprayed with waste petroleum fuel products and waste solvents to increase the thermal content of the coal and power plant output. Three USTs were located in the area. Two were used for the storage of waste fuel products. They were installed in the 1980s and removed in July, 1995. The third UST was used to store diesel fuel for power plant equipment (CH2M HILL 2003a). Prior to installation of the tanks waste oil was placed in drums adjacent to the coal pile (U.S. Army 2011). The coal storage yard site features are shown in Figure 5-9.

Areas north and east of the coal storage yard are industrial and areas to the south and west contain mixed hardwood forests (U.S. Army 1996b). An unlined cooling pond is located immediately west of the coal storage yard, it is used for storage of cooling water circulated from the power plant.

FWA is underlain by soil and sediment that consists of silt, sand, and gravel that range from 10 ft to 400 ft thick. Discontinuous permafrost occurs at depths of 3 ft to more than 50 ft and is more prevalent north of the Chena River (U.S. Army 1996b).

The coal storage yard is located within a 500 year floodplain. Groundwater occurs at approximately 11 to 12 ft bgs and varies seasonally by several ft. Groundwater flows northwest at estimated velocities that range from 243 ft per year to 2,917 ft per year (U.S. Army 1996b). The cooling pond is hydraulically connected to the groundwater aquifer. Permafrost was not encountered during investigations at the coal storage yard.

No endangered or threatened species reside in the area (U.S. Army 2011).

5.8.1.2 Land and Resource Use

The site is still used for coal storage. It is located in a restricted area that is not developed. Current land use is light industrial. Water supply wells for FWA are located downgradient of the site, approximately 900 ft to the northwest. Groundwater use is considered residential because water supply wells for the City of Fairbanks are located in the same aquifer where contamination was identified at the coal storage yard (U.S. Army 2006).

5.8.1.3 History of Contamination

The primary sources of contamination at the coal storage yard were associated with waste fuel products that were sprayed on the coal pile, the storage of these waste fuel products, leaks from the USTs, and the coal pile. Soil and groundwater contamination were identified during a RI. Soil sampling was conducted at the coal storage yard between 1999 and 2002, and groundwater sampling was performed semi-annually (spring and fall) until 2003 (U.S. Army 2006).

5.8.1.4 Initial Response

No pre-ROD cleanup activities or response actions were performed at the site.

5.8.1.5 Basis for Taking Action

Previous investigations determined that the former coal storage yard source area contained several relatively small and discontinuous contaminated soil zones that were attributed to the practice of applying oil to the coal pile and leaks from the three USTs. Soil contaminants consisted of petroleum hydrocarbons (diesel fuel) and TCE. No risks greater than 1 x 10^{-6} or a hazard quotient of one were associated with current or future use of the soils (U.S. Army 1996).

Groundwater contained benzene, TCE, and bis(2-ethylhexly)phthalate above federal drinking water MCLs and USEPA RBCs (CH2M HILL 2003a). Risks associated with potential downgradient drinking water users exceeded an excess lifetime cancer risk of 1 x 10^{-4} (U.S. Army 1996b).

5.8.2 Remedial Actions

5.8.2.1 Remedy Selection

The following RAOs were established for soil and groundwater in the August 1996 ROD:

Soil

- Prevent migration of soil contaminants to groundwater that could result in groundwater contamination and exceedances of federal MCLs and AWQS (18 AAC 70).

Groundwater

- Restore groundwater to its beneficial use of drinking water quality within a reasonable time frame (estimated at 9 years).
- Reduce further migration of contaminated groundwater from the source areas.
- Prevent use of groundwater containing contaminants at levels above federal MCLs and AWQS (18 AAC 70).
- Use natural attenuation to attain AWQS (18 AAC 70).

COCs and site cleanup goals for soil and groundwater are identified in Table 5-15; they represent USEPA and State of Alaska MCLs.

Table 5-15 OU-4 Coal Storage Yard Soil and Groundwater COC Cleanup Goals

COC	Cleanup Goal	Basis
Surface and Subsurface Soils		
Benzene	0.5 mg/kg	ADEC[1]
BTEX	15 mg/kg	ADEC[1]
DRO	200 mg/kg	ADEC[1]
GRO	100 mg/kg	ADEC[1]
Groundwater		
Benzene	5 µg/L	USEPA MCL [2]
bis(2-Ethylhexyl) phthalate	6 µg/L	USEPA MCL [2]
Toluene	1,000 µg/L	USEPA MCL [2]
TCE	5 µg/L	USEPA MCL [2]

Notes:

1 ADEC Method One (18 AAC 75, Table A1), based on a Site Matrix Score of 39.
2 40 CFR 141.61

The selected remedy included the following components:

AS/SVE

- *In situ* treatment of groundwater via AS to remove VOCs; AS points would be located in areas of highest contamination.
- *In situ* treatment of soil via SVE; SVE wells would be located in areas of highest contamination and operated until the groundwater MCLs were achieved.
- Evaluation and modification of the AS/SVE system as necessary to optimize its effectiveness in achieving RAOs.

The AS/SVE system was designed to operate during May through October and was estimated to require nine years to achieve the cleanup goals.

Monitoring

- Natural attenuation to achieve the AWQS after the AS/SVE system was shut down.
- Monitoring of nested downgradient wells during the remedial action to ensure protection of FWA drinking water supply wells.

Institutional Controls

- Maintaining ICs that included access restrictions and well development restrictions as long as hazardous substances remained on site at levels that precluded unrestricted use. Restrictions on groundwater would be implemented until contaminant levels were below the federal MCLs and AWQS.

5.8.2.2 Remedy Implementation

The AS/SVE system was installed in 1997; it consisted of 27 AS points and 14 SVE wells. The system was shut down in October 2000 to perform a rebound study. Soil sampling conducted in 2002 did not identify residual contamination in the source area and groundwater concentrations did not rebound. The treatment system was decommissioned in 2004 (U.S. Army 2006).

Groundwater monitoring was performed semi-annually during operation of the treatment system. COCs were not detected in groundwater at concentrations greater than the MCLs after 2001. The RPMs decided to discontinue the monitoring program in 2003 because the RAOs had been met (U.S. Army 2006).

ICs were implemented; they consisted of access restrictions that included posted signs, deed restrictions on future land use, restrictions on groundwater well installation, and well use advisories. Significant elements of the FWA base-wide IC policy include project planning procedures, dig clearance requirements, standard operating procedures associated with LUC/ICs, and incorporation of LUC/IC details in a FWA GIS database. LUC/ICs are still in effect at the coal storage yard. Excavation and groundwater intrusion are restricted and may only be authorized by FWA Directorate of Public Works, Environmental Department (U.S. Army 1996b).

The coal storage yard was recommended for NFA in the second FWA five-year review (U.S. Army 2011).

5.8.2.3 Operation, Maintenance and Monitoring

Operation, maintenance and monitoring activities are no longer necessary at the site.

5.8.3 Progress Since the Last Five-Year Review

The Third Five-Year Review Report (U.S. Army 2011) provided the following protectiveness statement for OU-4:

> *"The remedy at OU4 has been implemented and is protective of human health and the environment. The remedy is relying upon Monitored Natural Attenuation to achieve final cleanup goals in groundwater over time, and in the interim, exposure pathways that could result in unacceptable risks are being controlled and Institutional Controls are preventing exposure to, or ingestion of, contaminated groundwater."*

The following recommendations were provided in the Third Five-Year Review Report:

- Perform post-wide IC inspection and evaluate protectiveness. Update restricted use boundaries in GIS as new information becomes available.
- Develop the parameters for an annual report of IC effectiveness and corrective actions taken (spring 2012 milestone date).
- Update the database of LUC/IC summary documents (October 2013 milestone date), which consist of tables that describes in greater detail the ICs, the objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms.

The status of these recommendations and actions taken to address them are discussed below.

- A post-wide IC inspection is performed and results are documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).
- Parameters for an annual report of IC effectiveness and corrective actions taken have been developed; they are used in the annual IC reports.
- Tables that describe in detail the ICs, objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms were updated and documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

5.8.4 Site Inspection

A site inspection was conducted by USACE on August 11, 2015 to obtain familiarity with the site, review records, examine the remedial action area, and assess protectiveness of the remedy. Site access was limited due to construction activities in the area. The site was viewed where possible; it is being used for coal storage. The west side of the site is fenced and developed for light industrial use with restricted access. A completed site inspection checklist is provided in Attachment 4. A photograph is provided in Attachment 5.

FWA staff indicated that LUCs/ICs are maintained as required by the ROD.

The most recent IC review of OU-4 Coal Storage Yard is documented in the draft 2014 IC report (FES 2015f), which concluded:

- There was no evidence of unauthorized installation or use of groundwater wells.
- No soil disturbing activities were observed.
- Site land uses and adjacent land use have not changed.

The five-year review site inspection confirmed these conclusions.

5.8.5 Data Review

There is no new operation, maintenance or monitoring data since the previous five-year review.

5.8.6 Technical Assessment

5.8.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

Yes, the remedy is functioning as intended by the ROD. The estimated timeframe to achieve the cleanup goals at the Coal Storage Yard was 9 years. The remedy was implemented and the remedial action is complete. Soil and groundwater cleanup goals have been attained. Groundwater monitoring was discontinued in 2003. The AS/SVE system was shut down in 2000 and decommissioned in 2004. The second five-year review recommended NFA for the site.

LUC/ICs have been implemented and are functioning as intended.

Opportunities to improve the performance or reduce monitoring costs were not identified in the five-year review.

No early indicators of potential problems were identified.

5.8.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy are still valid.

All soil and groundwater cleanup goals were ARAR-based. There are no newly promulgated or modified requirements of federal and state environmental laws that would change the protectiveness of the groundwater and soil remedies implemented at the coal storage yard. An ARAR assessment is provided in Attachment 7.

LUC/ICs are still in place, they restrict site access and groundwater use. The exposure assumptions established at the time of the ROD are still valid. The coal storage yard is an industrial use property where little undisturbed high-quality ecological habitat exists. A complete ecological exposure pathway that would warrant evaluation of ecological risk is lacking. A risk assessment and toxicology assessment is provided in Attachment 8.

5.8.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy as described in the ROD.

5.8.6.4 Technical Assessment Summary

The AS/SVE system was installed in 1997 and operated seasonally until 2000. ICs were implemented and maintained as required by the ROD. MNA was evaluated following the AS/SVE system shut down. RAOs were achieved in 2003 and groundwater monitoring was

discontinued. No changes in ARARs or the risk assessment were identified that would affect the protectiveness of the remedy.

5.8.7 Issues

No issues were identified at the OU-4 Coal Storage Yard that affect protectiveness of the remedy.

The following issue that does not affect the protectiveness of the OU-4 Coal Storage Yard remedy was identified:

- The remedial action has attained all RAOs and groundwater cleanup goals (for residential use) identified in the OU-4 ROD. The site meets unlimited use and unrestricted exposure criteria identified in the ROD.

5.8.8 Recommendations for Follow-up Actions

The remedial action has attained all RAOs and groundwater cleanup goals. The site meets unlimited use and unrestricted exposure criteria identified in the ROD. No recommendations for follow-up action affecting the protectiveness of the remedy were identified.

The following recommendations for follow-up actions do not affect protectiveness of the remedy:

- An iRACR should be completed to document remedial action completion under CERCLA and five-year reviews should be discontinued. If the site retains IC restrictions, the five-year review must be conducted to evaluate that component of the remedy.

5.8.9 Protectiveness Statement

The remedy at OU-4 Coal Storage Yard is protective of human health and the environment because all RAOs have been attained.

5.9 OU-5 West Quartermaster's Fueling System

5.9.1 Background Information

The WQFS was divided into four subareas: WQFS1, WQFS2, WQFS3, and WQFS4. Contaminated soil in WQFS4 is addressed under the 2-PTY program and is not included in the OU-5 remedial actions. Contaminated groundwater beneath WQFS4 is being addressed in OU-5.

5.9.1.1 Physical Characteristics

The WQFS area covers approximately 50 acres and is bordered to the north by a south trending meander of the Chena River, to the west by the ROLF, to the south by Taxiway 18, and to the east by the EQFS (Figures 2-1 and 5-10). The terrain is open tussock flats as the buildings have all been removed from the site. The WQFS is located within the 500-year floodplain of the Chena River. No endangered or threatened species reside in the area. Groundwater is located approximately 15 to 17 ft bgs.

5.9.1.2 Land and Resource Use

Current land use in the WQFS is light industrial; current and future groundwater use is considered residential because water supply wells for the City of Fairbanks are located in the same unconfined aquifer. The closest residences to WQFS are approximately one mile west. The residential area includes a school. Access to WQFS is unrestricted and the area is used for recreational purposes that includes a bicycle trail. Access to the Chena River is unrestricted.

5.9.1.3 History of Contamination

Activities within the WQFS included vehicle and aircraft maintenance operations and the associated use and disposal of solvents and other cleaning and maintenance compounds. The WQFS also included USTs and ASTs, a pump house and fueling islands. Drains within the WQFS were connected to a wood-stave pipe that drained to the river. The underground fuel pipelines and a network of aboveground and buried fuel piping were abandoned in place. All pipelines were reported to be cleaned before they were abandoned. Several leaking drums containing a tarry substance were exposed along the Chena River and removed in 1995; nine nearby buried drums and approximately 3 CY of contaminated soil were excavated in 1996. The primary sources of contaminants in groundwater at WQFS were from surface disposal of solvents, petroleum spills and leaks, and other past disposal practices.

Groundwater contamination extended approximately 70 ft bgs or 60 ft below the water table. The approximate extent of groundwater contamination was 43 acres. Initial investigations conducted at the WQFS revealed four groundwater plumes. Two free product plumes (mostly jet fuel and diesel fuel) existed within the source area. The larger plume was about 4½ acres and encompassed an area where the majority of fuel pumps, dispenser islands, and storage tanks were located. The smaller free product plume extended about 600 ft southwest of Building 1599 and coincided with a bermed area around a possible fuel containment structure. A benzene plume covered about 25 acres. A plume of 1,2-DCA extended from the north of Front Street to the Chena River, overlapping the free product and benzene plumes and extended to a depth of approximately 20 ft bgs. DRO and GRO were also detected, but their extent was not defined.

Soil contamination in WQFS subareas was estimated at approximately 150,600 CY.

5.9.1.4 Initial Response

Removal or treatability studies completed prior to the 1999 ROD include the following:

- In 1980, the U.S. Army excavated a trench in WQFS2 near the bank of the Chena River and installed a sheet metal retaining structure to prevent further migration of fuel leaks into the Chena River.
- Several leaking drums containing a tarry substance at WQFS3 were exposed along the Chena River and removed in 1995; nine nearby buried drums and approximately 3 CY of contaminated soil were excavated in 1996.
- In 1998 approximately 700 CY of contaminated soil and a sheet metal retaining structure was removed from WQFS2. An AS curtain was installed in this area to minimize contaminant migration into the Chena River and a harbor and absorbent boom system was deployed to contain any potential sheen in the Chena River during ice-free months.
- Between 1996 to 1998, several treatability studies were initiated to evaluate technologies that were considered for incorporation into WQFS remediation plans:
    - AS/SVE with horizontal wells in WQFS1
    - Source Area AS/SVE in WQFS1
    - *In-situ* soil heating in WQFS1 using radio frequency and six-phase heating to heat soil and enhance biodegradation and volatilization (completed in 1999 with mixed success)
    - *In-situ* ORC in WQFS2 to enhance the rate of reduction of VOCs (completed with limited success)
    - Bench-scale tracer and biodegradation studies conducted to better understand the persistence of the contamination

5.9.1.5 Basis for Taking Action

Based on the results of the baseline risk assessment that assumed industrial use of soil and residential use of groundwater, COCs were identified in the 1999 ROD (U.S. Army 1999). They are provided in Table 5-16.

Table 5-16 OU-5 WQFS COCs

Media	COC
Groundwater	RRO
	DRO
	GRO
	1,2-DCA
	Benzene
	Toluene
Soil	DRO
	GRO
	Benzene
	Ethylbenzene
	Toluene
	Xylenes

Table 5-16 OU-5 WQFS COCs

Media	COC
Chena River Surface Waters	TAH
	TAqH

Note:

TAqH total aqueous hydrocarbons

5.9.2 Remedial Actions

5.9.2.1 Remedy Selection

The following RAOs were established in the OU-5 ROD:

Groundwater

- Restore groundwater to its beneficial uses within a reasonable time frame. Reduce or prevent further migration of contaminated groundwater from the source areas to the downgradient aquifer or surface water bodies that are closely hydrologically connected by achieving MCLs (where there are no nonzero maximum contaminant level goals [MCLGs]) and AWQS. For groundwater that is hydrologically connected to surface water, AWQS will apply for the following fresh water uses: (l)(A) Water Supply; (l)(B) Water Recreation; and (l)(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife.
- Ensure there is no risk to aquatic receptors through control of contaminant movement through the groundwater into the Chena River.
- Remove light non-aqueous phase liquid (LNAPL) to the extent practicable to eliminate film or sheen from groundwater.
- Prevent use of groundwater containing contaminants at levels above SDWA MCLs, non-zero MCLGs, or the following AWQS for fresh water uses: (l)(A) Water Supply; (l)(B) Water Recreation; and (l)(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife.

Soil

- Prevent the migration to groundwater of soil contaminants that could result in groundwater contamination and exceedances of federal MCLs and nonzero MCLGs and to groundwater that is closely hydrogeologically connected to surface water (such as the Chena River) that could result in exceedances of AWQS in surface water.

Chena River Sediments and Surface Water

- Reduce sources of contaminant releases to the Chena River
- Meet AWQS for the following fresh water uses: (1)(A) Water "J Supply; (1)(B) Water Recreation; and (1)(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife.
- Continue aquatic assessment

Several treatability studies were implemented at WQFS prior to release of the 1999 ROD. The purpose of the studies was to evaluate the effectiveness of the systems and/or to collect additional data for system modification. The remedies selected are described below.

Chena River Aquatic Assessment

- Perform an aquatic assessment of the Chena River during the spring and fall. It includes collecting water, sediment, and detritus (organic leaf litter) samples and analyzing them for contaminants of concern and water chemistry.
- Collect benthic macroinvertebrates such as insects and larvae and analyzing them through toxicological studies and bioassays.
- Determine the reductions of contaminant load into the Chena River from remedial actions and associated changes to aquatic organisms.

Institutional Controls

The OU-5 ROD required the U.S. Army to develop standard operating procedures (SOPs) to identify all land areas under restriction, identify the objectives that must be met by the restrictions, and specify the particular restrictions, controls, and mechanisms to be used to achieve the identified objectives. The SOPs were intended to help assure that the ICs selected in this and other OU RODs were carried out and remain in place until the USEPA, ADEC, and the U.S. Army determine they are no longer needed to protect the public and the environment. The SOPs serve as a single site-wide source documenting all ICs being implemented at FWA. The OU-5 ROD also indicates that the SOPs will be a component of the five year review process.

Components of the selected remedy are discussed below.

WQFS1, WQFS 2, and WQFS3

- *In-situ* soil heating (after the ROD was signed, it was determined that soil heating was not cost effective) (WQFS 1 only).
- Installation of an AS/SVE system.
- Installation of an AS curtain near the bank of the Chena River (WQFS 2 only).
- ICs including restrictions governing site access, on-site construction, and groundwater use.
- Groundwater monitoring including monitored natural attenuation for deep groundwater and areas not actively treated.

The ROD also required that abandoned buried fuel pipelines be purged of residual fuel to eliminate the potential for the lines to act as ongoing contaminant sources.

The cleanup goals identified in the ROD for COCs in groundwater, surface water, and sediment are presented in Table 5-17.

Table 5-17 OU-5 WQFS COC Cleanup Goals

Media	COC	Cleanup Goal
Groundwater	RRO	1,110 µg/L
	DRO	1,500 µg/L
	GRO	1,300 µg/L
	1,2-DCA	5 µg/L
	Benzene	5 µg/L
	Toluene	1,000 µg/L
	Floating-product petroleum hydrocarbons	Eliminate sheen
Soil	DRO	Active remediation of soils until contaminant levels in groundwater are consistently below state and federal MCLs
	GRO	
	Benzene	
	Ethylbenzene	
	Toluene	
	Xylenes	
Chena River Surface Water	TAH	10 µg/L
	TAqH	15 µg/L
	Petroleum hydrocarbons	Eliminate sheen
	COCs identified in the Post-wide risk assessment	Benthic macroinvertebrates assessment to establish baseline and monitor aquatic biotic integrity over time[1]
Chena River Sediments	Contaminated sediments that contain all COCs identified in the post-wide risk assessment	No concentration of toxic substances or petroleum hydrocarbons and other contaminants in bottom sediments allowed that cause deleterious effects to aquatic life
		Benthic macroinvertebrates assessment to establish baseline and monitor aquatic biotic integrity over time[1]

Note:

1 The Chena River Aquatic Assessment Program was conducted to evaluate the impact from contamination on the benthic communities. It found evidence that contamination from the FWA source areas was potentially adversely influencing biotic health in the Chena River ecosystem but did not prove that sediment toxicities caused changes in the benthic invertebrate communities of the Chena River. As a result, the program was discontinued. This decision is documented in the second Five-Year Review (U.S. Army 2006); however, the second Five-Year Review also notes that it is unlikely that decreases in sediment concentrations of PAHs detected in Seep Area samples were attributable to remediation efforts at OU-5. The Review indicated that these relatively low PAH concentrations may reflect souring flood events between 1997 and 2002, and low-flow conditions during the 1997 and 1998 sampling events.

The ROD estimated time frames to reach the cleanup goals are (U.S. Army 1999):

- WQFS1 – two years (source area) and 10 years (at the Chena River)
- WQFS2 – five years (source area) and five to 10 years (at the Chena River)
- WQFS3 – five years (source area) and five to 10 years (at the Chena River)

5.9.2.2 Remedy Implementation

Three AS/SVE systems (Horizontal Well, Source Area, and Sparge Curtain) were operated at the WQFS.

WQFS1

- A horizontal well AS/SVE system was installed in 1997 and expanded through 2001 to include 170 AS probes and 47 SVE wells.
    - Between 1997 and 2005, the system removed 275,000 pounds of petroleum hydrocarbons.
    - In 2005, groundwater contaminant concentrations showed a decreasing trend in the treatment zones and VOC removal rates decreased. The system was shut down in November 2005 for a rebound study.
    - In 2009, an evaluation of soil contamination remaining was performed using an ultra-violet light optical screening tool (UVOST) and soil sampling. The results indicated that the extent of soil contamination was similar to the extent identified in the RI. The primary contaminant was DRO and the majority of the remaining soil contamination was associated with the smear and saturated zones.
    - In 2011, the AS/SVE system was decommissioned.
- A source area AS/SVE system, installed in 1998, was expanded through 2001 to include 123 AS and 21 SVE wells.
    - Between 1998 and 2005, the system removed 162,000 pounds of VOCs.
    - In 2005, groundwater contaminant concentrations showed a decreasing trend in the treatment zones and VOC removal rates decreased. The system was shut down in November 2005 for a rebound study.
    - In 2009, an evaluation of soil contamination remaining was performed using UVOST and soil sampling. The results indicated that the extent of soil contamination was similar to the extent identified in the RI. The primary contaminant was DRO and the majority of the remaining soil contamination was associated with the smear and saturated zones.
    - In 2011, the AS/SVE system was decommissioned.

WQFS2

- A sparge curtain AS/SVE system was installed in 1998 to intercept and treat groundwater prior to migration to the Chena River. It consisted of four treatment zones.
    - The SVE portion of the system was shut down in January 2004 due to diminishing contaminant recoveries. The AS system was operated until 2012 when it was shut down due to a mechanical failure.

- In 2009, an evaluation of remaining soil contamination was performed using UVOST. The results indicated that contaminated soil extended from the bank of the Chena River south towards Gaffney Road, with depths ranging from the smear zone to the saturated zone in areas where previous excavation took place to some vadose zone and smear zone/saturated zone contamination south of the excavation area.
- In 2013, the RPMs agreed to keep the system off for a rebound study. In response to the 2015 OU-5 monitoring report, ADEC recommended leaving the AS curtain in place until an evaluation of contaminant migration is complete. The U.S. Army agreed to delay decommissioning of the AS curtain treatment system until data from a new monitoring well can be evaluated.

WQFS3

- An additional AS/SVE system was installed in 2000 (using the mechanical equipment from a system in WQFS2) and operated between 2001 and 2003. It was shut down because benzene in groundwater met the cleanup goal.

It is estimated that the AS/SVE systems collectively removed over 450,000 pounds of VOCs, as well as measurable free product on the water table. To supplement the active systems, several treatability studies also were completed, including ISCO injections and *in-situ* soil heating.

Chena River Harbor Boom

The Chena River harbor boom was installed in 1998 and is deployed every year between May and October. The OU-5 ROD does not include the boom. However, regulatory concurrence documented in the first five-year review report acknowledged that the boom will be maintained until RAOs will be met.

Pipeline Abandonment/Removal

Abandoned and buried fuel lines in the WQFS were pigged, emptied, and capped in 2000. Several hundred ft of lines also were removed in 2004 and 2005. All known pipelines have been removed and cleaned; however, in case any remaining pipelines are discovered, the U.S Army has an ongoing project to identify and remove fuel from them.

Groundwater Monitoring and Natural Attenuation Evaluation

Groundwater monitoring has been performed semi-annually between 1999 and 2009, with the number of wells sampled varying between 21 and 43. Following shut down of the AS/SVE systems, contaminant rebound evaluations have shown limited rebound of EDB, GRO, and benzene in the horizontal well and the source areas, and benzene in the sparge curtain source area. DRO is the primary COC remaining above the cleanup goal in all source areas and benzene remains above cleanup goal primarily in the former horizontal well source area.

Institutional Controls

The OU-5 ROD required the U.S. Army to develop SOPs to identify all land areas under restriction, identify the objectives that must be met by the restrictions, and specify the particular restrictions, controls, and mechanisms to be used to achieve the identified objectives. The SOPs were intended to help assure that the ICs selected in this and other OU RODs were carried out and remain in place until the USEPA, ADEC, and the U.S. Army determine they are no longer

needed to protect the public and the environment. The SOPs serve as a single site-wide source documenting all ICs being implemented at FWA. The OU-5 ROD also indicates that the SOPs will be a component of the five year review process.

ICs are maintained to ensure that groundwater will not be used until MCLs are attained. They include restrictions governing site access, construction, and water supply well installation, as long as hazardous substances remain on site at levels that preclude unlimited use and unrestricted exposure. Signs have been installed to inform the public of restrictions and activities in this area.

ICs are inspected annually and a complete summary of the survey and corrective actions taken are presented in an annual IC report. The first annual report was prepared for 2012 (FES 2013h) and prior IC inspections were documented in the OU-specific annual monitoring reports. IC inspections evaluate potential land use changes, site security (monitoring wells, etc., as applicable), or unauthorized groundwater use. In addition, reviews of the FWA IC GIS layer and the site-specific information in the ADEC contaminated sites database are conducted.

5.9.2.3 Operation, Maintenance and Monitoring

There are no active remediation systems operating at the OU-5 WQFS. Maintenance activities are limited to monitoring well inspections and weekly inspection of the seasonal Chena River harbor boom when it is deployed (between May and October). The results of harbor boom inspections are presented in the annual OU-5 monitoring reports.

During the annual groundwater sampling events, monitoring wells are inspected to ensure that they are accessible, locked, and in good condition. Results of the inspections are presented in the annual monitoring reports. Over the last several years, activities have included replacing well locks and adjusting well risers that were impacted by frost.

Currently, groundwater monitoring is performed as follows (see Figure 5-10 for well locations):

- Annual sampling in all areas of the WQFS except the sparge curtain source area, where sampling is performed semi-annually (only one round of samples was collected in 2014 in the sparge curtain area due to contractual issues).
- 10 wells are sampled to monitor the DRO plume; five wells are sampled along the Chena River; nine wells are sampled in the sparge curtain area; and 11 wells are sampled to monitor benzene concentrations.
- Groundwater samples in the WQFS are analyzed for DRO, GRO, VOCs (benzene, toluene, TCE, 1,2-DCA), EDB (select wells only), and geochemistry parameters. Samples from the sparge curtain area are also analyzed for PAHs.

The VOC analysis includes benzene, toluene, TCE, 1,2-DCA, and EDB (a non-ROD constituent).

5.9.3 Progress Since the Last Five-Year Review

The Third Five-Year Review Report (U.S. Army 2011) provided the following protectiveness statement for OU-5:

> *"The remedy at OU5 currently protects human health and the environment because Institutional Controls are preventing exposure to, or ingestion of, contaminated groundwater. However in order for the remedy to remain protective for the long term,*

continued monitoring of the Remedial Area 1a fence will be conducted to ensure security and identify the need for repairs."

Recommendations provided in the Third Five-Year Review Report and progress made to address them are identified below.

Recommendation: Continue the operation of the AS curtain and seasonal use of the boom along the Chena River.

Progress: Due to mechanical failure, the AS curtain system was shut down in February 2012 and the RPMs agreed to initiate a groundwater contaminant rebound study. In 2013, the RPMs agreed to decommission the system when funds are available. The Chena River boom is deployed annually between May and October. Wells in the sparge curtain area were sampled semi-annually through 2014 and were sampled twice in 2015.

Recommendation: Continue sampling monitoring wells within the Horizontal Well and Source Area source areas annually, and wells associated with the sparge curtain and along the bank of the Chena River semi-annually.

Progress: Monitoring wells have been sampled annually within the horizontal well area and source area. The sampling frequency for the wells along the Chena River was reduced from semi-annual to annual, based on agreement of the RPMs in 2012.

Recommendation: Continue LTMO analysis on an annual basis.

Progress: The LTMO is performed annually and the results are included in annual monitoring reports.

Recommendation: Decommission the horizontal well and source area treatment systems.

Progress: TheWQFS1 horizontal well and source area treatment systems were decommissioned in 2011. This activity was documented in a 2011 Technical Memorandum (FES, 2011c).

Recommendation: Complete additional soil and groundwater investigation to evaluate the extent of benzene remaining above cleanup levels in the horizontal well area.

Progress: Following soil sampling conducted in 2011, an ISCO treatability study was performed (details are provided below).

Recommendation: Conduct additional evaluation of the AS curtain performance and potential contaminant migration into the Chena River.

Progress: A Sparge Curtain Performance Monitoring Plan (PMP) was prepared in response to a request made during the annual RPM meeting in 2012 (details are provided below).

Recommendation: Notify USEPA and ADEC in a timely manner when systems are not operating.

Progress: There are no active systems currently operating at the WQFS.

Recommendation: Implement IC measures that include: 1) performing a post-wide IC inspection and evaluating protectiveness, 2) updating restricted use boundaries in GIS as new information becomes available, 3) developing the parameters for an Annual Report of IC effectiveness and corrective actions taken, and 4) updating tables that describes in greater detail

the ICs, the objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms.

Progress: These activities have been completed and are documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

To investigate the extent of benzene remaining above the cleanup goal in the horizontal well area, soil samples were collected in 2011 and up to 650 CY of benzene contaminated soil, primarily in the smear zone, were thought to be contributing to persistent groundwater contamination. To treat this hot spot area, an ISCO treatability study was initiated in 2012. The treatability study included the installation of 10 temporary wells to delineate the plume and the injection of three rounds of an ISCO product in September 2012, October 2012, and October 2013.

Three permanent monitoring wells were installed in the vicinity of the sparge curtain system in 2011. These wells are identified as AP-10220MW, AP-10221MW, and AP-10222MW (Figure 5-10).

A Sparge Curtain PMP was prepared in response to a request made at the annual RPM meeting in 2012. The purpose of the PMP was to provide a decision-making framework for interpretation of the results from site activities, optimize site activities to minimize long-term operation and monitoring cost while maintaining protectiveness of the Chena River, and document the progress towards achieving remedial goals. Data collection activities were conducted in 2012 to evaluate the performance and effectiveness of the Chena River boom (e.g., detailed visual sheen monitoring, collection of surface water, groundwater, and sediment samples adjacent to the boom, and an evaluation of dissolved contamination using a passive sampling technique). This data, along with sparge curtain system data, were used to develop the PMP, which is updated annually. Three objectives were identified in the PMP: (1) evaluate the effectiveness of the sparge curtain system on minimizing contaminant migration into the Chena River, (2) remediate the residual benzene contamination remaining in the WQFS source area above cleanup goals, and (3) evaluate natural attenuation and stability of the WQFS DRO plume.

5.9.4 Site Inspection

An inspection was conducted by USACE on August 11, 2015 to obtain familiarity with the site, review records, examine the remedial action area, and assess protectiveness of the remedy. The site was vegetated with forestation present along the Chena River. A boom was observed in the Chena River and portions of the former AS/SVE and AS curtain were observed, including the injection well banks and portions of the treatment system. FWA staff noted that the systems have been decommissioned and are not currently operating. Monitoring wells were locked and in good condition. No violations of the site-specific ICs were observed. Completed site inspection checklists are provided in Attachment 4 and site photographs are provided in Attachment 5.

FWA staff indicated that LUCs/ICs are maintained as required by the ROD.

The most recent IC review of the OU-5 Remedial Area is documented in the draft 2014 IC report (FES 2013h), which concluded:

- No evidence of unauthorized installation or use of groundwater wells.
- No soil disturbing activities were observed and vegetation is well maintained.

- Informational sign is intact but is showing signs of water damage.
- Wells at the site are easily assessable and are secured.
- Site land use has not changed.

The five-year review site inspection confirmed these conclusions.

5.9.5 Data Review

In 2009, soil sampling in the WQFS1 and WQFS2 treatment zone areas showed that the extent of DRO contamination in soil was similar to the extent identified in the RI and that the majority of the soil contamination was in the smear and saturated zones.

Monitoring activities at WQFS are currently focused on three objectives outlined in the Sparge Curtain PMP: to minimize migration of contaminants into the Chena River, to remediate residual benzene above the cleanup goal, and to evaluate natural attenuation and stability of the DRO plume. The latest findings, presented in the 2015 OU-5 Monitoring Report (FES 2016f), are discussed below and provided in Attachment 10. Well locations are shown on Figure 5-10.

In general, the sampling results from 2014 and 2015 showed water levels significantly higher (greater than 2 ft) than measured in previous years. This elevated groundwater condition was found across FWA and was caused by significant precipitation experienced in the spring and summer and warmer than usual spring temperatures. Changes in benzene, GRO, and DRO contaminant plumes resulting from treatment system operation and natural attenuation within the WQFS are illustrated in Attachment 10 (Figure 4-2).

Sparge Curtain Area

Groundwater samples were collected twice (May and August) in 2015 from nine wells in the Sparge Curtain monitoring program. Monitoring results showed the following:

- Two wells (AP-6946 and AP-7662) contained DRO above the cleanup goal in May 2015. An additional two wells (AP-10235 and AP-10220) detected DRO above the cleanup goal in August 2015. All four of these wells are outside the area excavated in 1998.
- No significant DRO contaminant rebound was observed in the sparge curtain area although persistent DRO contamination was identified in upgradient monitoring wells.
- Sheen was not identified on the purge water associated with wells along the Chena River and occurrence of sheen on the Chena River was intermittent.
- Sheen observations at individual stations along the boom (summarized in Table 3-6, *Chena River Sheen Observations (2012 through 2015)* in Attachment 10) depicts a decreasing trend in NAPL migration to the river.
- There were no observed exceedances of TAH or TAqH.

Natural attenuation parameters were monitored in the Sparge Curtain Area since the curtain was turned off in 2012. Conditions are generally reducing with DO concentrations below 2 mg/L in all wells except AP-10235MW, which was 2.8 mg/L. Groundwater geochemistry was assessed in the area of long-term exceedances of the cleanup level (AP-6946 and AP7662). Anaerobic biodegradation of hydrocarbons is likely occurring with iron, manganese, and/or sulfate reduction.

These results indicate that the contaminant plume is not migrating into the Chena River. According to the 2015 monitoring report for OU-5 (FES, 2016f), sheen has only been observed within the boom area and that the boom is effectively containing sheen releases. This five-year review recommends continued semi-annual groundwater sampling and boom deployment in 2016.

WQFS Source Area

Groundwater samples were collected and analyzed from 25 wells in the WQFS source areas in May 2015. The following results were obtained:

- Benzene concentrations were above the cleanup goal (5 µg/L) in six out of 10 wells in the WQFS benzene area and remained above 10 µg/L in three wells (AP-7455S, AP-10260, and OU5-TW2). Based on a long-term MAROS evaluation and short term trend analysis included in the 2015 monitoring report (see Attachment 10), the benzene Mann-Kendall trends were generally stable or decreasing and there is no evidence of benzene migration:
    - AP-7455S: stable (2007-2015)/stable (2011-2015)
    - AP-10260: Insufficient data available (2007-2015)/potentially decreasing (2011-2015)
    - OU5-TW2: no trend (2007-2015)/no trend (2011-2015)
    - OU5-TW6: no trend (2007-2015)/potentially increasing (2011-2015)
    - OU5-TW8: stable (2007-2015)/no trend (2011-2015)
    - OU5-TW10: no trend (2007-2015)/no trend (2011-2015)
- Benzene concentrations in upgradient monitoring well AP-8064 fluctuated just above the cleanup goal in 2015. The Mann-Kendall results for this well are potentially increasing (2007-2015) and no trend (2011-2015). An increasing trend in benzene concentrations was identified in one other well, AP-5974, located upgradient and across Front Street from the WQFS benzene area; however, the concentration of benzene at this location did not exceed the cleanup goal in 2015.
- The benzene dissolved mass exhibited no trend and decreased slightly between 2014 and 2015.
- DRO exceeded the cleanup goal in eight of 10 wells. The concentrations were lower than those measured in 2014 and the plume shows an overall decreasing trend. The results of a long-term MAROS evaluation were included in the 2015 monitoring report (see Attachment 10):
    - All sampling locations were stable, potentially decreasing, or exhibited no trend except for well AP-5975 located west of the former sparge curtain treatment system. DRO concentrations at this well fluctuated from 2,900 µg/L in 2011 to 3,500 µg/L in 2015.
- GRO concentrations continue to decrease and DRO concentrations remain stable in the WQFS benzene area based on both a dissolved contaminant mass trend and a location of the center of mass trend included in the 2015 monitoring report. The benzene and GRO centers of mass exhibited decreasing trends.
- The spread of the plumes around the center of mass trends showed a decreasing trend parallel and perpendicular to groundwater flow for DRO. The GRO and benzene plumes

showed decreasing trends parallel to groundwater flow and stable trends perpendicular to groundwater flow.

- Wells along the Chena River showed concentrations remaining stable for DRO and TAH.

Geochemical conditions in the vicinity of the DRO plume is largely reducing with DO concentrations less than 1 mg/L. Iron, manganese and sulfate concentrations indicate that reduction of these compounds is occurring. The most reduced conditions (highest dissolved iron and manganese, and lowest sulfate concentrations) were detected south of Gaffney Road within the former Horizontal Well and Source Area treatment areas.

The 2015 monitoring report for OU-5 (FES 2016f) recommended continued annual groundwater monitoring at the WQFS and removal of six wells (OU5-TW3, OU5-TW4, OU5-TW5, OU5-TW6, OU5-TW7, and OU5-TW9) from the monitoring program before the 2016 sampling event. These were temporary wells used for the ISCO treatability study and were not considered necessary for long-term monitoring.

5.9.6 Technical Assessment

5.9.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

Yes, the remedy is functioning as intended by the ROD.

The estimated timeframes to attain cleanup goals at the WQFS included the following:

- WQFS-1 Source Area (2 years) and Chena River (10 years)
- WQFS-2 Source Area (5 years) and Chena River (10 years)
- WQFS-3 Source Area (5 years) and Chena River (5-10 years)

Groundwater contaminant levels (DRO and benzene) remain above the cleanup goals and soil sampling data collected after active treatment indicates the presence of a smear zone that likely continues to contribute to groundwater contamination. Visual inspections of the Chena River identified an intermittent sheen on the water surface.

The RPMs recognized these unfulfilled ROD objectives and in 2012 and recommended the development of a Sparge Curtain PMP to provide a decision-making framework for interpretation of the results from site activities and to document the progress towards achieving remedial goals.

Despite their persistence, monitoring data have shown that the groundwater plumes are stable and significant rebound of groundwater contaminant concentrations has not been observed in the sparge curtain area. Furthermore, the occurrence of sheen in the Chena River has decreased and the boom minimizes contaminant migration.

LUC/ICs have been implemented and are functioning as intended.

Opportunities to improve the performance of ICs have been identified. The IC SOPs were intended to incorporate all information needed to understand the type of restrictions, location of restrictions, and maintenance/enforcement measures for all ICs required across all OUs/sites. Although ICs do not include engineering controls such as fences or caps, LUCs encompass both ICs and engineering controls. It is recommended that a the SOPs and accompanying documents needed to fully define the LUCs across the site, including types of controls, location of controls,

specific responsibilities for LUCs including maintenance and enforcement be incorporated into one comprehensive living document.

Opportunities to reduce monitoring costs were not identified in this five-year review.

The following early indicator of a potential problem was identified for the WQFS: direct correlations between increases in stormwater infiltration and contaminant concentrations were identified.

5.9.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection for protection of human health are still valid. The current exposures and major exposure assumptions for future potential land use at the site have not changed. The toxicity criteria used to develop risk-based cleanup goals are reviewed in Attachment 8. That attachment also evaluates the potential for vapor intrusion at the site, since it was not previously evaluated. USEPA and ADEC guidance on vapor intrusion was either developed or significantly updated within the last five years.

There are no newly promulgated or modified requirements of federal and state environmental laws that change the protectiveness of the remedies implemented.

For protection of the environment (Chena River), the weight of evidence from sampling events performed in the past five years indicates that the RAOs remain protective. The lines of evidence include collection of additional sediment and surface water samples from the Chena River (both discrete and passive surface water sampling), pore water samples from wells placed on the shores of the river, groundwater samples from monitoring wells adjacent to the river, sheen observations along the river, observations of river stage and shoreline width, and the installation of a boom in the river. In 2015, levels of benzene in one of the monitoring wells along the Chena River (AP-10220) showed a potentially increasing trend relative to previous years. Note that benzene remains below the groundwater cleanup goal at this location. DRO is also intermittently detected at monitoring well AP-10220 above the cleanup goal. The concentration of DRO (documented as "stable" based on the 2015 data evaluation) has exceeded the cleanup level three times in the past five monitoring events.

The first exceedance of the DRO cleanup goal was identified in monitoring well AP-10235. The DRO concentrations remain below cleanup goals at wells located closer to the Chena River (AP-10221, AP-7727, AP-77289, and AP-7729). Further monitoring is required to accurately assess whether the increase at AP-10235 is due to groundwater elevation fluctuations or DRO plume migration.

Contaminant increases may be the result of fluctuating water elevations due to precipitation (most notably identified in 2014). There is also residual soil contamination present. The contaminant trends in these wells should be closely monitored in the future to ensure continued protection of the Chena River and to assess the proposed decommissioning of the AS curtain system.

5.9.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No information has come to light that could call into question the protectiveness of the remedy for the intended use of the property as described in the ROD; however, the USEPA has identified 1,4-dioxane as an emerging contaminant.

An assessment has not been performed at the OU-5 WQFS to evaluate whether a release of the stabilizer 1,4-dioxane. A recommendation to perform sampling is included below; however, this issue is not anticipated to affect protectiveness based on the following information:

- LUCs/ICs have been implemented preventing receptors from direct contact with subsurface contaminants at the OU-5 WQFS.
- A hypothetical USEPA VISL was calculated for 1,4-dioxane (530,000 µg/L). This value is over four orders of magnitude greater than a VISL calculated for TCE under the same conditions (15 µg/L). ADEC does not have a VISL for 1,4-dioxane (VISL for TCE in groundwater is 5.2 µg/L). Based on this information, 1,4-dioxane should not pose a risk via vapor intrusion where no risk is identified for TCE.
- Groundwater contaminant concentrations at the OU-5 WQFS are relatively low.
- The closest drinking water supplies include:
    - The Golden Heart Utilities has four water supply wells (AK2310730 - community) located 3.1 miles from the OU-5 WQFS on the banks of the Chena River. These wells are unlikely to be influenced by the OU-5 WQFS due to the distance of separation, low contaminant concentrations, and groundwater flow direction.
    - The system operator was contacted on 27 October 2016 to request monitoring data for 1,4-dioxane as required for this system under the Unregulated Contaminant Monitoring Rule 3 (UCMR3). The operator indicated that the system was sampled for 1,4-dioxane twice in 2013 (February and August), however, the sampling point was at the entry point to the distribution system (post-treatment). The results indicate that no 1,4-dioxane was detected in the water samples at concentrations above the laboratory's minimum reporting limit of <0.07 µg/L. No raw water quality data was available for 1,4-dioxane.
    - Pioneer drinking water wells (AK2310714 - community) for the Hamilton Subdivision are located approximately 1.7 miles from the WQFS (see Figure 3-1). These wells are separated from the WQFS by a hydrogeologic divide (Chena River).
    - FWA has eight on-post wells (AK2310918 - community) and one well servicing the golf course (AK2311095 - non-community). In addition to those wells identified by the State, an emergency water supply well is located within the OU-2 DRMO Yard (see Section 5.3). The well locations are depicted on Figure 3-1. Only one well located on FWA is currently designated as a drinking water source (Building 3559 Water Well). This well is located approximately 1.1 miles southwest from the OU-5 WQFS. Based on the distance of separation and

groundwater flow direction at the WQFS, this well is unlikely to be influenced by the impacts at the WQFS.

- The OU-5 WQFS is located adjacent to the Chena River. Sediment and surface water studies were completed on the River to assess benthic macroinvertebrate toxicological studies and bioassays, and to monitor aquatic biotic integrity. No adverse impacts to the Chena River were identified from releases at the WQFS.
- No other sensitive receptors were identified.

5.9.6.4 Technical Assessment Summary

WQFS1

A source area AS/SVE system was installed in 1997 and expanded through 2001. It was shut down in 2005. A horizontal well AS/SVE system was installed in 1997 and expanded through 2001. It was shut down in 2005. Recent monitoring data indicates that DRO, GRO, and benzene exceeded their cleanup goals. The estimated timeframes to achieve cleanup goals in groundwater have passed. The benzene concentration trends are generally stable or decreasing, GRO concentrations are decreasing, and DRO concentrations remain stable. IC were implemented and are maintained as required in the ROD to prevent receptors from exposure to groundwater impacts. No changes in the ARARs or risk assessment were identified that would affect the protectiveness of the remedy.

WQFS2

A sparge curtain AS/SVE system was installed in 1998. The SVE portion of the system was shut down in 2004 and the AS system was operated until 2012. DRO and benzene have exceeded their cleanup goals; the estimated time frames have passed. Benzene trends are generally stable or decreasing, GRO concentrations are decreasing, and DRO concentrations are stable. IC were implemented and are maintained as required in the ROD to prevent receptors from exposure to groundwater impacts. No changes in the ARARs or risk assessment were identified that would affect the protectiveness of the remedy.

WQFS3

An AS/SVE system was installed in 2000 and shut down in 2003. All COCs have reached their cleanup goals. No changes in the ARARs or risk assessment were identified that would affect the protectiveness of the remedy.

5.9.7 Issues

The following issues were identified that may affect the future protectiveness of the OU-5 WQFS remedy:

- The historical decommissioning of infrastructure may have resulted in the abandonment of pipeline with impacts at the WQFS.
- An assessment for 1,4-dioxane has not been performed at the OU-5 WQFS.

The following concerns were identified that do not affect the protectiveness of the remedy:

- The Chena River boom was lifted off its supports in 2014 and rested along the riverbank due to a rise in the river level caused by heavy precipitation in the spring/summer.

Precautions should be taken to avoid this problem in the future (e.g., increase the height of the support posts).

- RRO, a COC, is not currently included in the groundwater monitoring program. Written justification for eliminating this parameter was not found by the five-year review.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.

5.9.8 Recommendations for Follow-up Actions

The following recommendations for follow-up actions were identified that may affect the future protectiveness of the OU-5 WQFS remedy:

- Conduct an investigation and determine if there are any previously undiscovered source areas at the WQFS.
- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the OU-5 WQFS. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

Recommendations for follow-up actions that do not affect protectiveness of the remedy are provided below:

- Implement measures to avoid future displacement of the Chena River Boom (e.g., increase height of the support posts).
- Provide justification on why RRO was dropped from the monitoring program.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. This will be initiated in November 2016 with a planned completion date of September 2018.

5.9.9 Protectiveness Statement

The remedy at OU-5 WQFS currently protects human health and the environment because:

- Initial remedial responses were performed and AS/SVE systems were installed and operated in accordance with the ROD. The treatment systems have recovered significant contaminant mass and reduced or prevented further migration of contaminated groundwater to downgradient areas and the Chena River.
- Natural attenuation is an active process that has reduced or prevented further migration of contaminated groundwater to downgradient areas and the Chena River.
- Occurrences of sheen in the Chena River have decreased.
- The Chena River Aquatic Assessment Program did not identify adverse impacts to benthic communities in the river.
- ICs are in place to ensure that groundwater containing contaminants above SDWA MCLs, non-zero MCLGs, or relevant AWQS (fresh water use criteria) will not be used until the cleanup goals are attained.

However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness:

- Conduct an investigation and determine if there are any previously undiscovered source areas at the WQFS.
- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the OU-5 WQFS. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

5.10 OU-5 East Quartermaster's Fueling System

5.10.1 Background Information

5.10.1.1 Physical Characteristics

The EQFS area covers approximately 40 acres between Taxiway 18 and the Chena River, and between Building 1579 to the southwest and Building 1054 to the northwest (Figures 2-1 and 5-11). The site is located within the 500-year floodplain of the Chena River. No endangered or threatened species reside in the area. Groundwater is located approximately 15 to 17 ft bgs.

5.10.1.2 Land and Resource Use

Current land use for EQFS is light industrial and groundwater use is considered residential because water supply wells for the City of Fairbanks are located in the same unconfined aquifer as groundwater contamination downgradient of the EQFS. The closest residences to EQFS are approximately ¼ mile northeast. Each residential area includes a school. Access to EQFS is unrestricted and the area is used for recreational purposes, which includes a bicycle trail. Access to the Chena River is unrestricted.

5.10.1.3 History of Contamination

The EQFS has been used for vehicle storage and maintenance, dry cleaning, fuels testing, refueling, pesticide storage and mixing, and waste storage (for example, polychlorinated biphenyls containing transformers, chemicals, paints, oils, brake fluid, and solvents). The EQFS included USTs, ASTs, a pump house, fueling islands, and an eight-inch diameter fuel pipeline that was abandoned but is still in place. Drains were connected to a wooden pipe that connected to the river. Solvents, pesticides, and petroleum contamination were found in groundwater beneath the site. Suspected sources include spills and leaks from pipelines, fueling stations and undocumented spills.

In 1989 and 1992, an investigation showed both petroleum and solvent contamination in the soil and groundwater. In 1994, a comprehensive evaluation of the EQFS was conducted, which included installing groundwater probes, soil borings, and monitoring wells (HLA 1996). The groundwater data identified several plumes (fuels and solvents). The soil data identified fuel and solvent contamination, which was believed to have originated from surface disposal and undocumented spills.

5.10.1.4 Initial Response

In June 1994, prior to the signing of the 1999 ROD, an AS/SVE treatability study was initiated at Building 1060 East. Results of the study showed that AS/AVE would be a viable remedial alternative. A natural attenuation treatability study, initiated in September 1997, showed a reduction in contaminant mass over time.

5.10.1.5 Basis for Taking Action

Based on the results of a baseline risk assessment that assumed industrial use of soil and residential use of groundwater, COCs for OU-5 EQFS were identified in the 1999 ROD. They are listed in Table 5-18.

Table 5-18 OU-5 EQFS COCs

Media	COC
Groundwater	RRO
	DRO
	1,2-DCA
	Toluene
	TCE
	1,2-EDB
	Bis(2-chlorethyl)ether
Soil	DRO
	GRO
	Xylenes
Chena River Surface Waters	TAH
	TAqH

5.10.2 Remedial Actions

5.10.2.1 Remedy Selection

RAOs established in the May 1999 ROD are discussed below.

Groundwater

- Restore groundwater to its beneficial uses within a reasonable time frame (defined as five years). Reduce or prevent further migration of contaminated groundwater from the source areas to the downgradient aquifer or surface water bodies that are closely hydrologically connected by achieving MCLs (where there are no nonzero MCLGs) and AWQS. For groundwater that is hydrologically connected to surface water, AWQS will apply for the following Fresh Water Uses: (l)(A) Water Supply; (l)(B) Water Recreation; and (l)(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife.
- Ensure there is no risk to aquatic receptors through control of contaminant movement through the groundwater into the Chena River.
- Remove LNAPL to the extent practicable to eliminate film or sheen from groundwater.
- Prevent use of groundwater containing contaminants at levels above SDWA MCLs, nonzero MCLGs, or the following AWQS for fresh water uses: (l)(A) Water Supply; (l)(B) Water Recreation; and (l)(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife.

Soil

- Prevent the migration to groundwater of soil contaminants that could result in groundwater contamination and exceedances of federal MCLs and nonzero MCLGs and to groundwater that is closely hydrogeologically connected to surface water (such as the Chena River) that could result in exceedances of AWQS in surface water (EQFS and WQFS).

Chena River Sediments

- Reduce sources of contaminant releases to the Chena River.

Chena River Surface Water

- Meet AWQS for the following fresh water uses: (1)(A) Water "J Supply; (1)(B) Water Recreation; and (1)(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife.
- Continue aquatic assessment.
- The selected remedy consisted of operating an AS/SVE system, ICs, and long-term monitoring and natural attenuation of groundwater COCs.

Cleanup goals identified in the ROD for COCs in groundwater, soil, surface water, and sediment are presented in Table 5-19.

Table 5-19 OU-5 EQFS COC Cleanup Goals

Media	COC or Parameter	ROD Cleanup Goal [1,2]
Groundwater	RRO	1,110 µg/L
	DRO	1,500 µg/L
	1,2-DCA	5 µg/L
	Toluene	1,000 µg/L
	TCE	5 µg/L
	1,2-EDB	0.05 µg/L
	Bis(2-chlorethyl)ether	0.0092 µg/L
	Floating-product petroleum hydrocarbons	Eliminate sheen
Soil	DRO	Active remediation of soils until contaminant levels in groundwater are consistently below state and federal MCLs
	GRO	
	Xylenes	
Chena River Surface Water	TAH	10 µg/L
	TAqH	15 µg/L
	Petroleum hydrocarbons	Eliminate sheen
	COCs identified in the Post-wide risk assessment	Benthic macroinvertebrates assessment to establish baseline and monitor aquatic biotic integrity over time
Chena River Sediments [3]	Contaminated sediments that contain all COCs identified in the post-wide risk assessment	No concentration of toxic substances or petroleum hydrocarbons and other contaminants in bottom sediments allowed that cause deleterious effects to aquatic life
		Benthic macroinvertebrates assessment to establish baseline and monitor aquatic biotic integrity over time[1]

Notes:

1 Groundwater and cleanup goals are maximum contaminant levels from the National and State Drinking Water Regulations (40 CFR 141.61 and 18 AAC 80) and 18 AAC 75 Table C.
2 Surface water cleanup goals are maximum contaminant levels from the Clean Water Act and 18 AAC 70.
3 The Chena River Aquatic Assessment Program was conducted to evaluate the impact from contamination on benthic communities. The results confirmed the presence of PAHs and petroleum hydrocarbon sheens but no adverse impact to benthic communities was identified. As a result, the program was discontinued. This decision is documented in the second Five-Year Review (US Army 2006).

5.10.2.2 Remedy Implementation

The AS/SVE system began operating as a treatability study on the east side of Building 1060 in 1994. It was shut down in September 2000, refurbished, and moved to the west side of Building 1060 where it operated from 2000 to 2005. It was decommissioned in 2010 when groundwater cleanup goals were achieved.

A natural attenuation treatability study was initiated in 1997; it showed a reduction in contaminant mass over time. Monitored natural attenuation was selected for deep groundwater and areas outside the active remediation system in EQFS. These included four areas known as Flowpaths A, B, C, and the Apple Street Hot Spot. Groundwater sampling in these areas was discontinued following the 2010 sampling event, with one exception; three monitoring wells associated with Flowpaths B and C were sampled in 2011 due to the identification of DRO contaminated soil in nearby Buildings 1565 and 1578. The 2011 sampling showed no exceedances of any COC cleanup goal and sampling was discontinued in these wells. The only wells in the EQFS that remain active for sampling are six wells known as the Flowpath D wells. They are currently sampled every five years.

The ROD required the U.S. Army to develop SOPs to identify all land areas under restriction, identify the objectives that must be met by the restrictions, and specify the particular restrictions, controls, and mechanisms to be used to achieve the identified objectives. The SOPs were intended to help assure that the ICs selected in this and other OU RODs were carried out and remain in place until the USEPA, ADEC, and the U.S. Army determine they are no longer needed to protect the public and the environment. The SOPs serve as a single site-wide source documenting all ICs being implemented at FWA. The OU-5 ROD also indicates that the SOPs will be a component of the five year review process.

ICs are maintained to ensure that groundwater will not be used until MCLs are attained. They include restrictions governing site access, construction, and water supply well installation as long as hazardous substances remain on site at levels that preclude unrestricted use. Signs have been installed to inform the public of restrictions and activities in this area.

Each OU is inspected annually and a complete summary of the survey and corrective actions taken are presented in an annual IC report. The first annual report was prepared for 2012 (FES 2013h) and prior IC inspection results were included in the OU-specific annual monitoring reports. IC inspections evaluate potential land use changes, site security (monitoring wells, etc., as applicable), or unauthorized groundwater use. In addition, reviews of the FWA IC GIS layer and the site-specific information in the ADEC Contaminated Sites database are conducted.

5.10.2.3 Operation, Maintenance and Monitoring

There are no active remediation systems operating at the EQFS and maintenance activities are limited to monitoring well inspections. The monitoring wells are inspected during sampling events to ensure that they are accessible, locked, and in good condition. Results of the inspections are presented in the monitoring reports. The wells are also inspected as part of the Installation-wide IC inspection. The last available report (2014) provided comments to replace or repair missing flush mount bolts, a cap, and damaged flush mount lids for three of the EQFS wells.

Groundwater monitoring is conducted every five years at six Flowpath D wells illustrated on Figure 5-11. The last sampling event took place in May 2015. Samples were analyzed for DRO and natural attenuation parameters (DO, ORP, manganese [dissolved], iron [dissolved], and sulfate). A seventh well (AP-7751) was decommissioned in 2012 because it obstructed a construction project. It was sampled prior to decommissioning and analyzed for GRO, DRO, benzene, toluene, TCE, 1,2-DCA, 1,2-EDB, and natural attenuation parameters.

Three wells (AP-6181, AP-7553, and AP-6193) were sampled in 2011 to evaluate potential groundwater contamination resulting from contaminated soil identified in 2010.

5.10.3 Progress Since the Last Five-Year Review

The Third Five-Year Review Report (U.S. Army 2011) provided the following protectiveness statement for OU-5:

> *"The remedy at OU5 currently protects human health and the environment because Institutional Controls are preventing exposure to, or ingestion of, contaminated groundwater. However in order for the remedy to remain protective for the long term, continued monitoring of the Remedial Area 1a fence will be conducted to ensure security and identify the need for repairs."*

Recommendations provided in the Third Five-Year Review Report and progress made to address them are identified below.

Recommendation: Discontinue groundwater sampling in Flowpath A, Flowpath B, Flowpath C, and the Apple Street Hot Spot wells and decommission the wells.

Progress: Sampling was discontinued at these locations following the 2010 sampling event; the wells should be decommissioned.

Recommendation: Continue groundwater sampling in specific wells associated with contamination found at Building 1565.

Progress: Three wells were sampled in 2011 and the data showed no exceedances of any COC. Sampling in these wells was discontinued and the wells should be decommissioned.

Recommendation: Continue groundwater sampling in Flowpath D on a five-year frequency.

Progress: Six of seven Flowpath D wells were sampled in 2015. Well AP-7751 was sampled in 2012 prior to decommissioning.

Recommendation: Implement IC measures that include: 1) performing a post-wide IC inspection and evaluating protectiveness, 2) updating restricted use boundaries in GIS as new information becomes available, 3) developing the parameters for an Annual Report of IC

effectiveness and corrective actions taken, and 4) updating tables that describes in greater detail the ICs, the objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms.

Progress: These activities have been completed and are documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

5.10.4 Site Inspection

An inspection was conducted by USACE on August 11, 2015 to obtained familiarity with the site, review records, examine the remedial action area, and assess protectiveness of the remedy. The site was vegetated. No violations of the site-specific ICs were observed. Monitoring wells were locked and in good condition. Completed site inspection checklist forms are provided in Attachment 4 and site photographs are provided in Attachment 5.

FWA staff indicated that LUCs/ICs are maintained as required by the ROD.

The most recent IC review of the OU-5 Remedial Area is documented in the draft 2014 IC report (FES 2015f), which concluded:

- No evidence of unauthorized installation or use of groundwater wells was observed.
- No soil disturbing activities were observed and vegetation is well maintained.
- Wells at the site are easily assessable and are secured.
- Site land use has not changed.

The five-year review site inspection confirmed these conclusions.

5.10.5 Data Review

The 2015 analytical data for six wells sampled in Flowpath D (AP-7490, AP-7752, AP-7753, AP-7754, AP-7755, and AP-7823) showed DRO concentrations below the cleanup goal (Figure 5-1 in Appendix 10). Note that only DRO was sampled for in 2015 based on a decision made by the RPMs in the Winter 2015 FFA meeting. All other COCs were below cleanup goals after the treatment system was shut down. The 2012 results for well AP-7751 indicate that all ROD COCs analyzed were below the cleanup goals (RRO and bis(2-chlorethyl)ether were not analyzed).

Results of the previous sampling event in 2010 showed DRO exceeding the cleanup goal in AP-7755 (2,500 µg/L). Elevated DRO concentrations below the 1,500 µg/L cleanup goal were also identified in AP-7754 (1,400 µg/L) and AP-7753 (850 µg/L).

DRO concentrations were evaluated in the five-year review using the Mann-Kendall test to determine if any well shows a statistically significant upward or downward trend in concentration (Appendix 10). The results show a downward trend in wells AP-7490, AP-7751, AP-7752, AP-7753, and AP-7754. No trend is identified in wells AP-7755 and AP-7823.

The Chena River Aquatic Assessment Program documented that low concentrations of PAHs were present in sediments adjacent and downgradient of seep areas. With two exceptions, the toxicity to test organisms exposed to seep area sediments was comparable to test organisms exposed to reference area sediments (CH2M HILL 2002). A 2012 OU-5 monitoring report concluded that PAH detections in river sediment do not represent increased ecological risk (FES 2013e).

5.10.6 Technical Assessment

5.10.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

Yes, the remedy is functioning as intended by the ROD.

The AS/SVE system at Building 1060 was operated until MCLs were attained. Groundwater monitoring data has documented that natural attenuation is an active process that has reduced contaminant mass at the EQFS site. COC exceedances have not been observed in groundwater and sampling has been discontinued at the Flowpath A, Flowpath B, Flowpath C, and the Apple Street Hot Spot area. The sampling program now consists of six wells that are sampled every five years at Flowpath D. Recent groundwater monitoring results for DRO at this area were below the cleanup goal.

The estimated timeframe to achieve the cleanup goals was five years at the EQFS. An AS/SVE system operated as a treatability study prior to the ROD from 1994 to 1999 and continued after the ROD from 1999 to 2005 when it was shut down because the groundwater cleanup goals were achieved.

Contaminant source releases to the Chena River have been reduced. Monitoring of Chena River sediments has documented that low PAH concentrations do not represent an increased ecological risk.

Opportunities to improve the performance of ICs have been identified. The IC SOPs were intended to incorporate all information needed to understand the type of restrictions, location of restrictions, and maintenance/enforcement measures for all ICs required across all OUs/sites. Although ICs do not include engineering controls such as fences or caps, LUCs encompass both ICs and engineering controls. It is recommended that a the SOPs and accompanying documents needed to fully define the LUCs across the site, including types of controls, location of controls, and specific responsibilities for LUCs including maintenance and enforcement, be incorporated into one comprehensive living document.

Opportunities to reduce monitoring costs were not identified in the five-year review.

No early indicators of potential problems were identified.

5.10.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

Yes, the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection for protection of human health are still valid.

The groundwater cleanup goals for RRO, DRO, 1,2-DCA, toluene, TCE, and 1,2-EDB were MCL-based. There are no newly promulgated or modified requirements of federal and state environmental laws that would change the protectiveness of the remedies (Attachment 7).

The groundwater cleanup goal for bis(2-chloroethyl)ether was risk-based. The toxicity criteria for this compound has not changed, but the USEPA's current risk-based concentration is now slightly greater due to changes in risk assessment methods (Attachment 8).

For protection of the environment (Chena River), the weight of evidence from various sampling events performed in the last five years indicates that the cleanup goals and RAOs are still valid.

5.10.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No information has come to light that could call into question the protectiveness of the remedy for the intended use of the property as described in the ROD; however, the USEPA has identified 1,4-dioxane as an emerging contaminant. A recommendation to perform sampling is included below; however, this issue is not anticipated to affect protectiveness based on the following information:

- LUCs/ICs have been implemented preventing receptors from direct contact with subsurface contaminants at the OU-5 EQFS.
- A hypothetical USEPA VISL was calculated for 1,4-dioxane (530,000 µg/L). This value is over four orders of magnitude greater than a VISL calculated for TCE under the same conditions (15 µg/L). ADEC does not have a VISL for 1,4-dioxane (VISL for TCE in groundwater is 5.2 µg/L). Based on this information, 1,4-dioxane should not pose a risk via vapor intrusion where no risk is identified for TCE.
- Groundwater contaminant concentrations at the OU-5 EQFS are relatively low.
- The closest drinking water supplies include:
    - The Golden Heart Utilities has four water supply wells (AK2310730 - community) located 3.3 miles from the OU-5 EQFS on the banks of the Chena River. These wells are unlikely to be influenced by the OU-5 EQFS due to the distance of separation, low contaminant concentrations, and groundwater flow direction.
    - The system operator was contacted on 27 October 2016 to request monitoring data for 1,4-dioxane as required for this system under the Unregulated Contaminant Monitoring Rule 3 (UCMR3). The operator indicated that the system was sampled for 1,4-dioxane twice in 2013 (February and August), however, the sampling point was at the entry point to the distribution system (post-treatment). The results indicate that no 1,4-dioxane was detected in the water samples at concentrations above the laboratory's minimum reporting limit of <0.07 µg/L. No raw water quality data was available for 1,4-dioxane.
    - Pioneer drinking water wells (AK2310714 - community) for the Hamilton Subdivision are located approximately 1.9 miles from the EQFS (see Figure 3-1). These wells are separated from the EQFS by a hydrogeologic divide (Chena River).
    - FWA has eight on-post wells (AK2310918 - community) and one well servicing the golf course (AK2311095 - non-community). In addition to those wells identified by the State, an emergency water supply well is located within the OU-2 DRMO Yard (see Section 5.3). The well locations are depicted on Figure 3-1. Only one well located on FWA is currently designated as a drinking water source (Building 3559 Water Well). This well is located approximately 1.2 miles southwest from the EQFS. Based on the distance of separation and direction of

groundwater flow, it is unlikely this well would be adversely impacted by the EQFS.

- The OU-5 EQFS is located adjacent to the Chena River. Sediment and surface water studies were completed on the River to assess benthic macroinvertebrate toxicological studies and bioassays, and to monitor aquatic biotic integrity. No adverse impacts to the Chena River were identified from releases at the WQFS.
- No other sensitive receptors were identified.

LUC/ICs have been implemented and maintained in accordance with the ROD. They have prevented the use of contaminated groundwater.

5.10.6.4 Technical Assessment Summary

An AS/SVE system was operated as a treatability study in 1994 prior to issuing the ROD in 1999. It was shut down in 2005 because the groundwater cleanup goals were achieved. All COC concentrations are below their cleanup goals. No changes in ARARs or the risk assessment were identified that would affect the protectiveness of the remedy.

5.10.7 Issues

The following issue was identified that may affect the future protectiveness of the OU-5 EQFS remedy:

- An assessment for 1,4-dioxane has not been performed at OU-5 EQFS.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.

5.10.8 Recommendations for Follow-up Actions

The following recommendation for follow-up actions was identified that may affect the future protectiveness of the OU-5 EQFS remedy:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the OU-5 EQFS. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. This will be initiated in November 2016 with a planned completion date of September 2018.

5.10.9 Protectiveness Statement

The remedy at OU-5 EQFS currently protects human health and the environment because:

- Initial remedial responses were performed and an AS/SVE system was installed and operated in accordance with the ROD. The treatment system has reduced or prevented further migration of contaminated groundwater to downgradient areas and the Chena River.

- Natural attenuation is an active process that has reduced or prevented further migration of contaminated groundwater to downgradient areas and the Chena River.
- Occurrences of sheen in the Chena River have decreased based on sheen observations at individual stations along the boom documented in the 2015 monitoring report.
- The Chena River Aquatic River Assessment Program did not identify adverse impacts to benthic communities in the river.
- ICs are in place to ensure that groundwater containing contaminants above SDWA MCLs, non-zero MCLGs, or relevant AWQS (fresh water use criteria) will not be used until the cleanup goals are attained.

However, in order for the remedy to remain protective in the long-term, the following action needs to be taken to ensure protectiveness:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the OU-5 EQFS. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

5.11 OU-5 Remedial Area 1A Birch Hill Tank Farm ASTs

5.11.1 Background Information

OU-5 Remedial Area 1A is located on Birch Hill in the northwest corner of FWA (Figures 2-1 and 5-12). As part of the OU-3 ROD, the BHTF area was divided into two areas: Remedial Area 1A, which dealt with the petroleum and lead-contaminated soils surrounding the ASTs on Birch Hill; and Remedial Areas 1B, which dealt with groundwater contamination from the tanks, as well as several other sub-areas in the Birch Hill area. In order to provide more time to select appropriate cleanup goals and remedies for the lead-contaminated soils, Remedial Area 1A was transferred to OU-5.

The BHTF was constructed between 1943 and 1959 as a fuel storage facility. The facility included: fourteen 10,000-barrel and two 25,000-barrel ASTs and associated underground pipeline systems, pump houses, a manifold building, and a truck fill stand. Over the years, the ASTs contained arctic-grade diesel, jet fuel, and leaded and unleaded gasoline. The tanks were emptied and cleaned in 1993, and in January 1994 a closure letter was submitted to ADEC stating that all tanks, facility piping, and fuel handling appurtenances were purged of fuel, cleaned, and the piping was disconnected and flanged off from the tanks and filled with nitrogen. The ASTs were removed in 2015.

5.11.1.1 Physical Characteristics

Remedial Area 1A covers approximately 110 acres. The ground surface gently slopes southward and then westward at about 1.8 ft per mile. The BHTF was constructed on the southwest slope of Birch Hill, between elevations 530 ft and 725 ft, which are above the surrounding river plain and cantonment area that are approximately 450 ft in elevation.

The subsurface contains discontinuous permafrost and poorly drained soils covered by thick organic mats. Surface water ponding is common throughout the area during spring melt-off, after which mid-summer conditions dry the land surface. Wetlands are scattered throughout the area and shrub and forested wetlands border the southern portion. No endangered or threatened species reside in the area.

5.11.1.2 Land and Resource Use

The current land use is considered light industrial in the remedial area and light industrial, recreational, and residential in the surrounding areas. The groundwater below Remedial Area 1A is not currently a source of drinking water, although the Shannon Park Baptist Church and Steese Chapel on Lazelle Road are approximately ¼ mile west and have groundwater wells. Neither of these wells are currently used for drinking water. The U.S. Army currently fills a water holding tank at Shannon Park Baptist Church once a month. Bottled water was supplied to the Steese Chapel, which was discontinued at their request.

Fifty-two acres adjacent to the BHTF was sold in early 2006 for the Lazelle Estates residential housing development. The development included 220 lots, 91 of which were built by 2007. The development shares a property line with FWA, yet housing construction is concentrated along the Steese Highway that is approximately 1,000 ft from the Installation boundary. All of the housing units are on city water.

5.11.1.3 History of Contamination

RIs in this area found petroleum and lead hydrocarbons in surface and subsurface soils, with the most significant levels within bermed areas around the ASTs. The concentrations decreased with depth and distance from the tanks. Petroleum hydrocarbons (identified as Jet A fuel) were detected in surface and subsurface soil at a maximum concentration of 5,500 mg/kg. Low levels of other VOCs also were detected.

The source of the petroleum and lead contamination in soil at the BHTF is sludge from the bottom of the tanks, lead-containing thread lubricant used on bolt threads, and leaded paint chips from tank maintenance. A total of 16 borings were completed and 47 surface soil samples were collected during the RI. Lead was detected in all the samples, with a maximum concentration of 7,840 mg/kg. Figure 5-12 shows the locations of the tanks where samples were taken and where cleanup goals were exceeded. The highest concentrations were detected adjacent to the tanks, with lead concentrations decreasing with distance from the tanks.

In 2006, an investigation was conducted to estimate the volume of contaminated soil surrounding the ASTs. The estimated volume of contaminated soil (exceeding ADEC's industrial use 1,000 mg/kg industrial cleanup level) was 1,850 CY (2,800 tons). The highest concentrations of lead (14,500 mg/kg) were found directly adjacent to the ASTs in the upper 2 ft of soil.

5.11.1.4 Initial Response

No pre-ROD cleanup activities or response actions were performed at OU-5 Remedial Area 1A.

5.11.1.5 Basis for Taking Action

Based on the results of the baseline risk assessment that assumed industrial use of soil, lead was identified as a COC for Remedial Area 1A in the ROD. Petroleum contamination is also present.

5.11.2 Remedial Actions

5.11.2.1 Remedy Selection

The RAO for Remedial Area 1A is to limit human health and terrestrial receptor exposure to lead contaminated soil. The cleanup goal for lead contaminated soil is 1,000 mg/kg.

The selected remedy for Remedial Area 1A presented in the May 1999 ROD is ICs, which include land use and access restrictions, signage, and maintenance of the existing fence. The OU-5 ROD also stated that *"Soils containing petroleum and other contaminants will be cleaned up when the tanks are removed under the conditions of the Two-Party Agreement"*.

5.11.2.2 Remedy Implementation

Each OU is inspected annually and a complete summary of the survey and corrective actions taken are presented in an annual IC report. The first annual report was prepared in 2012 (FES 2013h). Prior to 2014, the results of IC inspections were included in the OU-specific annual monitoring reports. IC inspections evaluate potential land use changes, site security (monitoring wells, etc., as applicable), or unauthorized groundwater use. In addition, reviews of the FWA IC GIS layer and the site-specific information in the ADEC Contaminated Sites database are conducted.

5.11.2.3 Operation, Maintenance and Monitoring

There are no systems or wells associated with OU-5 Remedial Area 1A.

5.11.3 Progress Since the Last Five-Year Review

The Third Five-Year Review Report (U.S. Army 2011) provided the following protectiveness statement for OU-5:

> *"The remedy at OU5 currently protects human health and the environment because Institutional Controls are preventing exposure to, or ingestion of, contaminated groundwater. However in order for the remedy to remain protective for the long term, continued monitoring of the Remedial Area 1a fence will be conducted to ensure security and identify the need for repairs."*

The Third Five-Year Review Report recommended increased security in the BHTF area and repair of the BHTF fence, when required. Based on the information obtained from the 2014 IC Report, installation security was increased and fence repairs were made in a timely fashion.

In the summer of 2015, the BHTF ASTs were removed. Excavation of lead contaminated soil to 400 mg/kg was planned immediately following the AST removal but had to be postponed until spring 2016. Based on work plans submitted by the contractors, Marsh Creek LLC and Weston Solutions, Inc., up to 3,500 tons (2,000 tons plus an optional 1,500 tons) of contaminated soil will be excavated and disposed of offsite. Following excavation, confirmation samples will be collected from the bottom and sidewalls of each excavation and the excavation will be backfilled. A lead contaminated soil removal work plan was approved and the removal actions are planned for implementation in 2016.

The Third Five-Year Review Report also provided a requirement to implement IC measures that include: 1) performing a post-wide IC inspection and evaluating protectiveness, 2) updating restricted use boundaries in GIS as new information becomes available, 3) developing the parameters for an Annual Report of IC effectiveness and corrective actions taken, and 4) updating tables that describes in greater detail the ICs, the objectives to be met by the restrictions, and any specific restrictions, controls, and mechanisms. These activities have been completed and are documented in annual IC reports prepared for 2012, 2013, and 2014 (FES 2013d, 2015a, 2015f).

IC inspections of the OU-5 Remedial Area 1A fence were conducted monthly between February and December 2014. The inspections were conducted only along the western boundary (which is most prone to breaches) due to access limitations around the rest of the fence from snow in the winter. Several breaches to the security fence were observed during some of these inspections. FWA DPW was notified and repairs were made. Graffiti was also observed on the former tanks and fence signs.

5.11.4 Site Inspection

Remedial Area 1A was inspected by USACE on August 11, 2015 to examine the remediated areas and assess the protectiveness of the remedies. The site was forested and included staging areas for remedial activities occurring on 2-PTY sites and other construction activities. All wells appeared locked and in good condition. Fuel piping was observed in the area; FWA staff indicated that the piping is associated with the pipeline and not the tank farm.

Evidence of historical trespassing including fencing damage (repaired) and graffiti were observed onsite. Fencing repairs were completed. The information sign was in good condition. Site inspection checklists are provided in Attachment 4 and site photographs are provided in Attachment 5.

FWA staff indicated that LUCs/ICs are maintained as required by the ROD.

The IC review of the OU-5 Remedial Area documented in the draft 2014 IC report concluded the following:

- No evidence of unauthorized installation or use of groundwater wells was identified.
- No soil disturbing activities were observed and vegetation is well maintained.
- Informational sign is intact but is showing signs of water damage.
- Wells at the site are easily assessable and are secured.
- Site land use has not changed. The ASTs have been removed from the site.

The five-year review site inspection confirmed these conclusions.

5.11.5 Data Review

There is no data available for review because monitoring is not performed at Remedial Area 1A.

5.11.6 Technical Assessment

5.11.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

Yes the remedy is functioning as intended by the ROD. LUCs have been implemented and are limiting human and terrestrial receptor exposure to lead contaminated soil.

No early indicators of potential problems were identified.

5.11.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

Yes, the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection for protection of human health are still valid. The current exposures and major exposure assumptions for future potential land use at the site have not changed. The toxicity criteria used to develop risk-based cleanup goals are reviewed in Attachment 8.

Although the RBC for industrial exposure to lead in soil (identified as a to-be-considered criterion in the ROD) is now lower than it was at the time of the remedy, this does not affect protectiveness of the remedy since the current target for excavation of contaminated soil is the USEPA's RBC for protection of residential exposure. Remedial action is currently being planned to remove the contaminated soil from Remedial Area 1A (Marsh Creek and Weston 2015). The current plan is to remove all soils in excess of 400 mg/kg lead, which is the target level to protect human health in a residential setting (USEPA 2015b). The remedial action identified in the 1999 OU-5 ROD referred to a To-Be-Considered criterion of the USEPA's Region 9 Industrial Preliminary Remediation Goal (1,000 mg/kg lead) at the time of the ROD. The USEPA's current industrial RBC for soil lead is 800 mg/kg (USEPA 2015b). The lowering of the RBC to protect industrial exposure does not affect the protectiveness of the remedy at area 1A, since the decision was made to excavate all lead concentrations above 400 mg/kg, which is protective of residential use.

5.11.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy for the intended use of the property as described in the ROD.

5.11.6.4 Technical Assessment Summary

The Remedial Area 1A remedy, ICs, was implemented and is maintained as required by the ROD. The ICs limit receptor exposure to lead-contaminated soil. No changes to the ARARs or risk assessment were identified that would affect the protectiveness of the remedy.

5.11.7 Issues

No issues were identified that affect protectiveness of the remedy at OU-5 Remedial Area 1A.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.

5.11.8 Recommendations for Follow-up Actions

There are no recommendations for follow-up actions at OU-5 Remedial Area 1A.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. This will be initiated in November 2016 with a planned completion date of September 2018.

5.11.9 Protectiveness Statement

The remedy at OU-5 Remedial Area 1A (BHTF ASTs) is protective of human health and the environment because:

- ICs are in place to limit human and terrestrial receptor exposure to contaminated soil
- There is no evidence of unauthorized installation or use of groundwater wells, no soil disturbing activities, and warning signs are intact.

5.12 OU-5 Open Burning/Open Detonation Area

5.12.1 Background Information

The OB/OD Area, formerly called the Explosives Ordnance Detonation Area, is within an active small-arms impact range on FWA. It is located approximately 1,000 ft north of the Tanana River and 1,500 ft south of a flood control dike. The exact boundaries of the OB/OD Area have not been well defined. The historically depicted extents of the OB/OD Area are provided on Figure 1-11, *OB/OD Area Site Plan*, in Attachment 11. It contains a berm that measures about 150 ft by 450 ft. The site was used by the U.S. Army from as early as the mid-1960s to as late as the mid-1980s for open burning/open detonation of unexploded ordnance and dud ordnance, unused propellants (black powder), rocket motors and small-arms ammunition.

The OB/OD Area was identified as a RCRA-regulated land-based unit in the 1991 FFCA that was signed by the U.S. Army and USEPA. Required corrective actions for the OB/OD area outlined in the 1991 FFCA and the 1992 FFA include the following actions: (1) submit a closure plan and post-closure plan with the interim status standards; and (2) integrate all RCRA corrective actions with any ongoing CERCLA response actions. The USEPA, ADEC, and U.S. Army decided to combine response actions under RCRA and CERCLA remedial action for the following reasons: the OB/OD Area is administratively subject to RCRA closure authority; the OB/OD Area is within the active firing range, which is subject to CERCLA authority; there were similar, but not identical, historical actions that took place at the OB/OD Area (destruction of explosives) and the range (use as a firing range with residuals of explosives remaining); and applying CERCLA authority concurrently with RCRA closure and corrective action requirements will minimize response costs as much as possible while remaining fully protective.

USEPA also determined that it was appropriate to allow final RCRA closure of the OB/OD Area concurrently with final clearance of the operating range, because the OB/OD Area is within the operating range and because it was anticipated that unexploded ordnance (UXO) would continue to be present at the operating range, RCRA closure prior to range closure would be technically complex, with little, if any, demonstrable environmental benefit. Therefore, USEPA approved the delay of closure of the OB/OD Area in accordance with 40 CFR 265.113(b)(l)(I). The OU-5 ROD was released pursuant to CERCLA and RCRA to record a no further action decision on remedial and corrective action and the decision to delay administrative closure of the regulated unit.

In accordance with the ROD and the RCRA permit, the U.S. Army is required to evaluate, no less often than the five-year reviews, whether delay of closure of the OB/OD area is no longer viable for one of the following reasons:

- The active range is no longer operating
- The post is being closed
- Any other reason

The ROD also states that *"The Army also will evaluate the status of RCRA rules and regulations for military munitions ranges and unexploded ordnance to determine whether additional RCRA requirements must be met."* The site is also subject to inspections to determine whether ICs to restrict land use and protect human health and the environment are sufficient.

5.12.1.1 Physical Characteristics

The OB/OD Area has not been used since the mid-1980s. It is situated within an active small-arms impact range on FWA. The physical location is approximately 1,000 ft north of the Tanana River and 1,500 ft south of a flood control dike. The site is located along the east side of a water-filled, gravel borrow pit and is bounded to the north and east by gravel berms. The bermed area comprising the OB/OD site measures approximately 150 ft by 450 ft. The soil within the OB/OD area is a permafrost silty clay. The OB/OD Area was cleared of trees and brush in early 2015 in order to prepare the area for a geophysical survey conducted to evaluate the location as a possible staging area in support of a Tanana River Burial Pit Removal Action (ERDC, CRREL 2015).

5.12.1.2 Land and Resource Use

The OB/OD Area is an active RCRA-regulated unit located within an operational range area known as the small-arms range impact range. The area is also part of a dud impact area. The reasonably anticipated future use of the land continues to be as an operational range. FWA has no plans to close the range. According to DoD policy, the OB/OD Area cannot be used for other purposes or transferred to the general public unless the unit is closed in accordance with the RCRA permit and clearance techniques ensure the area is sufficiently free of UXO and related hazards.

5.12.1.3 History of Contamination

The history of contamination presented below is based on referenced CERCLA and RCRA documents. The U.S. Army intends to perform a file review to garner additional history on the site. A schedule for the file review was not available at the time of the five-year review. The U.S. Army also intends to obtain more detailed site boundary information at the time of the RCRA closure. This work is postponed while the site functions as a portion of an active range.

The OB/OD Area was reportedly used for disposing of UXO and dud ordnance, unused propellants (black powder), rocket motors, small-arms ammunition, and other hazardous materials. A RCRA Facility Assessment (RFA) was conducted at the OB/OD Area in 1991. The RFA indicated that FWA EOD Detachment operated occasionally and detonated less than 4,000 pounds of waste ordnance each year. It noted that the maximum explosive charge used to detonate munitions was a 50-pound charge and was usually C-4. During the winter months, the charge was reduced to 25 pounds or less because of atmospheric conditions.

According to the 1996 RI, field representatives from the U.S. Army, USEPA, ADEC, and USACE accompanied by two ordnance experts, completed a site visit on September 1, 1994. With the assistance of the ordnance experts, this reconnaissance team identified appropriate sampling locations. Eight soil samples were collected at a depth of 3 to 6 inches bgs on the inside lip of two impact craters and from four areas where vegetation appeared stressed or sparse. Initially, samples were only going to be collected in detonation craters. However, during the field visit, the reconnaissance team agreed that the low vegetation areas also should be sampled. One water sample was collected from a detonation crater. This sample is considered representative of a groundwater sample, because the water level in the crater was reflective of groundwater elevation. The sampling strategy was designed to identify the worst-case contamination at the site. The 1994 sampling locations and results are depicted in Attachment 11, Figure 1-12, *OB/OD Area Chemical Concentrations in Soil and Water*. All samples were

analyzed for halogenated VOCs, DRO, pesticides, PCBs, chemical agents, organosulfur compounds, explosives, explosives breakdown products, thioglycol, and chloroacetic acid.

An additional eight soil samples were collected from approximately the same locations for metals analyses from the OU-5 OB/OD Area during the OU-5 RI in 1996. Background samples were also collected from two locations 1,100 ft northwest of the OB/OD Area, which are depicted in Attachment 11, Figure 3-3, *OB/OD Area Surface Soil Sample Locations*. The soil samples were collected from 3 to 6 inches bgs. Details of these sampling events including sample locations and results are provided in the RI.

According to the OU-5 ROD, the sampling program for the OB/OD area was designed to identify any released contaminants from historical detonation activities. The primary sources of observed contaminants are explosive ordnance that was destroyed during the normal course of operation. Information about the potential hazardous wastes and hazardous waste constituents at the OB/OD Area was obtained primarily from the results from a 1994 surface soil sampling investigation conducted by the U.S. Army, and results from the 1996 OU-5 RI. Data tables from the RI have been extracted and included in Attachment 11 as Table 6-16, *Concentration Ranges and Detection Frequencies of Analytes Detected in Soil Samples from OB/OD Area* and Table 7-1, *Comparison of Metals Concentrations in Surface-Soil Samples at the OB/OD Area to Background Concentrations*.

No contaminants that exceed any ARARs were identified at the OB/OD Area. On the basis of the low levels of DRO and the organosulfur compound (Planevin) identified, no risk assessment was completed. The OB/OD Area is within an active range, where human access is extremely restrictive. The evaluation of the site indicated that there were no complete exposure pathways for contaminants and that the contaminants exist at such low levels that they are not of concern. The low contaminant levels were found to not pose an unacceptable risk to human health or the environment. Additionally, since the earliest site investigations in 1990, no munitions or munitions debris have been observed in the OB/OD Area. On the basis of the results of the RI/FS at the OB/OD Area and an evaluation of data collected at the site, no further action was selected for the OB/OD Area. Because of concerns about potential human exposure to UXO, it was noted that ICs to monitor and control access and to restrict land use would apply to the OB/OD Area.

There is no evidence that the OB/OD Area was used to store or bury munitions or munitions debris.

5.12.1.4 Initial Response

No pre-ROD cleanup activities or response actions were performed at OB/OD Area.

5.12.1.5 Basis for Taking Action

The OB/OD area was a RCRA regulated unit subject to closure requirements. It was located within an operational range that may have been contaminated by munitions constituents and potential UXO associated with intended use as a range. Therefore, closure was delayed. A component of the decision to delay closure was the ICs associated with the operational range, which restricted use and access.

5.12.2 Remedial Actions

The OU-5 ROD states that *"…no further action is selected for the former OB/OD area for hazardous chemicals. Because of concerns about potential human exposure to unexploded ordnance, the Army has institutional controls that provide monitoring and control of access of the site. These controls are required to remain in place. No analysis of remedial alternatives was conducted for the OB/OD area."* Although no remedial actions were required to address hazardous chemicals at the OB/OD area, the ROD requires that no less often than during the CERCLA five-year reviews, the U.S. Army will evaluate the OB/OD area. This evaluation would include review of the active range and any UXO within the OB/OD area and range to determine whether ICs to restrict land use and protect human health and the environment are sufficient. The U.S. Army would also evaluate the status of RCRA rules and regulations for military munitions ranges and UXO to determine whether additional RCRA requirements must be met.

The U.S. Army implemented ICs at the OB/OD Area in 1999. Figure 5-13 in Attachment 1 depicts the boundaries of the ICs.

5.12.3 Progress Since the Last Five-Year Review

The third five-year review for FWA evaluated whether delay of closure affected the OB/OD Area. It determined that delay of closure did not affect the OB/OD Area because the range had not been closed and FWA continued to be an active installation. Therefore, it was concluded that continued delay of closure of the site was appropriate.

5.12.4 Site Inspection

A road has been hardened to provide access for a removal action in an area where buried munitions and munitions debris were discovered adjacent to the Tanana River, approximately 1000 ft from the OB/OD Area. A locked gate controls vehicular access to the road, which runs adjacent to the OB/OD Area. The Tanana River site is not part of the OB/OD Area and is undergoing a removal action for munitions and munitions debris buried at the site.

The OB/OD Area primarily consists of dense tree and brush growth. It contains an approximate 2 acre area that was cleared in 2015 for a geophysical survey. The surrounding area is wooded. A lake created from a gravel borrow area, is west of the site. Nothing beyond the clearance of trees demarcates it as being different than other areas of the operational range.

5.12.5 Data Review

After review of the OU-5 ROD, RCRA Permit and attached Interim Closure Plan, no information has been received to suggest that no action is no longer protective of human health and the environment. A *Safety Clearance Survey to Support the Evaluation of the Proposed Staging Area for the Tanana River Burial Pit Removal Action Summary Report* (ERDC, CRREL 2015) was also reviewed. Based on the Safety Clearance Report, a visual and geophysical survey was conducted in the OB/OD Area to determine whether the area was suitable as a staging area and did not evaluate protectiveness of the remedy. According to the Safety Clearance Report, no UXO or discarded military munitions were discovered in the area surveyed, and based on the electromagnetic survey, it was concluded that the area is considered safe for use as a staging area for future removal actions at the Tanana River site.

Trespassers were discovered on the nearby Tanana River site in June 2013. The U.S. Army notified the USEPA of the following enhancements to the ICs at the OB/OD Area as a result of this discovery (U.S. Army 2016):

- Patrols conducted by range control personnel have been increased to weekly.
- Additional signage has been placed along the perimeter of the impact area that includes the Tanana River site and OU-5 OB/OD Area to warn people both of the potential explosives hazards associated with the impact area and that the impact area access is restricted.
- Periodic inspections of the signs is performed.
- A temporary access road was constructed to provide access for the removal of the Tanana River burial site and a staging area near OU-5 OB/OD. A gate has been installed to prohibit entry to the road leading to the Tanana River site and OU-5 OB/OD Area.
- Daily inspections of the temporary access road and flood control dike are required when the operational range is in use. The operational range is normally active Monday through Friday each week.

The access road will be removed once the removal action at the Tanana River site is completed. The patrols and periodic inspections will continue to be conducted by range personnel and environmental staff, respectively.

The U.S. Army plans to perform a file review to collect additional information on the OU-5 OB/OD Area to present a thorough narrative of site history and use.

5.12.6 Current Status of the Site

A technical assessment was not performed for the OU-5 OB/OD area since no further action was selected for the former OB/OD area for hazardous chemicals.

Based on ICs in place for the operational range that limit land use and access, it is appropriate that closure of the OB/OD Area under RCRA continue to be deferred. Although, trespassers accessed an area of the operational range known as the Tanana River burial site, there is no evidence that trespassers have accessed the OB/OD area. The Tanana River burial site and the OB/OD Area are distinct and dissimilar sites. The Tanana River burial site is adjacent to the Tanana River, which can be used by the public. Because of the eroding river bank, brass munitions from the Tanana River burial site could be seen from the river. The OB/OD Area is not adjacent to publicly accessible water bodies or roads, and nothing demarcates the unit as being different than the rest of the operational range area. Additionally, the OB/OD Area was used for open burn and open detonation activities and has been found to pose no unacceptable risk. The ICs required for the OB/OD Area are a result of the regulated unit being located within an operational range, which is and will continue to be subject to the deposition of intended use munitions that may pose an explosive hazard. After the discovery of the Tanana River burial site, FWA Range Control reviewed the range controls that are in place. Signs warning of hazards and prohibiting access were inspected and added, patrols were increased, a gate was added, and Range Control is updating its Range Control Standard Operating Procedures to ensure that these measures remain in place.

The U.S. Army has evaluated whether delay of closure affects the OB/OD Area and has determined it does not. No UXO have been discovered and the OB/OD Area has not been disturbed. Additionally, no new RCRA or munitions' rules have been promulgated in the last

five years that would change the unregulated status of intended use munitions or UXO on the operational range. An ARAR evaluation has been completed as required in the RCRA permit and is included in Attachment 7.

The range has not been closed and will continue to be used as operational range into the reasonably anticipated future. Additionally, if UXO is discovered during patrols, the UXO will be addressed in accordance with normal range clearance procedures. The area continues to be subject to deposition of munitions and munitions constituents, making closure technically complex and with little if any demonstrable environmental benefit. Therefore, the current ICs are sufficient to protect human health and the environment, and the delay of closure of the OU-5 OB/OD unit continues to be appropriate.

The U.S. Army is currently drafting a SOP for inspection of the OB/OD Area. Current activities include inspection of the site gate every day that live-fire exercises are conducted, and weekly routine inspections. No detailed documentation of these activities is prepared; however, the SOP will require specific inspection of the OB/OD Area for site use and activities. Any issues identified during inspections must be reported to the DPW Environmental staff.

5.12.7 Issues

No issues were identified affecting the protectiveness of the OU-5 OB/OD area or delayed closure under the RCRA permit.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.

5.12.8 Recommendations for Follow-Up Actions

No recommendations for follow-up actions were identified affecting the protectiveness of the OU-5 OB/OD area or delayed closure under the RCRA permit.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. The development process will be initiated in November 2016 with a planned completion date of September 2018.

5.12.9 Protectiveness Statement

A remedy has not been selected for the OU-5 OB/OD Area. The following statement was developed to meet the requirements for an assessment of delayed RCRA closure and UXO ICs:

No further action with UXO ICs and delayed RCRA closure of the OU-5 OB/OD area is protective of human health and the environment.

This statement is supported by the following:

- The OB/OD IC components have been improved since trespassers were identified on a site located 1,000 ft from the OB/OD Area. Improvements include increased frequency of inspection and access controls.

- There is no evidence of unauthorized installation or use of groundwater wells or evidence of soil disturbing activities, and warning sites are intact at the OB/OD Area.

5.13 OU-6 Former Communications Site

5.13.1 Background Information

OU-6, Former Communications Site, is situated on FWA between Alder and Neely Roads, east of White Street and west of the FWA Central Heat and Power Plant (Figure 2-1). OU-6 previously contained or was used for barracks, company headquarters, communications and radar systems, salvage/reclamation yard activities, debris disposal, firefighter training, and possible ammunition storage. Much of what is known about OU-6 has been inferred from historical photographs from 1947 to present, the 1958 FWA "Master Plans", past geographical surveys, and military operations with similar missions conducted at other locations.

The Former Communications Site was selected for construction of military housing, referred to as the Tanana Trails Family Housing Development (formerly known as Taku Gardens Family Housing Development), in 2002 and 2003. Work began in mid-2005 with the installation of foundations and underground utilities for 65 planned residential buildings and two mechanical buildings. Construction activities for the housing development lead to the discovery of buried debris and munitions-related items and environmental contamination in soil and groundwater at the site.

5.13.1.1 Physical Characteristics

OU-6 is approximately 54 acres. Housing units (55 structures) and related infrastructure have been constructed on the site. Current site conditions are shown on Figure 5-14.

Soil beneath the site generally consists of sandy silt near the surface that changes to sand and sand with silt and gravel at approximately 8 to 10 ft bgs. Permafrost and low subsurface temperatures have only been reported in the southeastern portion of the site (CH2M HILL 2010c).

OU-6 is located within the Chena River floodplain. Surface water is channeled through engineered drainage swales in west and northwest sections of the site. The Chena River is located approximately 1,500 ft north of the site.

Groundwater occurs in Chena Formation sediments at approximately 13.5 to 23 ft bgs. Unconfined conditions are present in permafrost-free areas. Groundwater generally flows northwest, consistent with regional flow in the Tanana Basin alluvial aquifer. The Chena Formation has relatively high hydraulic conductivity, estimated at up to 1,400 ft per day. The vertical hydraulic conductivity is estimated at 30 ft per day (U.S. Army 2015).

5.13.1.2 Land and Resource Use

The Former Communication Site was selected for development in 2003/2004, and construction of 64 original military housing units began in April 2005. Occupancy of the housing development was prohibited by an action memorandum issued in 2007 (U.S. Army 2007). This requirement, along with perimeter fencing, were rescinded by the OU-6 ROD (U.S. Army 2016). Housing units at OU-6 are now occupied by military families stationed at FWA (U.S. Army 2015).

Groundwater is the only potable water source for FWA and the Fairbanks area. Approximately 95 percent of the potable water on FWA is supplied by two large capacity wells located in Building 3559, which is outside the northeast corner of OU-6. The wells were installed to a

depth of approximately 100 ft bgs and screened from 60 to 80 ft bgs. They provide approximately 1.6 to 2.4 million gallons of water per day.

5.13.1.3 History of Contamination

Previous site activities included the dumping of solid waste and debris into a former meander channel of the Chena River (Hoppe's Slough). Unusable military equipment and hardware discarded by the U.S. Army and U.S. Air Force was also buried onsite. Aerial photographs taken between 1948 and 1967 show drum stockpiles, fire training burn areas, and the remains of a wrecked aircraft. A Post Exchange Service Station (gas station) and a salvage yard were located in the northeast section of the site.

The Former Communication Site was selected for future military housing in 2002/2003 (OASIS 2007). Site investigations conducted prior to construction of the housing development identified surface and buried materials that consisted of metal and munitions debris. U.S. Army munitions experts determined that the munitions debris did not contain any explosive hazards. PCB soil contamination was detected. Site investigations ensued, which are summarized below (OASIS 2007).

- **October 2003** - Soil borings installed and sampled during a geophysical and geotechnical survey performed by USACE, Alaska District and the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) documented the presence of metal debris at the Former Communication Site.
- **November 2003-November 2004** - Pre-construction soil boring sample results collected during the USACE geotechnical/chemical surveys indicated low-level PCB compounds in two soil borings. Metal debris was encountered in some of the geotechnical soil borings.
- **April 2004** - Site clearing activities were performed and uncovered extensive amounts of scrap metal, drums, and discarded military Munitions and Explosives of Concern (MEC) in the north section of the source area.
- **May 2004** - R&M Consultants, Inc. conducted a geophysical survey for housing construction. The survey documented subsurface metallic debris at several locations.
- **March and April 2005** - A follow-up limited characterization was performed and did not confirm the presence of PCBs previously detected in two soil borings.
- **June 2005** – Petroleum contamination was discovered in the northwest corner of the Former Communication Site (in the area of Building 5 through 9) during housing construction. Soil and groundwater samples were collected and confirmed fuel contamination.
- **Late June 2005** – High levels of PCBs and associated chlorinated solvents were detected in the original Building 52 foundation. A construction site clearance for PCBs identified high levels of chlorinated contamination in the surface and subsurface soil. Ongoing construction activities were using or moving the potentially contaminated soil at the construction site.
- **August 2005** – Investigations were initiated to ensure protectiveness of workers and nearby residents. Stockpiled soil, trenches, and traffic areas were kept wet to minimize dust and air transport of contamination from the site. In addition to soil sampling, the investigation included collection and testing of wipe samples from adjacent residences

west of the Former Communication Site and construction equipment left on-site when the U.S. Army suspended construction activities, and shallow groundwater testing. On-site field screening of Aroclor 1260 supplemented the off-site analytical testing.

- **2005-2006** – Preliminary source evaluations were conducted to provide sufficient information to determine if a RI was required. An initial phase evaluation consisted of reviewing historical information about site activities, waste disposal practices, and prior investigations. A second phase evaluation focused on characterizing buried debris, soil, soil gas, stockpiles, and groundwater at the site.
- **2007 to 2010 -** RI data established the nature and extent of contamination at the site. Modelling of drinking water supply wells adjacent to the northeast corner of the site (Building 3559) suggested that the hydraulic capture zone associated with a pumping rate of 1,700 gallons per minute would extend to a limited portion of the site where contaminated groundwater had historically exceeded ADEC cleanup levels.

The extent of soil and groundwater contamination identified at OU-6 is illustrated on figures provided in Attachment 12.

Five areas of concern (AOCs) (also referred to as source areas) were identified through the review of historical documents and investigation results at the Former Communication Site. The AOCs are depicted in Attachment 12 on an OASIS figure, *Source Areas,* and labeled as figure Appendix C. The AOCs are described as follows:

- **Subarea A**: Formerly a fenced storage area used from the early 1940s to late 1960s. Stored materials may have included salvaged parts and drums. Additional uses include a concrete batch plant, company headquarters, barracks, and railroad tracks. A large stained area was identified where fire training activities may have occurred. Airplane debris was also observed on historical aerial photographs.
- **Subarea B**: This area was formerly developed with temporary buildings for company headquarters and barracks. DRO was detected in groundwater and soil associated with fuel storage for military activities in the 1950s.
- **Subarea C**: Former location of company headquarters and barracks. Buried metal debris and odors were encountered during excavations in this area. The metal debris was removed by construction activities.
- **Subarea D**: This area was used for salvage activities beginning in the 1940s. Other activities include munition, live ammunition, transformer, and drum storage.
- **Subarea E**: This area was formerly the location of communication and radar systems. The area may have also been used for the storage of live ammunition, weapons, and rockets.

5.13.1.4 Initial Response

The U.S. Army performed several response actions prior to the ROD. These are described below and illustrated on figures provided in Attachment 12.

- **Time-critical removal action (2005)**: Soil/debris was removed from the site coincident with characterization activities. A chain-link security fence was erected around an exclusion zone on the site and an 8-ft high permanent chain-link fence with three-

stranded barbed wire was installed around the perimeter of the entire site. Warning signs were placed every 100 ft on the chain-link fence.

- **Preliminary source evaluations (2005 to 2006)**: Petroleum contaminated soil was excavated and transported to an off-site thermal treatment facility in Fairbanks, Alaska. The treated soil was disposed of at the FWA solid waste landfill. Non-hazardous metallic debris was segregated from soil and disposed of at the FWA solid waste landfill.
- **Interim LUCS (2007)**: Interim LUCs are described in a 2007 Action Memorandum (U.S. Army 2007), which documented the time-critical removal action and established interim LUCs for the site that would remain in place until permanent LUCs were established in a ROD. The interim LUCs consisted of:
    - Prohibiting residential use and occupancy of newly constructed housing units until all investigation and cleanup required under CERCLA to protect human health and the environment was complete and regulator coordination had been undertaken.
    - Maintaining fencing and warning signs around the perimeter of the site to restrict access.
    - Groundwater use restrictions prohibiting the drilling and use of water wells for potable water, fire suppression, irrigation or other consumptive purposes.
    - Prohibiting soil disturbing activities associated with construction or renovation of new or existing facilities to include residential and commercial construction, road repair and realignment, utility work, digging, trenching, excavation, paving, or drilling of soil borings except when such activities were carried out in accordance with an Excavation Clearance Request approved by the U.S. Army in consultation with USEPA and ADEC. In cases of emergency, standard reporting requirements and practices would be followed.
- **RI-related removal activities (2007 to 2010)**:
    - PCB-contaminated soil was excavated, characterized, and properly disposed.
    - Petroleum- and pesticide-contaminated soil was excavated, characterized, and properly disposed.
    - Mostly crushed and empty drums and non-hazardous munitions-related items were excavated and properly disposed or recycled. Contaminated soil was excavated, characterized, and properly disposed.
    - Drums and grease-affected soil from beneath Building 49 were removed.
    - Construction-generated soil was properly disposed.
- **Post RI time-critical removal action (2010 - 2011)**:
    - Contaminated soil from three excavations (north of Building 11, east of Building 48, and south of Building 24) was properly disposed.
    - DRO-contaminated soil from a drainage swale excavation was removed and disposed.
    - Metal debris, overpacks of expended charcoal filters, and potentially chromium-contaminated soil associated with charcoal filters found in the vicinity of Building 27 were removed and properly disposed.

- DRO, TCE, and benzene-contaminated soil from a drainage swale excavation north of Building 38 was removed and properly disposed.
- Contaminated soil near Building 42 (western side of the site) was excavated and properly disposed.

The total amount of waste removed during these actions is summarized below (U.S. Army 2012, 2014).

- 3,368 CY of PCB contaminated soil
- 66 CY of pesticide contaminated soil
- 3,354 CY of petroleum/solvent contaminated soil
- 2,934 items classified as munitions related debris
- 1,061 drums, all but eight of which were empty and crushed

5.13.1.5 Basis for Taking Action

Environmental investigations conducted prior to and during the RI identified contaminated soil and groundwater (U.S. Army 2014).

Soil

Debris, drums, munitions-related items, and contaminated soil encountered during investigation activities and removal actions were removed to the greatest extent practicable and properly disposed of. Soil contaminated with POL and residual concentrations of 1,2,3-TCP, VOCs, SVOCS, pesticides, herbicides, and explosive compounds remained in the subsurface between 5 and 15 ft bgs.

Groundwater

Groundwater at OU-6 is contaminated with POL and VOCs. Presumed source areas were removed to the greatest extent practicable. Five groundwater plumes are present:

- A TCE plume
- A TCP plume
- A main DRO plume
- DRO plumes associated with monitoring wells MW62 and MW77

Site COCs were documented in the ROD (U.S. Army 2014) and are listed in Table 5-20.

Table 5-20 OU-6 Former Communications Site COCs

Media	COC
Soil	1,2,3-TCP
	DRO
	Aluminum
	Copper
	Manganese
Groundwater	1,2,3-TCP
	TCE
	DRO
	RRO

5.13.2 Remedial Actions

5.13.2.1 Remedy Selection

RAOs established in the January 2014 ROD (U.S. Army 2014) are listed below.

Soil

- Protect against human exposure to COCs in soil. This RAO will be achieved if soil containing COCs at concentrations exceeding PCLs is managed through administrative processes, or if COCs in soil are reduced to meet the cleanup goals.

Groundwater

- Protect against human exposure to COCs in groundwater. This RAO will be attained if the exposure pathway to human receptors is limited or eliminated through administrative processes, or if COC concentrations in groundwater are reduced to meet the cleanup goals.
- Return groundwater to its beneficial use as a drinking water source. VOCs are expected to reach the cleanup goals within 25 years; it is expected that remediation of DRO and RRO will take longer. This RAO will be achieved when groundwater COCs are below the cleanup goals.

The cleanup goals for COCs in soil and groundwater are presented in Table 5-21.

Table 5-21 OU-6 Former Communications Site Soil and Groundwater COC Cleanup Goals

COC	Cleanup Goal	Basis
Soils		
1,2,3-TCP	0.17 mg/kg	1
DRO	10,250 mg/kg	2
Aluminum	77,000 mg/kg	3
Copper	4,160 mg/kg	2
Manganese	1,800 mg/kg	3
Groundwater		
1,2,3-TCP	0.12 µg/L	4
TCE	5 µg/L	5
DRO	1,500 µg/L	4
RRO	1,100 µg/L	4

Notes:

1 ADEC inhalation risk-based cleanup level
2 ADEC direct contact risk-based cleanup level
3 USEPA risk-based screening level
4 ADEC Table C cleanup level
5 Federal and state drinking water MCL

The selected remedy consists of (U.S. Army 2014, U.S. Army 2015):

- ICs prohibiting any soil disturbing activity greater than 6 inches bgs without FWA DPW-approved Work Request, a U.S. Army-, USEPA-, and ADEC-approved Environmental Work Plan, and a FWA DPW-approved Excavation Clearance Request. In cases of an

emergency, standard reporting requirements described in the Excavation Clearance Request will be followed. This includes the following possible activities: residential and commercial construction, road repair and realignment, trenching, excavation, paving, and drilling soil borings for the purpose of monitoring well installation.

- ICs prohibiting the use of or access to groundwater beneath OU-6. This includes:
  - Prohibiting drinking and other domestic uses, fire suppression, irrigation, or other consumptive purposes.
  - Prohibiting the installation of dewatering wells, monitoring wells, irrigation, fire suppression, or potable water wells without prior approval from the U.S. Army via an approved Work Request, a U.S. Army-, USEPA-, and ADEC- approved Environmental Work Plan, and an approved Excavation Clearance Request.
- ICs prohibiting damage or defacement of a monitoring well.
- Groundwater sampling to monitor the progress of natural attenuation processes and to ensure that contamination is not migrating toward FWA drinking water supply wells located outside the northeast corner of the site.
- Disposal and transport of soil or groundwater from OU-6 must meet standards for container type, sampling and analysis for potential contamination, marking and labeling, and moving and storage requirements specified in U.S. Army Regulations. Soil or groundwater from OU-6 will not be removed without permission from an authorized U.S. Army representative and concurrence from the USEPA and ADEC. The U.S. Army shall notify the USEPA and ADEC of any proposed waste disposal/treatment facility that will be receiving soil or groundwater from the site.

5.13.2.2 Remedy Implementation

ICs were implemented when the final Remedial Design/Remedial Action Work Plan for OU-6 (U.S. Army 2015) was issued (May 2015). Groundwater monitoring data collected as of this five-year review has not been performed under an approved work plan and has not been accepted by USEPA.

5.13.2.3 Maintenance and Monitoring

Maintenance and monitoring activities at OU-6 are described below (U.S. Army 2015).

IC Inspections and Maintenance

IC inspections are conducted annually and consist of:

- Reviewing records for compliance with dig permits and deviations
- Observing site conditions and noting any LUC inconsistencies
- Inspecting the monitoring wells

Routine activities involve maintaining the ICs and monitoring well network integrity. The OU-6 Institutional Control Implementation and Assurance Plan, included as an appendix to the OU-6 Remedial Design/Remedial Action Work Plan (U.S. Army 2015), identifies details required to maintain the integrity of the remedy and ensure that it remains protective of human health and the environment.

Results of the IC inspection and maintenance activities are documented in an Annual Institutional Controls Report for Operable Unit 6. Site inspections were conducted in September and October 2015. The inspections determined that ICs were implemented. No unauthorized activities were observed and only minor corrective measures were required to address deficiencies.

- Unauthorized access to soil below six inches was not observed
- Unauthorized installation of water wells was not observed
- Unauthorized use of groundwater beneath OU-6 was not observed
- Minor corrective actions were completed, including replacing locks in three monitoring wells (MW-20, -51, and -90)

Groundwater Monitoring

Groundwater monitoring will be performed to track COC concentrations and water quality parameters to assess the progress of natural attenuation until the COCs meet the groundwater cleanup goals and groundwater is acceptable for unrestricted use and unlimited exposure (U.S. Army 2015). Samples will be collected biannually or at a frequency agreed upon by the U.S. Army, USEPA, and ADEC. Table 5-22 identifies groundwater monitoring requirements. Well locations are shown on Figure 5-14.

Table 5-22 OU-6 Former Communications Site Groundwater Monitoring Requirements

Well	Parameters			
	DRO/RRO [1]	VOCs [2]	Low-level VOCs [3]	MNA Parameters [4,5]
MW-03	X			X
MW-06A	X			X
MW-08			X	
MW-12R	X			X
MW-13			X	X
MW-28	X		X	X
MW-32R	X		X	X
MW-33	X		X	X
MW-35	X		X	X
MW-37	X		X	X
MW-38	X		X	X
MW-39			X	X
MW-47			X	X
MW-48	X			X
MW-58	X			X
MW-61		X	X	X
MW-62	X	X	X	X
MW-64	X			X
MW-77	X			X
MW-78			X	X
MW-79			X	X
MW-80			X	X
MW-82				
MW-91			X	

Table 5-22 OU-6 Former Communications Site Groundwater Monitoring Requirements

Well	Parameters			
	DRO/RRO [1]	VOCs [2]	Low-level VOCs [3]	MNA Parameters [4,5]
MW-93			X	

Notes:

1 DRO by Method AK102/RRO by Method AK 103
2 SW846 Method 8260
3 SW846 Method 8260 SIM
4 MNA parameters: ferrous iron, dissolved potassium, dissolved manganese. Sulfate, alkalinity, nitrogen as NO_2/NO_3, ammonia, phosphorous, and methane
5 Ferrous iron by field test kit

The U.S. Army will follow the USEPA guidance document, *Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well (USEPA 2014c)* to determine when RAOs have been met. Before removing any well from the monitoring network, an appropriate statistical method approved by the USEPA and ADEC will be used to determine when the 95-percent upper confidence limit or equal is at or below the cleanup goal.

The groundwater monitoring program has not been implemented since the USEPA- and ADEC-approved Remedial Design/Remedial Action Work Plan.

5.13.3 Progress Since the Last Five-Year Review

This is the first five-year review of the OU-6 Former Communications Site.

5.13.4 Site Inspection

A site inspection was conducted by USACE on August 11, 2015 to obtain familiarity with the site, review records, examine the remedial action area, and assess protectiveness of the remedy. The site contains new military housing and related infrastructure (i.e. roads and utilities). The perimeter fence that was installed as an interim LUC was not present. FWA staff indicated that vapor mitigation systems had been installed in the housing units. The systems are not required by the ROD; they were proactively installed by the U.S. Army to address any potential VOC vapor intrusion issues. Some of the housing units were occupied.

5.13.5 Data Review

There is no routine monitoring and maintenance data to review associated with the OU-6 selected remedy since the USEPA- and ADEC-approved Remedial Design/Remedial Action Work Plan.

Although not included as part of the remedy selected in the 2014 ROD, investigations were performed in OU-6 to assess the site for emerging contaminants perfluorinated compounds (PFCs). The OU-6 area was specifically assessed for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) associated with the historical use of aqueous firefighting foams. Potential former fire training areas were identified in historical records. Soil samples were collected in October 2013. Soil sample locations and results are depicted in Attachment 12, Figure 4-2, *PFOS and PFOA Concentrations in FTP-3B Soil* Samples. The results of the soil sampling are also summarized on Table A-4, *Subsurface Soil Sample Results* in Attachment 12.

The soil data was compared to proposed ADEC rule 18 AAC 75 and EPA Region 4 Residential Soil Screening Levels. No exceedances of these screening levels were identified.

Groundwater samples were collected in November 2013 and June 2015. The groundwater sample locations and results are depicted in Attachment 12, Figure 4-4, *PFOA and PFOS Concentrations in FTP-3B Groundwater Samples*. The results are also tabulated in Attachment 12, Table A-6, *2015 Groundwater Sample Results*. The results are compared to proposed ADEC rule 19 AAC 75 and EPA Provisional Health Advisory Levels. Exceedances of these values were identified in two sampling locations in November 2013:

- AP-10276MW, PFOA detected at 0.44 µg/L, exceeds both the proposed ADEC rule (PFOA, 0.401 µg/L) and USEPA Provisional Health Advisory Level (PFOA, 0.40 µg/L) This well is located in Subarea E.
- AP-10278MW, PFOS detected at 0.75 µg/L, (exceeds both the proposed ADEC rule (PFOS, 0.601 µg/L) and the USEPA Provisional Health Advisory Level (PFOS, 0.20 µg/L)). This well is located in Subarea A. Data validation identified this result as estimated due to matrix interference.
- AP-6148, PFOS detected at 0.2 µg/L, exceeds the USEPA Provisional Health Advisory Level (PFOS, 0.20 µg/L).

  This well is located in the southern portion of Subarea A.

Repeat sampling from these locations in June 2015 identified the following results:

- AP-10276MW, PFOA detected at 0.33 µg/L (below screening levels).
- AP-10278MW, PFOS detected at 0.75 µg/L (exceeds both the proposed ADEC rule (PFOS, 0.601 µg/L) and the EPA Provisional Health Advisory Level (PFOS, 0.20 µg/L)).
- AP-6148, PFOS detected at 2.0 µg/L (exceeds both the proposed ADEC rule (PFOS, 0.601 µg/L) and the EPA Provisional Health Advisory Level (PFOS, 0.20 µg/L)).

No other exceedances of the screening levels were identified in November 2013 or June 2015.

5.13.6 Technical Assessment

5.13.6.1 Question A

Is the Remedy Functioning as Intended by the Decision Document?

Yes, the remedy is functioning as intended by the ROD.

LUCs have been implemented to protect against human exposure to COCs in soil. The inspection conducted in October and November 2015 determined that no unauthorized activities were observed and only minor corrective measures were required at three monitoring wells (new locks installed).

Groundwater monitoring results used to track COC concentrations and assess the progress of natural attenuation have not been accepted by the USEPA and ADEC.

No opportunities for optimization and no early indicators of potential issues were identified by the five-year review.

No early indicators of potential problems were identified.

5.13.6.2 Question B

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Still Valid?

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection at OU-6 remain valid. The site is now being used for residential use. Residential exposure was assessed during the RI and identified as an anticipated land use at the time of the ROD. No changes to toxicity criteria for risk-based cleanup goals identified in the ROD for soil and groundwater, or vapor intrusion screening levels used in the VI monitoring reports have occurred.

There are no newly promulgated or modified requirements of federal and state environmental laws that would change the protectiveness of the soil or groundwater remedies implemented in OU-6.

5.13.6.3 Question C

Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

No other information has come to light that would call into question the protectiveness of the remedy.

5.13.6.4 Technical Assessment Summary

The OU-6 remedy, ICs, have been implemented and are maintained as required by the ROD to prevent receptors from exposure to impacted groundwater. Groundwater monitoring in accordance with the ROD will begin in 2016. Elevated concentrations of PFOA and PFOS were detected in groundwater monitoring samples collected in 2013 and 2015 to assess PFCs as emerging contaminants. This data will be reviewed with the USEPA to determine whether additional sampling/remedial actions are necessary to address these groundwater impacts. Since ICs remain in place at OU-6, this data does not affect the protectiveness of the remedy at OU-6. No changes to ARARs or the risk assessment were identified that would affect the protectiveness of the remedy.

5.13.7 Issues

No issues were identified that affect protectiveness of the remedy.

The following site-wide concern was identified that does not affect the protectiveness of the FWA remedies:

- The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.

5.13.8 Recommendations for Follow-up Actions

There are no recommendations for follow-up actions at the OU-6 Former Communications Site.

The following site-wide recommendation was identified that does not affect the protectiveness of the FWA remedies:

- The U.S. Army should develop a revised site-wide IC program to include LUC/IC requirements. It will be initiated in November 2016 with a planned completion date of September 2018.

5.13.9 Protectiveness Statement

The remedy at OU-6 is protective of human health and the environment because:

- ICs are in-place to ensure that human exposure to contaminated soil and groundwater will not occur.
- There is no evidence of unauthorized installation or use of groundwater wells.
- Groundwater quality data will be used to assess the performance of the OU-6 remedy in the future.

6.0 SUMMARY

6.1 Recommendations for Follow-up actions

Table 6-1 provides recommendations to address current issues that affect protectiveness at FWA sites subject to this five-year review.

Table 6-1 Recommendations for Issues That Affect Protectiveness at FWA

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Yes or No)	
					Current	Future
OU-1 801 Drum Burial Site						
Under agreement among the RPMs, data was not collected from monitoring wells located between currently monitored points and the 801 Military Housing Area for inclusion in the five-year review. Data from these wells was not available for use in the vapor intrusion assessment at OU-1.	Collect groundwater samples from monitoring wells AP-6326, AP-6327, AP-7162, and AP-10042 for analysis for VOCs and complete a vapor intrusion assessment.	FWA	USEPA	September 2018	No	Yes
An assessment for 1,4-dioxane has not been performed at monitoring well AP-6326	Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the 801 Drum Burial Site. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.	FWA	USEPA	September 2018	No	Yes
OU-2 Building 1168 Leach Well and DRMO Yard						
An assessment for 1,4-dioxane has not been performed at the Building 1168 Leach Well site and DRMO Yard.	Perform sampling to evaluate whether a release pf 1,4-dioxane has occurred at the Building 1168 Leach Well and DRMO sites. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.	FWA	USEPA	September 2018	No	Yes

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Yes or No)	
					Current	Future
OU-3 Remedial Area 1B (BHTF - GW), Remedial Area 2 (Valve Pits and ROLF), and Remedial Area 3 (FEP Mileposts 2.7 and 3.0)						
The inhalation pathway should not have been eliminated during development of the TMB cleanup goals in the OU-3 ESD. The 1994 baseline risk assessment clearly considered residential inhalation of VOCs from tap water to be a complete exposure pathway, which was quantified in characterizing the baseline risk from exposure to site contaminants.	Re-establish the cleanup goals for 1,2,4-TMB and 1,3,5-TMB in groundwater using either of the following methods: 1) update the RBCs by including the inhalation pathway and using the 2016 USEPA IRIS toxicity assessment, or 2) adopt the cleanup goals established in 18 AAC 75.	FWA	USEPA	September 2018	No	Yes
OU-3 Remedial Area 1B (BHTF - GW)						
The benzene and 1,2-DCA concentrations continue to exceed cleanup goals and exhibit increasing trends in some monitoring locations.	Perform a data gap investigation and recommend a future course of action for Remedial Area 1B.	FWA	USEPA	September 2018	No	Yes
OU-3 Remedial Area 2 (Valve Pits and ROLF)						
The historical decommissioning of infrastructure may have resulted in the abandonment of pipeline with impacts at Remedial Area 2.	Conduct an investigation and determine if there are any previously undiscovered source areas at Remedial Area 2.	FWA	USEPA	September 2018	No	Yes

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Yes or No)	
					Current	Future
OU-3 Remedial Area 3 (FEP Mileposts 2.7 and 3.0)						
The concentrations of benzene remain high and exhibit increasing trends in several wells. Analysis has shown that groundwater cleanup goals will not be achieved for these areas within a reasonable period of time.	Perform a data gap investigation and recommend a future course of action for the milepost sites (This activity is currently under contract with the U.S. Army).	FWA	USEPA	September 2018	No	Yes
OU-4 Landfill						
An assessment for 1,4-dioxane has not been performed at the Landfill.	Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Landfill. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.	FWA	USEPA	September 2018	No	Yes
OU-5 WQFS						
The historical decommissioning of infrastructure may have resulted in the abandonment of pipeline with impacts at the WQFS.	Conduct an investigation and determine if there are any previously undiscovered source areas at the WQFS.	FWA	USEPA	September 2018	No	Yes
OU-5 EQFS						
An assessment for 1,4-dioxane has not been performed at OU-5 WQFS or EQFS.	Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the OU-5 WQFS or EQFS. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.	FWA	USEPA	September 2018	No	Yes

Table 6-2 provides recommendations to address concerns that do not affect protectiveness at FWA sites subject to this five-year review.

Table 6-2 Recommendations for Concerns That Do Not Affect Protectiveness at FWA

Concern	Recommendations/ Follow-up Actions	Party Responsible
Site-Wide		
The site-wide SOP does not include documentation and information regarding all LUCs required throughout FWA.	The U.S. Army will develop a revised site-wide IC program to include LUC/IC requirements. The development process will be initiated in November 2016 with a planned completion date of September 2018.	FWA
OU-1 801 (Drum Burial Site)		
The reporting limit for dieldrin in groundwater in 2015 exceeded the cleanup goal.	Provide greater scrutiny of groundwater analytical limits during future monitoring events.	FWA
Insufficient groundwater quality data is available to determining attainment of cleanup levels at monitoring wells AP-10042 and AP-7163.	Increase monitoring frequency in these wells from once every five years to biennial (2017 and 2019) until the next five-year review.	FWA
OU-2 (Building 1168 Leach Well)		
All cleanup goals identified in the OU-2 ROD have been attained, although petroleum contamination persists at the site.	An iRACR should be completed to document remedial action complete under CERCLA.	FWA
OU-2 (DRMO Yard)		
The OU-2 ROD prohibits the refilling of the DRMO Yard fire suppression water tank from the existing DRMO Yard potable water supply until state and federal MCLs are met within the contaminant plume. The potable well was used in the past to fill the fire suppression water tank and is tested routinely to confirm that the water meets state and federal MCLs.	The U.S. Army will restrict future use of the DRMO Yard potable water supply in accordance with the ROD.	FWA
Frost-jacked monitoring points were observed on site at the time of the site inspection in the OU-2 DRMO Yard.	Frost-jacked points should be evaluated for repair or replacement in the OU-2 DRMO Yard.	FWA

Table 6-2 Recommendations for Concerns That Do Not Affect Protectiveness at FWA

Concern	Recommendations/ Follow-up Actions	Party Responsible
OU-3 Remedial Area 1B (BHTF)		
All COCs have attenuated to below the cleanup goals in the alluvial aquifer near Building 1173, in the alluvial and bedrock aquifers near the Truck Fill Stand, and in the alluvial and bedrock aquifers at the Thaw Channel Area.	Groundwater monitoring should be reevaluated after remedial work under the 2-Party Agreement is completed (petroleum and other contaminant removal). The well inventory should be incorporated, where appropriate, into the attenuation monitoring program for the bedrock aquifer at Birch Hill. An optimized alluvium and bedrock well array should be selected to monitor the attenuation of recalcitrant COCs so a remedy completion strategy can be defined. The MAROS sampling periodicity analysis presented in the 2015 monitoring report should continue to be used as a basis for other potential changes to the groundwater sampling program.	FWA
OU-3 Remedial Area 2(Valve Pits and ROLF)		
An ISCO injection treatability study was conducted at Valve Pit A	Continue to evaluate whether ISCO injections or excavation of contaminated soil at Valve Pit A would enhance natural attenuation in groundwater	FWA
OU-4 Coal Storage Yard		
The remedial action has attained all RAOs and groundwater cleanup goals (for residential use) identified in the OU-4 ROD. The site meets unlimited use and unrestricted exposure criteria identified in the ROD.	An iRACR should be completed to document remedial action completion under CERCLA. If the site retains IC restrictions, the five-year review must be conducted to evaluate that component of the remedy.	FWA
OU-5 (WQFS)		
In 2014 the Chena River boom was lifted off its supports and rested along the riverbank due to a rise in the river level caused by heavy precipitation in the spring/summer that year.	Implement measures to avoid future displacement of the Chena River Boom (e.g., increase height of the support posts).	FWA
RRO was apparently dropped from the monitoring program but no written justification was found	Provide justification on why RRO was dropped from the monitoring program.	FWA

6.2 Protectiveness Statements

OU-1

The remedy at OU-1 is protective of human health and the environment because:

- Contaminant source removal (drums and contaminated soil) was completed.
- Migration of COCs in groundwater to the Chena River and downgradient drinking water wells is not occurring based on sampling results that indicate the plume is stable.
- Based on groundwater data and a comparison of groundwater quality to the calculated USEPA VISLs, the vapor intrusion exposure pathway is incomplete at the 801 Drum Burial Site.
- ICs are in place to ensure that groundwater will not be used until cleanup goals are attained and to assure that exposure to any contaminated soil at the site will not occur.

However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness:

- Collect groundwater samples from monitoring wells AP-6326, AP-6327, AP-7162, and AP-10042 for analysis for VOCs and complete a vapor intrusion assessment.
- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the 801 Drum Burial Site. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-2

The remedies at OU-2 currently protect human health and the environment because:

- All cleanup goals have been attained at the Building 1168 Leach Well site, although petroleum contamination persists at the site.
- Migration of COCs in groundwater from the DRMO-1 and DRMO-4 source areas has been reduced by the remedial actions.
- ICs are in place to ensure that groundwater containing COCs will not be used.

However, in order for the remedies to be protective in the long-term, the following action needs to be taken to ensure protectiveness:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Building 1168 Leach Well site and DRMO Yard. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-3

The remedies at OU-3 currently protect human health and the environment because:

- Further migration of contaminated groundwater has been reduced by the remedial actions and natural attenuation.
- There are no complete pathways for human exposure to groundwater. ICs are in place to ensure that groundwater containing COCs will not be used.
- Off-post risks associated with the consumption of contaminated groundwater at Remedial Area 1B are mitigated by attenuation of COCs in the alluvial aquifer.

However, in order for the remedies to be protective in the long-term, the following action needs to be taken:

- Re-establish the cleanup goals for 1,2,4-TMB and 1,3,5-TMB in groundwater using either of the following methods: 1) update the RBCs by including the inhalation pathway and using information from a new USEPA IRIS toxicity assessment that was under development during drafting of this report and just released as final on September 9, 2016, or 2) adopt the cleanup goals established in 18 AAC 75.
- Perform a data gap investigation at Remedial Area 1B and the FEP Mileposts 2.7 and 3.0 sites and recommend a future course of action for the sites. (This activity is currently under contract with the U.S. Army for the Milepost sites).
- Conduct an investigation to evaluate if there are any previously undiscovered source areas at the Remedial Area 2 (Valve Pits and ROLF).

OU-4

The remedies at OU-4 currently protect human health and the environment because:

- All RAOs have been attained at the Coal Storage Yard.
- Further migration of contaminated groundwater from the Landfill Source Area has been reduced by the implemented remedy and natural attenuation.
- ICs are in place at the Landfill Source Area to ensure that contaminated groundwater will not be used until the cleanup goals are attained.

However, in order for the remedies to be protective in the future, the following action needs to be taken to ensure protectiveness:

- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the Landfill. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-5

The remedies at OU-5 currently protect human health and the environment because:

- Initial remedial responses were performed at WQFS/EQFS and AS/SVE systems were installed and operated in accordance with the ROD. The treatment systems have recovered significant mass and reduced or prevented further migration of contaminated groundwater to downgradient areas and the Chena River.
- Natural attenuation is an active process that has reduced or prevented further migration of contaminated groundwater to downgradient areas and the Chena River from the WQFS/EQFS.
- The Chena River Aquatic Assessment Program did not identify adverse impacts associated with the WQFS/EQFS to benthic communities in the river.
- Occurrences of sheen in the Chena River have decreased.
- ICs are in place at the WQFS/EQFS to ensure that groundwater containing contaminants above SDWA MCLs, non-zero MCLGs, or relevant AWQS (fresh water use criteria) will not be used until the cleanup goals are attained.

- ICs are in place at Remedial Area 1A to limit human and terrestrial receptor exposure to lead contaminated soil.
- The OB/OD IC components have been improved since trespassers were identified on a site located 1,000 ft from the OB/OD. Improvements include increased frequency of inspections and access controls.
- There is no evidence of unauthorized installation or use of groundwater wells or evidence of soil disturbing activities, and warning signs are intact at Remedial Area 1A and the OB/OD area.

However, in order for the remedies to be protective in the future, the following action needs to be taken to ensure protectiveness:

- Conduct an investigation and determine if there are any previously undiscovered source areas at the WQFS.
- Perform sampling to evaluate whether a release of 1,4-dioxane has occurred at the OU-5 WQFS or EQFS. If present, evaluate whether 1,4-dioxane poses an unacceptable risk to human health and the environment.

OU-6

The remedy at OU-6 is protective of human health and the environment because:

- ICs are in-place to ensure that human exposure to contaminated soil and groundwater will not occur.
- There is no evidence of unauthorized installation or use of groundwater wells.
- Groundwater quality data will be used to assess the performance of the OU-6 remedy in the future.

6.3 Next Review

The next review for FWA will be conducted by September 2021.