RECORD OF DECISION
for
OPERABLE UNIT 3
FORT WAINWRIGHT
FAIRBANKS, ALASKA

JANUARY 1996

DECLARATION STATEMENT
for
RECORD OF DECISION
FORT WAINWRIGHT
FAIRBANKS, ALASKA
OPERABLE UNIT 3
JANUARY 1996

SITE NAME AND LOCATION

Operable Unit 3
Fort Wainwright
Fairbanks, Alaska

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the selected remedial actions for Operable Unit 3 at Fort Wainwright in Fairbanks, Alaska. Operable Unit 3 comprises the following areas: the Tank Farm; the Railcar Off-Loading Facility; and Mileposts 2.7, 3.0, and 15.75 of the Fairbanks-Eielson Pipeline. The ROD was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986; 42 United States Code, Section 9601 *et seq.*; and, to the extent practicable, in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan, 40 Code of Federal Regulations 300 *et seq.* This decision is based on the Administrative Record for this operable unit.

The United States Army; the United States Environmental Protection Agency; and the State of Alaska, through the Alaska Department of Environmental Conservation, have agreed to the selected remedies.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment. Specific hazardous substances include benzene, toluene, ethylbenzene, xylenes, 1,2-dichloroethane, isopropylbenzene, trimethylbenzene, and inorganic lead.

DESCRIPTION OF SELECTED REMEDIES

This is the first operable unit to reach a final-action ROD. This ROD addresses soil and groundwater contamination at Operable Unit 3.

The remedies were selected to reduce and prevent the risks associated with potential current or future exposure to the contaminants. The remedial action objectives of this ROD are designed to:

- Restore groundwater to drinking water quality;
- Clean up soil to prevent further leaching of contaminants into groundwater; and
- Reduce or prevent further migration of contaminated groundwater.

The major components of the remedies are:

- *In situ* soil vapor extraction and air sparging of groundwater will be implemented to remove fuel-related contaminants to a level that attains Safe Drinking Water Act levels; and
- After achieving Safe Drinking Water Act levels, natural attenuation will be relied upon to attain Alaska Water Quality Standards.

Groundwater monitoring will be used to evaluate effectiveness of selected remedies and to ensure that cleanup standards are attained.

STATUTORY DETERMINATIONS

The selected remedies are protective of human health and the environment, comply with state and federal requirements that are legally applicable or relevant and appropriate to the remedial actions, and are cost-effective. The remedies utilize permanent solutions and alternative treatment to the maximum extent practicable and satisfy the statutory preference for remedies that employ treatment to reduce toxicity, mobility, or volume as a principal element.

Because the remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted within five years after commencement of remedial action.

Signature sheet for the foregoing Operable Unit 3, Fort Wainwright. Record of Decision between the United States Army and the United States Environmental Protection Agency, Region X, with concurrence by the Alaska Department of Environmental Conservation.

Robert L. Ord III
Robert L. Ord, III
Lieutenant General, U.S. Army
Commanding

3/26/96
Date

Signature sheet for the foregoing Operable Unit 3, Fort Wainwright, Record of Decision between the United States Army and the United States Environmental Protection Agency, Region X, with concurrence by the Alaska Department of Environmental Conservation.

Chuck Clarke
Chuck Clarke
Regional Administrator, Region X
United States Environmental Protection Agency

4/9/96
Date

Signature sheet for the foregoing Operable Unit 3, Fort Wainwright, Record of Decision between the United States Army and the United States Environmental Protection Agency, Region X, with concurrence by the Alaska Department of Environmental Conservation.

Lynn J. Tomich Kent

for Kurt Fredriksson
Director, Spill Prevention and Response
Alaska Department of Environmental Conservation

4/4/96
Date

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LIST OF ILLUSTRATIONS

LIST OF ACRONYMS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ARARs	Applicable or relevant and appropriate requirements
ASTs	Aboveground storage tanks
BGS	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and total xylenes
CANOL	Canadian Oil Line
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	Cubic feet per minute
Corps	United States Army Corps of Engineers, Alaska District
COPCs	Chemicals of potential concern
COCs	Contaminants of concern
EPA	United States Environmental Protection Agency
EPCs	Exposure point concentrations
ERA	Ecological Risk Assessment
FFA	Federal facility agreement
FS	Feasibility Study
GRO	Gasoline-range organics
HHRA	Human Health Risk Assessment
MCL	Maximum contaminant level
MCLG	Maximum Contaminent Level Goals
μg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MSL	Mean sea level
MUS	Municipal Utilities System
NCP	National Contingency Plan
NOAELs	No observed adverse effect levels
NPL	National Priorities List
OU-3	Operable Unit 3
RBCs	Risk-based concentrations
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RfDs	Reference doses
RME	Reasonable maximum exposure
ROD	Record of Decision
ROLF	Railcar Off-Loading Facility
SARA	Superfund Amendments and Reauthorization Act
TCLP	Toxicity characteristic leaching procedure
TFS	Truck Fill Stand
USC	United States Code
USTs	Underground storage tanks
VES	Vapor extraction system
VOC	Volatile organic compound

RECORD OF DECISION
FORT WAINWRIGHT
FAIRBANKS, ALASKA
OPERABLE UNIT 3
JANUARY 1996

This Record of Decision for Operable Unit 3 presents the remedial alternatives considered, provides the rationale for the remedial actions selected, and states how the remedial actions satisfy the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) statutory requirements. Fort Wainwright was listed on the National Priorities List in August 1990 under CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986.

The United States Army completed a Remedial Investigation (RI) to provide information regarding the nature and extent of soil and groundwater contamination. A baseline Risk Assessment was developed and used in conjunction with the RI to determine the need for remedial action and to aid in selecting remedies. A Feasibility Study was completed to evaluate remedial options.

1.0 SITE NAME, LOCATION, AND DESCRIPTION

1.1 SITE LOCATION AND DESCRIPTION

Fort Wainwright, also referred to as *the site,* is located on the east edge of the City of Fairbanks in the Fairbanks-North Star Borough in interior Alaska (see Figure 1). Primary missions at Fort Wainwright include 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 industrial activities include fixed-wing aircraft, helicopter, and support vehicle maintenance. The 918,000-acre site includes the main post area, a range complex, and two maneuver areas.

Fort Wainwright originally was established as a cold-weather testing station in 1938. Renamed Ladd Army Airfield in 1939, the site next served as a resupply point for remote field stations and a crew transfer point in the Lend-Lease Program through which military aircraft and other supplies were ferried to the Soviet Union during World War II. In 1947, the site was redesignated as Ladd Air Force Base and began serving as a resupply and maintenance base for remote distance early warning sites and experimental stations in the Arctic Ocean. The site was renamed Fort Wainwright on January 1, 1961, and all of its operations were transferred to the United States Army.

Most of Operable Unit 3 (OU-3) is located in the main cantonment area of Fort Wainwright. It consists of the following source areas: the Tank Farm on Birch Hill and associated Truck Fill Stand (TFS) at the base of Birch Hill, a Railcar Off-Loading Facility (ROLF), and three mileposts along the Fairbanks-Eielson Pipeline (Mileposts 2.7, 3.0, and 15.75). Figure 1 illustrates the entire installation and each source area.

1.1.1 Tank Farm Source Area

The Tank Farm is located north of the main cantonment area and is illustrated in Figure 2. The boundaries of this source area extend from the aboveground storage tanks (ASTs) on Birch Hill to Valve Pit A, which is on the northwest bank of the Chena River. The Tank Farm includes 14 bolted-steel, 10,000-barrel tanks and two welded-steel, 25,000-barrel tanks on the southwest slope of Birch Hill; three buildings; two underground storage tanks (USTs); pipelines connecting the tanks; two welded-steel, 2,250-barrel ASTs at the TFS area; the Canadian Oil Line (CANOL) pipeline; and Valve Pit A.

All the tanks were used to store fuel for Fort Wainwright and Eielson Air Force Base. Fuel stored in the tanks included arctic-grade diesel fuel, aviation-grade leaded gasoline, aircraft turbine and jet engine fuel (JP-4), leaded vehicle motor gasoline, and unleaded and regular motor fuel. All tanks have been emptied and cleaned. The pipelines have been purged. The two original USTs were removed; one was replaced with a double-walled tank in the 1980s.

The elevation of the north section of the Tank Farm, the AST area on Birch Hill, ranges from 441 feet to 748 feet above mean sea level (MSL). Except in developed areas, Birch Hill is densely forested. No permanent surface water bodies are located on Birch Hill near the ASTs. However, snow and ice meltwater accumulate in the depressions and in the diked areas around the ASTs.

CORPS OF ENGINEERS U.S. ARMY

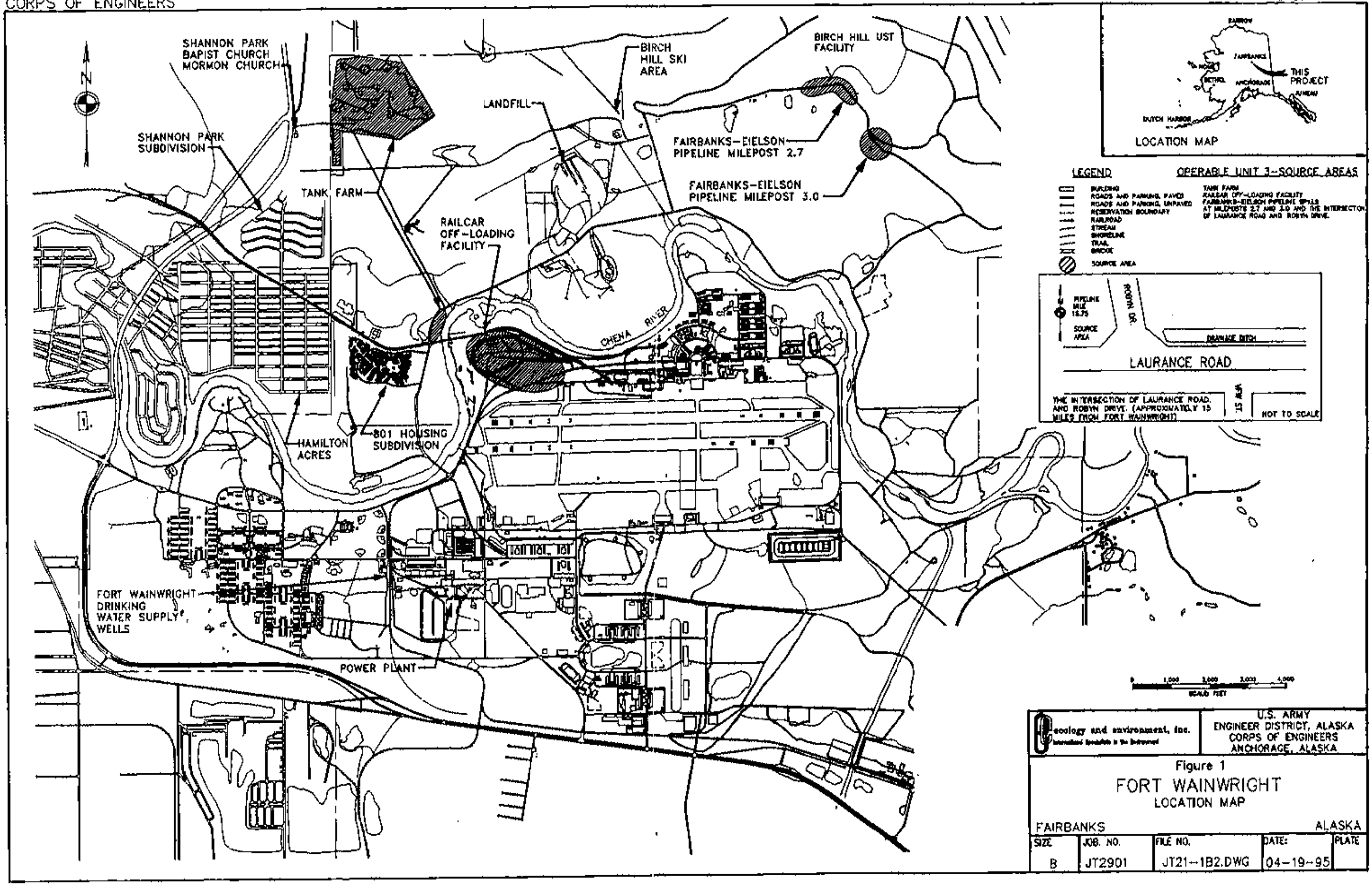

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Figure 1
FORT WAINWRIGHT
LOCATION MAP

FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
B	JT2901	JT21-1B2.DWG	04-19-95	

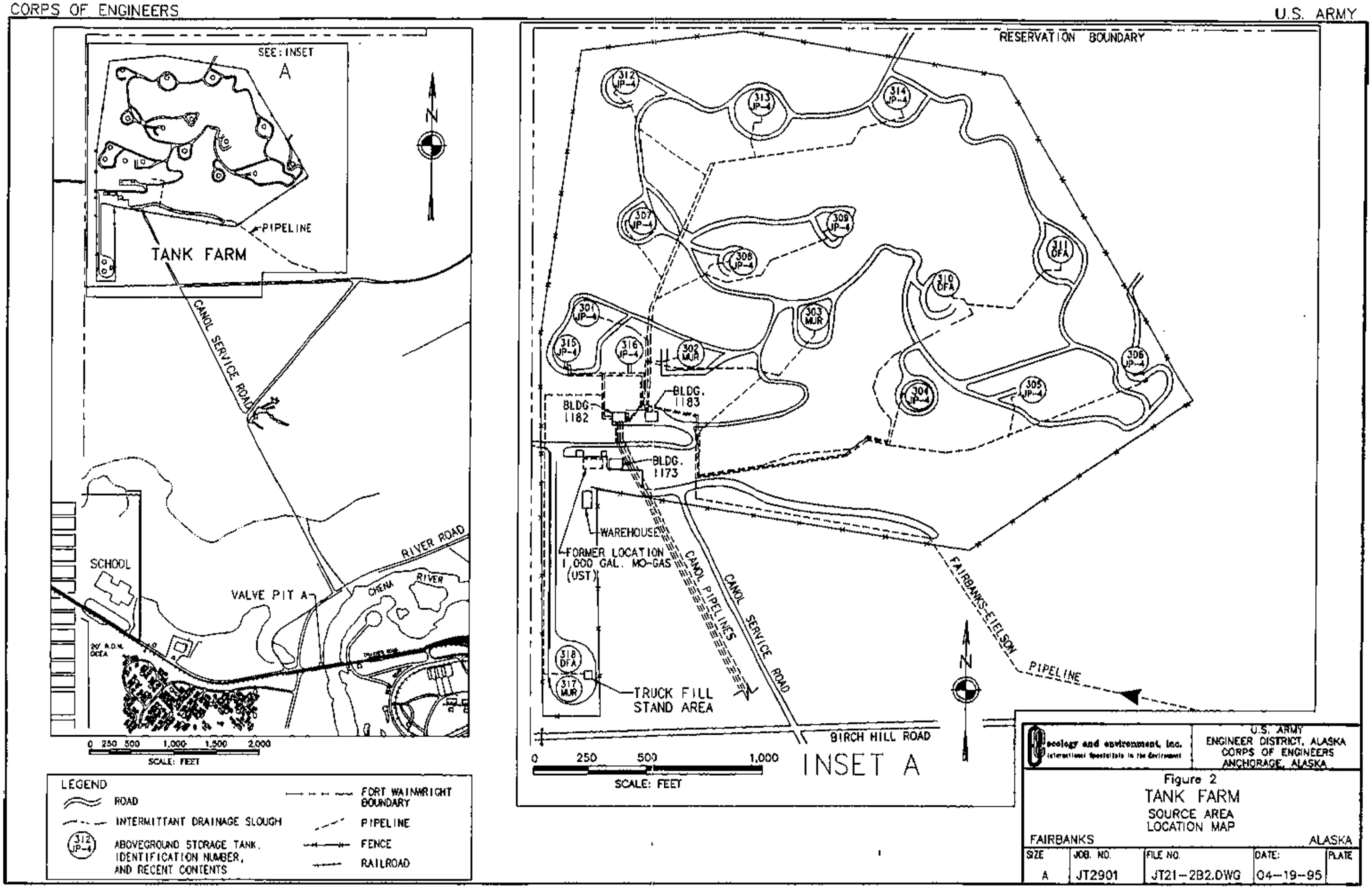

Figure 2
TANK FARM
SOURCE AREA
LOCATION MAP

The south section of the Tank Farm, including the TFS area and Valve Pit A, is located in the Chena River floodplain. This section is characterized by nearly flat topography that gently slopes southward. The subsurface is typified by discontinuous permafrost and poorly drained soils covered by thick organic mats. Surface water ponding is common throughout the area from spring breakup until early to mid-summer. Wetlands are scattered throughout the area.

1.1.2 Railcar Off-Loading Facility Source Area

The ROLF, which is located south of the Tank Farm, is illustrated in Figure 3. A pipeline connects the ROLF to the Tank Farm. The ROLF is bounded on its north and west sides by the Chena River and Gaffney Road on the south side. The ROLF was built in 1939 to receive fuel from tanks on railcars and to distribute the fuels to the airfield refueling points, quarter-master fuel, and the Birch Hill AST Tank Farm. The facility is no longer used, but the following structures are still present: a TFS, one area with 16-tank-car unloading headers and another with eight-tank-car unloading headers, three 8-inch and four 3-inch pipelines that traverse the facility, five valve pits (B, C, D, E, and F), and two warehouses (Buildings 1129 and 1130). Fuel was stored in USTs at this facility until they were removed in 1990.

The ROLF is located on a nearly flat floodplain of the Chena River. Brush and birch trees grow along the Chena River and adjacent to Valve Pits B and C. Trees and brush have been cleared elsewhere in the ROLF. Surface water bodies are not present in the central region of the ROLF. A steep west-facing embankment is west of Valve Pit C. Small ponds and wetlands occur in the area between the embankment and the Chena River.

1.1.3 Milepost Source Areas

The Fairbanks-Eielson Pipeline was constructed in 1953 and 1954 and put into service in 1955 to transport fuel from Haines to Fairbanks. The portion of the pipeline between Fort Wainwright and the Mapco refinery was decommissioned in 1992. Spills have been reported at two locations along the pipeline at Milepost 2.7 and at Laurance Road and Robyn Drive in the City of North Pole (Milepost 15.75). Contamination was detected at Milepost 3.0 during an investigation of the Birch Hill UST facility.

The Milepost 2.7 Source Area includes areas that were contaminated by the pipeline break, TFSs 1 and 2, a water separator, valve pits, and some pipelines associated with the Birch Hill UST facility. Figure 4 illustrates Milepost 2.7. The Milepost 2.7 Source Area consists of a moderately to steeply south-facing hillside north of the pipeline and a shallow, south-facing slope south of the pipeline. The source area is located within a surface water drainage pathway from the upland Birch Hill UST facility, northeast of the pipeline source area. Soils in the Milepost 2.7 Source Area are poorly drained. Ponded surface water is common from spring breakup until mid-summer. A black spruce-scrub-shrub wetland borders the south side of the source area. The area is densely vegetated. Discontinuous permafrost is typical in the area's subsurface soils.

The Milepost 3.0 Source Area includes contaminated areas associated with the Fairbanks-Eielson Pipeline, a TFS, a water separator, valve pits, and some pipelines associated with the Birch Hill UST facility (see Figures 1 and 4). Site descriptions provided for Milepost 2.7 are accurate for the Milepost 3.0 Source Area as well.

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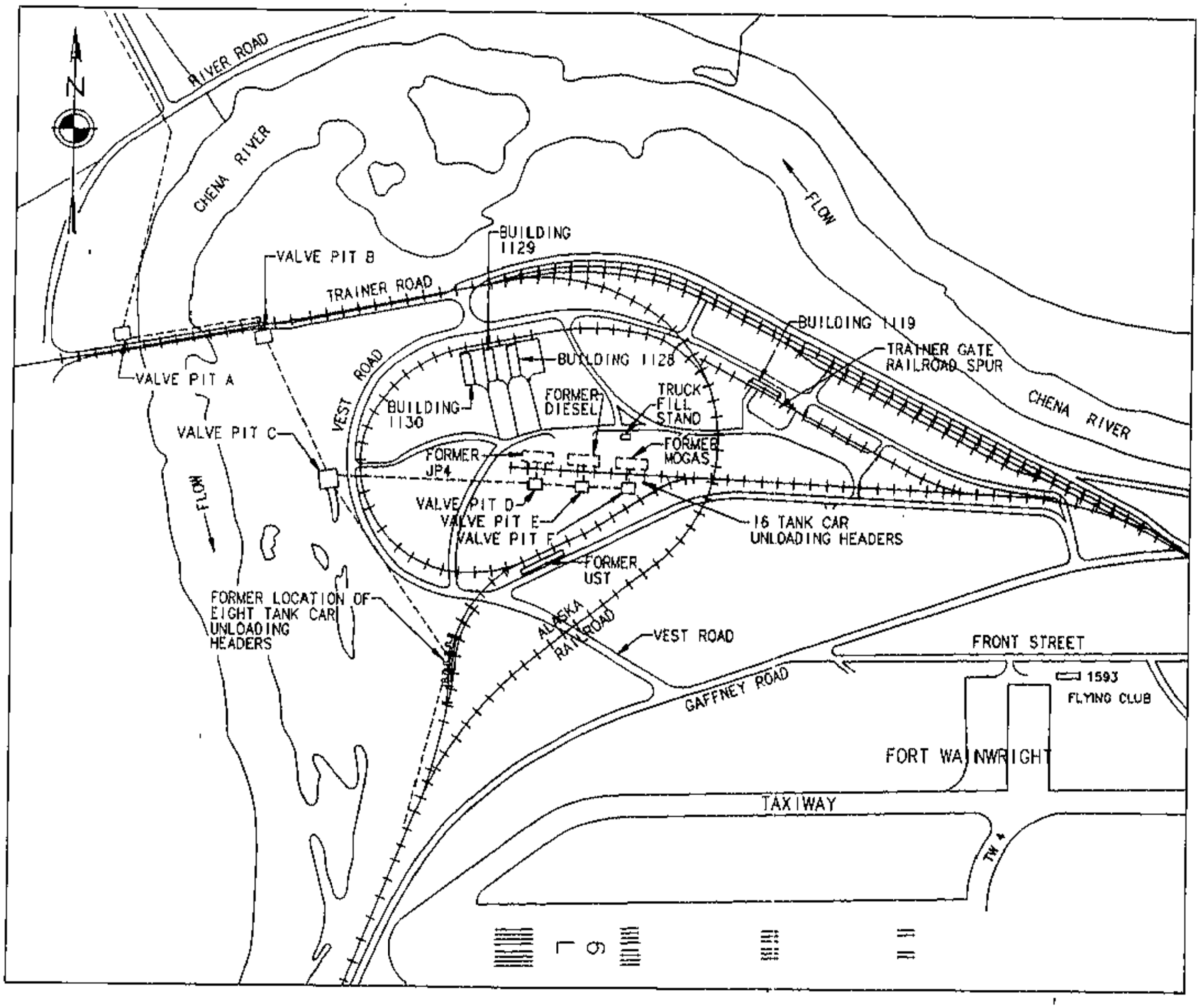

LEGEND

- ROAD
- DRAINAGE SLOUGH
- FORMER UST LOCATION
- PIPELINE LOCATION

0 250 500 1,000

SCALE: FEET

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Figure 3
RAILCAR OFF-LOADING FACILITY (ROLF)
SOURCE AREA
LOCATION MAP

FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
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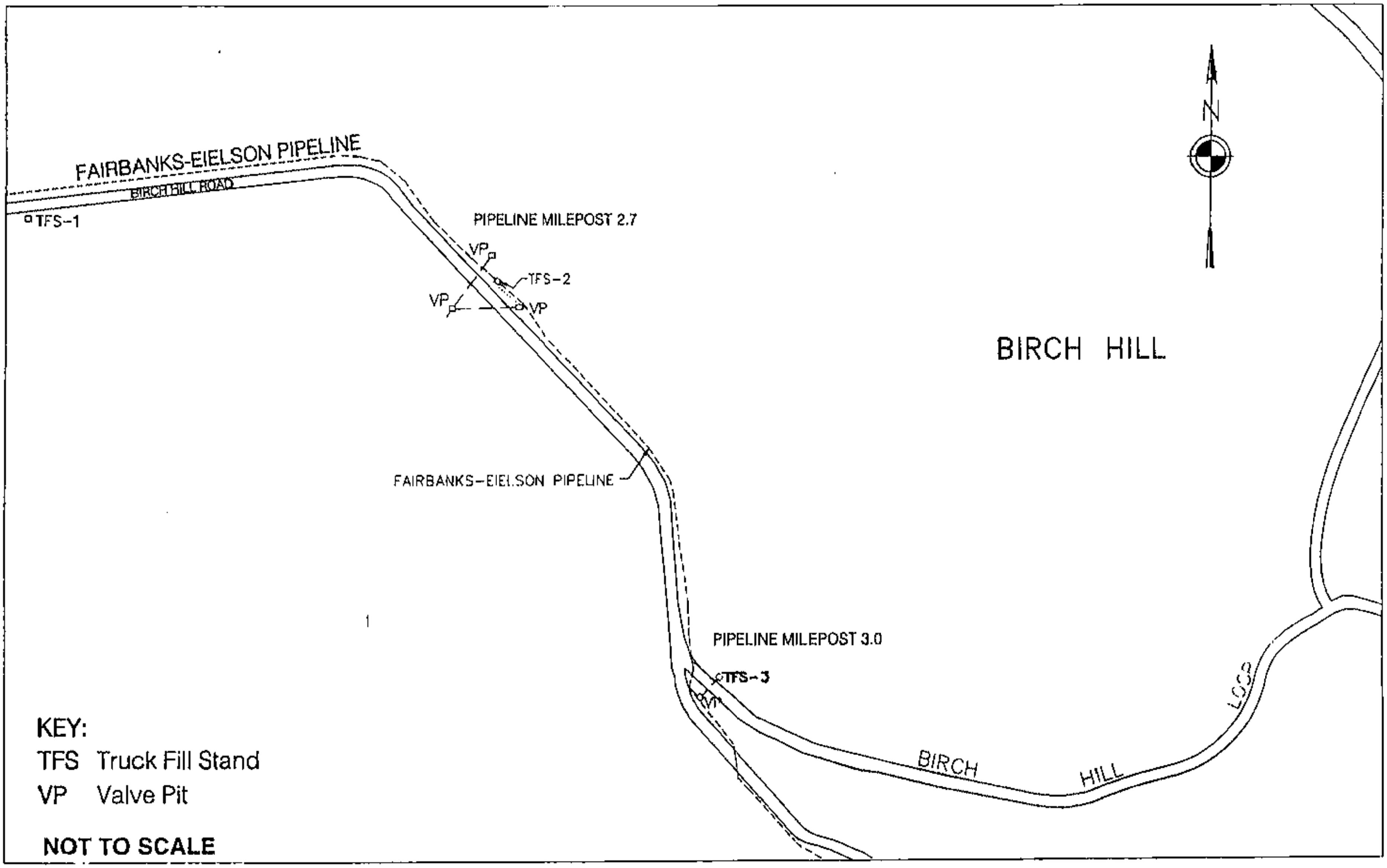


Figure 4 MILEPOST 2.7 AND 3.0 SOURCE AREAS

The Milepost 15.75 Source Area is located in a residential area approximately 1 mile south of North Pole between the Chena River to the north and east and the Tanana River to the west. The source area is located on an off-post right-of-way for a military fuel pipeline. Figure 5 illustrates Milepost 15.75. This source area includes all contaminated areas associated with a fuel spill from a 1989 underground pipeline break. The site is flat except for drainage ditches that parallel Laurance Road. The drainage ditch on the south side of Laurance Road usually contains water. Soils in the area are sandy with little gravel and generally are moderately well-drained. The surrounding area is forested with trees and shrubs.

1.2 HYDROGEOLOGY

The main aquifer in the Fort Wainwright area, including the Milepost 15.75 Source Area, is an alluvial aquifer in a buried river valley. According to United States Geological Survey maps, this aquifer ranges from a few feet thick at the base of Birch Hill to at least 300 feet thick under the fort's main cantonment area. The aquifer may reach a thickness of 700 feet in the Tanana River valley.

Groundwater in the Tanana-Chena floodplain generally occurs under unconfined conditions. A confined layer of groundwater may develop seasonally where the depth to the water table is less than the depth of the seasonal frost penetration. A confined groundwater layer also may occur beneath permafrost, where the frozen ground forms a wall around the water.

The depth to groundwater at the fort varies from approximately 20 feet at the base of Birch Hill to 7 feet below ground surface (BGS) south of the Fort Wainwright airfield. Close to the Chena River, the depth to groundwater may range from 5 feet to 15 feet. The depth to groundwater in the North Pole area by the Tanana River varies from 5 feet to 10 feet BGS. It should be noted that the depth to groundwater varies with seasonal changes, changes to the normal weather trends, and the stages of the Tanana and Chena Rivers.

Groundwater movement between the Tanana and Chena Rivers follows a northwest regional pattern but fluctuates seasonally because of the effects of changing river stages. Although the level of the Chena River is controlled, seasonal fluctuations in levels do occur.

Groundwater levels near the Chena River may fluctuate greatly because of river stages. Typically, groundwater levels increase when the river stage increases, particularly during spring breakup and late summer runoff. Groundwater levels usually decrease during fall and winter, when precipitation becomes snow. When river water levels go down, the groundwater seeps into surface water bodies, such as the Chena River.

In addition to shifts in the groundwater flow direction because of the surface water hydrology, the groundwater flow direction may be impacted by high-volume pumping for dewatering operations.

Where present, permafrost forms discontinuous confining layers that influence groundwater movement and distribution. The presence of near-surface permafrost usually restricts groundwater movement within the shallow subsurface. Three types of aquifers are associated with permafrost: suprapermafrost aquifers, intrapermafrost aquifers, and subpermafrost aquifers. A suprapermafrost aquifer is situated above the permafrost table in the active layer, and the permafrost tables act as a relatively impermeable basal boundary. Suprapermafrost

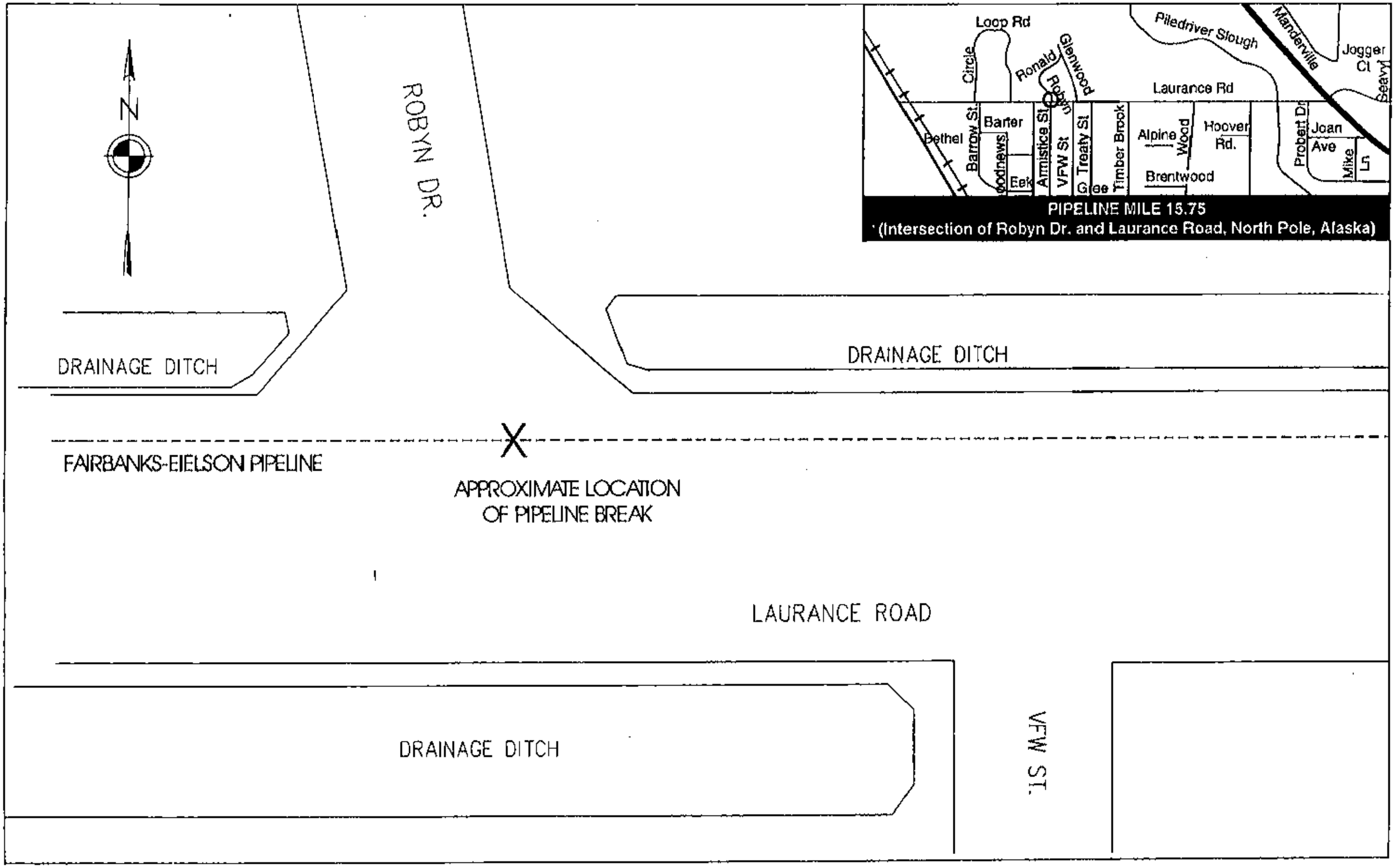


Figure 5 MILEPOST 15.75 SOURCE AREA

aquifers are usually seasonal aquifers that freeze or experience significant storage depletion in the winter. Many of the monitoring wells at Fort Wainwright and some domestic wells are completed in the suprapermafrost aquifer. Intrapermafrost aquifers are found in unfrozen talik zones within the body of permafrost. Subpermafrost aquifers are situated below the permafrost serving as a relatively impermeable boundary.

Groundwater characterization conducted during the Remedial Investigation (RI) indicates the presence of thaw channels in the Tank Farm area.

The Chena River flows through Fort Wainwright to the City of Fairbanks and into the Tanana River. The ROLF, Valve Pit A, and Valve Pit B are located directly on the banks of the Chena River. The wells that are located downstream along the Chena River include the Fairbanks Municipal Utilities System (MUS; 1 mile), College Utilities (1.5 miles), and numerous residential wells located on the north bank of the river less than 0.5 mile downstream.

1.3 LAND USE

Land use at the OU-3 source areas is generally light industrial. There are residential areas directly adjacent to and hydrogeologically downgradient of the Tank Farm Source Area and Milepost 15.75. Recreational uses are known to occur at all source areas because of the presence of the Chena River and dense wooded areas.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 SITE HISTORY

The Tank Farm and associated TFS are part of the Fairbanks Fuel Terminal, which was constructed in 1943 beginning with the installation of the fourteen 10,000-barrel-capacity, bolted-steel tanks on Birch Hill. The mission of the Fairbanks Fuel Terminal was to provide backup fuel support for Eielson Air Force Base. Fuel was transported via the CANOL pipeline and the Haines-Fairbanks pipeline. At Fort Wainwright, the CANOL pipeline connected the Birch Hill UST facility to the ROLF and ran west to the Tank Farm. The portion of the pipeline between the ROLF and the Tank Farm remains in place. The Haines-Fairbanks pipeline was constructed from 1954 to 1955. The only active portion of this pipeline, now called the Fairbanks-Eielson Pipeline, runs between Eielson Air Force Base and the Mapco refinery in North Pole.

2.1.1 Tank Farm Source Area

Petroleum spills occurred in and around the tanks and the TFS throughout the fuel terminal's history. The bolted-steel tanks were subject to minor leaks, and many truck spills occurred in the TFS area. In addition, the tanks were painted with lead-based paints, which subsequently were sandblasted. As a result, surface soils around the ASTs are contaminated with lead-based paint. Surface and subsurface soils at the Fairbanks Fuel Terminal also are contaminated with petroleum. Groundwater beneath the terminal at the base of Birch Hill also contains petroleum constituents.

2.1.2 Railcar Off-Loading Facility Source Area

Available records indicate that one 20-gallon spill of fuel occurred at the ROLF between 1970 and 1987. However, it is known that the tank car headers were prone to minor leaks, and at least one major spill of JP-4 occurred at one of the headers. Additionally, the USTs formerly at the ROLF reportedly were overfilled on numerous occasions. In 1991, a pipeline from Valve Pit C to the airfield failed a hydrostatic pressure test and was taken out of service. Valve pits on either side of the Chena River and at the ROLF had leaks. Subsurface soil and groundwater are contaminated with petroleum constituents.

2.1.3 Milepost Source Areas

Between 1956 and 1972, 40 ruptures were reported along the former Haines-Fairbanks pipeline. In the late 1970s, the multiproduct Fairbanks-Eielson Pipeline was ruptured by a contractor operating excavation equipment near Milepost 2.7. The pipeline contained fuel at the time. The damaged section was isolated at the nearby valve pits.

As previously stated, the Fairbanks-Eielson Pipeline has suffered numerous leaks since its construction. However, no specific ruptures in the pipeline have been documented at the Milepost 3.0 Source Area. Subsurface soil contamination was documented at Milepost 3.0 during previous area investigative activities, which originally were intended to characterize potential contaminant migration from the Birch Hill UST facility. The Army suspected that contamination at Milepost 3.0 was the result of a leak in the Fairbanks-Eielson Pipeline.

On August 26, 1989, the Fairbanks-Eielson Pipeline at Milepost 15.75 was ruptured when a contractor was upgrading Laurance Road and establishing a subgrade level for Robyn Drive. Following notification that the pipeline had ruptured, the pipeline was closed at the north Chena River flood control isolation valve and at the isolation valve at Milepost 14.75. An earthen berm contained most of the spilled fuel. Sorbent materials and a vacuum truck from the Mapco refinery recovered approximately 2,400 gallons within 2 hours of the spill. At least 4,200 gallons are estimated to have spilled. Contaminated soils were removed from the spill area immediately following the recovery of liquid fuel.

2.2 ENFORCEMENT ACTIVITIES

Fort Wainwright was placed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List in August 1990. Consequently, a federal facility agreement (FFA) was executed in spring 1992 among the United States Environmental Protection Agency (EPA), Alaska Department of Environmental Conservation (ADEC), and United States Department of Defense. The FFA details the responsibilities and authority associated with each party pursuant to the CERCLA process and the associated environmental investigation and remediation requirements associated with Fort Wainwright. The FFA divided Fort Wainwright into five OUs, one of which is OU-3, and outlined the general requirements for investigation and/or remediation of OU-3.

The OU-3 RI and Feasibility Study (FS) were performed in accordance with the RI/FS Management Plan for OU-3. The RI fieldwork was conducted during September and October 1993, and the final RI and Risk Assessment Reports were submitted to EPA in October 1994. The OU-3 FS was submitted to EPA in April 1995.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The public was encouraged to participate in the selection of the remedies for OU-3 during a public comment period from April 19 to May 19, 1995. The *Fort Wainwright Proposed Plan for Operable Unit 3* presented more than 25 combinations of options, considered by the Army, EPA, and ADEC, to address contamination in soil and groundwater at OU-3. The Proposed Plan was released to the public on April 19, 1995, and copies of a Proposed Plan summary fact sheet were sent to all known interested parties, including approximately 150 elected officials and concerned citizens. An informational Fact Sheet dated March 1995, providing information about the Army's entire cleanup program at Fort Wainwright, was mailed to the same known interested parties.

The Proposed Plan summarized available information regarding the OU. Additional materials were placed in two information repositories, one at the Noel Wien Library in Fairbanks and the other at the Fort Wainwright Post Library. An Administrative Record, including all items placed in the information repositories and other documents used in the selection of the remedial actions, was established in Building 3023 on Fort Wainwright. The public was welcome to inspect materials available in the Administrative Record and the information repositories during business hours.

Interested citizens were invited to comment on the Proposed Plan and the remedy selection process by mailing comments to the Fort Wainwright Project Manager, by calling a toll-free telephone number to record a comment, or by attending and commenting at a public meeting on April 25, 1995, at the Noel Wien Library in Fairbanks. One organization submitted comments in writing, no comments were recorded on the toll-free telephone line, and one person provided oral comments at the public meeting. Twenty-four people attended the public meeting, which also included presentations on an interim action for a source area in OU-1.

Display advertisements in the *Fairbanks Daily News-Miner*, published on April 12, 16, 19, 23, 24, and 25, 1995, also included information regarding the information repositories, the toll-free telephone line, and an address for submitting written comments.

The Responsiveness Summary, Appendix A to this document, summarizes and addresses public comments on the Proposed Plan.

This decision document presents the selected OU-3 remedial action, chosen in accordance with CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision for OU-3 is based on the Administrative Record. An index to the documents contained in the Administrative Record for OU-3 is provided in Appendix B.

4.0 SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

As with many CERCLA sites, the problems at Fort Wainwright are complex. As a result, the Army, EPA, and ADEC divided the fort into five OUs, one of which is OU-3. OU-3 is the first OU at Fort Wainwright to have completed the RI/FS process and to begin final remedial action activities.

The remedial action described in this Record of Decision (ROD) addresses threats to human health and the environment posed by contamination at OU-3. The RI/FS has defined potential risks because of the possibility of contaminant migration to residential and public drinking water supply wells that are downgradient from the OU-3 source areas if remediation does not occur.

EPA, ADEC, and the Army have agreed to address petroleum-contaminated soils at the Tank Farm ASTs under 18 Alaska Administrative Code (AAC) 78 in the Two-Party Agreement between ADEC and the Army. It has also been agreed to defer selection of the final remedy for the lead-based paint in soils at the ASTs; this source will be addressed in the ROD for OU-5.

5.0 SITE CHARACTERISTICS

The OU-3 RI results indicate that soil and groundwater are contaminated with petroleum fuel products in all the areas investigated. The specific chemicals of concern associated with the petroleum contamination include benzene, toluene, ethylbenzene, and total xylenes (BTEX); 1,2-dichloroethane; isopropylbenzene; and trimethylbenzene. Groundwater contaminated with petroleum may be discharging from the ROLF and Valve Pit A into the Chena River. In addition, surface soils surrounding ASTs at the Tank Farm are contaminated with lead and petroleum.

Refer to the end of this section for tables and illustrations cited in Section 5.

5.1 TANK FARM SOURCE AREA

5.1.1 Hydrogeology and Groundwater Use

The Tank Farm Source Area has three distinct hydrogeologic areas: the ASTs on Birch Hill; the area between the TFS and the base of Birch Hill; and the area south of the TFS, including Valve Pit A.

Birch Hill consists of loess overlaying Birch Creek schist and other bedrock units. Figure 6 illustrates a geologic cross section for a portion of the Tank Farm Source Area. Groundwater is known to occur in the Birch Creek schist but was not encountered during an investigation at the ASTs on Birch Hill. The static water level in a well approximately 300 feet north of the ASTs historically has been 500 feet above MSL. Groundwater flow in the bedrock aquifer at the Tank Farm is expected to occur mainly in fractures and to flow to the southwest. Monitoring well locations at the Tank Farm are illustrated in Figure 7.

The presence, location, and extent of permafrost from the base of Birch Hill southward to Chena River significantly affect the groundwater flow direction in this part of the Tank Farm source area, as illustrated in Figure 8. Groundwater occurs at approximately 20 feet to 22 feet BGS in the TFS area at the base of Birch Hill in the suprapermafrost groundwater zone. Groundwater in this area flows to the southwest. Shallow discontinuous permafrost in this area may channel groundwater into thawed corridors that occur in meander scars, and a hydraulic connection may exist between the suprapermafrost groundwater zone in the thawed areas and the subpermafrost groundwater zone.

South of the TFS, while no suprapermafrost aquifer is known to exist, a subpermafrost aquifer and thaw bulbs occur (see Figure 6). Hydraulic gradients measured in this area indicate that groundwater from the unconfined aquifer may flow downward in an unfrozen area into the confined subpermafrost aquifer. In the adjacent Shannon Park Subdivision, groundwater occurs at approximately 10 feet to 12 feet in a suprapermafrost groundwater zone. Shannon Park residents use city water; they do not use water in the aquifer located immediately below the subdivision.

An apparent groundwater divide exists in the vicinity of Valve Pit A. Groundwater immediately adjacent to the valve pit flows east toward the Chena River; however, groundwater several hundred feet west of the valve pit flows consistent with the westward regional groundwater flow direction. Near Valve Pit A, groundwater occurs at a depth of approximately 13 feet BGS. No permafrost exists in this area.

The closest drinking water wells to the Tank Farm Source Area are located at the Shannon Park Baptist Church and Mormon Chapel on Lazelle Road approximately 0.25 mile downgradient of the Tank Farm buildings (see Figure 1).

5.1.2 Current Land Use

The Tank Farm is the only OU-3 source area that borders Fairbanks. Some residential development is north of the ASTs on Birch Hill. The area immediately downgradient of the TFS is undeveloped and is known as the Bentley Trust Property. The Shannon Park Subdivision, a residential development, is immediately south of the Bentley Trust Property. Valve Pit A is located less than 0.25 mile northeast of the 801 Housing Subdivision (Birchwood) on Fort Wainwright. Approximately 1,580 people live in this subdivision. Scrub-shrub and forested wetlands border the southern portion of the TFS area.

5.1.3 Previous Investigations

In 1988, a soil-gas survey was conducted at the Tank Farm. Contamination was detected in soil-gas samples collected from the base of Birch Hill within the Tank Farm area. In 1987, five monitoring wells (AP-5271, AP-5272, AP-5273, AP-5274, and AP-5275) were installed along the west boundary of the Tank Farm and the wells were sampled periodically as part of the basewide groundwater monitoring program. These wells were screened below the top of the water table in suprapermafrost groundwater. Samples collected from most of the monitoring wells contained petroleum products and significant quantities of BTEX above maximum contaminant levels (MCLs) during sampling events. Monitoring wells installed as part of the United States Army Corp of Engineers, Alaska Distict, (Corps) groundwater monitoring program are identified by *GWM* in this document. In 1992, monitoring wells in the TFS area and in the area between the Tank Farm and the Chena River were installed, and these wells are known as *the picket wells* because they are situated in a fence-like pattern along the west boundary of Fort Wainwright. The picket wells are sampled biannually. Monitoring wells AP-5782, AP-5783, AP-5785 (a subpermafrost well), AP-5787, AP-5788, and AP-5791 were sampled during the OU-3 RI. Monitoring wells included in the Fort Wainwright picket well program are identified by *PW* in this document.

Two churches with drinking water supply wells are located off post 0.25 mile downgradient of the Tank Farm near Lazelle Road (Figure 1). Table 1 summarizes the results of all contaminants detected during sampling events of these wells from 1991 to 1994. 1,2,-dichloroethane has been the only volatile organic compound (VOC) detected at concentrations close to Safe Drinking Water Act levels.

5.1.4 Remedial Investigation Results

For the RI, the Tank Farm Source Area was divided into seven sub-areas based on geographic locations and differing physical characteristics. Accordingly, RI results are discussed relative to the individual sub-areas. The sub-areas' boundaries are illustrated in Figure 9.

5.1.5 Remedial Results for Soils

Birch Hill Aboveground Storage Tanks Sub-Area

Petroleum hydrocarbons were found in surface and subsurface soils, with the most significant levels within the bermed areas around the ASTs. Petroleum hydrocarbon levels decrease with depth and distance from the tanks. At the ASTs with less than 15 feet of underlying silt, soil contamination was generally highest at the interface between silt and schist bedrock.

In surface soil and subsurface soil, petroleum hydrocarbons (quantified as Jet A fuel) were detected at a maximum concentration of 5,500 milligrams per kilogram (mg/kg). Low levels of VOCs also were detected. Total lead was detected in surface soils up to a maximum concentration of 7,840 mg/kg; the highest toxicity characteristic leaching procedure (TCLP) result for lead in surface soil was 5.4 milligrams per liter (mg/L), which exceeds the Resource Conservation and Recovery Act (RCRA) hazardous waste characteristic criterion of 5 mg/L for lead (see Figure 10). Table 2 summarizes soils results in the Birch Hill sub-area.

Building 1173 Sub-Area

Subsurface soil contamination is present in the Building 1173 sub-area from the water table to approximately 7 feet above the water table. Subsurface soil contamination in this area is most concentrated near the base of Birch Hill. The subsurface soil contamination likely contributes to groundwater contamination observed in the Lazelle Road sub-area.

Low levels of petroleum hydrocarbons (quantified as diesel and Jet A fuel) were detected in surface soils in this area. VOCs were not detected in surface soil. Total lead concentrations in surface soil were less than 13 mg/kg.

In subsurface soil, petroleum hydrocarbons (quantified as diesel fuel) were detected at a maximum concentration of 340 mg/kg. The highest VOC concentration detected in subsurface soil was 97 mg/kg of ethylbenzene. Total lead concentrations in subsurface soil were less than 17 mg/kg. Table 3 summarizes the analytical data for surface and subsurface soils in the Building 1173 sub-area.

Truck Fill Stand Sub-Area

The extent and distribution of contamination in the TFS sub-area appear to be discontinuous, with no apparent spatial trends. This area is underlain by discontinuous zones of permafrost (see Figure 11). The ASTs located adjacent to the TFS have been a source of petroleum contamination either through spills and overfilling or leaking tanks.

In surface soil, low levels of petroleum hydrocarbons (quantified as bunker C-range organic compounds) were detected. VOCs were not detected in surface soil. Total lead concentrations in surface soil were less than 18 mg/kg.

In subsurface soil, low levels of petroleum hydrocarbons (quantified as bunker C-range organic compounds) and VOCs (toluene) were detected. Total lead concentrations in subsurface soil were less than 15 mg/kg. Table 4 summarizes the analytical data for soils at the TFS sub-area.

Lazelle Road Sub-Area

Surface soils in this sub-area do not appear to be impacted by subsurface releases from the Tank Farm. Contaminant levels in subsurface soil decrease with distance west of the Tank Farm Source Area. Permafrost to the south of Lazelle Road and bedrock to the north appear to restrict the southern and northern extent of subsurface contamination.

In surface soil, petroleum hydrocarbons (quantified as diesel fuel by field screening analysis) were detected up to a maximum concentration of 109 mg/kg. None of the surface soil samples were submitted for VOC or total lead analyses.

In subsurface soil, low levels of petroleum hydrocarbons (quantified as bunker C-range organic compounds) were detected. VOCs were not detected in subsurface soil. Total lead concentrations were less than 79 mg/kg. Table 5 summarizes the analytical data for soils in the Lazelle Road sub-area.

Shannon Park Subdivision Sub-Area

Localized areas of subsurface soil contamination were found in the Shannon Park Subdivision; however, this contamination appears to originate from sources other than the Fort Wainwright Tank Farm. This conclusion is based on the types of fuel detected (diesel fuel similar to heating oil) and the localized nature of the contamination.

In subsurface soil, low levels of petroleum hydrocarbons (quantified as bunker C-range organic compounds) were detected. VOCs were not detected in subsurface soil. Total lead concentrations were less than 15 mg/kg. Table 6 summarizes the analytical data for soils in the Shannon Park Subdivision sub-area.

CANOL Road Sub-Area

Low levels of petroleum hydrocarbons (quantified as diesel fuel by field screening analysis) were detected in surface soils in this sub-area. None of the surface soil samples were submitted for VOC or total lead analyses.

In subsurface soil, low levels of petroleum hydrocarbons (quantified as bunker C-range organic compounds) and VOCs were detected. Total lead concentrations in subsurface soil were less than 17 mg/kg. Table 7 summarizes the analytical data for soils in the CANOL Road sub-area.

Valve Pit A Sub-Area

Soil contamination at Valve Pit A is concentrated around the valve pit structure and extends at least 200 feet north and south of the valve pit. Figure 12 illustrates soil contamination in this sub-area and proximity to the Chena River.

Low levels of petroleum hydrocarbons (quantified as diesel fuel by field screening analysis) were detected in surface soils. None of the surface soil samples were submitted for VOC or total lead analyses.

In subsurface soil, petroleum hydrocarbons (quantified as kerosene) were detected up to a maximum concentration of 3,800 mg/kg. Low levels of VOCs also were detected. Benzene in subsurface soil was detected at a concentration of 10 mg/kg in one sample. Total lead concentrations were less than 8 mg/kg. Table 8 summarizes the analytical data for soils in the Valve Pit A sub-area.

5.1.6 Remedial Investigation Results for Groundwater

Birch Hill Aboveground Storage Tanks Sub-Area

Monitoring wells in this sub-area include AP-6053 (RI), AP-6054 (RI), AP-6055 (RI), and AP-5271 (GWM). All of these wells are located at the base of Birch Hill.

The highest detected concentration of petroleum hydrocarbons (quantified as gasoline) was 23,000 micrograms per liter (μg/L). The highest concentration of VOCs detected in this area was 150 μg/L for benzene, which exceeds the MCL of 5 μg/L. Low levels of other VOCs also were detected in groundwater in this sub-area. Total lead was detected up to a maximum concentration of 140 μg/L; however, dissolved lead concentrations were less than 5 μg/L, which is below the MCL of 15 μg/L. Total lead samples were more turbid than dissolved lead samples because of filtering of the dissolved lead samples before containerization.

Refer to Figure 13 for an illustration of benzene concentrations in groundwater. Table 9 summarizes all of the analytical data for groundwater at this sub-area.

Building 1173 Sub-Area

Monitoring wells in this sub-area include AP-6056 (RI), AP-5272 (GWM), and AP-5273 (GWM). All of these wells are located between the base of Birch Hill and the TFS area.

The highest detected concentration of petroleum hydrocarbons (quantified as Jet A fuel) was 380 μg/L. The highest concentration of VOCs detected in this sub-area was 120 μg/L for benzene, which exceeds the MCL of 5 μg/L. Low levels of other VOCs also were detected in groundwater in this sub-area. Total lead was detected up to a maximum concentration of 73 μg/L; however, dissolved lead was not detected in any of the monitoring well samples. Total lead samples were more turbid than dissolved lead samples because of filtering of the dissolved lead samples before containerization.

Table 10 summarizes all of the analytical data for groundwater at this sub-area.

Truck Fill Stand Sub-Area

Monitoring wells in this sub-area include AP-6066 (RI), AP-5274 (GWM), AP-5275 (GWM), AP-5782 (PW), AP-5783 (PW), and AP-5785 (PW). These wells are located along the western boundary of the fort and adjacent to the TFS area.

The highest detected concentration of petroleum hydrocarbons (quantified as bunker C-range organic compounds) was 1,000 μg/L. The highest concentration of VOCs detected in this sub-area was 11 μg/L for benzene, which exceeds the MCL of 5 μg/L. Low levels of other VOCs also were detected in groundwater in this sub-area. Total lead was detected up to a maximum concentration of 150 μg/L; however, dissolved lead was not detected in any of the samples. Total lead samples were more turbid than dissolved lead samples because of filtering of the dissolved lead samples before containerization.

Refer to Figure 13 for an illustration of benzene concentrations in groundwater in the TFS sub-area. Table 11 summarizes all of the analytical data for groundwater at this sub-area.

Lazelle Road Sub-Area

One monitoring well, AP-6071 (RI), is located within this sub-area. Petroleum hydrocarbons (quantified as gasoline) were detected at a concentration of 6,800 μg/L. VOCs were not detected in the well in two separate sampling events. Total lead was detected at a concentration of 10 μg/L, but dissolved lead was not detected in the monitoring well. Table 12 summarizes the analytical data for groundwater in the Lazelle Road sub-area.

Shannon Park Subdivision Sub-Area

Monitoring wells in this sub-area include AP-6057 (RI), AP-6067 (RI), AP-6068 (RI), AP-6069 (RI), and AP-6070 (RI). These wells are located off post within the Shannon Park Subdivision west of the Tank Farm Source Area.

The highest detected concentration of petroleum hydrocarbons (quantified as bunker C-range organic compounds) was 1,100 μg/L. VOCs were not detected in any of the monitoring wells in this sub-area. Total lead was detected up to a maximum concentration of 150 μg/L; however, dissolved lead was not detected in any of the wells. Total lead samples were more turbid than dissolved lead samples because of filtering of the dissolved lead samples before containerization. Table 13 summarizes the analytical data for groundwater in the Shannon Park Subdivision sub-area.

CANOL Road Sub-Area

Monitoring wells in this sub-area include AP-5787 (GWM), AP-5788 (GWM), AP-6058 (RI), AP-6059 (RI), AP-5791 (GWM), AP-6060 (RI), AP-6061 (RI), AP-6062 (RI), and AP-6063 (RI). These wells are generally located along the corridor formed by the CANOL pipelines and associated service road.

The highest detected concentration of petroleum hydrocarbons (quantified as gasoline) detected in this sub-area was 6,900 μg/L; however, this well did not contain detectable levels of petroleum hydrocarbons when re-sampled. VOCs were not detected in any of the monitoring wells. Total lead was detected up to a maximum concentration of 88 μg/L; however, detected dissolved lead concentrations were less than 5 μg/L, which is less than the MCL of 15 μg/L. Total lead samples were more turbid than dissolved lead samples because of filtering of the dissolved lead samples before containerization. Table 14 summarizes the analytical data for groundwater samples from the CANOL Road sub-area.

Valve Pit A Sub-Area

Monitoring wells located in this sub-area include AP-6064 (RI) and AP-6065 (RI). Both wells are located adjacent to the concrete valve pit structure.

Petroleum hydrocarbons (quantified as gasoline) were detected up to a maximum concentration of 43,000 μg/L. Three VOCs were detected above MCLs in this sub-area: benzene at a maximum concentration of 1,700 μg/L, ethylbenzene at a maximum concentration of 1,600 μg/L, and toluene at a maximum concentration of 12,000 μg/L. Total lead concentrations ranged up to a maximum concentration of 300 μg/L; however, dissolved lead was detected at a maximum concentration of 2.7 μg/L, which is less than the MCL of 15 μg/L.

Refer to Figure 16 for an illustration of benzene concentrations in groundwater at the Valve Pit A sub-area. Table 15 summarizes all of the analytical data for the Valve Pit A sub-area.

5.2 RAILCAR OFF-LOADING FACILITY SOURCE AREA

5.2.1 Hydrogeology and Groundwater Use

Groundwater occurs at approximately 12 feet BGS at the ROLF Source Area. The water table occurs in the coarse-grained facies of the Chena alluvium. Groundwater flows to the west-northwest in the area around the ROLF Source Area. Variations to flow direction are due to the stage of the Chena River. Because it was not encountered in this area, shallow permafrost is not expected to affect groundwater flow.

The Pioneer wells in the Hamilton Acres Subdivision are a Class A drinking water source approximately 1 mile downgradient of the ROLF. Four drinking water supply wells serving Fort Wainwright are located approximately 1 mile south of the ROLF (see Figure 1). The ROLF, Valve Pit A, and Valve Pit B are located directly on the banks of the Chena River. The wells that are located downstream along the Chena River include the Fairbanks MUS (1 mile), College Utilities (1.5 miles), and numerous residential wells located on the north bank of the river less than 0.5 mile downstream.

5.2.2 Current Land Use

The ROLF is located immediately north of the Fort Wainwright airport and is approximately 0.3 mile from the 801 Housing Subdivision. The Chena River is located between the ROLF and the 801 Housing Subdivision. The North Post Housing Subdivision is 0.7 mile from the ROLF and houses 698 people. A scrub-shrub wetland borders the northeast edge of the ROLF. This area of the Chena River is used heavily by residents and nonresidents involved in recreational sport fishing, boating, and hiking.

5.2.3 Previous Investigations

A soil-gas survey was conducted at the ROLF and associated valve pits in 1988. Samples collected from soil-gas probes installed at the ROLF revealed a contaminant plume centered on the railroad spur containing the 16-tank-car unloading headers and the former USTs. Monitoring well AP-5527 was installed at the ROLF in 1989 and contained free-floating product in most of the sampling events since its installation.

5.2.4 Remedial Investigation Results

For the RI, the ROLF Source Area was divided into three sub-areas based on geographic location and differing physical characteristics. Accordingly, the RI results are discussed relative to these sub-areas. The ROLF sub-area boundaries are illustrated in Figure 14.

5.2.5 Remedial Investigation Results for Soils

Valve Pit B Sub-Area

Petroleum-contaminated soils extend from Valve Pit B to the Chena River. Soil boring data suggest that subsurface contamination extends approximately 500 feet north and south of the valve pit. Fluctuating groundwater levels, a result of Chena River stage variations, have created a smear zone of petroleum contamination in subsurface soil. This smear zone extends from the water table to approximately 4 feet above the water table. Figure 15 shows the proximity of the Chena River to Valve Pit B.

In surface soil, petroleum hydrocarbons (quantified as diesel fuel by field screening analysis) were detected up to a maximum concentration of 28 mg/kg. No surface soil samples were submitted for VOC or lead analyses.

In subsurface soil, petroleum hydrocarbons (quantified as Jet A fuel) were detected at a maximum concentration of 2,700 mg/kg. Low levels of VOCs were detected in subsurface soils throughout the Valve Pit B sub-area. Total lead concentrations were less than 15 mg/kg. Table 16 summarizes the analytical data for soils at the Valve Pit B sub-area.

Central Railcar Off-Loading Facility Sub-Area

The central ROLF sub-area has been impacted by petroleum releases originating from Valve Pit C and from a complex system of valve pits, off-loading headers, and former UST sites located in the center of the sub-area.

In surface soil, petroleum hydrocarbons (quantified as diesel fuel) were detected up to a maximum concentration of 5,900 mg/kg. VOCs were not detected in surface soils. Total lead was detected up to a maximum concentration of 101 mg/kg.

In subsurface soil, petroleum hydrocarbons (quantified as Jet A fuel) were detected up to a maximum concentration of 2,600 mg/kg. Benzene was detected up to a maximum concentration of 2.4 mg/kg in subsurface soil. Total lead in subsurface soil was detected at a maximum concentration of 18.2 mg/kg. TCLP lead was detected at a maximum concentration of 0.032 mg/L, which is below the RCRA hazardous waste characteristic criterion of 5 mg/L for lead. Table 17 summarizes the analytical data for soils at the central ROLF sub-area.

Front Street Sub-Area

Contamination of soils in the Front Street sub-area appears to originate from a source located east of the ROLF. Because another source area included in OU-5 is located in this direction, this sub-area is thought to represent the leading edge of a contaminant plume unrelated to historical operations at the ROLF Source Area.

In subsurface soil, petroleum hydrocarbons (quantified as Jet A fuel) were detected at a maximum concentration of 260 mg/kg. Low levels of VOCs were detected in subsurface soil. Total lead concentrations were less than 8 mg/kg. Table 18 summarizes the analytical data for soils at the Front Street sub-area.

5.2.6 Remedial Investigation Results for Groundwater

Valve Pit B Sub-Area

Monitoring wells in this sub-area include AP-5998 (RI) and AP-6018 (RI), which are located adjacent to the Valve Pit and the Chena River.

The highest level of petroleum hydrocarbons (quantified as Jet A fuel) was detected at a concentration of 3,600 μg/L; however, free-floating petroleum product has been observed in groundwater in this sub-area. VOCs detected include benzene at a maximum concentration of 1,400 μg/L, which exceeds the MCL of 5 μg/L, and toluene at a maximum concentration of 3,900 μg/L, which exceeds the MCL of 1,000 μg/L. Total lead was detected at a maximum concentration of 160 μg/L, and dissolved lead was detected at a maximum concentration of 9.9 μg/L, which is less than the MCL of 15 μg/L for lead.

Refer to Figure 16 for an illustration of benzene concentrations in groundwater at this sub-area. Table 19 summarizes all of the analytical data for groundwater at the Valve Pit B sub-area.

Central Railcar Off-Loading Facility Sub-Area

Monitoring wells in this sub-area include AP-5999 (RI), AP-6000 (RI), AP-6001 (RI), AP-6002 (RI), AP-6003 (RI), AP-6004 (RI), AP-6005 (RI), AP-6006 (RI), AP-6007 (RI), AP-6008 (RI), AP-6009 (RI), AP-6010 (RI), AP-6013 (RI), AP-6014 (RI), AP-6015 (RI), and AP-5527 (GWM).

The highest concentration of petroleum hydrocarbons (quantified as JP-4 fuel) detected in groundwater was 120,000 μg/L. Four VOCs were detected above MCLs: benzene at a maximum concentration of 5,800 μg/L, which is above the MCL of 5 μg/L; ethylbenzene at a maximum concentration of 1,100 μg/L, which is above the MCL of 700 μg/L; toluene at a maximum concentration of 15,000 μg/L, which is above the MCL of 1,000 μg/L; and 1,2-dichloroethane at a maximum concentration of 6 μg/L, which is above the MCL of 5 μg/L. In addition, 1,2,4-trimethylbenzene was detected at a maximum concentration of 710 μg/L, 1,3,5-trimethylbenzene was detected at a maximum concentration of 190 μg/L, and isopropylbenzene was detected at a maximum concentration of 1,200 μg/L. Total lead was detected at a maximum concentration of 330 μg/L, and dissolved lead was detected at a maximum concentration of 160 μg/L, both of which exceed the MCL of 15 μg/L for lead. Figure 16 illustrates benzene concentrations in groundwater. Table 20 summarizes the analytical data for groundwater at the central ROLF sub-area.

Front Street Sub-Area

Monitoring wells in this sub-area include AP-6011 (RI), AP-6012 (RI), AP-6016 (RI), and AP-5537 (GWM). These monitoring wells are located east of the central ROLF near Front Street.

The highest detected concentration of petroleum hydrocarbons (quantified as diesel fuel) was 10,000 μg/L. VOCs detected include 1,2,4-trimethylbenzene up to 250 μg/L, 1,3,5-trimethylbenzene up to 530 μg/L, and benzene up to 140 μg/L, which is above the MCL of 5 μg/L for benzene. Total lead was detected at a maximum concentration of 260 μg/L, but dissolved lead was not detected in groundwater samples from this sub-area.

Refer to Figure 16 for an illustration of benzene concentrations in groundwater. Table 21 summarizes the analytical data for groundwater at the Front Street sub-area.

5.3 MILEPOST SOURCE AREAS

5.3.1 Milepost 2.7

Hydrogeology and Groundwater

Groundwater occurs approximately 2 feet BGS at the Milepost 2.7 Source Area. The water table occurs in an alluvial suprapermafrost aquifer in the Fairbanks loess. Groundwater flows to the southwest across the source area. The main groundwater flow path may be in the thaw bulb beneath Birch Hill Road and the Fairbanks-Eielson Pipeline.

The closest drinking water well to Milepost 2.7 is located at the Birch Hill Ski Area, approximately 1 mile west (see Figure 1). However, this well is completed in the Birch Creek schist aquifer, not the alluvial aquifer. These aquifers are not hydraulically connected.

Current Land Use

The Milepost 2.7 Source Area is located within a military training area approximately 1 mile and across the Chena River from any residential development. This area also has recreational uses. A black spruce-scrub-shrub wetland complex borders the southern extent of this source area.

Previous Investigations

A soil-gas survey was conducted along the Fairbanks-Eielson Pipeline in 1989. Benzene was detected at elevated concentrations.

The Corps also conducted a subsurface investigation at the Fairbanks-Eielson Pipeline and collected subsurface soil and groundwater samples from four soil borings. Analysis of samples collected near the Milepost 2.7 Source Area revealed petroleum hydrocarbon contamination, with the highest concentrations occurring in a subsurface soil sample collected from borehole AP-5650 at 15 feet BGS. Analytes detected in a sample collected from a monitoring well contained benzene concentrations ranging from 120 μg/L to 318 μg/L. Gasoline or gasoline-range organics (GRO) were detected each time the well was sampled.

Diesel-range organics also were detected. The diesel was detected in a quality control sample but not in any other replicate samples. Isopropylbenzene; 1,2,3-trimethylbenzene; and 1,2,4-trimethylbenzene were detected when they were analyzed for during the most recent sampling event.

Remedial Investigation Results

Surface soil contamination extends approximately 120 feet south of the Milepost 2.7 pipeline break location into adjacent wetlands. This surface contamination could result from upwelling contaminated groundwater or contaminated surface runoff originating from the TFS-2 area. Subsurface soil contamination extends laterally underneath Birch Hill Road adjacent to TFS-1 and TFS-2. This subsurface soil contamination likely is bounded to the south by shallow permafrost and to the north by schist bedrock associated with the Birch Hill formation.

Remedial Investigation Results for Soils

In surface soil, petroleum hydrocarbons (quantified as gasoline) were detected at a maximum concentration of 470 mg/kg. Low levels of VOCs were detected in surface soils. Total lead was detected at concentrations less than 44 mg/kg.

In subsurface soil, petroleum hydrocarbons (quantified as gasoline) were detected at a maximum concentration of 290 mg/kg. Low levels of VOCs were detected in subsurface soils throughout the source area. Total lead concentrations in subsurface soil were less than 17 mg/kg. One subsurface soil sample analyzed for TCLP lead contained lead at a concentration of 0.034 mg/L, which is below the RCRA hazardous waste characteristic criterion of 5 mg/L for lead. Table 22 summarizes the analytical data for surface and subsurface soils at the Milepost 2.7 Source Area.

Remedial Investigation Results for Groundwater

Monitoring wells in this source area include AP-5650 (GWM), AP-5651 (GWM), AP-6034 (RI), AP-6035 (RI), and AP-6036 (RI).

The highest detected concentration of petroleum hydrocarbons (quantified as gasoline) was 2,100 μg/L. Benzene was detected at a concentration of 140 μg/L, which exceeds the MCL of 5 μg/L; low levels of other VOCs also were detected in Milepost 2.7 groundwater. Total lead was detected up to a maximum concentration of 150 μg/L, but dissolved lead was detected at a maximum concentration of 4 μg/L, which is below the MCL of 15 μg/L.

Refer to Figure 17 for an illustration of benzene concentrations in groundwater at Milepost 2.7. Table 23 summarizes all of the analytical data for groundwater at the Milepost 2.7 Source Area.

5.3.2 Milepost 3.0

Hydrogeology and Groundwater Use

Groundwater ranges from 12 feet to 18 feet BGS at the Milepost 3.0 Source Area. The water table occurs in an alluvial suprapermafrost aquifer in the Fairbanks loess. Groundwater flows to the southwest across Mileposts 2.7 and 3.0. The main groundwater flow path at these source areas may be in the thaw bulb beneath Birch Hill Road and the Fairbanks-Eielson Pipeline.

The closest well to Milepost 3.0 is located at the Birch Hill Ski Area, approximately 1.25 miles away (see Figure 1). However, this well is completed in the Birch Creek schist aquifer, not the alluvial aquifer; therefore, these wells are not hydraulically connected.

Current Land Use

The Milepost 3.0 Source Area is located within a military training area approximately 1 mile from and across the Chena River from any residential development. This area also has recreational uses. A black spruce-scrub-shrub wetland complex borders the southern extent of this source area.

Previous Investigations

Monitoring well AP-5522 was installed near Milepost 3.0 at TFS-3 in August 1989 as part of the Fort Wainwright basewide groundwater monitoring program. Subsurface soil samples contained gasoline, bunker oil, and xylenes. To date, all groundwater samples collected from monitoring well AP-5522 during basewide sampling events contained GRO, benzene, and xylenes; benzene and xylene concentrations consistently have exceeded MCLs.

Remedial Investigation Results for Soils

Petroleum contamination in subsurface soil at Milepost 3.0 is concentrated mostly along Birch Hill Road. The contamination extends northwest toward Milepost 2.7; no discernable break in subsurface soil contamination between Milepost 2.7 and Milepost 3.0 has been found. Subsurface soil contamination also extends approximately 250 feet southeast from the Milepost 3.0 Source Area underneath Birch Hill Road and approximately 200 feet south of the road under adjacent wetlands. A smear zone of subsurface soil contamination extended from the water table to 10 feet below the water table at the time of the RI.

In subsurface soil, petroleum hydrocarbons (quantified as bunker C-range organic compounds) were detected at a maximum concentration of 82 mg/kg. Benzene was detected at a maximum concentration of 19 mg/kg in subsurface soil. Low levels of other VOCs also were detected. Total lead concentrations were less than 18 mg/kg. Table 24 summarizes the analytical data for soil in the Milepost 3.0 Source Area.

Remedial Investigation Results for Groundwater

Monitoring wells in this source area include AP-5522 (GWM), AP-5846 (GWM), AP-5848 (GWM), AP-5849 (GWM), AP-5850 (GWM), AP-6037 (RI), AP-6038 (RI), AP-6039 (RI), and AP-6040 (RI).

The highest detected concentration of petroleum hydrocarbons (quantified as gasoline) was 5,400 μg/L. Three VOCs were detected above MCLs: benzene at a maximum concentration of 7,200 μg/L, which is above the MCL of 5 μg/L; ethylbenzene at a maximum concentration of 1,100 μg/L, which is above the MCL of 700 μg/L; and toluene at a maximum concentration of 2,300 μg/L, which is above the MCL of 1,000 μg/L. Low levels of other VOCs also were detected. Total lead was detected at a maximum concentration of 280 μg/L, but dissolved lead was detected at a maximum concentration of 11 μg/L, which is below the MCL of 15 μg/L for lead.

Refer to Figure 17 for an illustration of benzene concentrations in groundwater at the Milepost 3.0 Source Area. Table 25 summarizes the analytical data for groundwater at the Milepost 3.0 Source Area.

5.3.3 Milepost 15.75

Hydrogeology and Groundwater Use

Groundwater occurs at approximately 12 feet BGS at the Milepost 15.75 Source Area. The water table occurs in the coarse-grained facies of the floodplain alluvium. Groundwater flows northwest through the source area. Variations in the flow direction may occur because of the influence of the Tanana River.

The nearest drinking water wells are located at residences on Robyn Drive and Laurance Road. These wells are located approximately 205 feet downgradient from the former spill location at Milepost 15.75.

Current Land Use

The Milepost 15.75 Source Area is in a residential area west of North Pole. The population of North Pole is 1,456. Wetlands occur within 0.25 mile of the source area.

Previous Investigations

A soil-gas survey was conducted at the Milepost 15.75 Source Area in 1989. Elevated levels of benzene concentrations were detected in 1992, four soil borings were installed, and one soil boring (AP-5658) was completed as a well. Elevated levels of petroleum products were detected at this site.

Remedial Investigation Results for Soils

The extent of subsurface petroleum contamination at the Milepost 15.75 Source Area is confined to an area extending 50 feet to 100 feet downgradient of the spill location. The shallow groundwater gradient in this area may have contributed to lateral spreading of contaminants in subsurface soil and groundwater.

In subsurface soil, petroleum hydrocarbons (quantified as bunker C-range organic compounds) were detected at a maximum concentration of 40 mg/kg. Low levels of VOCs were detected in subsurface soils. Total lead concentrations were less than 9 mg/kg. Table 26 summarizes the analytical data for soils at the Milepost 15.75 Source Area.

Remedial Investigation Results for Groundwater

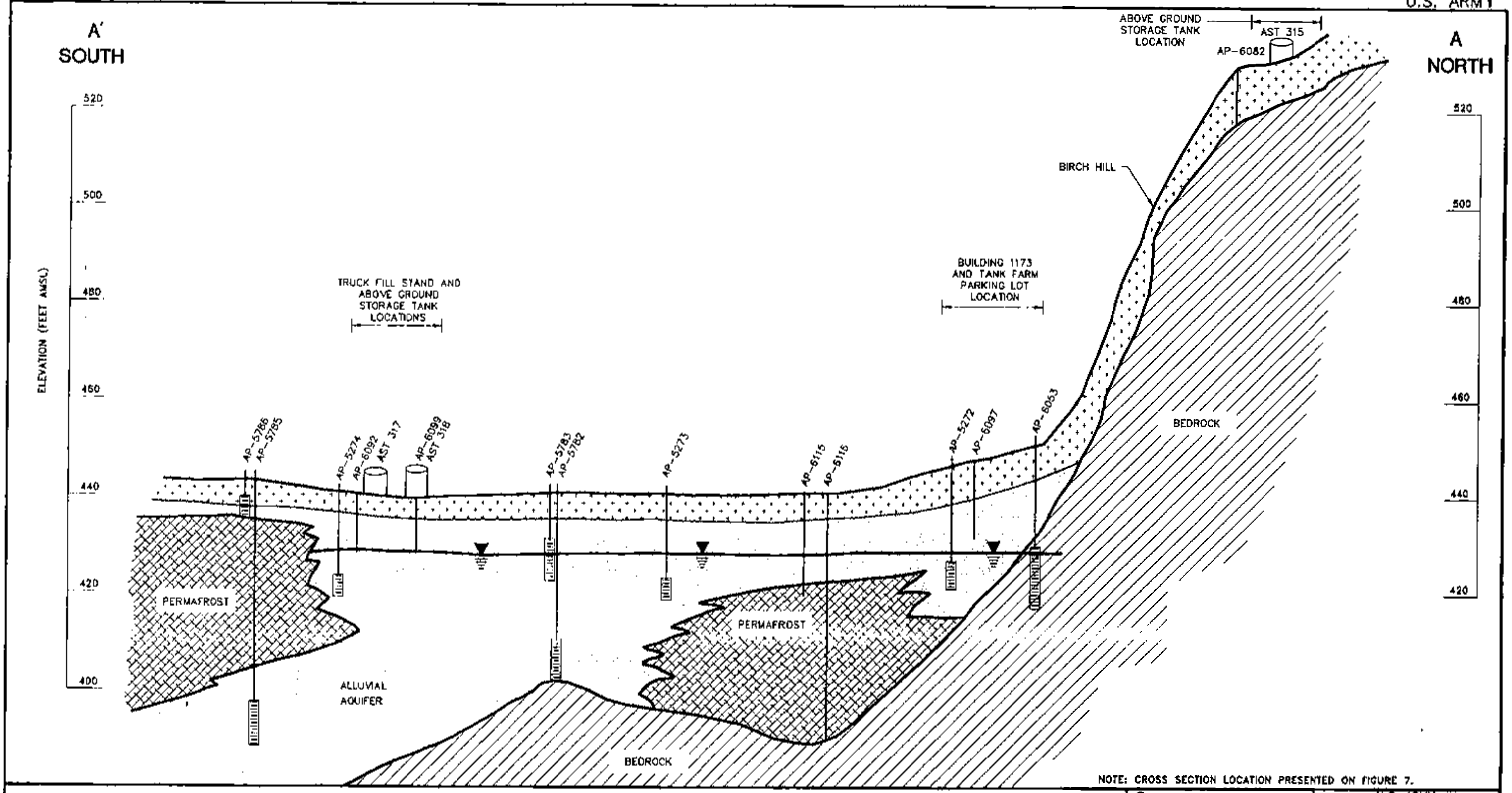
Monitoring wells in this source area include AP-6041 (RI), AP-6042 (RI), AP-6043 (RI), and AP-6044 (RI). The highest detected concentration of petroleum hydrocarbons (quantified as bunker C-range organic compounds) was 300 μg/L. VOCs detected in the groundwater include 1,2-dichloroethane at a maximum concentration of 8 μg/L, which is above the MCL of 5 μg/L, and benzene at a maximum concentration of 34 μg/L, which is above the MCL of 5 μg/L. Total lead was detected at concentrations up to 170 μg/L; however, dissolved lead was not detected in any of the monitoring wells.

Refer to Figure 18 for an illustration of benzene concentrations in groundwater. Table 27 summarizes all of the analytical data for groundwater at the Milepost 15.75 Source Area.

Figures

CORPS OF ENGINEERS

U.S. ARMY



NOTE: CROSS SECTION LOCATION PRESENTED ON FIGURE 7.

HORIZONTAL SCALE

0 150 300 450 FEET

VERTICAL SCALE

0 20 40 60 FEET

LEGEND

AP-5785 MONITORING WELL OR SOIL BORING DESIGNATION

460' ELEVATION ABOVE MEAN SEA LEVEL (AMSL)

▼ GROUNDWATER/VADOSE ZONE INTERFACE

AST ABOVEGROUND STORAGE TANK

NOTE: WATER TABLE ELEVATIONS BASED ON OCTOBER 25, 1993 WATER LEVEL READINGS.

░ FINE-GRAINED SAND AND SILT (Fairbanks Loess on Birch Hill, Chena Alluvium in Chena River floodplain)

☐ SAND AND GRAVEL (Chena Alluvium)

▨ BIRCH CREEK SCHIST

▩ PERMAFROST

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Figure 6

NORTH-SOUTH GEOLOGIC CROSS SECTION

FROM THE ASTS TO THE TFS
OPERABLE UNIT 3

FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
B	JT2950	JT2C0368	08/95	

DACA
DELIVERY ORDER No.

60912

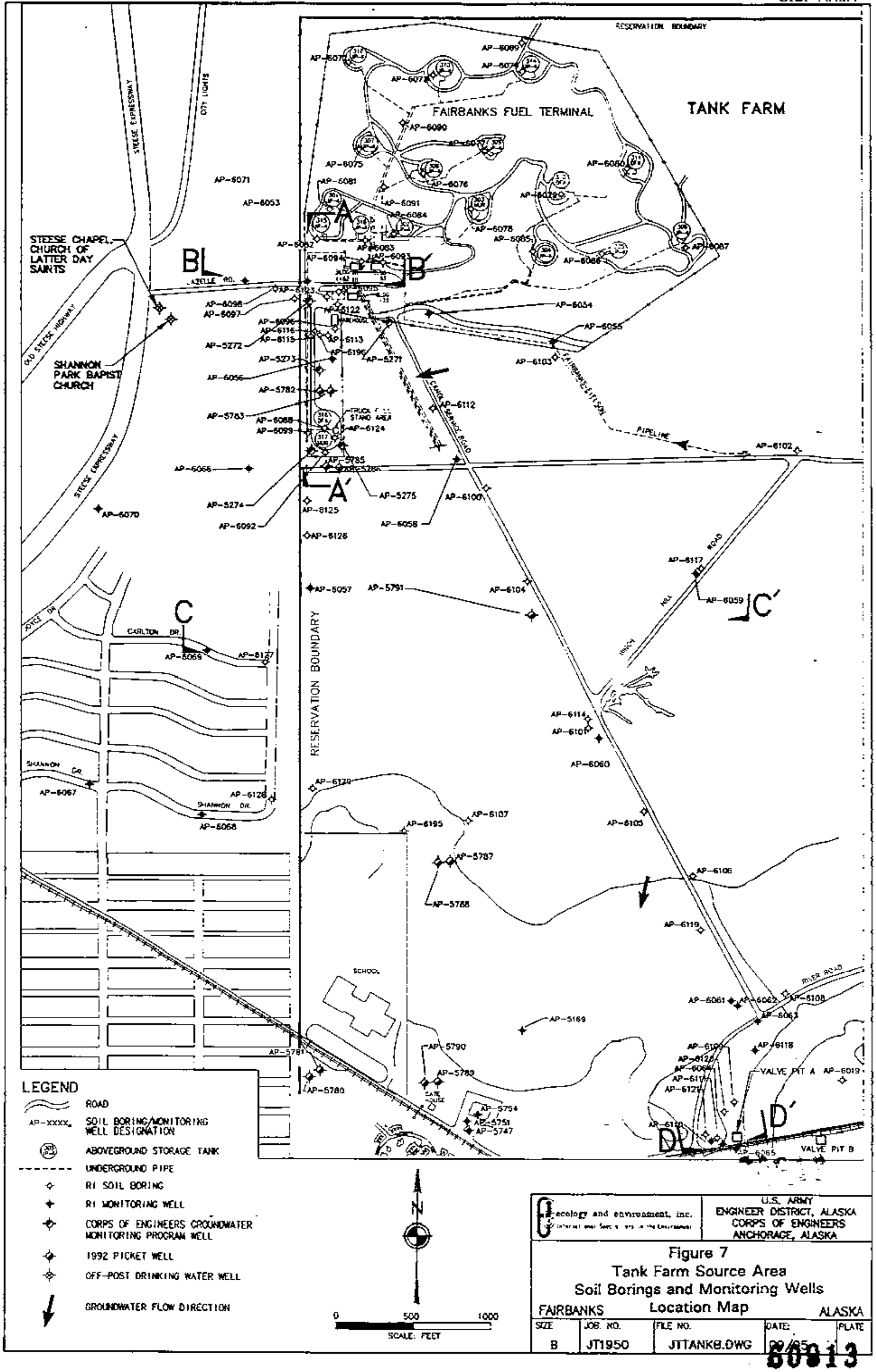

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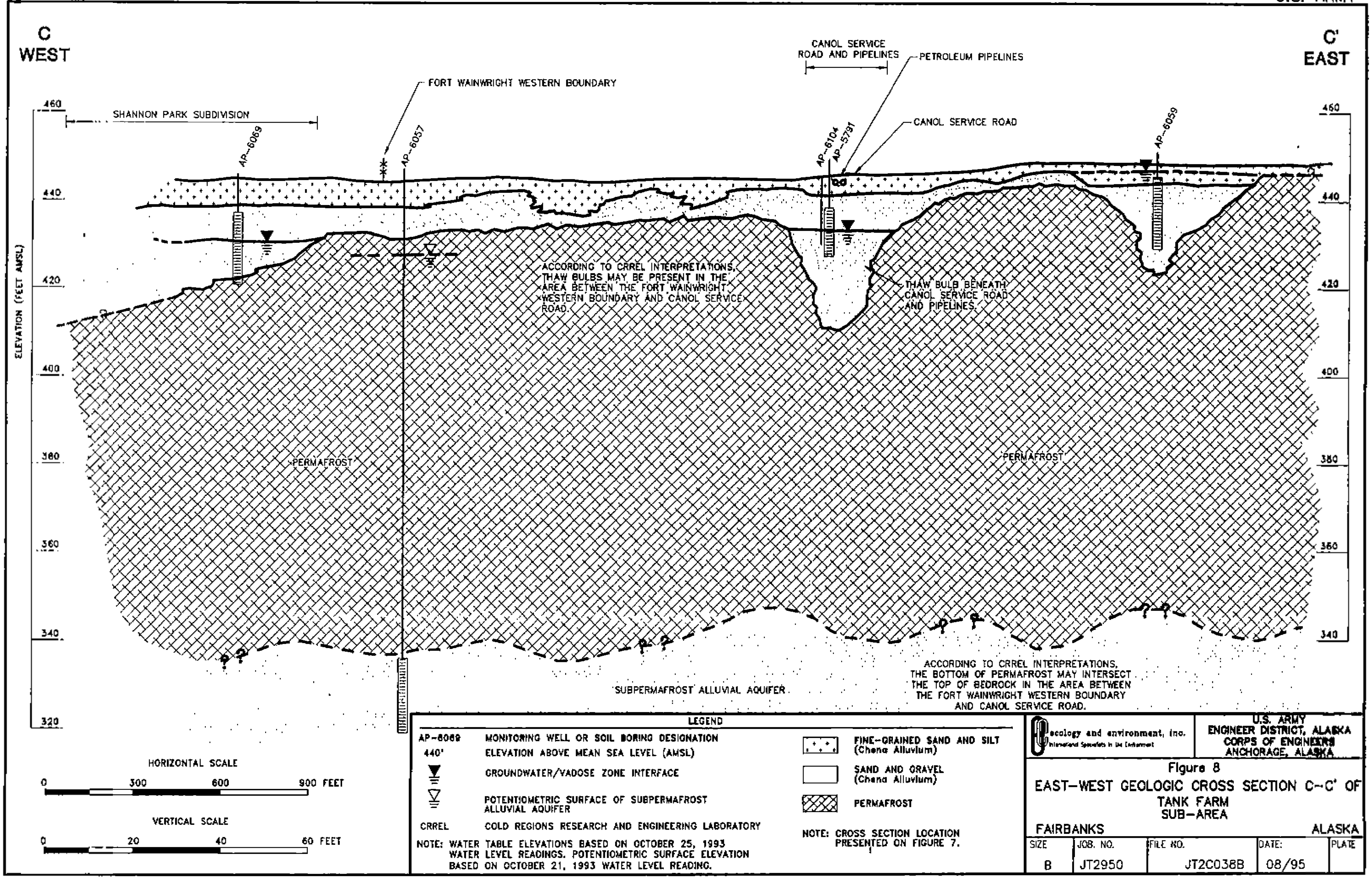
Figure 7
Tank Farm Source Area
Soil Borings and Monitoring Wells
Location Map

FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
B	JT1950	JTTANKB.DWG	09/95	

CORPS OF ENGINEERS U.S. ARMY



LEGEND

AP-6069	MONITORING WELL OR SOIL BORING DESIGNATION
440'	ELEVATION ABOVE MEAN SEA LEVEL (AMSL)
▼	GROUNDWATER/VADOSE ZONE INTERFACE
▽	POTENTIOMETRIC SURFACE OF SUBPERMAFROST ALLUVIAL AQUIFER
CRREL	COLD REGIONS RESEARCH AND ENGINEERING LABORATORY
⁘	FINE-GRAINED SAND AND SILT (Chena Alluvium)
☐	SAND AND GRAVEL (Chena Alluvium)
▨	PERMAFROST

NOTE: WATER TABLE ELEVATIONS BASED ON OCTOBER 25, 1993 WATER LEVEL READINGS. POTENTIOMETRIC SURFACE ELEVATION BASED ON OCTOBER 21, 1993 WATER LEVEL READING.

NOTE: CROSS SECTION LOCATION PRESENTED ON FIGURE 7.

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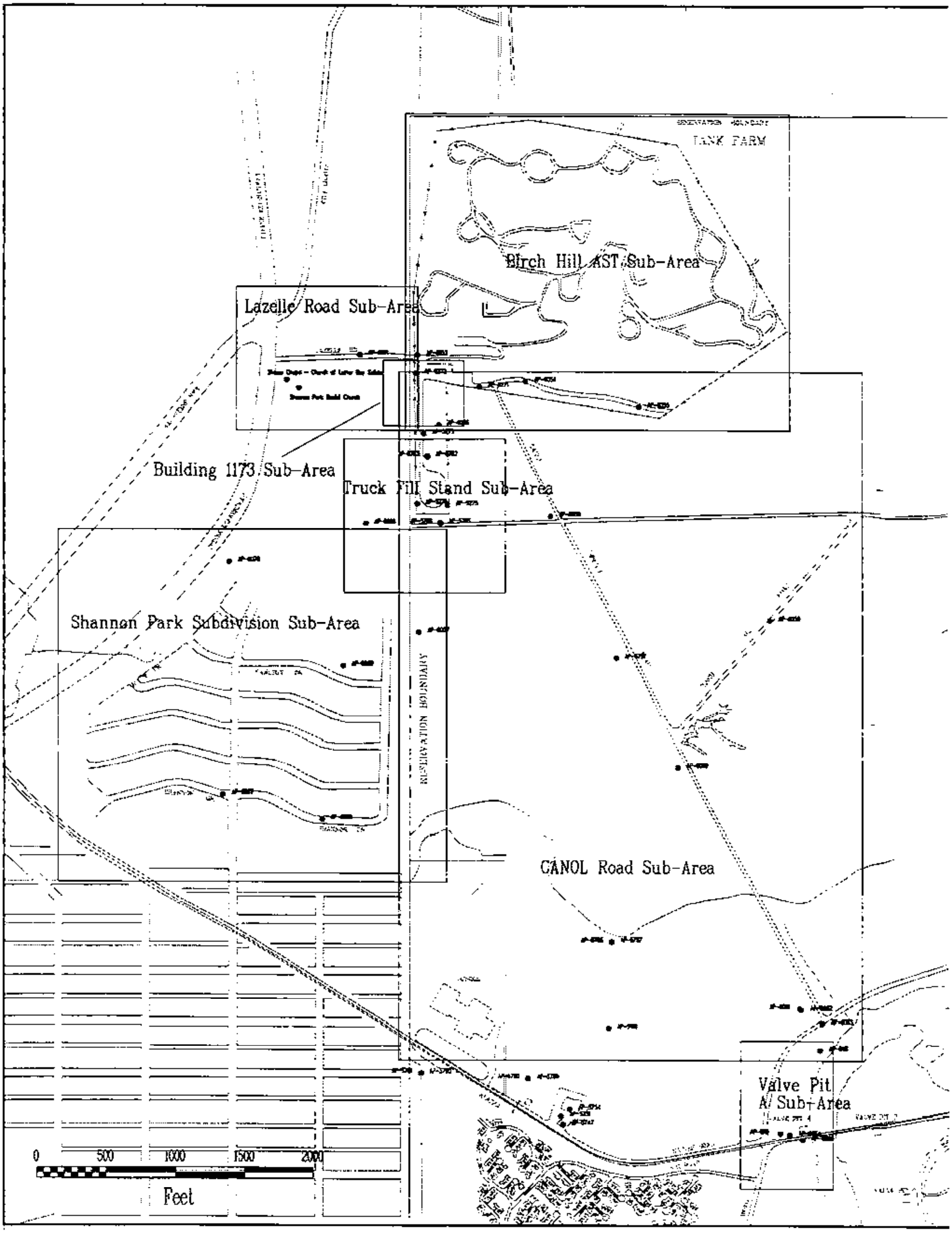
Figure 8

EAST-WEST GEOLOGIC CROSS SECTION C-C' OF TANK FARM SUB-AREA

FAIRBANKS ALASKA

SIZE	JOB NO.	FILE NO.	DATE:	PLATE
B	JT2950	JT2C038B	08/95	

DACA
DELIVERY ORDER No.



LEGEND

- ● Monitoring Wells

N

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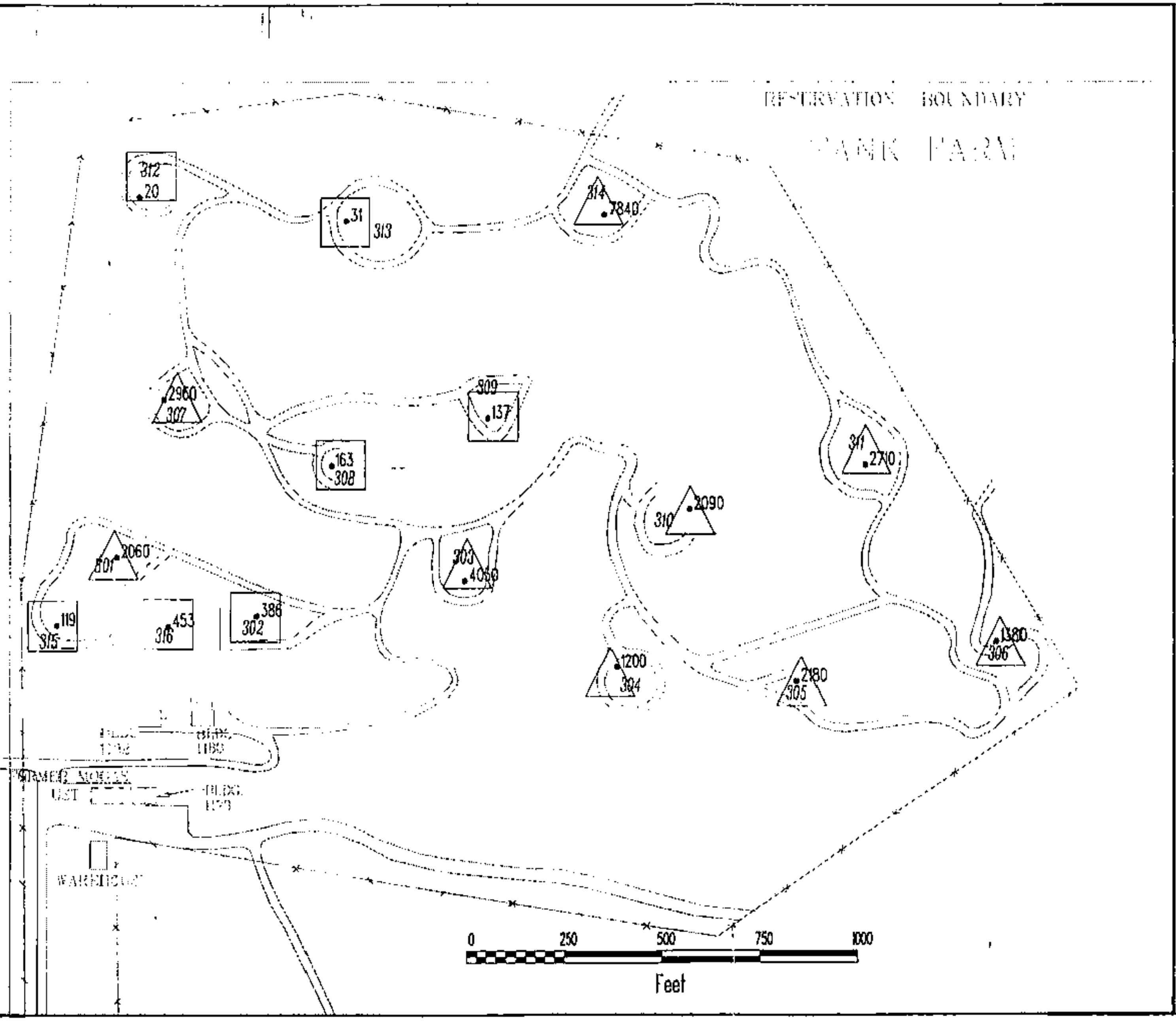
FIGURE 9
TANK FARM SUB-AREA
LOCATION MAP

60915

SIZE	JOB NO.	FILE NO.	DATE	PLATE
B	JT-2		09/05/95	



LEGEND

- • 10 – Sample Location and Lead Concentration in mg/kg
- 301 – Tank Number
- ☐ 0 – 1,000 mg/kg
- △ Greater Than 1,000 mg/kg

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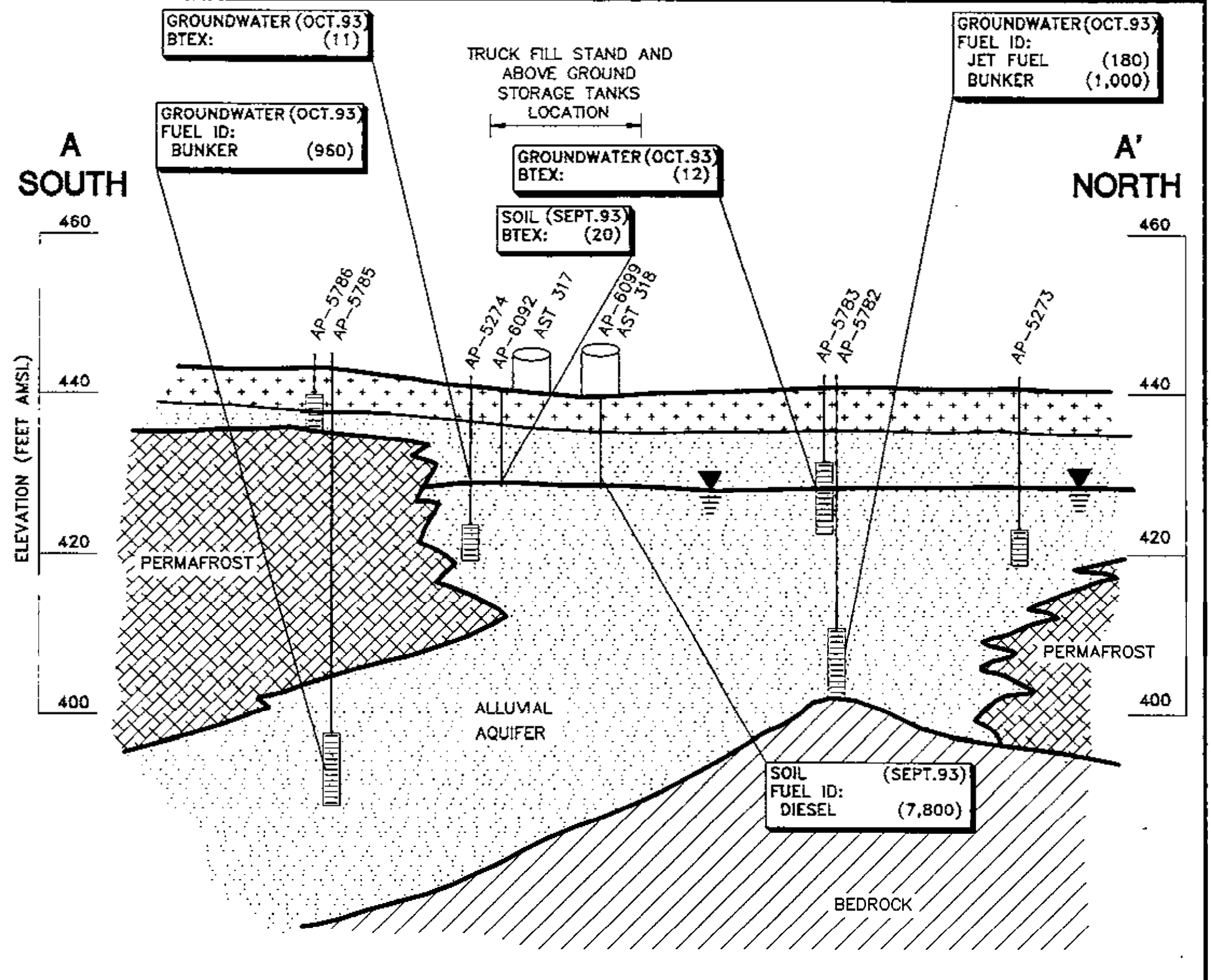
FIGURE 10

MAXIMUM LEAD CONCENTRATIONS IN SURFACE SOIL
BIRCH HILL AST SUB-AREA

SIZE	JOB. NO.	FILE NO.	DATE	PLATE
B	JT-2		09/05/95	

60916



NOTE: CROSS SECTION LOCATION PRESENTED ON FIGURE 7.

LEGEND

AP-6039	MONITORING WELL OR SOIL BORING DESIGNATION
440'	ELEVATION ABOVE MEAN SEA LEVEL (AMSL)
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
FUEL ID	FUEL IDENTIFICATION
(10,000)	SOIL CONCENTRATION IN MICROGRAMS PER KILOGRAM (µg/kg) GROUNDWATER CONCENTRATION IN MICROGRAMS PER LITER (µg/L)
▼	GROUNDWATER/VADOSE ZONE INTERFACE

░	SAND AND GRAVEL (Chena Alluvium)
▨	BIRCH CREEK SCHIST
⁘	FINE-GRAINED SAND AND SILT (Fairbanks Loess ON BIRCH HILL, Chena Alluvium IN CHENA RIVER FLOODPLAIN.)
▩	PERMAFROST

NOTE: WATER TABLE ELEVATIONS BASED ON OCTOBER 25, 1993, WATER LEVEL READINGS.

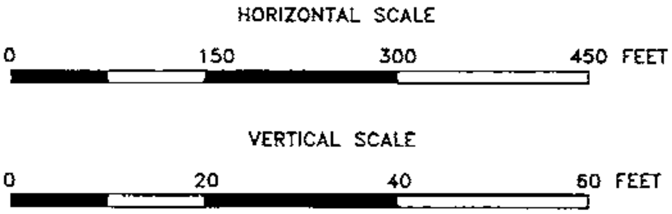


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Figure 11

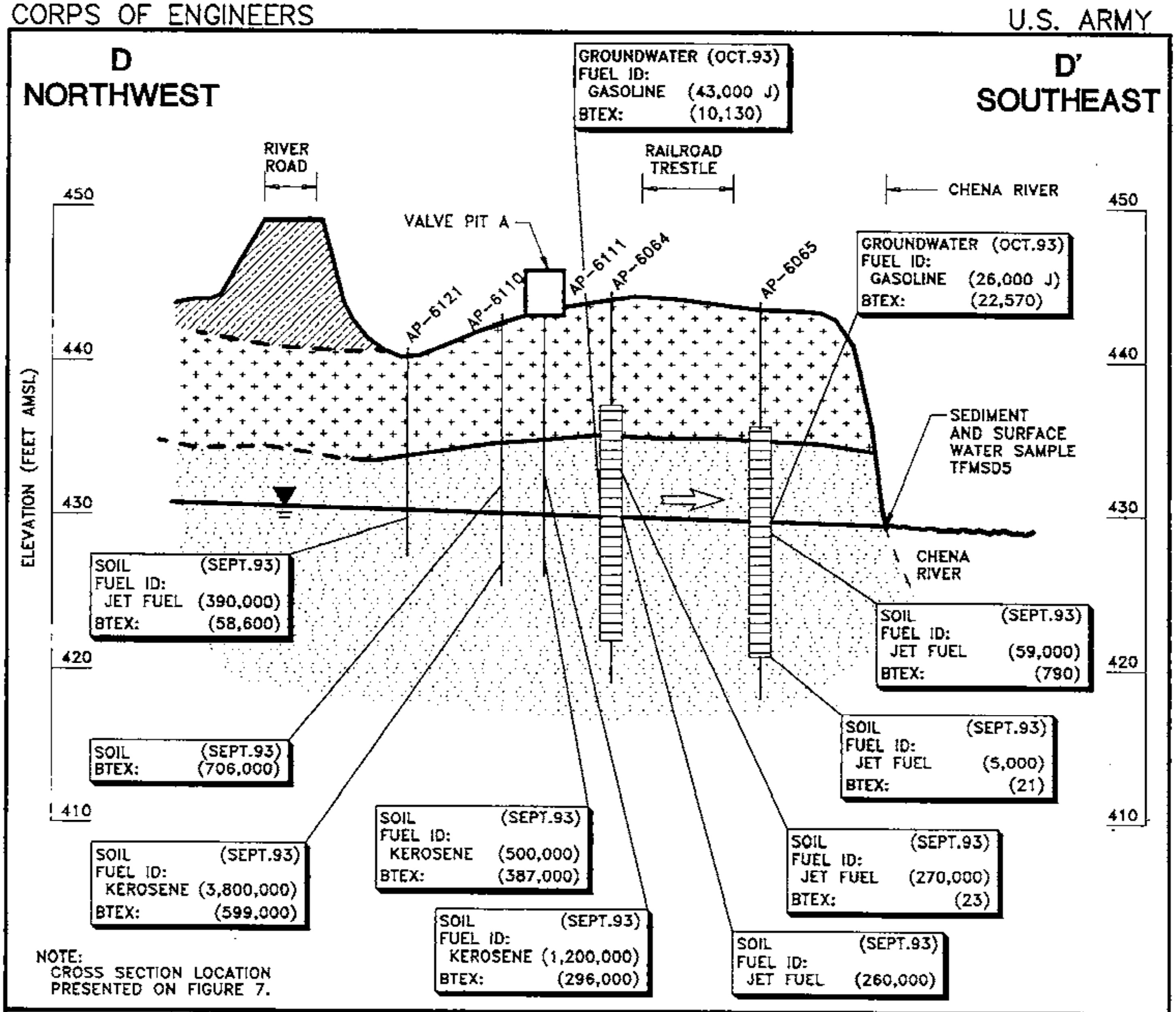
TOTAL BTEX AND FUEL ID CONCENTRATIONS

TFS SUB-AREA

FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
A	JT2950	JT2C016A	08/95	

DACA
DELIVERY ORDER No.
60917



NOTE:
CROSS SECTION LOCATION PRESENTED ON FIGURE 7.

LEGEND

AP-6064	MONITORING WELL OR SOIL BORING DESIGNATION	▼	GROUNDWATER/VADOSE ZONE INTERFACE
440'	ELEVATION ABOVE MEAN SEA LEVEL (AMSL)	⇐	DIRECTION OF GROUNDWATER FLOW
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES	▨	FILL
FUEL ID	FUEL IDENTIFICATION	+ +	FINE-GRAINED SAND AND SILT (Chena Alluvium)
(10,000)	SOIL CONCENTRATION IN MICROGRAMS PER KILOGRAM ($\mu g/kg$) GROUNDWATER CONCENTRATION IN MICROGRAMS PER LITER ($\mu g/L$)	☐	SAND AND GRAVEL (Chena Alluvium)

NOTE: WATER TABLE ELEVATIONS BASED ON OCTOBER 25, 1993, WATER LEVEL READINGS.

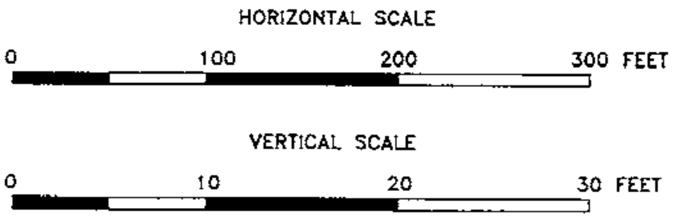


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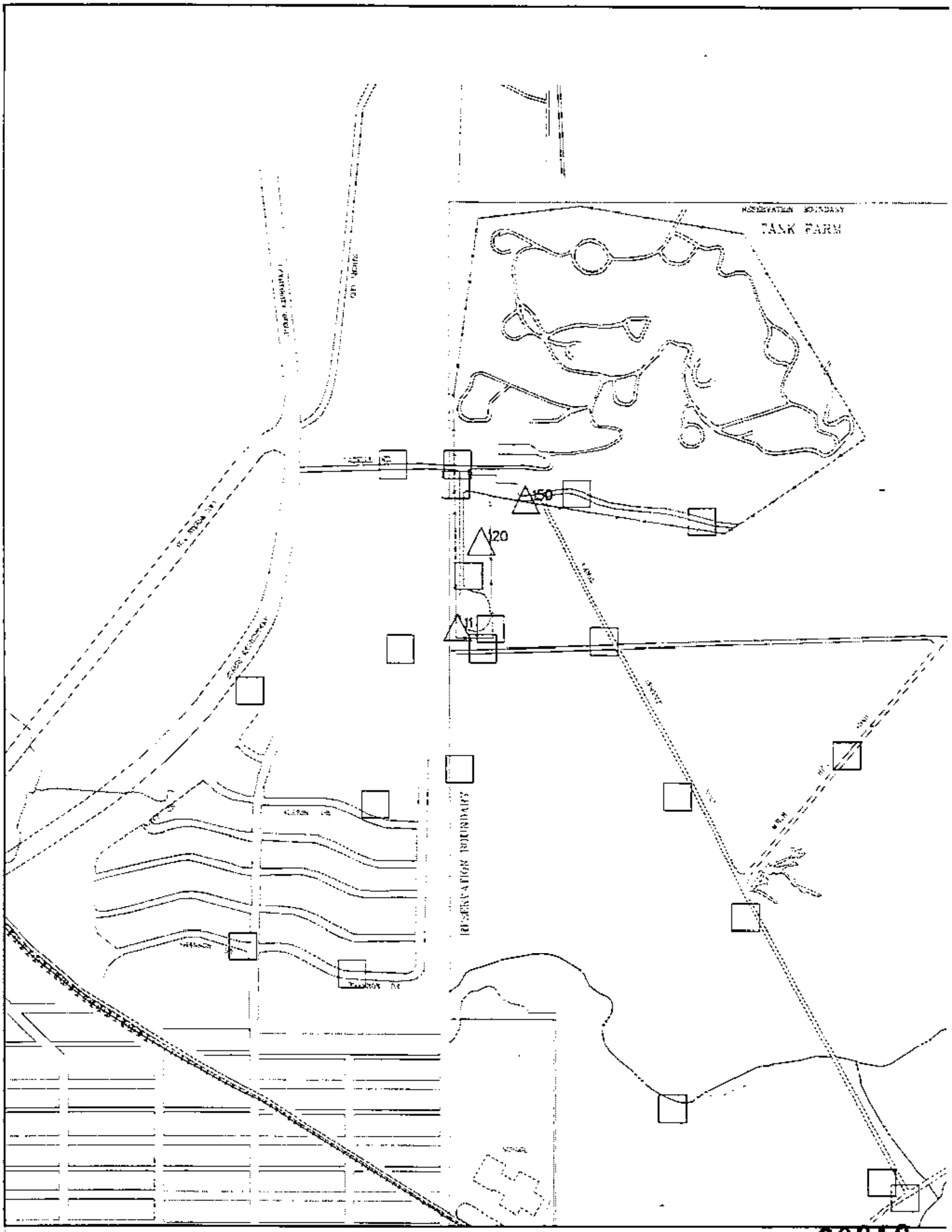
Figure 12

TOTAL BTEX AND FUEL ID CONCENTRATIONS

VALVE PIT A
SUB-AREA

FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
A	JT2950	JT2C014A	08/95	



LEGEND

☐ Benzene Not Detected

△ 10 – Benzene Detected ug/L

——— - — Intermittent Slough

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FIGURE 13

BENZENE CONCENTRATIONS IN GROUNDWATER SAMPLES
AT THE TANK FARM SOURCE AREA

SIZE	JOB. NO.	FILE NO.	DATE	PLATE
B	JT-2		09/05/95	

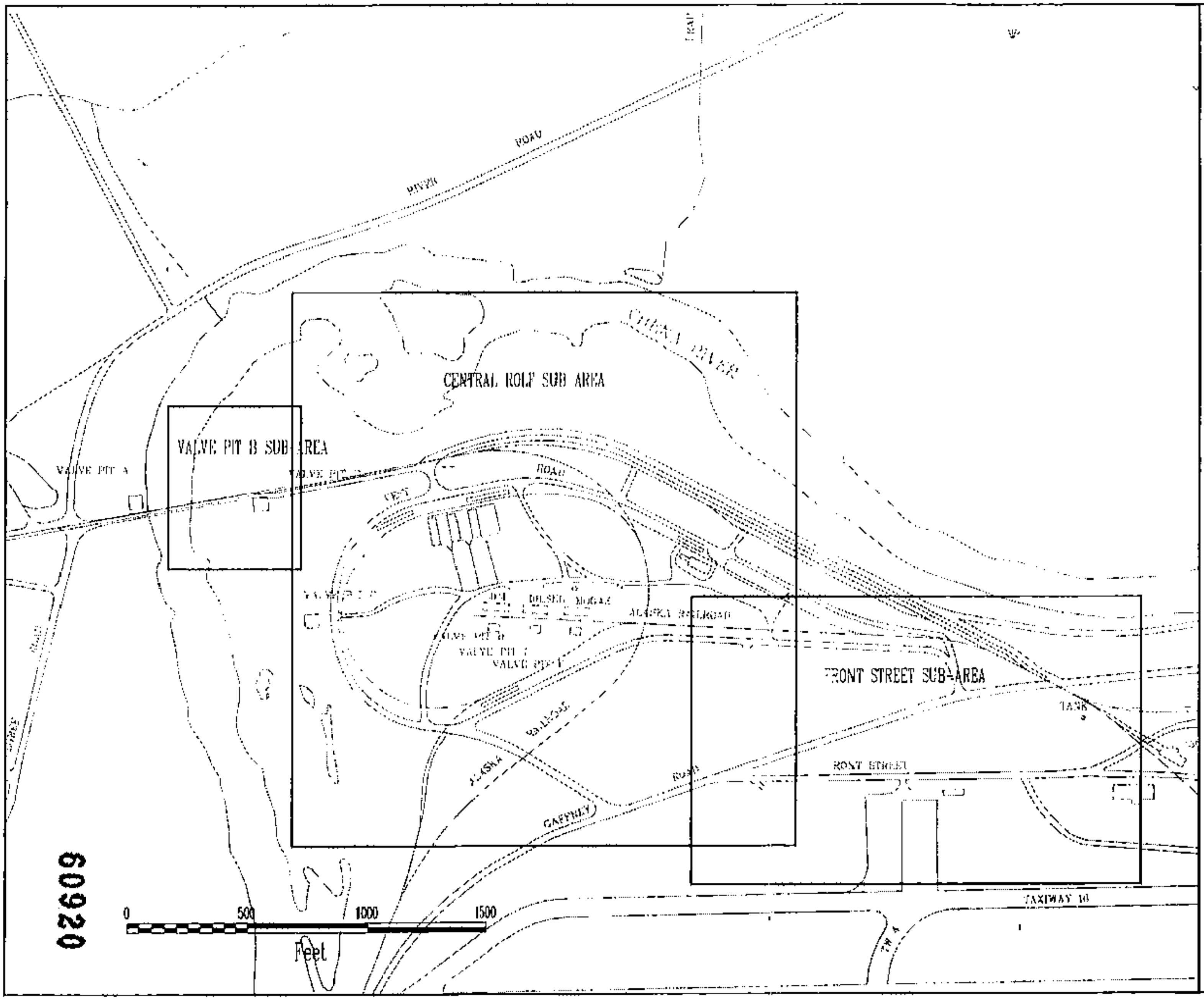

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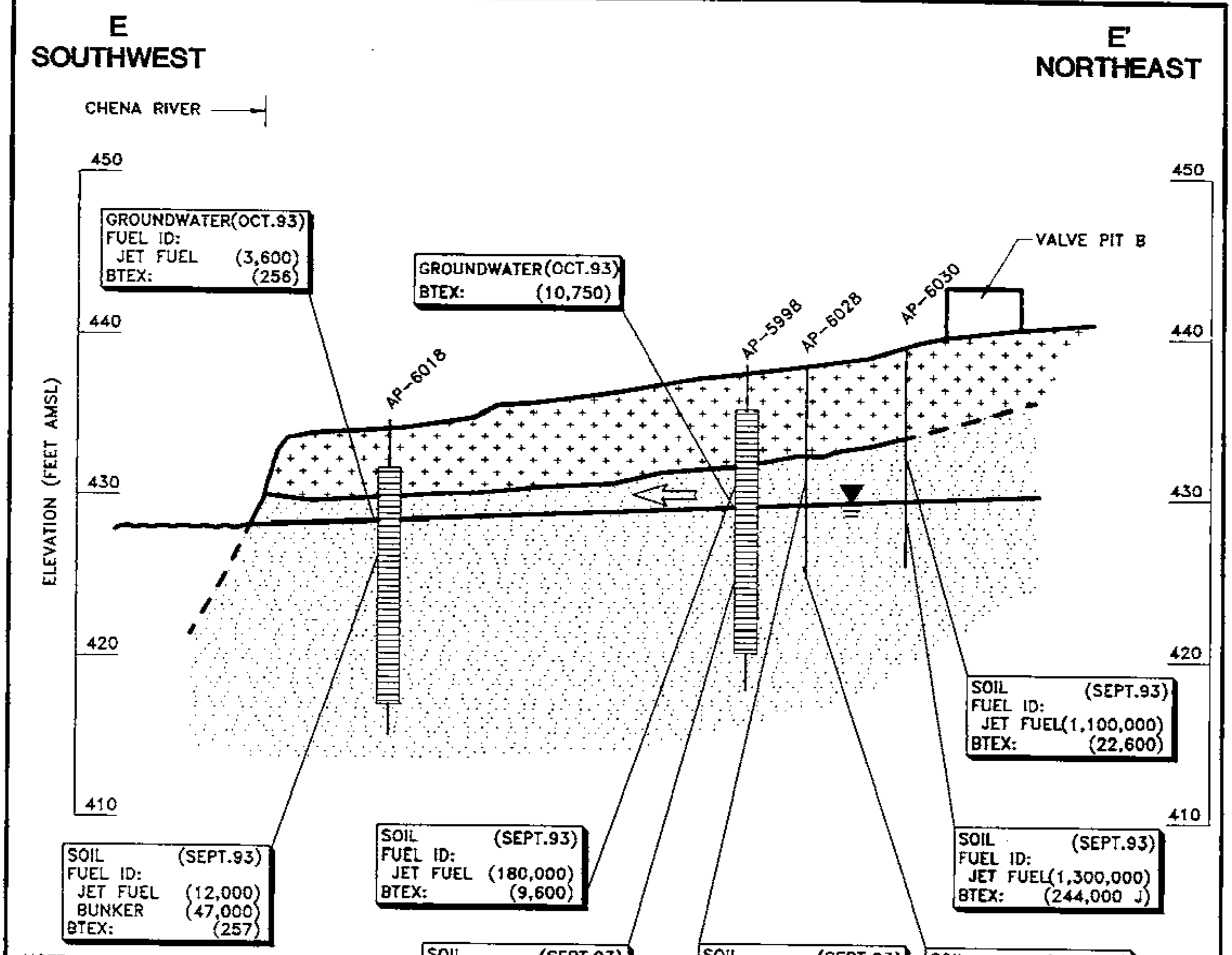
Figure 14
RAILCAR OFF-LOADING FACILITY
SUB-AREA MAP

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
8	JZ-8		3/1/94	



NOTE:
CROSS SECTION LOCATION
PRESENTED ON FIGURE 18

LEGEND

BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
FUEL ID	FUEL IDENTIFICATION
(10,000)	SOIL CONCENTRATION IN MICROGRAMS PER KILOGRAM (μg/kg) GROUNDWATER CONCENTRATION IN MICROGRAMS PER LITER (μg/L)
J	ESTIMATED
AP–6018	MONITORING WELL OR SOIL BORING DESIGNATION
440'	ELEVATION ABOVE MEAN SEA LEVEL (AMSL)
▼	GROUNDWATER/VADOSE ZONE INTERFACE
⇦	DIRECTION OF GROUNDWATER FLOW
▨	FINE–GRAINED SAND AND SILT (Chena Alluvium)
☐	SAND AND GRAVEL (Chena Alluvium)

NOTE: WATER TABLE ELEVATIONS BASED ON OCTOBER 25, 1993, WATER LEVEL READINGS.

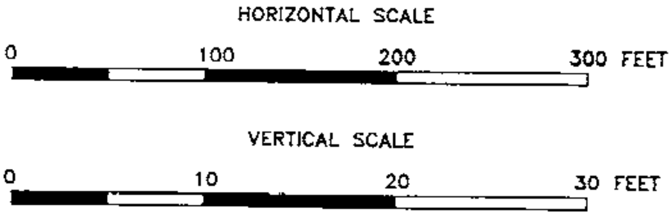


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Figure 15

TOTAL BTEX AND FUEL ID CONCENTRATIONS
RAILCAR OFF-LOADING FACILITY-VALVE PIT B SUB-AREA CROSS SECTION
OPERABLE UNIT 3
FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
A	JT2950	JZ8C011A	08/95	

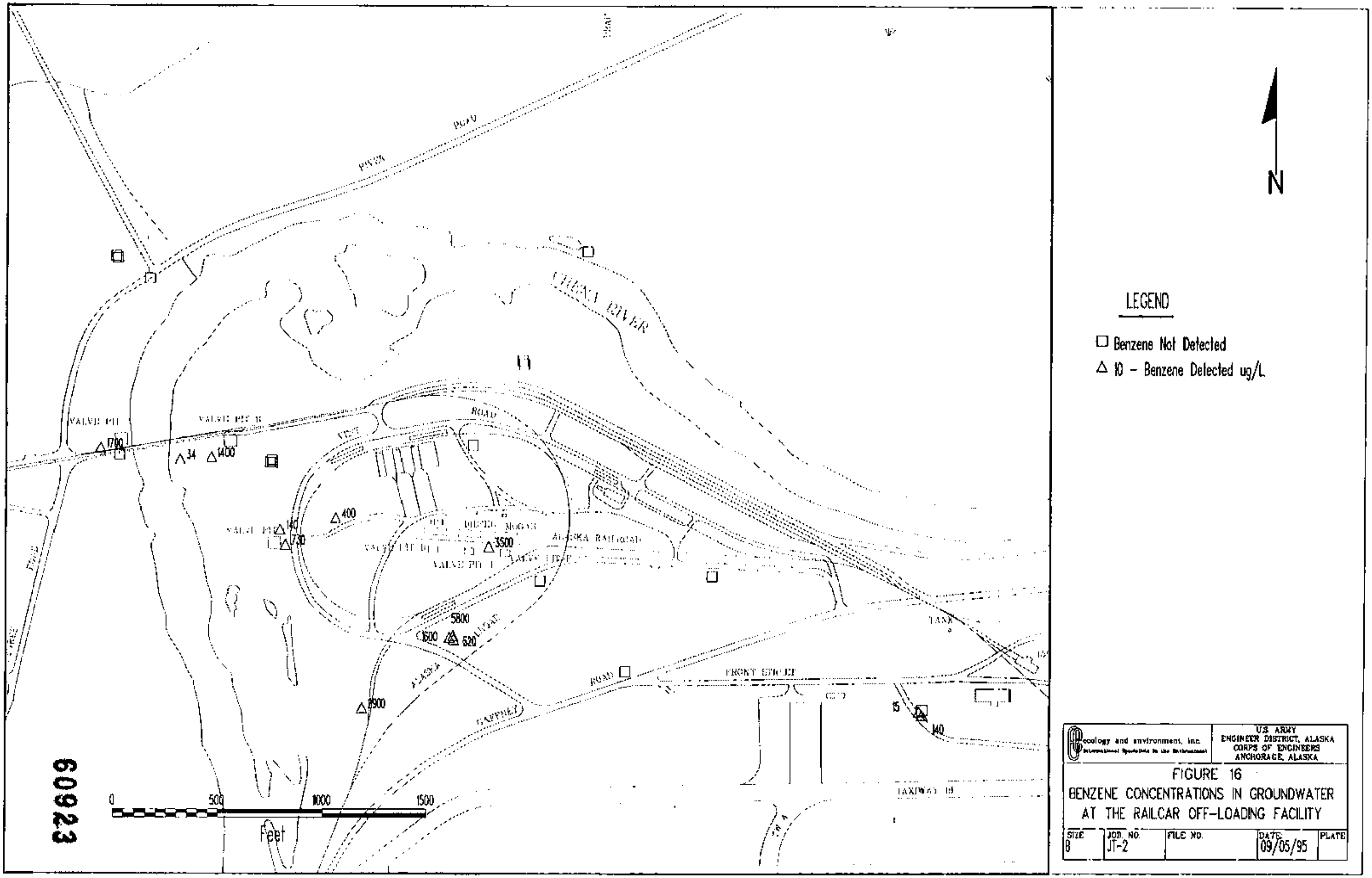

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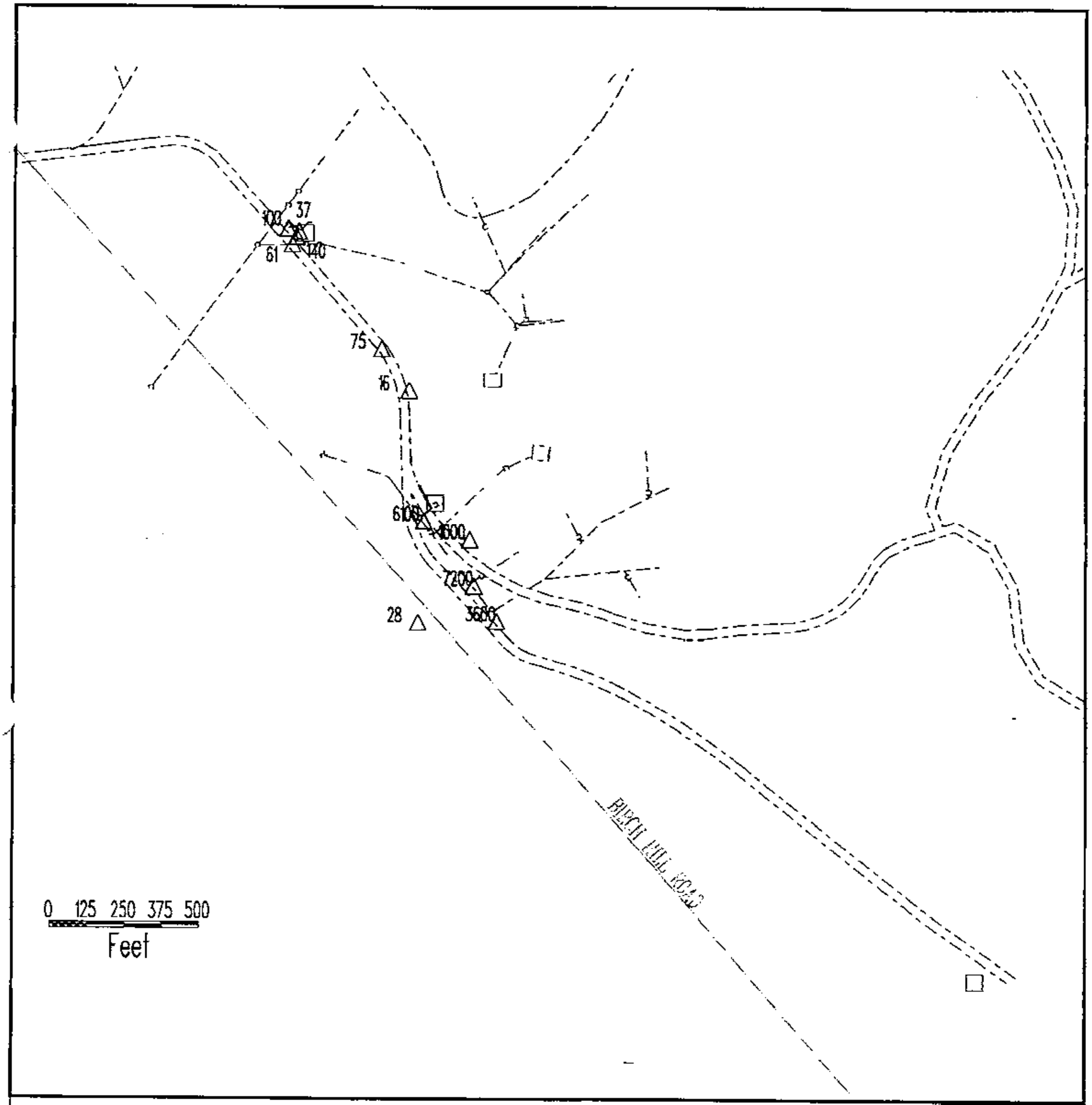
FIGURE 16

BENZENE CONCENTRATIONS IN GROUNDWATER
AT THE RAILCAR OFF-LOADING FACILITY

SIZE	JOB NO.	FILE NO.	DATE	PLATE
B	JT-2		09/05/95	

60923



LEGEND

□ Benzene Not Detected

△ 10 - Benzene Detected ug/L

------ Fairbanks-Eielson Pipeline

N

60924

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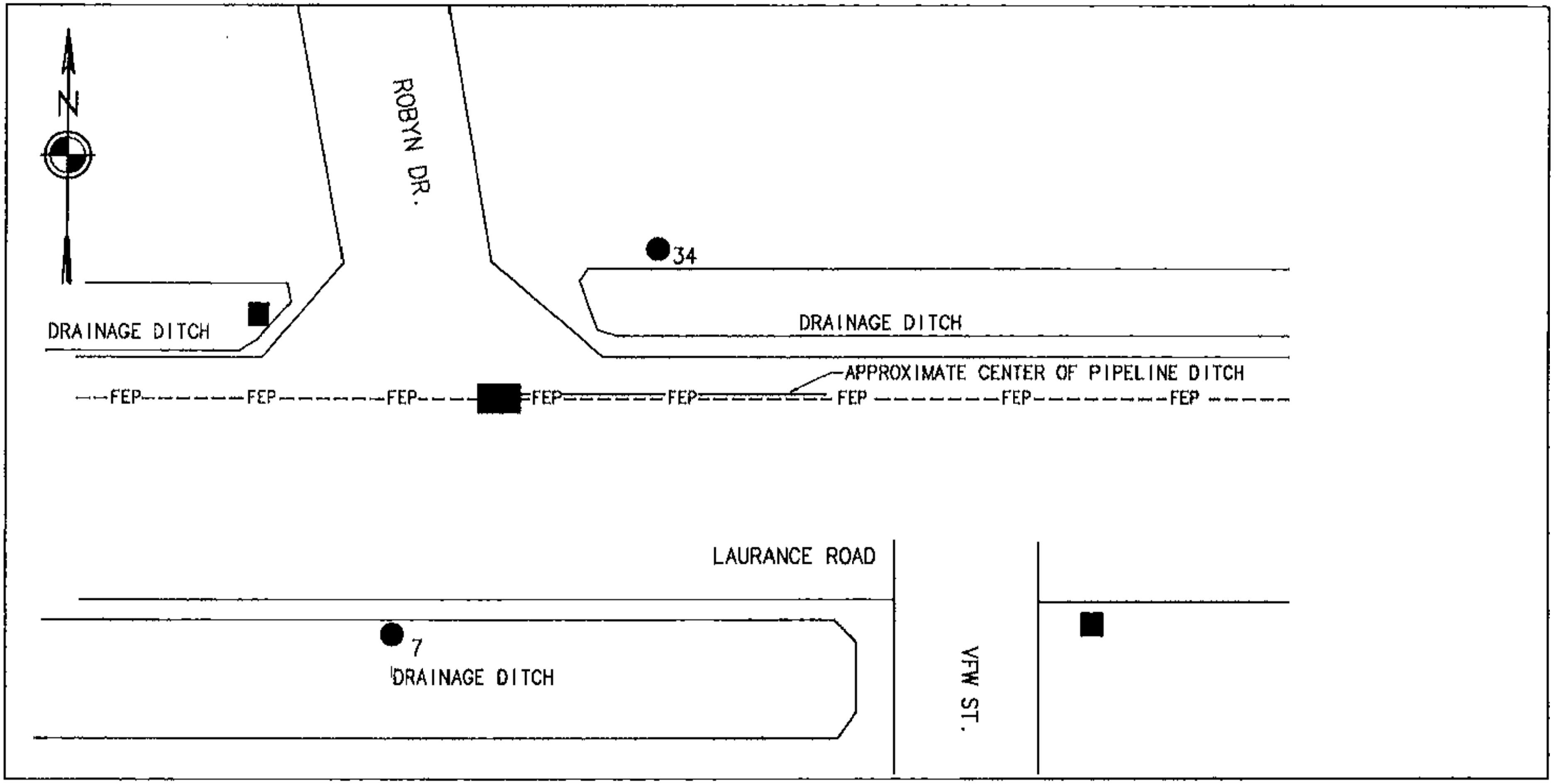
FIGURE 17
BENZENE CONCENTRATIONS IN GROUNDWATER
AT MILEPOST 2.7 AND 3.0 SOURCE AREAS

SIZE	JOB. NO.	FILE NO.	DATE	PLATE
A	JT-2		09/05/95	



LEGEND

--FEP-- FAIRBANKS-EIELSON PIPELINE

▬ APPROXIMATE PIPELINE BREAK

■ BENZENE NOT DETECTED

● BENZENE DETECTED ug/L

SOURCE: DEPARTMENT OF TRANSPORTATION, 1992; USACE, 1991

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Figure 18

BENZENE CONCENTRATIONS IN GROUNDWATER AT MILEPOST 15.75 SOURCE AREA, OPERABLE UNIT 3

FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
A	JT2950	JT2-28A.DWG	09-05-95	

Tables

Table 1

SUMMARY OF GROUNDWATER SAMPLING RESULTS
OFF POST WELLS
FORT WAINWRIGHT, ALASKA
(μg/L)

	MCL[a] or RBC[b]	11/91	12/91	6/93	1/94	2/94	6/94	7/94
Steese Chapel								
1,2 dichloroethane	5[a]	1.8	1.6	2	3.4	2.6	ND	1.26
Isopropylbenzene	820[b]	ND	ND	1	1.0	0.7	ND	1.30
m+p xylenes	10,000[a,c]	ND	ND	0.26	ND	ND	ND	0.3
1,2,4-trimethylbenzene	14[b]	ND	ND	ND	ND	ND	ND	0.23
Shannon Park Baptist Church								
1,2 dichloroethane	5[a]	2.7	2.9	NA	5.04	4.4	5.35	5.38
Isopropylbenzene	820[b]	4.4	6	NA	7.98	7.9	7.27	8.13
sec-Butylbenzene	*	ND	ND	NA	0.67	ND	ND	0.65
n-Propylbenzene	*	ND	ND	NA	0.46	ND	ND	ND
1,2,4-trimethylbenzene	14[b]	ND	ND	NA	0.26	0.4	0.3	0.32

* No maximum contaminant level exists; no risk-based concentration or derived remediation goal was generated for this contaminant in the Operable Unit 3 risk assessment.

[a] Safe Drinking Water Act Maximum Contaminant Level for Public Water Supply Systems.

[b] Risk Based Concentration assumes residential groundwater ingestion, inhalation, and dermal contact and is based on a hazard quotient of 1.0.

[c] This value is reported for total xylenes.

Key:

NA = Not applicable.
ND = Not detected.

Table 2

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
TANK FARM—BIRCH HILL AST SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Surface Soil				Subsurface Soil			
Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen-tration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen-tration[a]
FSPH (Mod. 418.1) (mg/kg)	49/16	20-2,040	AP-6090	392	64/22	22-6,730	AP-6087, 5′	990
Fuel ID (Mod. 8015) (mg/kg)								
Gasoline	44/2	300-340	TFM307V	320	25/0	—	—	—
Diesel No. 2	44/18	3-1,200 J	TFM305V	274.572	25/2	5-8.3	AP-6080, 15′	6.65
Jet A	44/3	16 J-5,500	AP-6090	2,638.667	25/7	13-300	AP-6091, 6′	125.571
JP-4	44/0	—	—	—	25/2	5.5-91	AP-6090, 7′	48.250
Bunker C-range organic compounds	44/23	29 J-220 J	—	67.174	25/8	28-140	AP-6090, 7′	56.875
VOCs (EPA 8260) (mg/kg)								
1,2,4-Trimethylbenzene	40/2	1.7-28	TFM303V	14.850	24/4	16-58	AP-6083, 4′	36.25
1,2-Dibromoethane	40/0	—	—	—	24/1	0.067	AP-6075, 11′	—
1,3,5-Trimethylbenzene	40/4	0.009-44	TFM303V	12.097	24/5	0.260-92	AP-6090, 7′	37.32
Benzene	40/0	—	—	—	24/1	3	AP-6083, 4′	—
Ethylbenzene	40/1	16	TFM303V	—	24/3	2.5-23	AP-6083, 4′	15.833
Isopropylbenzene	40/1	2.9	TFM303V	—	24/3	0.960-62	AP-6090, 7′	23.653
Naphthalene	40/0	—	—	—	24/3	2.2-11	AP-6083, 4′	7.1
Toluene	40/1	49	TFM303V	—	24/3	0.830-47	AP-6090, 7′	27.61
m+p xylene	40/4	0.008-100	TFM303V	26.777	24/4	64-220	AP-6090, 7′	82.85
o-xylene	40/3	0.007-39	TFM303V	11.727	24/4	3.1-82	AP-6090, 7′	33.025
n-Butylbenzene	40/0	—	—	—	24/3	1.6-6	AP-6083, 4′	3.633

Key at end of table.

Table 2

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
TANK FARM—BIRCH HILL AST SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Surface Soil				Subsurface Soil			
Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen-tration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen-tration[a]
n-Propylbenzene	40/1	5.2	TFM303V	—	24/4	1.9-12	AP-6083, 4′	5.95
p-isopropyltoluene	40/2	1.2-1.4 J	TFM303V	1.3	24/5	0.071-10	AP-6083, 4′	2.766
sec-Butylbenzene	40/0	—	—	—	24/2	0.8-4	AP-6083, 4′	2.400
tert-Butylbenzene	40/0	—	—	—	24/1	1.9	AP-6091, 6′	—
Total Lead (EPA 7421) (mg/kg)	43/43	8.3-7,840	TFM314V	727	24/24	3.6-35.7	AP-6090, 7′	14
Lead (TCLP) (EPA 7421/1311) (mg/L)	3/3	1.7-5.4	TFM303V	3	0/0	—	—	—

[a] Rounded mean of detected concentrations.

Key:

AST = Aboveground storage tank.
EPA = United States Enviromental Protection Agency.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
J = Estimated concentration.
mg/kg = Milligrams per kilogram.
mg/L = Milligrams per liter.
TCLP = Toxicity characteristic leaching procedure.
VOCs = Volatile organic compounds.

Table 3

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
TANK FARM—BUILDING 1173 SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Surface Soil				Subsurface Soil			
Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
FSPH (Mod. 418.1) (mg/kg)	7/4	28-780	AP-6122	264	28/7	22-4,954	AP-6095, 19′	1.459
Fuel ID (Mod. 8015) (mg/kg)								
Diesel No. 2	2/1	33	AP-6123	—	12/1	340	AP-6122, 18′	—
Jet A	2/1	12	AP-6096	—	12/1	180	AP-6096, 16′	—
Bunker C-range organic compounds	2	—	—	—	12/2	42-50	AP-6056, 6′	46
VOCs (EPA 8260) (mg/kg)								
1,2,4-Trimethylbenzene	2/0	—	—	—	11/1	37 E	AP-6122, 18′	—
1,3,5-Trimethylbenzene	2/0	—	—	—	11/1	58 E	AP-6122, 18′	—
Benzene	2/0	—	—	—	11/2	0.016-2.3	AP-6122, 18′	1.158
Ethylbenzene	2/0	—	—	—	11/1	97	AP-6122, 18′	—
Isopropylbenzene	2/0	—	—	—	11/1	9.2	AP-6122, 18′	—
Naphthalene	2/0	—	—	—	11/1	5	AP-6122, 18′	—
Toluene	2/0	—	—	—	11/2	0.007-39 E	AP-6122, 18′	19.504
m+p xylene	2/0	—	—	—	11/1	43 E	AP-6122, 18′	—
o-xylene	2/0	—	—	—	11/1	42 E	AP-6122, 18′	—
n-Butylbenzene	2/0	—	—	—	11/1	3.6	AP-6122, 18′	—
n-Propylbenzene	2/0	—	—	—	11/1	11	AP-6122, 18′	—
p-isopropyltoluene	2/0	—	—	—	11/1	6.1	AP-6122, 18′	—

Key at end of table.

Table 3

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
TANK FARM—BUILDING 1173 SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Surface Soil				Subsurface Soil			
Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
sec-Butylbenzene	2/0	—	—	—	11/1	3.8	AP-6122, 18′	—
Total Lead (EPA 7421) (mg/kg)	2/2	3.9-12.4	AP-6123	8	13/13	2.2-16.7	AP-6056, 6′	7.2

[a] Rounded mean of detected concentrations.

Key:

E = Concentration exceeds the calibration range for the analytical instrument.
EPA = United States Environmental Protection Agency.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
mg/kg = Milligrams per kilogram.
VOCs = Volatile organic compounds.

Table 4

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
TANK FARM—TRUCK FILL STAND SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Surface Soil				Subsurface Soil			
Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
FSPH (mg/kg)	5/1	35	AP-6099	—	19/4	20-2,079	AP-6125, 7′	1,262
Fuel ID (mg/kg)								
Diesel No. 2	2/0	—	—	—	6/1	7.8	AP-6099, 21′	—
Bunker C-range organic compounds	2/1	48 J	AP-6088	—	6/1	41	AP-6066, 18′	—
VOCs (mg/kg)								
Toluene	2/0	—	—	—	6/1	0.009	AP-6126, 4′	—
Total Lead (mg/kg)	2/2	10-17.8	AP-6088	14	6/6	3.4-14.8	AP-6099, 21′	7

[a] Rounded mean of detected concentrations.

Key:

J = Estimated concentration.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
mg/kg = Milligrams per kilogram.
VOCs = Volatile organic compounds.

Table 5

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
LAZELLE ROAD SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Surface Soil				Subsurface Soil			
Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen-tration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen-tration[a]
FSPH (Mod. 418.1) (mg/kg)	4/4	42-109	AP-6097	69.5	20/20	3-31	AP-6097	7.9
Fuel ID (mg/kg)								
Bunker C-range organic compounds	—	—	—	—	6/2	12-18	AP-6098	15
Total Lead (EPA 7421) (mg/kg)	—	—	—	—	6/6	5.1-78.7	AP-6098	31.3

[a] Rounded mean of detected concentrations.

Key:

EPA = United States Environmental Protection Agency.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
mg/kg = Milligrams per kilogram.

Table 6

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
SHANNON PARK SUBDIVISION SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	Surface Soil				Subsurface Soil			
	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen-tration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen-tration[a]
FSPH (Mod. 418.1) (mg/kg)	1/1	—	AP-6070	10	31/31	0-288	AP-6067	37
Fuel ID (mg/kg)								
Bunker C-range organic compounds	1/1	—	AP-6070	39	11/4	15-120	AP-6067	55.5
Total Lead (EPA 7421) (mg/kg)	1/1	—	AP-6070	12.2	11/11	2.7-14.8	AP-6129	7.94

[a] Rounded mean of detected concentrations.

Key:

EPA = United States Environmental Protection Agency.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
mg/kg = Milligrams per kilogram.

Table 7

SUMMARY OF SUBSURFACE SOIL RESULTS
TANK FARM—CANOL SERVICE ROAD SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Subsurface Soil			
Analyte and Concentration Units	**No. of Samples Analyzed/ Detected**	**Range of Detected Concentrations**	**Location of Maximum Concentration**	**Mean Concentration[a]**
FSPH (Mod. 418.1) (mg/kg)	58/2	20-32	AP-6107 8′	26
Fuel ID (mg/kg)				
Bunker C-range organic compounds	25/6	38 J - 79	AP-6060 11′	52.5
VOCs (EPA 8260) (mg/kg)				
1,3,5-Trimethylbenzene	25/1	0.003 J	AP-6101 16′	
Toluene	25/1	0.008	AP-6101 16′	
m+p xylene	25/1	0.024	AP-6101 16′	
o-xylene	25/1	0.007	AP-6101 16′	
Total Lead (EPA 7421) (mg/kg)	25/25	2.5-16.2	AP-6102 6′ AP-6107 4′	7

[a] Rounded mean of detected concentrations.

Key:

EPA = United States Environmental Protection Agency.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
J = Estimated concentration.
mg/kg = Milligrams per kilogram.
VOCs = Volatile organic compounds.

Table 8

SUMMARY OF SUBSURFACE SOIL RESULTS
TANK FARM—VALVE PIT A SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	Surface Soil			
	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
FSPH (Mod. 418.1) (mg/kg)	25/11	24-9,620	AP-6110 11′	3,411
Fuel ID (MOD 8015) (mg/kg)				
Jet A	12/6	5-390	AP-6121 11′	167.667
Kerosene	12/3	500 J-3,800 J	AP-6110 16′	1,833.333
VOCs (EPA 8260) (mg/kg)				
1,2,4-Trimethylbenzene	11/8	0.077-200 E	AP-6110 11′	76.951
1,3,5-Trimethylbenzene	11/8	0.044-270 E	AP-6110 11′	104.354
Benzene	11/1	10	AP-6110 16′	—
Ethylbenzene	11/6	0.110-50 E	AP-6110 16′	23.118
Isopropylbenzene	11/5	0.052-13	AP-6110 16′	8.11
Naphthalene	11/5	0.050-16	AP-6110 11′	9.11
Toluene	11/5	0.110-200 E	AP-6110 16′	106.022
m+p xylene	11/8	0.016-360 E	AP-6110 11′	125.057
o-xylene	11/6	0.007-150 E	AP-6110 11′	61.36
n-Butylbenzene	11/7	0.017-18	AP-6110 11′	8.783
n-Propylbenzene	11/5	0.084-22	AP-6110 16′	13.217
p-isopropyltoluene	11/7	0.025-26	AP-6110 11′	10.448
sec-Butylbenzene	11/6	0.008-8.7	AP-6110 11′	4.890
BNAs (EPA 8270) (mg/kg)				
2-Methylnaphthalene	1/1	0.730	AP-6064 11′	—
Napthhalene	1/1	0.270 J	AP-6064 11′	—
Total Lead (EPA 7421) (mg/kg)	14/14	2.1-7.6	AP-6064 11′	5
TCLP Lead (EPA 7421/1311) (mg/L)	1/1	0.03	AP-6064 11′	—

[a] Rounded mean of detected concentrations.

Key:

E = Concentration exceeds the calibration range for the analytical instrument.
EPA = United States Environmental Protection Agency.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
J = Estimated concentration.
mg/kg = Milligrams per kilogram.
VOCs = Volatile organic compounds.

Table 9

SUMMARY OF GROUNDWATER RESULTS
TANK FARM—BIRCH HILL AST SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
TRPH (Mod. 418.1) (μg/L)	4/2	810-10,400	AP-6053	6,000
Fuel ID (Mod. 8015) (μg/L)				
Gasoline	3/1	23,000	AP-6053	—
Bunker C-range organic compounds	3/2	960-1,000	AP-6055	980
VOCs (EPA 8260) (μg/L)				
1,2,4-Trimethylbenzene	4/1	32	AP-5271	—
1,3,5-Trimethylbenzene	4/2	9-20	AP-6053	14
Benzene	4/1	150	AP-5271	—
Ethylbenzene	4/2	10-64	AP-5271	37
Isopropylbenzene	4/2	9-20	AP-5271	14
Naphthalene	4/2	8-23	AP-6053	16
Toluene	4/2	14-24	AP-5271	19
m+p xylene	4/2	10-100	AP-5271	55
o-xylene	4/1	23	AP-5271	—
n-Propylbenzene	4/1	14	AP-5271	—
p-isopropyltoluene	4/1	15	AP-6053	—
Total Lead (EPA 7421) (μg/L)	4/4	9.3-140	AP-6053	55
Dissolved Lead (EPA 7421) (μg/L)	4/1	4.8	AP-6053	—

[a] Rounded mean of detected concentrations.

Key:

AST = Aboveground storage tank.
EPA = United States Environmental Protection Agency.
Fuel ID = Fuel identification.
μg/L = Micrograms per liter.
TRPH = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.

Table 10

SUMMARY OF GROUNDWATER RESULTS
TANK FARM—BUILDING 1173 SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
Fuel ID (μg/L)				
Gasoline	3/1	110 J	AP-5273	—
Jet A	3/1	380	AP-6056	—
VOCs (μg/L)				
Benzene	2/1	120	AP-6056	—
Isopropylbenzene	2/1	8	AP-6056	—
Total Lead (μg/L)	3/3	30-73	AP-6056	51

[a] Rounded mean of detected concentrations.

Key:

J = Estimated concentration.
Fuel ID = Fuel identification.
μg/L = Micrograms per liter.
VOCs = Volatile organic compounds.

Table 11

SUMMARY OF GROUNDWATER RESULTS
TANK FARM—TRUCK FILL STAND SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
TRPH (EPA 418.1) (µg/L)	6/1	470	AP-5274	—
Fuel ID (Mod. 8015) (µg/L)				
Jet A	6/1	180	AP-5782	—
Bunker C-range organic compounds	6/2	960-1,000	AP-5782	980
VOCs (EPA 8260) (µg/L)				
Benzene	6/1	11	AP-5274	—
Toluene	6/1	7	AP-5783	—
m+p xylene	6/1	5	AP-5783	—
Total Lead (EPA 7421) (µg/L)	6/6	2.4-150	AP-6066	42

[a] Rounded mean of detected concentrations.

Key:

EPA = United States Environmental Protection Agency.
Fuel ID = Fuel identification.
µg/L = Micrograms per liter.
TRPH = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.

Table 12

SUMMARY OF GROUNDWATER RESULTS
LAZELLE ROAD SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
Fuel ID (µg/L)				
Gasoline	1/1	6,800	AP-6071	—
VOCs (µg/L) None detected				
Total Lead (µg/L)	1/1	10	AP-6071	—

[a] Rounded mean of detected concentrations.

Key:

Fuel ID = Fuel identification.
µg/L = Micrograms per liter.
VOCs = Volatile organic compounds.

Table 13

SUMMARY OF GROUNDWATER RESULTS
SHANNON PARK SUBDIVISION SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
Fuel ID (μg/L)				
Bunker-C range organic compounds	5/1	1,100	AP-6070	—
VOCs (μg/L) None detected				
Total Lead (μg/L)	5/5	3.5-150	AP-6068	74.3

[a] Rounded mean of detected concentrations.

Key:

Fuel ID = Fuel identification.
μg/L = Micrograms per liter.
VOCs = Volatile organic compounds.

Table 14

SUMMARY OF GROUNDWATER RESULTS
CANOL ROAD SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
Fuel ID (μg/L)				
Gasoline	4/1	6,900	AP-6059	—
VOCs (μg/L) None detected				
Dissolved Lead (mg/L)	9/1	4.8	AP-6061	—
Total Lead (μg/L)	9/9	5.5-88	AP-6061	42.9

[a] Rounded mean of detected concentrations.

Key:

Fuel ID = Fuel identification.
μg/L = Micrograms per liter.
VOCs = Volatile organic compounds.

Table 15

SUMMARY OF GROUNDWATER RESULTS
TANK FARM—VALVE PIT A SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
TRPH (EPA 418.1) (μg/L)	2/2	11,600J-11,700J	AP-6065	11,700
Fuel ID (Mod. 8015) (μg/L)				
Gasoline	2/2	26,000 J-43,000 J	AP-6065	34,500
VOCs (EPA 8260) (μg/L)				
1,2,4-Trimethylbenzene	2/2	1,100-1,400	AP-6064	1,250
1,3,5-Trimethylbenzene	2/2	1,400-1,700	AP-6064	1,530
Benzene	2/1	1,700	AP-6064	—
Ethylbenzene	2/2	930-1,600	AP-6064	1,265
Toluene	2/2	4,100-12,000	AP-6064	8,050
m+p xylene	2/2	3,700-6,400	AP-6064	5,050
o-xylene	2/2	1,400-2,400	AP-6064	1,900
Total Lead (EPA 7421) (μg/L)	2/2	110-300	AP-6065	210
Dissolved Lead (EPA 7421) (μg/L)	2/1	2.7	AP-6064	—

[a] Rounded mean of detected concentrations.

Key:

EPA	United States Environmental Protection Agency.
Fuel ID	Fuel identification.
J	Estimated concentration.
μg/L	Micrograms per liter.
NA	Not applicable.
TRPH	Total recoverable petroleum hydrocarbons.
VOCs	Volatile organic compounds.

Table 16

SUMMARY OF SUBSURFACE SOIL RESULTS
ROLF—VALVE PIT B SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Subsurface Soil			
Analyte and Concentration Units	**No. of Samples Analyzed/ Detected**	**Range of Detected Concentrations**	**Location of Maximum Concentration**	**Mean Concen-tration[a]**
FSPH (Mod 418.1) (mg/kg)	13/9	26-19,800	AP-6028, 11′	4,697
Fuel ID (Mod 8015) (mg/kg)				
Jet A	9/8	12-2,700	AP-6027, 11′	1,069
Bunker C-range organic compound	9/2	47-58	AP-6027, 6′	52.5
VOCs (mg/kg)				
1,2,4-Trimethylbenzene	9/6	0.450-140	AP-6028, 11′	33.958
1,3,5-Trimethylbenzene	9/4	0.160-69 E,J	AP-6030, 11′	21.635
Benzene	9/1	0.170 J-.640 J	AP-5998, 11′	—
Ethylbenzene	9/5	0.730 J-110 E,J	AP-6030, 11′	35.3
Isopropylbenzene	9/6	0.076-33	AP-6028, 11′	8.579
Naphthalene	9/8	0.150-16	AP-6028, 11′	5.544
Toluene	9/4	0.170 J-120	AP-6028, 11′	36.750
m+p xylene	9/7	0.210-240	AP-6028, 11′	52.173
o-xylene	9/8	0.047 J-88	AP-6028, 11′	18.868
n-Butylbenzene	9/6	0.039-15	AP-6028, 11′	4.888
n-Propylbenzene	9/3	1.9-16	AP-6028, 11′	8.033
p-isopropyltoluene	9/8	0.068-20	AP-6028, 11′	6.059
sec-Butylbenzene	9/4	0.7-7.1	AP-6028, 11′	3.375
Total Lead (mg/kg)	9/9	0.003.2-14.5	AP-6028, 6′	8

[a] Rounded mean of detected concentrations.

Key:

E = Concentration exceeds the calibration range for the analytical instrument.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
J = Estimated concentration.
mg/kg = Milligrams per kilogram.
UJ = Estimated detection limit.
VOCs = Volatile organic compounds.

Table 17

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
CENTRAL ROLF SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	Surface Soil				Subsurface Soil			
	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentration	Location of Maximum Concentration	Mean Concentration[a]
FSPH (Mod 418.1) (mg/kg)	18/11	10	AP-6033, 11′	1,725	62/28	21-10,291	AP-6033, 11′	1,422
Fuel ID Mod 8015) (mg/kg)								
Diesel No. 2	16/3	5,900 J	—	2,060.667	31/7	5.1 J-150 J	AP-6020, 16′	33.986
Jet A	16/0	—	—	—	31/5	20-2,600 J	AP-6007, 13′	914
Bunker C-range organic compound	16/12	2,100 J	—	434.923	31/7	32-110 J	AP-6026, 11′	55.429
Kerosene	16/1	56 J	—	—	31/2	4-11 J	AP-6025, 6′	7.5
VOCs (EPA 8260) (mg/kg)								
1,2,4-Trimethylbenzene	16/0	—	—	—	28/7	0.009-140	AP-6007, 13′	33.853
1,3,5-Trimethylbenzene	16/0	—	—	—	28/4	0.005 J-25,000	AP-6033, 14′	6.841
Benzene	16/0	—	—	—	28/2	0.016-2.4	AP-6015, 13′	1.208
Ethylbenzene	16/0	—	—	—	28/4	2.1 E-91	AP-6007, 13′	37.05
Isopropylbenzene	16/0	—	—	—	28/5	0.140-360	AP-6007, 13′	86.008
Naphthalene	16/0	—	—	—	28/6	0.007-8.6	AP-6015, 13′	3.006
Toluene	16/0	—	—	—	28/6	0.019-320,000	AP-6007, 13′	77.862
m+p xylene	16/0	—	—	—	28/6	0.008-610	AP-6007, 13′	152.706
o-xylene	16/0	—	—	—	28/6	0.016-230	AP-6007, 13′	56.536
n-Butylbenzene	16/0	—	—	—	28/3	0.530-5	AP-6015, 13′	2.663
n-Propylbenzene	16/0	—	—	—	28/2	0.970-6.6	AP-6015, 13′	5.5

Key at end of table.

Table 17

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
CENTRAL ROLF SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	Surface Soil				Subsurface Soil			
	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concen- tration	Mean Concen- tration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentration	Location of Maximum Concentration	Mean Concen- tration[a]
p-isopropyltoluene	16/0	—	—	—	28/3	0.910-8.1	AP-6015, 13′	4.37
sec-Butylbenzene	16/0	—	—	—	28/3	0.340-2.7	AP-6015, 13′	2
BNAs (EPA 8270) (µg/kg)								
Naphthalene	2/0	—	—	—	3/1	0.450	AP-6005, 11′	—
2-Methylnaphthalene	2/0	—	—	—	3/2	0.12 J-.7	AP-6005, 11′	0.410
Total Lead (EPA 7421) (mg/kg)	16/16	7.5-101	AP-6023	23.5	31/31	2.7-18.2	AP-6007, 13′	6
Lead (TCLP) (EPA 7421/1311) (mg/L)	2/0	—	—	—	3/1	0.032	AP-6005, 11′	—

[a] Rounded mean of detected concentrations.

Key:

BNAs = Base/neutral and acid extractable organic compounds.
E = Concentration exceeds the calibration range for the analytical instrument.
EPA = United States Environmental Protection Agency.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
J = Estimated concentration.
mg/kg = Milligrams per kilogram.
mg/L = Milligrams per liter.
TCLP = Toxicity characteristic leaching procedure.
VOCs = Volatile organic compounds.

Table 18

SUMMARY OF SUBSURFACE SOIL SAMPLE RESULTS
ROLF--FRONT STREET SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Subsurface Soil			
Analyte and Concentration Units	**No. of Samples Analyzed/ Detected**	**Range of Detected Concentrations**	**Location of Maximum Concentration**	**Mean Concentration[a]**
FSPH (Mod. 418.1) (mg/kg)	21/4	97-881	AP-6017, 16′	448
Fuel ID (Mod. 8015) (mg/kg)				
Jet A	7/2	120-6 J	AP-6017, 16′	190
Bunker C-range organic compound	7/1	81	AP-6029, 11′	NA
VOCs (EPA 8260) (mg/kg)				
1,2,4-Trimethylbenzene	7/2	0.069-8.1	AP-6017, 16′	4.085
Ethylbenzene	7/1	0.710	AP-6017, 16′	NA
Naphthalene	7/2	0.011-1.3	AP-6017, 16′	0.656
m+p xylene	7/2	0.012-2.4	AP-6017, 16′	1.206
n-Butylbenzene	7/2	0.018-1.7	AP-6017, 16′	0.859
p-isopropyltoluene	7/2	0.026-2.3	AP-6017, 16′	1.163
sec-Butylbenzene	7/1	0.009	AP-6017, 21′	NA
tert-Butylbenzene	7/1	0.008	AP-6017, 21′	NA
Total Lead (EPA 7421) (mg/kg)	7/7	3.4-7.5	AP-6017, 16′	5.1

[a] Rounded mean of detected concentrations.

Key:

EPA = United States Environmental Protection Agency.
J = Estimated concentration.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
mg/kg = Milligrams per kilogram.
NA = Not applicable.
VOCs = Volatile organic compounds.

Table 19

SUMMARY OF GROUNDWATER RESULTS
ROLF—VALVE PIT B SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
TRPH (EPA 418.1) (μg/L)	2/2	6,900 J-51,600	AP-5998	24,000
Fuel (Mod. 8015) ID (μg/L)				
Jet A	1/1	3,600	AP-6018	—
VOCs (EPA 8260) (μg/L)				
1,2,4-Trimethylbenzene	2/2	120-800	AP-5998	460
1,3,5-Trimethylbenzene	2/1	50	AP-6018	—
Benzene	2/2	34-1,400	AP-5998	717
Ethylbenzene	2/2	18-650	AP-5998	334
Isopropylbenzene	2/1	48	AP-6018	—
Naphthalene	2/1	19	AP-6018	—
Toluene	2/1	3,900	AP-5998	—
m+p xylene	2/2	160-3,400	AP-5998	1,780
o-xylene	2/2	44-1,400	AP-5998	722
n-Propylbenzene	2/1	11	AP-6018	—
Total Lead (EPA 7421) (μg/L)	2/2	97-160	AP-6018	130
Dissolved Lead (EPA 7421) (μg/L)	2/1	9.9	AP-5998	—

[a] Rounded mean of detected concentrations.

Key:

EPA = United States Environmental Protection Agency.
Fuel ID = Fuel identification.
J = Estimated concentration.
TRPH = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.

Table 20

SUMMARY OF GROUNDWATER RESULTS
CENTRAL ROLF SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
TRPH (EPA 418.1) (μg/L)	15/11	710-1,190,000	AP-6015	138,000
Fuel ID (Mod. 8015) (μg/L)				
Gasoline	11/4	2,900-22,000	AP-6005	14,975
Diesel No. 2	11/2	190 J-4,000	AP-6008	2,095
JP-4	11/1	120,000	AP-5527	—
Bunker C-range organic compounds	11/2	320-640 J	AP-6001	480
VOCs (EPA 8260) (μg/L)				
1,2,4-Trimethylbenzene	15/7	18-710	AP-6014	417
1,2-Dichloroethane	15/1	6 J	AP-5999	—
1,3,5-Trimethylbenzene	15/4	21-190	AP-6006	105
Benzene	15/7	140-5,800	AP-6014	1,949
Ethylbenzene	15/7	330-1,100	AP-6014	700
Isopropylbenzene	15/5	73-1,200	AP-6007	311
Naphthalene	15/5	100-450	AP-6014	268
Toluene	15/7	2,500 E-15,000	AP-6007	6,457
m+p xylene	15/8	140-6,000	AP-6007	2,280
o-xylene	15/7	48-2,800	AP-6007	1,036
n-Propylbenzene	15/3	6-80	AP-6006	53
BNAs (EPA 8270) (μg/L)				
Naphthalene	13/1	150	AP-5527	—
2-Methylnaphthalene	13/1	220	AP-5527	—
Total Lead (EPA 7421) (μg/L)	15/15	1.3-330	AP-6007	96
Dissolved Lead (EPA 7421) (μg/L)	15/4	1.4-160	AP-6007	41

[a] Rounded mean of detected concentrations.

Key:

BNAs = Base/neutral and acid extractable organic compounds.
E = Concentration exceeds the calibration range for the analytical instrument.
EPA = United States Environmental Protection Agency.
Fuel ID = Fuel identification.
J = Estimated concentration.
μg/L = Micrograms per liter.
TRPH = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.

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Table 21

SUMMARY OF GROUNDWATER SAMPLE RESULTS
ROLF—FRONT STREET SUB-AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
TRPH (EPA 418.1) (µg/L)	5/3	260 J-7,300	AP-6016	4,000
Fuel ID (Mod 8015) (µg/L)				
Gasoline	5/1	6,100 J	AP-6016	—
Diesel No. 2	5/1	10,000	AP-5537	—
VOCs (EPA 8260) (µg/L)				
1,2,4-Trimethylbenzene	5/2	41-250	AP-6016	146
1,3,5-Trimethylbenzene	5/2	22-530	AP-6016	276
Benzene	5/2	15-140	AP-6016	78
Ethylbenzene	5/2	21-240	AP-6016	131
Isopropylbenzene	5/1	5	AP-5537	—
Naphthalene	5/2	26-420	AP-6016	223
Toluene	5/2	7-140	AP-6016	74
m+p xylene	5/3	5-500	AP-6016	181
n-Propylbenzene	5/1	6	AP-5537	—
BNAs (EPA 8270) (µg/L)				
Naphthalene	5/1	9 J	AP-5537	—
2-Methylnaphthalene	5/1	4 J	AP-5537	—
Total Lead (EPA 7421) (µg/L)	5/5	6.4-260	AP-6011	62

[a] Rounded mean of detected concentrations.

Key:

BNAs = Base/neutral and acid extractable organic compounds.
EPA = United States Environmental Protection Agency.
Fuel ID = Fuel identification.
J = Estimated concentrations.
µg/L = Micrograms per liter.
TRPH = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.

Table 22

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
PIPELINE MILEPOST 2.7 SOURCE AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	Surface Soil				Subsurface Soil			
	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen-tration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen-tration[a]
FSPH (Mod 418.1) (mg/kg)	10/0	—	—	—	7/4	25-574	AP-6036, 6′	181
Fuel ID (Mod 8015) (mg/kg)								
Gasoline	7/3	8.6-470	SS-3	164,533	4/2	22 J-290	AP-6036, 6′	156
Kerosene	7/0	—	—	—	4/2	2.3 J	AP-6035, 6′ AP-6035, 16′	2.3
Bunker C-range organic compounds	7/7	37-370	SS-3	121,571	4/3	49 J-65 J	AP-6035, 16′	58
VOCs (EPA 8260) (mg/kg)								
1,2,4-Trichlorobenzene	7/0	—	—	—	4/1	0.108	AP-6036, 16′	—
1,2,4-Trimethylbenzene	7/2	0.120-2.1	SS-3	1,110	4/1	0.53 E	AP-6035, 6′	—
1,3,5-Trimethylbenzene	7/2	0.091-2.5	SS-3	1,296	4/2	0.079-.69 E	AP-6035, 6′	0.385
Benzene	7/1	1,500	SS-3	—	4/2	0.008-.19	AP-6034, 11′	0.099
Ethylbenzene	7/0	—	—	—	4/3	0.058-.16	AP-6034, 11′	0.106
Isopropylbenzene	7/2	43-1,500	SS-1	772	4/3	0.021-.4 E	AP-6035, 6′	0.165
Toluene	7/1	3,400	SS-3	—	4/1	0.21	AP-6035, 6′	—
m+p xylene	7/1	86	SS-1	—	4/3	0.38-.66 E	AP-6035, 6′	0.48
o-xylene	7/0	—	—	—	4/3	0.14-.28	AP-6034, 11′	0.220

Key at end of table.

Table 22

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
PIPELINE MILEPOST 2.7 SOURCE AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Surface Soil				Subsurface Soil			
Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
n-Propylbenzene	7/0	—	—	—	4/2	0.013-.077	AP-6035, 6′	0.045
p-isopropyltoluene	7/0	—	—	—	4/2	0.033-.610	AP-6034, 11′	0.322
sec-Butylbenzene	7/0	—	—	—	4/1	0.01	AP-6035, 6′	—
Total Lead (EPA 7421) (mg/kg)	7/7	11.8-43.8	SS-3	26.1	4/4	10.5-16.9	AP-6034, 11′	14
Lead (TCLP) (EPA 7421/1311) (mg/L)	2/0	—	—	—	2/1	0.034	AP-6034, 6′	—

[a] Rounded mean of detected concentrations.

Key:

E = Concentration exceeds the calibration range for the analytical instrument.
EPA = United States Environmental Protection Agency.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
J = Estimated concentration.
mg/kg = Milligrams per kilogram.
mg/L = Milligrams per liter.
VOCs = Volatile organic compounds.

Table 23

SUMMARY OF GROUNDWATER RESULTS
PIPELINE MILEPOST 2.7 SOURCE AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
TRPH (EPA 418.1) (μg/L)	5/4	2,100-5,700	AP-6034	4,000
Fuel ID (Mod. 8015) (μg/L)				
Gasoline	4/4	390-2,100 J	AP-5651	1,103
Bunker C-range organic compounds	4/1	1,200	AP-6035	—
VOCs (EPA 8260) (μg/L)				
1,2,4-Trimethylbenzene	5/5	29-240 E	AP-5651	97
1,3,5-Trimethylbenzene	5/5	11-320 E	AP-5651	91
Benzene	5/4	37-140	AP-6034	85
Ethylbenzene	5/5	8-330 E	AP-5651	134
Isopropylbenzene	5/5	94-320 E	AP-5651	155
Toluene	5/4	23-700 E	AP-6034	253
m+p xylene	5/5	42-1,200 E	AP-5651	484
o-xylene	5/5	9-400 E	AP-5651	151
n-Propylbenzene	5/4	6-31	AP-5651	15
p-isopropyltoluene	5/1	10	AP-5651	—
Total Lead (EPA 7421) (μg/L)	5/5	25-150	AP-6034	66
Dissolved Lead (EPA 7421) (μg/L)	5/3	2-4	AP-5651	2.8

[a] Rounded mean of detected concentrations.

Key:

E = Concentration exceeds the calibration range for the analytical instrument.
EPA = United States Environmental Protection Agency.
Fuel ID = Fuel identification.
J = Estimated concentration.
μg/L = Micrograms per liter.
TRPH = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.

Table 24

SUMMARY OF SUBSURFACE SOIL RESULTS
PIPELINE MILEPOST 3.0 SOURCE AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Subsurface Soil			
Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
FSPH (Mod. 418.1) (mg/kg)	15/5	21-85	AP-6037, 6′	46
Fuel ID (Mod. 8015) (mg/kg)				
Gasoline	9/3	7.6-23	AP-6038, 6′	12.733
Diesel No. 2	9/2	8.5-18	AP-6039, 4′	13.25
Jet A	9/1	7.5	AP-6037, 6′	—
Bunker C-range organic compound	9/9	45-82	AP-6037, 6′	55
VOCs (EPA 8260) (mg/kg)				
Benzene	8/3	0.070-19	AP-6048, 5′	8.523
Ethylbenzene	8/1	1.8	AP-6048, 5′	—
Toluene	8/1	0.028	AP-6048, 15′	—
m+p xylene	8/2	0.009-1.4	AP-6048, 5′	0.705
BNAs (EPA 8270) (mg/kg)				
2-Methylnaphthalene	4/1	0.064 J	AP-6037, 6′	—
Total Lead (EPA 7421) (mg/kg)	9/9	10-17.3	AP-6048, 5′	14

[a] Rounded mean of detected concentrations.

Key:

BNA = Base/neutral and acid extractable organic compounds.
EPA = United States Environmental Protection Agency.
FSPH = Field screening petroleum hydrocarbon.
Fuel ID = Fuel identification.
J = Estimated concentration.
mg/kg = Milligrams per kilogram.
VOCs = Volatile organic compounds.

Table 25

SUMMARY OF GROUNDWATER RESULTS
PIPELINE MILEPOST 3.0 SOURCE AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concentration[a]
TRPH (EPA 418.1) (µg/L)	8/6	270-15,600 J	AP-5522	6,000
Fuel ID (Mod. 8015) (µg/L)				
Gasoline	8/3	180-5,400 J	AP-5522	2,157
Diesel No. 2	8/1	200 J	AP-5848	—
JP-4	8/1	1,200 J	AP-5850	—
Bunker C-range organic compound	8/2	750 J-900 J	AP-6037	825
VOCs (EPA 8260) (µg/L)				
1,2,4-Trimethylbenzene	8/4	12-340 E	AP-5522	129
1,2-Dibromoethane	8/1	840 E	AP-6040	—
1,3,5-Trimethylbenzene	8/4	28-670 E	AP-5522	243
Benzene	8/7	16-7,200 E	AP-6040	2,574
Ethylbenzene	8/5	6-1,100 E	AP-5522	460
Isopropylbenzene	8/3	99-240 E	AP-5522	166
Naphthalene	8/1	6	AP-5522	—
Toluene	8/3	60-2,300 E	AP-5522	847
m+p xylene	8/5	10-3,800 E	AP-5522	1,265
o-xylene	8/5	5-2,300 E	AP-5522	574
n-Propylbenzene	8/2	19-41	AP-5522	30
Total Lead (EPA 7421) (µg/L)	8/8	8.1-280	AP-5522	84
Dissolved Lead (EPA 7421) (µg/L)	8/2	4.1-11	AP-6038	7.6

[a] Rounded mean of detected concentrations.

Key:

E = Concentration exceeds the calibration range for the analytical instrument.
EPA = United States Environmental Protection Agency.
J = Estimated concentration.
Fuel ID = Fuel identification.
µg/L = Micrograms per liter.
TRPH = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.

Table 26

SUMMARY OF SURFACE AND SUBSURFACE SOIL RESULTS
PIPELINE MILEPOST 15.75 SOURCE AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

	Subsurface Soil				Surface Soil				
Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen-tration[a]	No. of Samples Analyzed/ Detected	Range of Detected Concentration	Location of Maximum Concentration	Range	Mean
FSPH (Mod 418.1) (mg/kg)	6/3	165-1,670	AP-6051, 11′	725	0/0	—	—	—	—
Fuel ID (Mod 8015) (mg/kg)									
Gasoline	—	—	—	—	4/3	0.081	0.554	0.0079-.081	0.044
Diesel No. 2	5/2	6.2 J-14.0	AP-6051, 6′	10.1	4/0	—	—	—	—
Bunker C-range organic compounds	5/2	31.0-40.0	AP-6043, 6′	35.5	4/4	0.280	0.554	0.050-.280	0.205
VOCs (EPA 8260) (mg/kg)	—	—	—	—	4/0	—	—	—	—
1,3,5-Trimethylbenzene	5/1	0.260 J	AP-6051, 6′	—	—	—	—	—	—
Benzene	5/1	0.033	AP-6050, 6′	—	—	—	—	—	—
m+p xylene	5/1	0.290 J	AP-6051, 6′	—	—	—	—	—	—
Total Lead (EPA 7421) (mg/kg)	5/5	5.7-8.6	AP-6041, 8′	7	—	—	—	—	—
TRPH (mg/kg)	—	—	—	—	4/4	503	553	296-503	387
Total Lead (mg/kg)	—	—	—	—	4/4	19	553	7.1-19	10.8

[a] Rounded mean of detected concentrations.

Key:

EPA = United States Environmental Protection Agency.
FSPH = Field screening petroleum hydrocarbons.
Fuel ID = Fuel identification.
J = Estimated concentration.
mg/kg = Milligrams per kilogram.
TRPH = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.

Table 27

SUMMARY OF GROUNDWATER RESULTS
MILEPOST 15.75 SOURCE AREA
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Analyte and Concentration Units	No. of Samples Analyzed/ Detected	Range of Detected Concentrations	Location of Maximum Concentration	Mean Concen- tration[a]
Fuel ID (Mod. 8015) (μg/L)				
Bunker C-range organic compound	3/1	300	AP-6041	—
VOCs (EPA 8260) (μg/L)				
1,2-Dichloroethane	3/1	8 J	AP-6041	—
Benzene	3/2	7-34	AP-6041	21
m+p xylene	3/1	5	AP-6043	—
Total Lead (EPA 7421) (μg/L)	3/3	29-170	AP-6041	94

[a] Rounded mean of detected concentrations.

Key:

EPA = United States Environmental Protection Agency.
Fuel ID = Fuel identification.
J = Estimated concentration.
μg/L = Micrograms per liter.
VOCs = Volatile organic compounds.

6.0 SUMMARY OF SITE RISKS

Human Health and Ecological Risk Assessments were conducted to determine the potential risks associated with the source areas at OU-3. The presence and concentration of contaminants were determined from the sample analytical data collected during the RI field investigation performed during summer 1993.

In summary, potentially unacceptable excess lifetime cancer risks and hazard indices are associated with domestic use of groundwater at all source areas. With respect to soil, sediment, and air, the overall conclusion of the risk assessments for current and future exposure scenarios is that excess lifetime cancer risks and hazard indices are acceptable as defined by EPA's Superfund program. However, because the potential exists for contaminant migration to downgradient groundwater users, risks could increase if no action is taken. While soil contaminant levels do not pose a hazard for direct human contact, the levels are high enough to pose a threat to potential downgradient groundwater receptors.

The Risk Assessment Report for OU-3 is available at the information repositories.

6.1 HUMAN HEALTH RISKS

The OU-3 baseline Human Health Risk Assessment (HHRA) evaluated potential adverse health effects attributable to site-related contaminants. This section summarizes the HHRA.

The HHRA was conducted according to the following tasks:

- Contaminant screening and evaluation to select chemicals of potential concern (COPCs);
- Exposure assessment;
- Toxicity assessment; and
- Risk characterization.

Uncertainties associated with each step in the risk assessment also were presented. The following section presents a brief discussion of the risk assessment steps described above.

6.1.1 Contaminant Screening and Evaluation

The chemicals to be evaluated in the HHRA were identified in this task. The COPCs were selected from data collected during the 1993 field program. Briefly, the COPC selection process involved the following tasks:

- Initial data review and analysis. Only those samples appropriate for risk assessment were selected for evaluation, based on data validation and laboratory contaminant criteria;
- Comparison of maximum detected concentrations with tabulated risk-based concentrations (RBCs) provided by EPA,

Region 3. These RBCs reflected residential exposure assumptions and 10^{-6} and 10^{-7} risks associated with groundwater and soils, respectively, or a hazard quotient of 0.1 for all media;

- Comparison of maximum detected concentrations of inorganics (i.e., metals) with naturally occurring background concentrations; and
- Evaluation of the potential for chemicals to bioaccumulate in aquatic organisms to identify COPCs in surface water and sediments. Chemicals with octanol water partition coefficients greater than 3 were selected as COPCs.

Chemicals were selected as COPCs for further evaluation in the risk assessment if the data passed the above validation criteria and the maximum detected concentrations exceeded the RBCs and background levels (for inorganics only). Table 28 shows the COPCs for each medium of concern. The following chemicals were retained as COPCs in at least one environmental medium: lead; 1,2-dibromoethane; 1,2-dichloroethane; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; benzene; chloroform; ethylbenzene; isopropylbenzene; xylenes; naphthalene; toluene; trichlorofluoromethane; and 2-methylnaphthalene. COPCs were not identified in surface water or sediments because the chemicals present in the surface water or sediments do not have the potential to bioaccumulate in the aquatic environment.

6.1.2 Exposure Assessment

The exposure assessment identified the human populations, in the OU-3 vicinity, which could come into contact with COPCs. The routes, duration, frequency, and magnitude of potential exposures were estimated in this section. The exposure assessment included the following steps:

- Characterizing the exposure setting,
- Identifying the potential exposure pathways,
- Identifying exposure scenarios, and
- Quantifying exposure.

For the purposes of the HHRA, OU-3 was divided into the following sub-areas: the Tank Farm and AST area; Valve Pit A; Valve Pit B; the central ROLF; and Mileposts 2.7, 3.0, and 15.75. These sub-areas reflect differences in geographic location, in addition to the nature and extent of contamination. Consequently, the exposure scenarios and COPCs varied at the different sub-areas.

Exposure factors were obtained principally from EPA, Region X, *Supplemental Risk Assessment Guidance for Superfund*. The default exposure factors were modified in the OU-3 risk assessment to reflect site-specific meteorological and other factors at Fort Wainwright. For example, soil, air, and dermal pathway exposure durations were assumed to be shorter because of snow cover six months of the year. To calculate exposure point concentrations

Table 28

CONTAMINANTS OF POTENTIAL CONCERN
HUMAN HEALTH RISK ASSESSMENT
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

COPC	Source Area			
	Tank Farm	ROLF	Mileposts 2.7 and 3.0	Milepost 15.75
Lead	SS[a]	GW[b]	—	—
1,2-Dibromoethane	—	—	GW	—
1,2-Dichloroethane	GW	GW	—	GW
1,2,4-Trimethylbenzene	SS, SB[c],GW	SB,GW	GW	—
1,3,5-Trimethylbenzene	SS,SB,GW	SB,GW	GW	—
Benzene	SB,GW	SB,GW	SB,GW	GW
Chloroform	—	GW	—	—
Ethylbenzene	GW	GW	GW	—
Isopropylbenzene	—	GW	GW	—
m+p-Xylene	GW	GW	GW	—
Naphthalene	—	GW	—	—
o-Xylene	GW	GW	GW	—
Toluene	GW	GW	GW	—
Trichlorofluoromethane	GW	—	—	—
2-Methylnaphthalene	—	GW	—	—

[a] COPC in surface soil.
[b] COPC in groundwater.
[c] COPC in subsurface soil.

Key:

— = Not identified as a COPC in environmental media at this source area.
COPC = Chemical of potential concern.
GW = Groundwater.
ROLF = Railcar Off-Loading Facility.
SB = Subsurface soil.
SS = Surface soil.

(EPCs) in soil, the maximum detected concentration and upper 95% confidence limit on the mean were compared and the smaller value was used. For groundwater, the EPC was the maximum detected concentration at each monitoring well location. Off-site COPC concentrations in groundwater also were evaluated in the risk assessment. Exposure scenarios that represent current land use and hypothetical future land use at OU-3 were developed.

Current Land Use

Current land use for recreational and light industrial scenarios was considered. Individuals potentially could be exposed to COPCs in soil by ingesting soil and inhaling vapors and dust. Exposures to groundwater under the source areas were not evaluated under current land use conditions because the groundwater beneath OU-3 is not currently used as a drinking water supply. A brief discussion of the individuals who potentially could be exposed to COPCs under current land use conditions (i.e., receptors) is presented below:

- At Valve Pit A, Valve Pit B, the central ROLF, and Mileposts 2.7 and 3.0, the only plausible exposures are to site visitors who may use the areas for recreational activities. However, because COPCs were identified only in subsurface soils at these sub-areas, risks associated with incidental ingestion of soil and inhalation of particulates were not evaluated; and

- No COPCs were identified in soils at Milepost 15.75. Therefore, a quantitative risk assessment of this sub-area could not be performed.

Future Land Use

The future land use scenario for all areas except Milepost 15.75 is considered light industrial (troop training area), recreational, and residential. The following exposure pathways were evaluated: incidental ingestion of soil; inhalation of soil-derived vapors and particulates; and exposure to COPCs in groundwater by ingestion, inhalation, and dermal contact. Milepost 15.75 is expected to remain a residential area for an indefinite period of time. Potential exposures to adult and child residents were evaluated at all sub-areas. These residents were assumed to use the groundwater beneath OU-3 as a source of drinking water.

6.1.3 Toxicity Assessment

The purpose of the toxicity assessment is to compile toxicity_data for the COPCs identified at OU-3 and to estimate the relationship between the extent of exposure to a COPC (i.e., dose level) and the likelihood or severity of adverse effects. This dose-response relationship provides the basis for deriving the toxicity values (i.e., slope factors and reference doses [RfDs]) used in the HHRA. The slope factors and reference doses for all the COPCs were obtained from the Integrated Risk Management System or Health Effects Assessment Summary Table, with the exception of those for 1,2,4- and 1,3,5-trimethylbenzene, which were obtained from the Environmental Criteria Assessment Office. It should be noted that an uncertainty factor of 10,000 is associated with the RfDs for 1,2,4- and 1,3,5-trimethylbenzene. Thus, the hazard quotients associated with these compounds are likely to considerably overestimate the actual risks. Qualitative descriptions of the potential toxic properties of the COPCs also were provided.

6.1.4 Risk Characterization

The risk characterization combines the information developed in the exposure and toxicity assessments to identify the contaminants of concern (COCs) at the site and to obtain estimates of the potential risks posed to human health. Risks were calculated for carcinogenic (cancer-causing) and noncarcinogenic (toxic) effects. EPA considers excess lifetime cancer risks between 1 in 1 million (1×10^{-6}) and 1 in 10,000 (1×10^{-4}) to be within the generally acceptable range; risks greater than 1 in 10,000 usually suggest the need to take action at a site. Noncarcinogenic effects are evaluated by calculating a ratio between the estimated intake of a contaminant and its corresponding RfD (i.e., the intake level at which no adverse health effects are expected to occur). If this ratio, called a hazard index, exceeds 1, then adverse noncarcinogenic health effects may be expected at the site. The potential risks and hazard indices described in this summary were calculated using reasonable maximum exposure (RME) assumptions. A complete exposure pathway must exist for a contaminant to pose a human health risk (i.e., the potential for a receptor to be exposed to a contaminant must exist).

Under current land use conditions, the estimates for carcinogenic and noncarcinogenic effects for OU-3 source areas fell within or below the acceptable risk range for CERCLA sites. These estimates apply to contaminants detected in soil in all the OU-3 source areas. However, under a future residential land use scenario, including use of groundwater as drinking water, several contaminants were detected in groundwater and soil at concentrations above EPA's acceptable risk range. These contaminants (or COCs) include benzene; 1,2-dichloroethane; 1,2-dibromoethane; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; and lead. The excess lifetime cancer risks and hazard indices calculated for OU-3 are summarized in Tables 29 and 30.

EPA's methodology for evaluating potential health effects associated with lead contamination (i.e., the integrated uptake/biokinetic model) is appropriate only for evaluating child exposures. Consequently, the risks associated with exposures to adult residents and workers and adolescent site visitors could not be assessed quantitatively.

Tank Farm Source Area

At the Tank Farm, which includes Valve Pit A, the complete exposure pathway at this time is to recreational users of the area near Valve Pit A; these users may inhale benzene vapors. The excess lifetime cancer risk was 6×10^{-8}. No noncarcinogenic contaminants were associated with this exposure pathway, so no hazard quotients were calculated.

The potential receptors of contamination at the Tank Farm include downgradient groundwater users; i.e., public drinking water supplies (the two churches), Class A municipal drinking water wells, and residential and recreational use areas. The excess lifetime cancer risks for exposure to COPCs in soil for residential and recreational scenarios were 6×10^{-6} and 6×10^{-8}, respectively. Hazard indices of less than 1 were determined assuming future residential, industrial, and recreational exposures at any location within the entire source area, except for

Table 29

CURRENT AND FUTURE RME EXCESS LIFETIME CANCER RISKS
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Subarea	Current Scenarios		Future Scenarios			
	Recreational Soil	Industrial Soil	Recreational Soil	Industrial Soil	Residential Soil	Residential Groundwater[a]
Tank Farm ASTs	NA[b]	NA[d]	NA[c]	NA[c]	NA[c]	5×10^{-5}
Valve Pit A	6×10^{-8}	NA[e]	6×10^{-8}	NA[e]	6×10^{-6}	6×10^{-4}
Valve Pit B	NA[c]	NA[e]	NA[c]	NA[e]	NA[c]	4×10^{-4}
Central ROLF	NA[c]	NA[e]	NA[c]	NA[e]	NA[c]	1×10^{-3}
Mileposts 2.7 and 3.0	1×10^{-7}	NA[e]	6×10^{-8}	NA[e]	6×10^{-6}	3×10^{-1}
Milepost 15.75	NA[c]	NA[c,e]	NA[c]	NA[c,e]	NA[c]	2×10^{-5}

[a] Groundwater risks are 95th percentile values.
[b] Recreational scenario not evaluated at this sub-area.
[c] No carcinogenic chemicals of potential concern.
[d] Lead was the only chemical of potential concern.
[e] Industrial scenario not evaluated at this sub-area.

Key:

ASTs = Aboveground storage tanks.
NA = Not applicable.
RME = Reasonable maximum exposure.

Table 30

CURRENT AND FUTURE RME HAZARD INDICES
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Sub-Area	Current Scenarios		Future Scenarios			
	Recreational Soil	Industrial Soil	Recreational Soil	Industrial Soil	Residential Soil	Residential Groundwater[a]
Tank Farm ASTs	NA[b]	NA[b]	0.0008	0.007	0.2	2
Valve Pit A	NA[b]	NA[c]	0.02	NA[c]	5	200
Valve Pit B	NA[b]	NA[c]	0.008	NA[c]	0.2	40
Central ROLF	NA[b]	NA[c]	0.004	NA[c]	1	50
Mileposts 2.7 and 3.0	NA[b]	NA[c]	NA[b]	NA[c]	NA[b]	60
Milepost 15.75	NA[b]	NA[c]	NA[b]	NA[c]	NA[b]	0

[a] Groundwater risks are 95th percentile values.

[b] No noncarcinogenic chemicals of potential concern.

[c] Industrial scenario not evaluated at this sub-area.

Key:

ASTs = Aboveground storage tanks.
NA = Not applicable.
RME = Reasonable maximum exposure.

Valve Pit A, where the hazard index was from the incidental ingestion of 1,2,4- and 1,3,5-trimethylbenzene under the residential exposure scenario.

Potential cancer risks associated with groundwater were calculated for each well sampled. RME cancer risks of 6×10^{-4} for ingestion of residential exposure to on-site groundwater were found at one of the Valve Pit A wells. The hazard index for wells at Valve Pit A was 200. The COCs were 1,2- and 1,3,5-trimethylbenzene and benzene.

The total excess lifetime cancer risk associated with exposure to groundwater originating from the Shannon Park Baptist Church well was 6×10^{-6}. The sole contributor to this risk estimate was 1,2-dichloroethane. The hazard indices associated with a future residential ingestion of this same water source were less than 1.

Railcar Off-Loading Facility Source Area

There are complete exposure pathways associated with contaminated soil and groundwater at the ROLF, which includes Valve Pit B.

The potential exposure pathways at the ROLF include Class A municipal drinking water wells, and residential and recreational use of contaminated groundwater by downgradient groundwater users. A soil exposure pathway hazard index of less than 1 was calculated using future RME residential, industrial, and recreational exposures at the Valve Pit B area. The hazard index for the central ROLF area under the residential soil ingestion scenario was 1. Carcinogenic COPCs were identified at the central ROLF and Valve Pit B.

Potential future cancer risks associated with the ingestion of groundwater were calculated for each well sampled. RME cancer risks in excess of 4×10^{-4} and 1×10^{-3} were found at Valve Pit B and the central ROLF areas, respectively, for a scenario of future residential use of on-site groundwater. The principal COC was benzene. The hazard indices are 40 and 50, respectively, for Valve Pit B and the central ROLF.

Milepost Source Areas

Mileposts 2.7 and 3.0

The complete current exposure pathway at Mileposts 2.7 and 3.0 is to recreational users who may inhale carcinogenic vapors. The excess lifetime cancer risk was 6×10^{-8}. No noncarcinogenic contaminants were associated with this exposure pathway, so no hazard quotients were calculated.

The complete future exposure pathways at Mileposts 2.7 and 3.0 include residential and recreational scenarios. The estimates of potential excess lifetime cancer risks for exposure to soil for these residential and recreational scenarios were 5.9×10^{-6} and 5.8×10^{-8}, respectively.

Potential cancer risks associated with groundwater were calculated for each well sampled. The highest cancer risk estimate was derived from monitoring well AP-6040 in a future residential ingestion scenario; the total cancer risk was 3×10^{-1}. The principal COCs were benzene and 1,2-dibromoethane. The RME hazard index for monitoring well AP-5522 was 80 because of 1,2,4- and 1,3,5-trimethylbenzene.

Milepost 15.75

At Milepost 15.75, a potential exposure pathway is ingestion of contaminated groundwater because of potential contaminant migration. Monitoring wells AP-6041 and AP-6043 were used in this evaluation. The potential risks were 2×10^{-5} because of benzene and 1,2-dichloroethane. No noncarcinogens were detected at Milepost 15.75.

6.1.5 Major Uncertainties

Uncertainty is associated with every step of the risk assessment process. The principal uncertainties associated with the OU-3 risk assessment are:

- The rate and extent of contaminant migration. This is the largest uncertainty in this risk assessment process. While there is a potential pathway for contaminants to migrate to downgradient users, the actual pathway and rate of migration are uncertain;

- Estimated concentrations. Several of the high COPC concentrations in groundwater were *E*-qualified, or estimated, reflecting exceedance of the linear portion of the calibration curve. Consequently, risk estimates derived from these concentrations are likely underestimates;

- Oral RfDs for 1,2,4-, and 1,3,5-trimethylbenzene derived from inhalation studies. Low confidence is placed in these RfDs, resulting in considerable uncertainty in the hazard quotients associated with these COCs. Because an uncertainty factor of 10,000 was applied to the inhalation lowest observed adverse effect level, the resulting RfDs are extremely conservative and would overestimate noncancer risk;

- Screening-level models used to evaluate the outdoor particulate and vapor inhalation pathways. These relatively simplistic approaches yield very conservative estimates of potential exposure. In particular, the soil-to-air volatilization model assumes that the contaminant concentration in soil is homogeneous from the soil surface to depth of concern. Additionally, the model assumes that the contaminated soil is not covered by contaminant-free soil material. Consequently, the models tend to overestimate exposures and risks;

- Derivation of future surface soil concentrations from subsurface soil data. The assumption that subsurface soil would be disturbed and mixed with the present surface soil layer is conservative. Additionally, when no surface soil analytical data were available, future receptors were assumed to be exposed to undiluted subsurface soil. Both of these assumptions serve to overestimate exposures and risks;

- Use of the Baptist church well data and hydraulically cross-gradient well data to assess potential off-site groundwater impacts from the Tank Farm and Milepost 15.75, respectively. These data serve to overestimate off-site groundwater exposures and risks;
- The risk associated with petroleum hydrocarbons other than individual constituents. This risk is unknown, and these contaminants were not considered in the risk assessment; and
- Existing concentrations assumed to be the concentrations or exposure source terms in the future. No reduction through natural degradation or attenuation over time is taken into account. This assumption may overestimate risk.

Because numerous conservative assumptions were used in the selection of COPCs and the exposure and toxicity assessments, the risk characterization results likely overestimate risks associated with COPCs at OU-3.

6.2 ECOLOGICAL RISKS

An Ecological Risk Assessment (ERA) addresses the impacts and potential risks posed by contaminants to natural habitats, including plants and animals, in the absence of remedial action. The OU-3 ERA evaluated the contaminants found in surface soils, surface waters, and sediments in habitats in and around the source areas to estimate the contaminants' impacts or potential risks to the natural environment.

The OU-3 ERA was conducted using available ecological information and data collected during the RI. The potential ecological risks were evaluated using established effects criteria and RME assumptions. The ERA was conducted according to EPA's current national and regional guidance, which includes:

- *Framework for Ecological Risk Assessment* (EPA/630/R92/001);
- Ecological Assessment of Superfund Sites: An Overview, ECO Update 1(2) (Office of Solid Waste and Emergency Response 9345.0-05I); and
- *Statement of Work for the Remedial Investigation/Feasibility Study Environmental Evaluation for Superfund Sites, Region X Guidance.*

Consistent with this guidance, the ERA was conducted in four main steps:

- Problem formulation describes the site; habitats on and near the source areas; selection of contaminants of potential ecological concern; contaminant release, migration, fate, and pathways of exposure; receptors of concern; ecological end points; and the conceptual ecological exposure model;

- Exposure assessment provides quantitative exposure scenarios and estimates for selected indicator species;

- Ecological effects assessment provides toxicological profiles of the COCs and summarizes the toxicity reference values for selected measurement species; and

- Risk characterization combines the information from the exposure assessment and ecological effects assessment to obtain estimates of potential ecological risk. This process includes an evaluation of the uncertainties of the assessment process, and a summary of and conclusions regarding the ecological significance of the predicted risks.

Unlike the HHRA, the ERA focused on the contaminants' effects on populations or communities, rather than on individuals. If a potential risk to individuals of a population was identified during the ERA, the risk was evaluated to determine whether it was biologically or ecologically significant. Potential risks to individual threatened or endangered species were considered.

No potential ecological risks were predicted for the ROLF or Mileposts 2.7, 3.0, and 15.75. The results of the ERA did indicate potential effects to wildlife because of lead; 1,2,4- and 1,3,5-trimethylbenzene; isopropylbenzene; and toluene exposure at the Tank Farm. Lead posed potential risks to all terrestrial biota except the red fox, while the other four contaminants posed potential risks only to the red squirrel and marten, which are unlikely to inhabit the Tank Farm Source Area. Consequently, the only potentially significant risks at OU-3 are because of wildlife exposure to lead in soils at the Tank Farm. However, given the conservative nature of the ERA, these potential risks are likely to be overestimated.

6.2.1 Summary of Uncertainties

The ERA is subject to uncertainties because virtually every step in the risk assessment process involves assumptions involving professional judgment. Principle uncertainties associated with the OU-3 ERA include the following:

- A limited number of samples was collected from the source areas, and the samples were biased toward areas of expected soil contamination. These factors are likely to result in an overestimation of potential risks to the OU-3 ecological receptors;

- Exposure parameters for all measurement species were selected based on professional judgment. The amount of food consumed daily, the different types of food consumed, and the percentage of the whole diet that each food item contributes were estimated based on a combination of scientific literature and limited field observation information. In addition, the amount of time spent foraging on site is estimated using similar information. Without extensive site-specific field data, it is unclear whether potential risks are under- or overestimated using the selected exposure parameters;

- Frequently, toxicity and exposure data from literature sources were not specific to the target receptors; therefore, extrapolation of the data to the species of concern was necessary. Differences in toxic response between species are well-documented, even among species of the same genus. Therefore, actual risk may be over- or underestimated;

- Uncertainty factors obtained from available literature and based on best professional judgment were applied to normalize toxicological data to chronic no observed adverse effect levels (NOAELs). Considerable uncertainty is associated with their application. However, the desired result is a conservative estimate of the NOAEL, which should result in a conservative estimate of any potential risks;

- Most of the available toxicity values were determined with laboratory animals under laboratory conditions. Such studies may not accurately reflect the effects of similar doses on free-ranging wildlife; and

- Toxicity values determined with indirect effect measures, (i.e., increased body weight) may not represent other significant indirect effects, such as behavioral changes that may be realized in wild populations.

The approach described in this ERA used realistic assumptions wherever possible; reasonable and conservative assumptions were used when empirical data were unavailable. As a consequence, potential ecological risks to OU-3 species are more likely to be overestimated than underestimated.

7.0 REMEDIAL ACTION OBJECTIVES

7.1 NEED FOR REMEDIAL ACTION

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment. Remedial actions were deemed necessary to protect human health and the environment:

Source Area	Reasons for Implementing Remedial Actions
Tank Farm, bottom of Birch Hill	• Benzene detected above Safe Drinking Water Act levels in groundwater • Proximity to site boundary, residential drinking water wells, and Class A public water supply system • Reduce contaminant migration in groundwater
Tank Farm, Valve Pit A	• Potential risk above 1×10^{-4} for groundwater ingestion • Benzene, ethylbenzene, and toluene were detected above Safe Drinking Water Act levels • Reduce contaminant migration into the Chena River
ROLF	• Potential risk above 1×10^{-4} for groundwater ingestion • Benzene, ethylbenzene, toluene, and 1,2-dichloroethane were detected above Safe Drinking Water Act levels • Reduce contaminant migration into the Chena River
Mileposts 2.7 and 3.0	• Potential risk above 1×10^{-4} for groundwater ingestion • Benzene, ethylbenzene, toluene, and ethylene dibromide were detected above Safe Drinking Water Act levels • Prevent further contaminant migration into nearby wetlands and groundwater
Milepost 15.75	• Benzene and 1,2-dichloroethane were detected above Safe Drinking Water Act levels • Proximity to residential area and private drinking water wells

7.2 REMEDIAL ACTION OBJECTIVES

The remedial action objectives are as follows:

7.2.1 Groundwater

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

7.2.2 Soil

- For petroleum-contaminated soil, prevent migration of contaminants from soil into the groundwater that would result in groundwater contamination and exceedance of Safe Drinking Water Act standards.

7.3 GOALS OF REMEDIAL ACTION

The following remediation goals have been generated for COCs for active remediation of groundwater and soil:

7.3.1 Groundwater

Chemicals of Concern	Remediation Goal (μg/L)
Benzene	5[a]
Toluene	1,000[a]
Ethylbenzene	700[a]
1,2-dibromoethane	0.05[a]
1,2-dichloroethane	5[a]
1,2,4-trimethylbenzene	14[b]
1,3,5-trimethylbenzene	12[b]

[a] Based on Safe Drinking Water Act Levels.
[b] Based on an RBC equivalent to a noncancer hazard quotient of 1 using residential groundwater exposure assumptions.

After Safe Drinking Water Act levels are achieved, it is anticipated that natural attenuation will continue and achieve final cleanup levels.

7.3.2 Soil

The remedial action goal for *in situ* soils contaminated with volatile organic and petroleum compounds is protection of the groundwater. Because the soils are acting as a continuing source of contamination to the groundwater, active remediation of the soils will continue until Safe Drinking Water Act levels are consistently met. Natural attenuation will continue until Alaska Water Quality Standards are achieved.

Petroleum-contaminated soils that are treated *ex situ* will be treated to State of Alaska Matrix Level A standards before they are returned to the source area.

7.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The following applicable or relevant and appropriate requirements (ARARs) are the most significant regulations that apply to the remedy selection:

- Safe Drinking Water Standards established MCLs, nonzero Maximum Contaminant Level Goals (MCLG), and action levels that are relevant and appropriate for groundwater. This requirement sets the active remediation goals for the groundwater. Alaska Water Quality Standards are also applicable; and

- Alaska Oil Pollution regulations are applicable, and Alaska regulations for leaking USTs are relevant and appropriate. These regulations require cleanup of petroleum-contaminated soils.

8.0 SUMMARY OF REMEDIAL ACTION ALTERNATIVES

8.1 REMEDIAL AREAS

Appropriate technologies were identified and screened for applicability to site conditions. The potential technologies then were combined into media-specific sitewide alternatives. Potential remedial alternatives for OU-3 were identified, screened, and evaluated in the FS, which is available at the information repositories. During the FS, OU-3 was divided into the following areas according to the type of contamination, hydrogeologic property, and presence of permafrost:

- Remedial Area 1a: Lead-based-paint-contaminated soil located near ASTs within the Tank Farm Source Area. The Army; EPA; and State of Alaska, through ADEC, have agreed to defer selection of a final remedy for the AST area located on the Birch Hill portion of the Tank Farm. This source area will be addressed in the ROD for OU-5. See Section 12.0 of this ROD for documentation of significant changes;

- Remedial Area 1b: Petroleum-contaminated soil and groundwater found at the area that extends south from the base of Birch Hill to the TFS at the southwest corner of the Tank Farm Source Area and that extends west toward Lazelle Road;

- Remedial Area 2: Petroleum-contaminated soil and groundwater found at Valve Pit A and the ROLF Source Area; and

- Remedial Area 3: Petroleum-contaminated soil and groundwater found at Mileposts 2.7 and 3.0, including TFS-1 and -2, and Milepost 15.75 along the Fairbanks-Eielson Pipeline.

Remedial technologies in different combinations were proposed to address the contamination at each remedial area. Table 31 summarizes the volume of contaminated soil and groundwater for each remedial area and the type of contamination present.

8.2 REMEDIAL ACTION ALTERNATIVE TECHNOLOGIES

The following are alternatives evaluated in the initial screening for remedial action:

8.2.1 No Action

A no-action alternative is presented for each remedial area to serve as a comparison against other alternatives.

8.2.2 Institutional Controls

Each remedial area includes an alternative involving institutional controls. Institutional controls are methods to restrict access to a site or use of groundwater or land. Institutional controls are used to decrease or eliminate human exposure to contaminants and are usually

Table 31

CONTAMINATED MEDIA VOLUME ESTIMATES
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Remedial Area	Estimated Soil Quantity (cubic yards)	Estimated Groundwater Quantity (gallons)	Contaminants of Concern
1a	3,200	N/A	Lead[a]
1b	25,000	5.8×10^6	Petroleum hydrocarbons and VOCs
2 (full area)	960,000	10.2×10^6	Petroleum hydrocarbons and VOCs
3	24,200	1.55×10^6	Petroleum hydrocarbons and VOCs

[a] Lead-contaminated soil is comingled with petroleum hydrocarbon contaminated soil.

Key:

N/A = Not applicable. Groundwater contamination not included in Remedial Area 1a.
VOCs = Volatile organic compounds.

relatively inexpensive to implement. However, the contamination is not removed or destroyed. Periodic review of the institutional controls is required to ensure that the protection of human health is maintained over time. Institutional controls for OU-3 include fencing, signs, long-term groundwater monitoring, access restrictions, site inspections, and combinations of these activities.

8.2.3 Remedial Areas 1b, 2, and 3: Soil Vapor Extraction of Petroleum-Contaminated Soil

Vapor extraction is a proven and reliable technology for the removal of VOCs from unsaturated soils. Petroleum hydrocarbon vapors in soil pore spaces in the vadose zone are transported from the soil by convection of pore-space air. As air flows through the soil, the lighter petroleum hydrocarbons volatilize into the air, provided the air is not already in equilibrium with the hydrocarbon contained within the soil. A series of extraction wells is installed, and vacuum blowers are attached to the extraction wells to create a vacuum in each well to increase the movement of air through the soil. The vacuum forces the volatile contaminants from the soil to the extraction wells and into a central treatment building, where vapors can be collected and treated by activated carbon or discharged directly into the atmosphere, depending on concentration.

Because the more volatile gasoline constituents (those with higher vapor pressures) are removed first, the product remaining in the soil contains a proportionately greater quantity of the less-volatile compounds with time. Because of this change in composition, the vapor concentrations and mass removal rates decrease with time. In addition to volatilizing hydrocarbons, the vapor extraction system (VES) supplies oxygen to soil microbes, which metabolize (biodegrade) a portion of the hydrocarbons.

An *in situ* VES typically uses vacuum blowers to pull air from perforated pipe installed in drilled wells without excavating the contaminated soil. An *in situ* VES is most applicable for remediating large soil volumes, where excavation is prohibitively expensive, or for remediating soils that cannot be excavated because of current land use or hydrogeologic conditions. Successful *in situ* VES design and operation depends on understanding the horizontal and vertical distribution of hydrocarbons relative to the extraction wells, the concentration of volatile hydrocarbons in the soil, and the air conductivity of the site soils. This type of information can be generated only through a site-specific subsurface investigation and pilot study.

Soils suitable for VES cell treatment include gravel, sand, silty sand, and nonplastic sandy silt. Because of their low air conductivity, clays are best treated by other remedial technologies. Organic soils should be analyzed on a site-specific basis because of their high potential for adsorption of hydrocarbons.

8.2.4 Remedial Areas 1b, 2, and 3: Steam Injection of Petroleum-Contaminated Soil

Steam injection typically is used in conjunction with other remedial technologies to increase the efficiency of removal of volatile contaminants from soil; it can be especially useful in cold climates. The injection of steam into the ground raises the temperature of the surrounding soil, making it easier to remove volatile contaminants using methods such as soil vapor extraction.

8.2.5 Remedial Areas 1b, 2, and 3: Bioventing of Petroleum-Contaminated Soil

Bioventing is the process of supplying oxygen and nutrients to subsurface soil to stimulate the aerobic degradation of contaminants. Oxygen and nutrients, such as nitrogen and phosphorus, are injected into the subsurface through wells similar to vapor extraction wells. This technology works well at sites with large quantities of petroleum-contaminated soil. Bioventing employs a low-flow process that will promote biodegradation but is relatively slow and temperature-dependent.

8.2.6 Remedial Area 3: Soil Pile Aeration of Petroleum-Contaminated Soil

This technology involves excavating contaminated soil and placing it on a geotextile liner in a bermed area. Perforated pipes are laid horizontally through the contaminated soil pile, and petroleum vapors are collected by creating a vacuum in the pipes. This technology is similar to vapor extraction, except that this technology requires that soil be excavated.

8.2.7 Remedial Areas 1b, 2, and 3: Bioremediation of Petroleum-Contaminated Groundwater

In this technology, oxygen and nutrients are injected directly into the aquifer to enhance natural degradation processes.

8.2.8 Remedial Areas 1b, 2, and 3: Air Stripping and Carbon Adsorption of Petroleum-Contaminated Groundwater

Similar to the approach for bioremediation, this technology involves pumping contaminated groundwater to the surface and treating it through an air stripping tower. The treatment process involves the introduction of air through the contaminated water to strip it of petroleum contaminants. The water then is passed through carbon filters to remove residual petroleum contamination from the water. The cost of this groundwater treatment technology is directly proportional to the volume of contaminated groundwater. Furthermore, the efficiency of pump-and-treat treatment is limited by chemical solubility and adsorption coefficients.

8.2.9 Remedial Areas 1b, 2, and 3: Air Sparging of Petroleum-Contaminated Groundwater

Air sparging is a remedial technology in which air is injected into groundwater below the layer of contamination. Air bubbles floating up through the contaminated groundwater cause contaminants to evaporate upward into the overlying soil. The vapors could be captured by a soil VES, as previously described. Air sparging, coupled with soil VES, remediates the volatile portion of the petroleum contamination by volatilization and by promoting biodegradation of the heavier portion of the petroleum without addition of nutrients.

In situ air sparging technology involves injecting a gaseous medium into the saturated zone below the areas of contamination. In most applications, air is used as the injected gas. The technology is based on the premise that contaminants dissolved in the groundwater and sorbed onto particles will partition into the air phase. Air phase contaminants then are transported into the vadose zone. Typically, air sparging is used in conjunction with a VES, which collects the air-phase contaminants and transfers them to a vapor treatment system, such as carbon adsorption. In addition, sparging using air increases the dissolved oxygen concentration in the groundwater, which in turn may increase naturally occurring biodegradation.

Gas flow rates are varied in order to provide the ideal air-to-water ratio to optimize the contaminant mass transfer from the liquid phase to the water phase. Air flow rates typically used range from 3 cubic feet per minute (cfm) to 10 cfm. Gas flow rate depends directly on the injection pressure. Injection pressure, in turn, depends on the static water head above the sparge point and the soil grain size. Higher pressures are required for fine-grained soils. Excessively fine-grained soils can result in the formation of subsurface gas pockets. Additionally, high injection pressures may result in subsurface fractures, which decrease the system's efficiency.

9.0 REMEDIAL ALTERNATIVE EVALUATION

The specific remedial action alternatives for each remedial area are discussed in this section. In many cases, several technologies and strategies are combined into one alternative. This section presents the alternatives for each remedial area in OU-3 and compares the selected alternatives to the other alternatives. The selection of alternatives was based on an evaluation using the nine Superfund criteria specified in Table 32. The first two criteria are known as threshold criteria that must be met by all selected remedial actions. The following five criteria are known as balancing criteria, and the final two criteria as modifying criteria.

The OU-3 FS should be consulted for more information about the alternatives and the comparisons among alternatives. It is available for review by the public in the Administrative Record and the information repositories.

9.1 ALTERNATIVES FOR REMEDIAL AREA 1B

Remedial Area 1b consists of petroleum-contaminated soil and groundwater between the base of Birch Hill and near the TFS at the southwest corner of the Tank Farm. The presence of localized areas of permafrost is a limiting factor for evaluation and placement of remedial alternatives. The remediation will be focused in areas with known sources of contamination and at locations where MCLs have been exceeded. The cost for each alternative is based on an estimated number of years to achieve remedial goals. A cost comparison table is presented in Table 33. The following alternatives were considered for Remedial Area 1b:

- Alternative 1: No action. Petroleum-contaminated soil and groundwater would remain in place. Passive remediation probably would occur with the natural degradation of the petroleum. No costs would be associated with this alternative;

- Alternative 2: Institutional controls. Petroleum-contaminated soil and groundwater would remain in place. Passive remediation probably would occur with natural degradation of the petroleum. Institutional controls would include fencing and signs, site maintenance, semi-annual groundwater monitoring, and site inspections every five years. Long-term groundwater monitoring also would be part of this alternative and is considered in the cost estimate. The cost was based on a 20-year monitoring period;

- Alternative 3: Soil vapor extraction, bioventing, steam injection of petroleum-contaminated soils, and bioremediation of petroleum-contaminated groundwater. Soil vapor extraction would remove petroleum hydrocarbon vapors from petroleum-contaminated soil. Bioventing would be utilized to stimulate aerobic degradation of contaminants. Steam injection would increase the efficiency of the other technologies by raising ground temperatures. Bioremediation would be employed to enhance natural degradation processes in the petroleum-contaminated groundwater. Long-term groundwater monitoring also would be part of this alternative and is considered in the cost estimate. The cost was based on a 20-year monitoring period;

Table 32

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY'S NINE EVALUATION CRITERIA OPERABLE UNIT 3 FORT WAINWRIGHT, ALASKA

1. Overall Protection of Human Health and the Environment

Addresses whether a remedy provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Addresses whether a remedy will meet all the ARARs or other federal and state environmental laws, or justifies a waiver.

3. Long-Term Effectiveness and Permanence

Refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals are met.

4. Reduction of Toxicity, Mobility, and Volume through Treatment

Focuses on the anticipated performance of the treatment technologies that may be used as a cleanup alternative.

5. Short-Term Effectiveness

Refers to the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

6. Implementability

Addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a specific solution.

7. Cost

Includes estimated capital and operations and maintenance costs.

8. State Acceptance

Considers whether the state, based on its review of the remedial investigation/feasibility study (RI/FS) and Proposed Plan concurs, opposes, or has no comment on the preferred alternative.

9. Community Acceptance

Considers all comments received from the public during the 30-day comment period on the RI/FS and Proposed Plan.

Table 33

REMEDIAL AREA 1B—COST COMPARISON TABLE
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Alternative	Capital Cost ($)	Operations and Maintenance[a] ($)	Years to Achieve Remedial Goals
1: No Action	0	0	—[b]
2: Institutional Controls	0	200,000	20
3: Soil Vapor Extraction, Bioventing, Steam Injection of Soil; Bioremediation of Groundwater	2,200,000	200,000	5
4: Soil Vapor Extraction, Bioventing, Steam Injection of Soil; Air Stripping/Carbon Absorption of Groundwater	2,200,000	200,000	10
5: Soil Vapor Extraction of Soil; Air Sparging of Groundwater	2,600,000	200,000	5

[a] Operations and Maintenance cost includes the estimated costs for 20 years of groundwater monitoring.

[b] The No Action alternative is not expected to achieve remedial goals.

- Alternative 4: Soil vapor extraction, bioventing, steam injection of petroleum-contaminated soil, and extraction followed by air stripping and carbon adsorption of petroleum-contaminated groundwater. As in Alternative 3, soil vapor extraction, bioventing, and steam injection would be utilized to remove petroleum hydrocarbons from contaminated soil. Air stripping and carbon adsorption would be used to pump contaminated groundwater to the surface and strip it of petroleum contaminants with air and filters. Long-term groundwater monitoring for 20 years also would be part of this alternative and is considered in the cost estimate. The cost was based on a 20-year monitoring period; and

- Alternative 5: Soil vapor extraction of petroleum-contaminated soils and air sparging of petroleum-contaminated groundwater. Soil vapor extraction would be used to remove petroleum hydrocarbons from petroleum-contaminated soil in this alternative. Air sparging would be used to force evaporation of contaminants and capture the resulting vapors with a vapor-extraction process. Long-term groundwater monitoring also would be part of this alternative and is considered in the cost estimate. The cost was based on a 20-year monitoring period.

9.2 EVALUATION OF ALTERNATIVES FOR REMEDIAL AREA 1B

The following sections summarize the evaluation of each alternative in reference to EPA's nine evaluation criteria.

9.2.1 Overall Protection of Human Health and the Environment

Alternative 1, the no-action alternative, would not protect human health and the environment because contamination would remain in place. Institutional controls, Alternative 2, would not protect human health because they would not prevent off-site migration of contaminants.

Alternatives 3, 4, and 5 would protect human health and the environment by reducing risk associated with contaminated groundwater and soil through implementation of active treatment technologies. These alternatives also would eliminate further leaching of contaminants from soil to groundwater and reduce the potential for further migration of contaminated groundwater.

9.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

No action and institutional controls, Alternatives 1 and 2, would not achieve applicable cleanup standards for soil and groundwater within reasonable time frames; therefore, the two alternatives will not be discussed further.

The groundwater remediation portion of Alternatives 3, 4, and 5 would achieve chemical-specific ARARs, such as federal Safe Drinking Water Act standards, within a reasonable time frame. The soil remediation portion of Alternatives 3, 4, and 5 would achieve chemical-specific ARARs, such as Alaska petroleum-contaminated soil regulations (18 AAC 78), to protect groundwater for drinking water use. All the alternatives would be implemented in compliance with action-specific ARARs, such as the federal Clean Air Act.

9.2.3 Long-Term Effectiveness and Permanence

The groundwater treatment portion of Alternatives 3, 4, and 5 would involve active irreversible reduction of contaminant concentrations and therefore would reduce risk to acceptable levels below ARARs. Current groundwater use restrictions would remain in place during remedial action implementation. Groundwater monitoring also would be required to evaluate the performance of the selected alternative. Vapor samples and air flow readings taken from the soil vapor monitoring probes and system exhaust sampling ports would be necessary to monitor the progress of cleanup, and to estimate the volume of hydrocarbons removed by the system. The soil treatment portion of each alternative would prevent further leaching of contaminants to groundwater. The VES could be expanded if additional contamination were discovered.

9.2.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternatives 3, 4, and 5 would include technologies that treat and reduce the toxicity and volume of soil and groundwater contaminants. Furthermore, the groundwater remediation portion of all the alternatives would prevent further migration of contaminated groundwater, while the soil remediation portion would prevent further leaching of contaminants into groundwater. All three alternatives would include technologies that have been used successfully in Alaska to clean up petroleum-contaminated sites. Soil vapor extraction, coupled with air sparging, is a technology that is being used to treat petroleum-contaminated soil and groundwater at other locations on Fort Wainwright. All the technologies are expected to reduce contamination to levels that do not pose risks to human health and the environment.

9.2.5 Short-Term Effectiveness

Alternatives 3, 4, and 5 would involve some short-term impacts associated with treatment system construction activities. A major advantage of the *in situ* soil VES would be the ability to install the system and conduct remediation with minimal disruption to the sites or surrounding environment. However, some construction impacts, such as dust emissions from operating heavy equipment and temporary disruption to daily operations or normal use near the Remedial Area 1b source areas, are expected to occur. The potential risks would be minimized by standard construction methods and engineering controls. Current groundwater use restriction would remain in place during the implementation of the remedial action. Alternatives 3 and 5 are expected to accomplish remediation goals in five to 10 years for soil and groundwater. Alternative 4 is expected to accomplish the groundwater remediation goals in 10 to 20 years, because pump-and-treat systems are limited by compound solubility and adsorption characteristics.

9.2.6 Implementability

Alternatives 3, 4, and 5 would be complex to implement, but all technologies are technically implementable. Construction methods and materials needed to implement all three alternatives are standard and available in Fairbanks. Alternative 3 is slightly less implementable than

Alternatives 4 and 5 because bioremediation technology would require some specialized materials and equipment, such as exogenous petroleum-degrading microorganisms and specialized bioreactor vessels not immediately available in the Fairbanks area. For treating the contaminated groundwater, Alternative 3 would require extensive hydrogeologic modeling and bioassessment screening studies. Alternative 4 would employ proven wastewater treatment technologies, such as air stripping and carbon adsorption. However, contaminant solubility in groundwater and soil adsorption coefficients may be the limiting factors, especially for removing contaminants in the smear zone. Alternatives 3 and 5 must be controlled properly to ensure that contaminants do not migrate from the site. Each alternative would require temperature-control devices for treatment to be effective because temperature remains an important variable for all three alternatives. The presence of permafrost would require that the selected technology system be placed in thaw channels because the treatment systems would be most effective in the thaw channels where the contaminants are most concentrated. Alternative 5 is the selected alternative because it has been implemented at Fort Wainwright with positive results. All three alternatives would require preliminary testing before full-scale construction to obtain site-specific design parameters; more time would be required for preliminary testing of Alternatives 3 and 5 because of their complexity.

9.2.7 Cost

Table 33 compares the costs of the alternatives considered for Remedial Area 1b. The cost for all three alternatives are comparable, and are based on present worth values with 10% discount rates. The estimated years to achieve Safe Drinking Water Act levels for each technology are based on contaminant levels detected during the RI, soil and groundwater physical data, and published treatment efficiency estimates for specific technologies. The estimated costs do not include those associated with preliminary testing of remedial technologies. For cost purposes, a 20-year monitoring program is assumed to achieve Alaska Water Quality Standards. Figure 19 shows the approximate location and number of wells used for cost estimation.

9.2.8 State Acceptance

ADEC has been involved with the development of remedial alternatives for OU-3 and concurs with the selected alternative for Remedial Area 1b.

9.2.9 Community Acceptance

On April 25, 1995, the Army conducted a public meeting to discuss the Proposed Plan for final remedial action at OU-3. Before the public meeting, a Proposed Plan summary fact sheet was sent to all known interested parties, totaling approximately 150. Proposed Plans were available by request. Results of the public meeting indicate that there is no opposition to any of the preferred alternatives. The written comment received during the public comment period supported the preferred alternatives for Remedial Areas 1a and 1b. One adjacent landowner expressed concern about the extent of the contamination at the Tank Farm.

Community responses to the remedial alternatives are presented in the Responsiveness Summary, which addresses comments received during the public comment period (see Appendix A).

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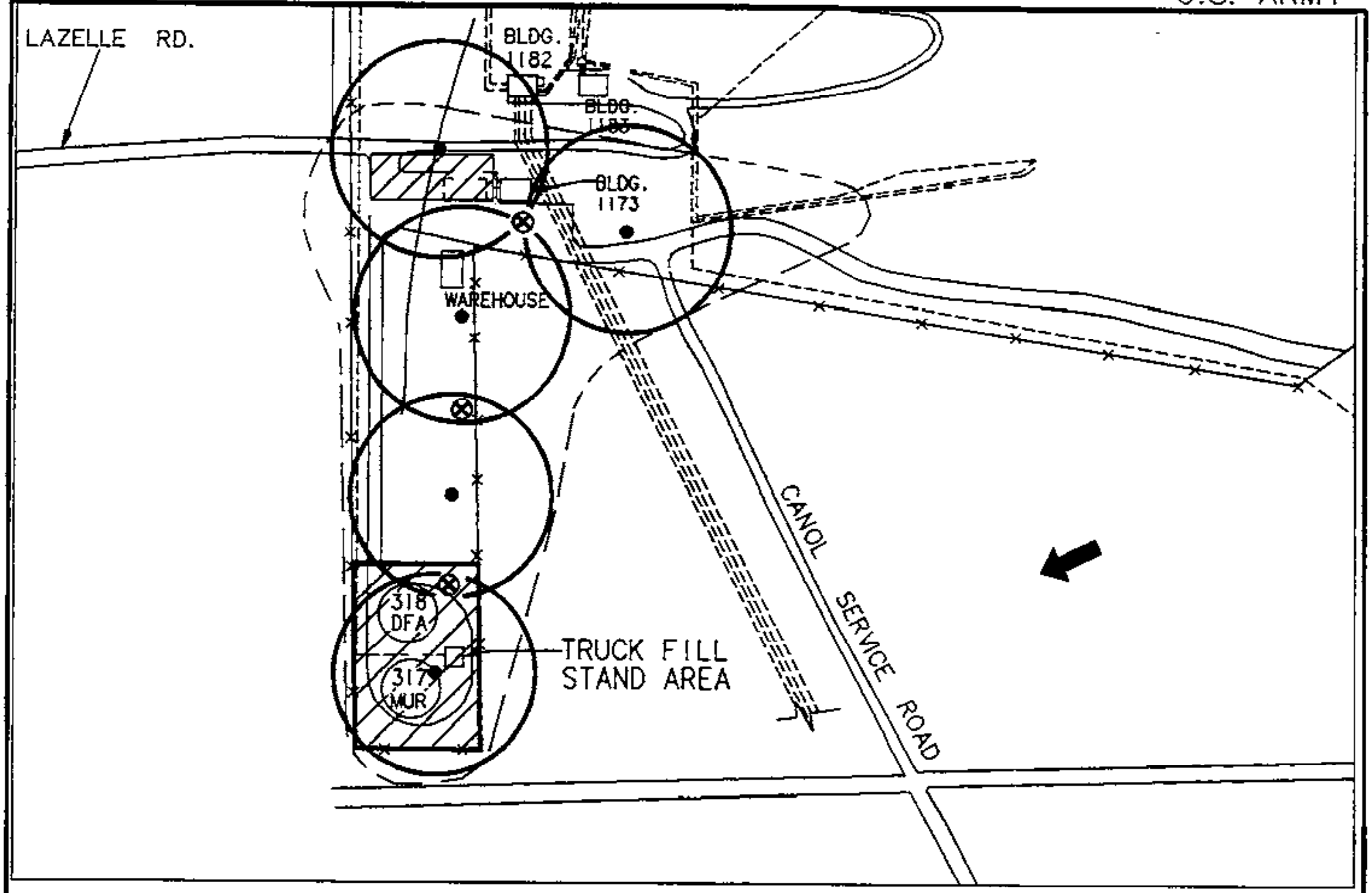
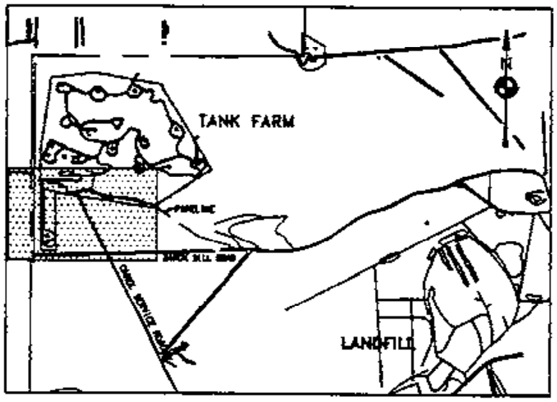
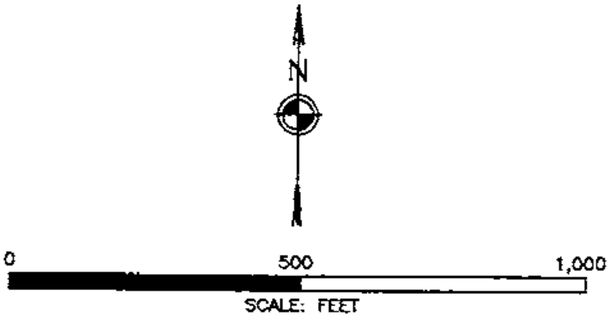




KEY PLAN



LEGEND

- - -	APPROXIMATE LIMITS OF GROUNDWATER CONTAMINATION
▨	APPROXIMATE LIMITS OF SOIL CONTAMINATION
⊙	EXTRACTION WELL AND ZONE OF INFLUENCE
⊗	INJECTION WELL LOCATION
↖	GROUNDWATER FLOW DIRECTION

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Figure 19
REMEDIAL AREA 1b
GROUNDWATER INJECTION AND EXTRACTION WELL PLACEMENT

TRUCK FILL STAND AND BUILDING 1173

FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
A	JY9040	JY94-7C.DWG	02-21-95	

Selected Alternative for Remedial Area 1b

The selected alternative for Remedial Area 1b is Alternative 5 (soil vapor extraction and air sparging of groundwater). The groundwater treatment technology will achieve the cleanup goals in a reasonable time frame at locations where MCLs have been exceeded in permafrost thaw channels. This alternative is also a more direct approach at treating the contaminants in the smear zone and saturated soil than the other alternatives. The soil treatment technology will achieve the primary goal of protecting groundwater for drinking water use. Furthermore, the effectiveness of the selected alternative has been proven at Fort Wainwright. In addition to the technologies chosen, long-term groundwater monitoring will be conducted to ensure that the treatment systems effectively reduce contamination and that off-site migration of contaminants does not occur. The monitoring will include periodical sampling of off-post wells, such as the church wells.

9.3 ALTERNATIVES FOR REMEDIAL AREA 2

Remedial Area 2 consists of petroleum-contaminated soil and groundwater at Valve Pit A and the ROLF. No permafrost is known to occur at this source area. Treatment will occur in known source areas and at a location where MCLs have been exceeded; this location is known as the "hot spot" option described in the Proposed Plan. The cost for each alternative is based on an estimated number of years to obtain remedial goals. A cost comparison is presented in Table 34. The following alternatives were considered for Remedial Area 2:

- Alternative 1: No action. Petroleum-contaminated soil and groundwater would remain in place. Passive remediation probably would occur with the natural degradation of the petroleum. No costs would be associated with this alternative;

- Alternative 2: Institutional controls. Petroleum-contaminated soil and groundwater would remain in place. Passive remediation probably would occur with the natural degradation of the petroleum. Institutional controls would include fences and signs, site maintenance, and semi-annual groundwater monitoring. Costs associated with the groundwater monitoring are based on a 20-year monitoring period;

- Alternative 3: Soil vapor extraction, bioventing, steam injection of petroleum-contaminated soils, and bioremediation of petroleum-contaminated groundwater. Soil vapor extraction would remove petroleum hydrocarbon vapors from petroleum-contaminated soil. Bioventing would be utilized to stimulate aerobic degradation of contaminants. Steam injection would increase the efficiency of the other technologies by raising ground temperatures. Bioremediation would be employed to enhance natural degradation processes in the petroleum-contaminated groundwater. Long-term groundwater monitoring also would be part of this alternative and is considered in the cost estimate. The cost was based on a 20-year monitoring period;

Table 34

REMEDIAL AREA 2—COST COMPARISON TABLE
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Alternative	Capital Cost ($)	Operations and Maintenance[a] ($)	Estimated Years to Achieve Remedial Goals
1: No Action	0	0	_[b]
2: Institutional Controls	0	300,000	20
3: Soil Vapor Extraction, Bioventing, Steam Injection of Soil; Bioremediation of Groundwater "Hot Spot" Treatment	1,400,000	300,000	5
4: Soil Vapor Extraction, Bioventing, Steam Injection of Soil; Air Stripping/Carbon Absorption of Groundwater "Hot Spot" Treatment	1,500,000	1,000,000	10
5: Soil Vapor Extraction of Soil; Air Sparging of Groundwater "Hot Spot" Treatment	900,000	100,000	5

[a] Operations and Maintenance cost includes the estimated costs for 20 years of groundwater monitoring.

[b] The No Action alternative is not expected to achieve remedial goals.

- Alternative 4: Soil vapor extraction, bioventing, steam injection of petroleum-contaminated soil, and extraction followed by air stripping and carbon adsorption of petroleum-contaminated groundwater. As in Alternative 3, soil vapor extraction, bioventing, and steam injection would be utilized to remove petroleum hydrocarbons from contaminated soil. Air stripping and carbon adsorption would be used to pump contaminated groundwater to the surface and strip it of petroleum contaminants with air and filters. Long-term groundwater monitoring for 20 years also would be part of this alternative and is considered in the cost estimate. The cost was based on a 20-year monitoring period; and

- Alternative 5: Soil vapor extraction of petroleum-contaminated soils and air sparging of petroleum-contaminated groundwater. Soil vapor extraction would be used to remove petroleum hydrocarbons from petroleum-contaminated soil in this alternative. Air sparging would be used to force evaporation of contaminants and capture the resulting vapors with a vapor-extraction process. Long-term groundwater monitoring also would be part of this alternative and is considered in the cost estimate. The cost would be based on a 20-year monitoring period.

9.4 EVALUATION OF ALTERNATIVES FOR REMEDIAL AREA 2

The following sections summarize the evaluation of each alternative in reference to EPA's nine evaluation criteria.

9.4.1 Overall Protection of Human Health and the Environment

No action, Alternative 1, would not protect human health or the environment because contamination at Remedial Area 2 would remain in place. Institutional controls, Alternative 2, would provide a mechanism for protecting human health by limiting access to contaminated soil and groundwater. No additional protection to environmental receptors, such as fish in the Chena River or other forms of wildlife, would be ensured by the implementation of institutional controls alone.

Alternatives 3, 4, and 5 would protect human health and the environment by reducing risk associated with contaminated groundwater and soil through implementation of active treatment technologies. These alternatives also would eliminate further leaching of contaminants from soil to groundwater and would reduce the potential for further migration of contaminated groundwater.

9.4.2 Compliance with Applicable or Relevant and Appropriate Requirements

No action and institutional controls, Alternatives 1 and 2, would not achieve ARARs because contamination at Remedial Area 2 would remain in place; therefore, these two alternatives will not be discussed further.

The groundwater remediation portion of Alternatives 3, 4, and 5 would achieve chemical-specific ARARs, such as federal Safe Drinking Water Act standards, within a reasonable time frame. The soil remediation portion of Alternatives 3, 4, and 5 would achieve chemical-specific ARARs, such as Alaska petroleum-contaminated soil regulations (18 AAC 78), to protect groundwater for drinking water use. All the alternatives would be implemented in compliance with action-specific ARARs, such as the federal Clean Air Act.

9.4.3 Long-Term Effectiveness and Permanence

The groundwater treatment portion of Alternatives 3, 4, and 5 would involve active irreversible reduction of contaminant concentrations and therefore would reduce risk to acceptable levels below ARARs. Current groundwater use restrictions would remain in place during remedial action implementation. Groundwater monitoring also would be required to evaluate the performance of the selected alternative. Vapor samples and air flow readings taken from the soil vapor monitoring probes and system exhaust sampling ports would be necessary to monitor the progress of cleanup, and to estimate the volume of hydrocarbons removed by the system. The soil treatment portion of each alternative would prevent further leaching of contaminants to groundwater. The VES could be expanded if additional contamination were discovered.

9.4.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternatives 3, 4, and 5 would include technologies that treat and reduce the toxicity and volume of soil and groundwater contaminants. Furthermore, the groundwater remediation portion of all the alternatives would prevent further migration of contaminated groundwater, while the soil remediation portion would prevent further leaching of contaminants into groundwater. All three alternatives would include technologies that have been used successfully in Alaska to clean up petroleum-contaminated sites. Soil vapor extraction, coupled with air sparging, is a technology that is being used to treat petroleum-contaminated soil and groundwater at other locations on Fort Wainwright. All the technologies are expected to reduce contamination to levels that do not pose risks to human health and the environment.

9.4.5 Short-Term Effectiveness

Alternatives 3, 4, and 5 would involve some short-term impacts associated with treatment system construction activities. A major advantage of *in situ* soil VES would be the ability to install the system and conduct remediation with minimal disruption to the sites or surrounding environment. However, some construction impacts, such as dust emissions from operating heavy equipment and temporary disruption to daily operations or normal use near the Remedial Area 2 source areas, are expected to occur. The potential risks would be minimized by standard construction methods and engineering controls. Current groundwater use restrictions would remain in place during the implementation of the remedial action. Alternatives 3 and 5 are expected to accomplish remediation goals in five to 10 years for soil and groundwater. Alternative 4 is expected to accomplish the groundwater remediation goals in 10 to 20 years, because pump-and-treat systems are limited by compound solubility and adsorption characteristics.

9.4.6 Implementability

Alternatives 3, 4, and 5 would be complex to implement, but all technologies are technically implementable. Construction methods and materials needed to implement all three alternatives are standard and available in Fairbanks. Alternative 3 is slightly less implementable than Alternatives 4 and 5 because bioremediation technology would require some specialized materials and equipment not immediately available in the Fairbanks area. For treating the contaminated groundwater, Alternative 3 would require extensive hydrogeologic modeling and bioassessment screening studies. Alternative 4 would employ proven wastewater treatment technologies, such as air stripping and carbon adsorption. However, contaminant solubility in groundwater and soil adsorption coefficients may be the limiting factors, especially for removing contaminants in the smear zone. Alternatives 3 and 5 must be controlled properly to ensure that contaminants do not migrate from the site. Each alternative would require temperature-control devices for treatment to be effective because temperature remains an important variable for all three alternatives. Alternative 5 is the selected alternative because it has been implemented at Fort Wainwright with positive results. All three alternatives would require preliminary testing before full-scale construction to obtain site-specific design parameters; more time would be required for preliminary testing of Alternatives 3 and 5 because of their complexity.

9.4.7 Cost

Table 34 compares the costs of the alternatives considered for Remedial Area 2. The cost for Alternative 5 is approximately $500,000 to $700,000 less than that for Alternatives 3 and 4. All the cost information is based on present worth values with 10% discount rates. The estimated years to achieve Safe Drinking Water Act levels for each technology are based on contaminant levels detected during the RI, soil and groundwater physical data, and published treatment efficiency estimates for specific technologies. The estimated costs do not include those associated with preliminary testing of remedial technologies. Figures 20 and 21 show the approximate location and number of wells used for cost estimation. For cost purposes, a 20-year monitoring program is assumed to achieve Alaska Water Quality Standards. Table 34 compares the costs of the alternatives and options considered for Remedial Area 2.

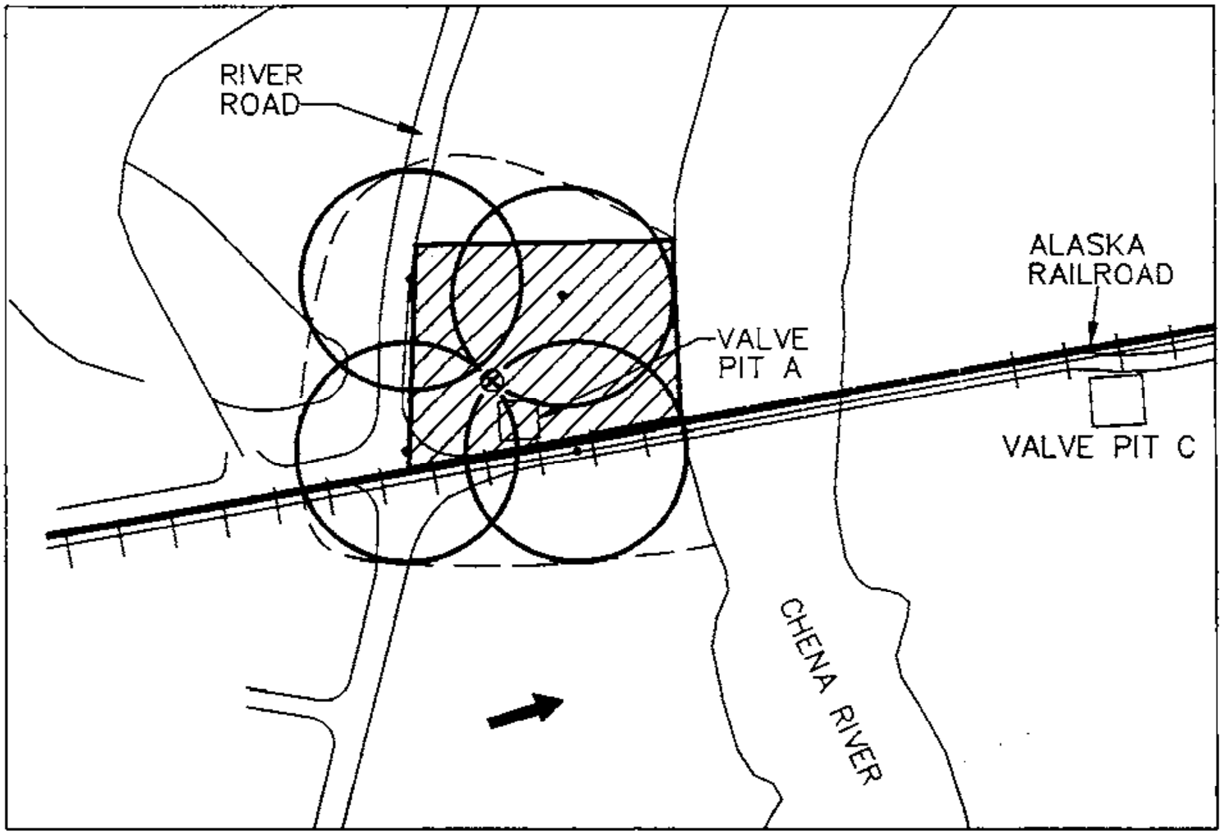
9.4.8 State Acceptance

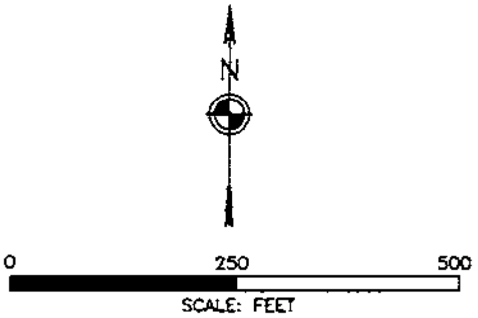
ADEC has been involved with the development of remedial alternatives for OU-3 and concurs with the selected alternative for Remedial Area 2.

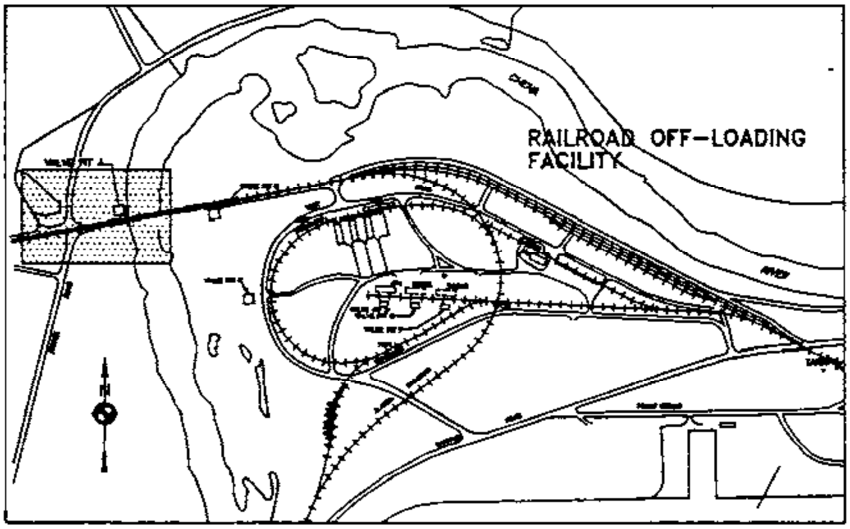
9.4.9 Community Acceptance

On April 25, 1995, the Army conducted a public meeting to discuss the Proposed Plan for final remedial action at OU-3. Before the public meeting, a Proposed Plan summary fact sheet was sent to all known interested parties, totaling approximately 150. Proposed Plans were available by request. Results of the public meeting indicate that there is no opposition to any of the preferred alternatives.

Community responses to the remedial alternatives are presented in the Responsiveness Summary, which addresses comments received during the public comment period (see Appendix A).







KEY PLAN

LEGEND

╌ ╌	APPROXIMATE LIMITS OF GROUNDWATER CONTAMINATION
▨	APPROXIMATE LIMITS OF SOIL CONTAMINATION
⊙	EXTRACTION WELL AND ZONE OF INFLUENCE
⊗	INJECTION WELL LOCATION
➡	GROUNDWATER FLOW DIRECTION

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Figure 20

REMEDIAL AREA 2 GROUNDWATER INJECTION AND EXTRACTION WELL PLACEMENT

TANK FARM SOURCE AREA – VALVE PIT A

FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
A	JY9040	JY94-2A2.DWG	11-08-94	

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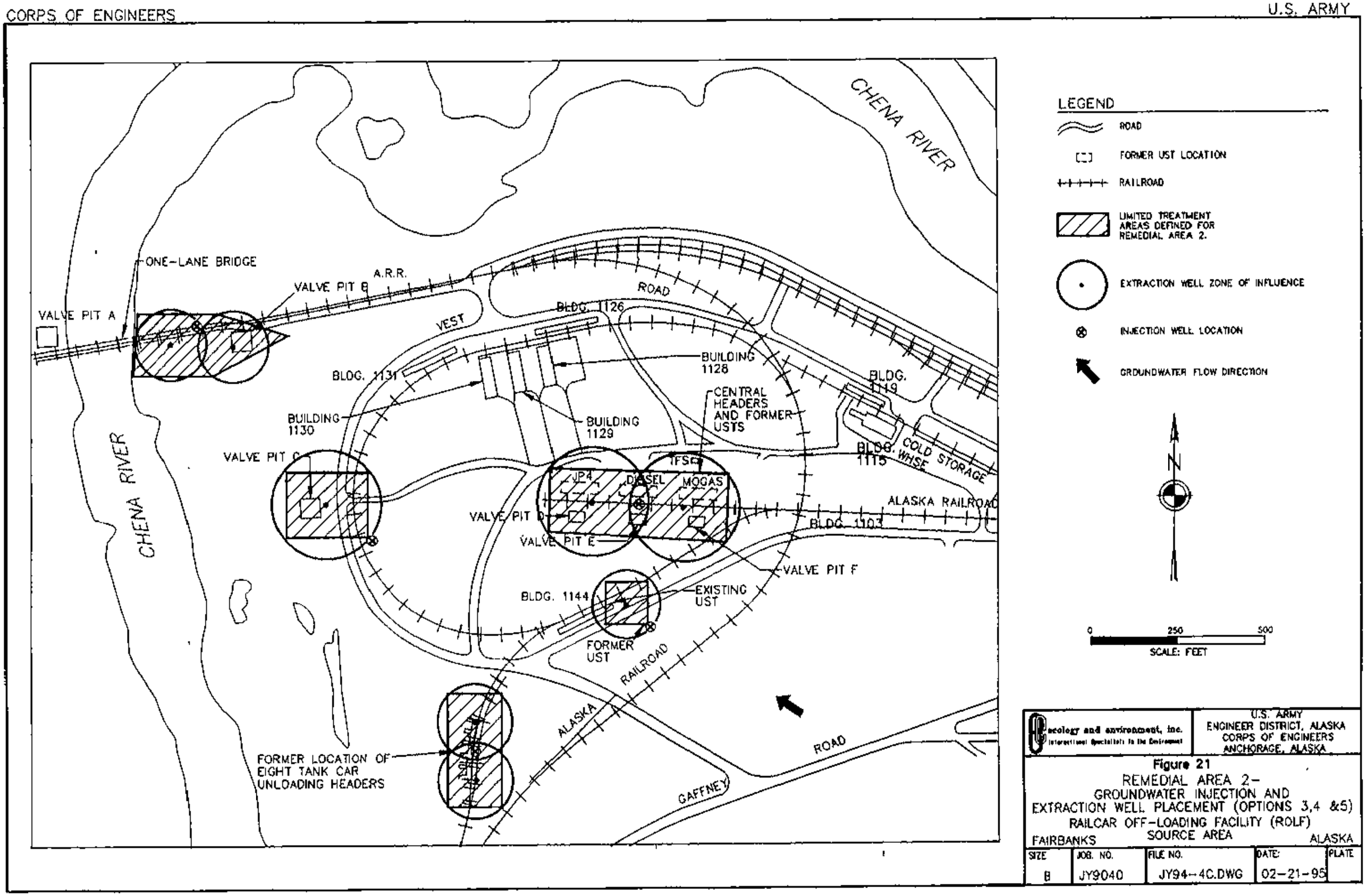

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Figure 21
REMEDIAL AREA 2–
GROUNDWATER INJECTION AND
EXTRACTION WELL PLACEMENT (OPTIONS 3,4 &5)
RAILCAR OFF-LOADING FACILITY (ROLF)
SOURCE AREA

FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
B	JY9040	JY94–4C.DWG	02–21–95	

Table 35

REMEDIAL AREA 3—COST COMPARISON TABLE
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Alternative	Capital Cost ($)	Operations and Maintenance[a] ($)	Estimated Years to Obtain Remedial Goals
1: No Action	0	0	—[b]
2: Institutional Controls	0	200,000	20
3: Soil Pile Aeration; Bioremediation of Groundwater	640,000	30,000	5
4: Soil Pile Aeration; Air Stripping/Carbon Absorption of Groundwater	610,000	60,000	10
5: Soil Vapor Extraction of Soil; Air Sparging of Groundwater	480,000	80,000	5

[a] Operations and Maintenance cost includes the estimated costs for 20 years of groundwater monitoring.

[b] The No Action alternative is not expected to achieve remedial goals.

Selected Alternative for Remedial Area 2

The selected alternative for Remedial Area 2 is Alternative 5 (soil vapor extraction and air sparging of groundwater). The groundwater treatment technology will achieve the cleanup goals in a reasonable time frame at locations where MCLs have been exceeded. This alternative also is a more direct approach at treating the contaminants in the smear zone than the other alternatives. The soil treatment technology will achieve the primary goal of protecting the groundwater for drinking water use. The treatment effectiveness of Alternative 5 has been proven in similar situations at Fort Wainwright. In addition to the technologies chosen, long-term groundwater monitoring will be conducted to ensure that the treatment systems effectively reduce contamination and that discharges of contamination to the Chena River do not occur.

9.5 ALTERNATIVES FOR REMEDIAL AREA 3

Remedial Area 3 consists of petroleum-contaminated soil and groundwater at Mileposts 2.7, 3.0, and 15.75 along the Fairbanks-Eielson Pipeline. The presence of localized areas of permafrost is a limiting factor for evaluation and placement of remedial alternatives for Mileposts 2.7 and 3.0. For all three milepost source areas, the selected alternative is expected to be placed in areas with known sources of contamination and at locations where MCLs have been exceeded. The cost for each alternative is based on an estimated number of years to obtain remedial goals. A cost comparison is presented in Table 35. The following alternatives were considered for Remedial Area 3:

- Alternative 1: No action. Petroleum-contaminated soil and groundwater would remain in place. Passive remediation of petroleum contamination likely would occur by natural processes. No costs would be associated with this alternative;

- Alternative 2: Institutional controls. Petroleum-contaminated soil and groundwater would remain in place. Passive remediation of petroleum contamination likely would occur by natural processes. Institutional controls would include semi-annual groundwater sampling and site inspections every five years. Long-term groundwater monitoring also would be part of this alternative and is considered in the cost estimate. The cost is based on a 20-year monitoring period;

- Alternative 3: Soil pile aeration and bioremediation of groundwater. Soil pile aeration would involve excavation of contaminated soil and vapor extraction with perforated pipes. Bioremediation would involve injection of oxygen and nutrients directly into the aquifer to enhance natural degradation processes. Long-term groundwater monitoring also would be part of this alternative and is considered in the cost estimate. The cost was based on a 20-year monitoring period;

- Alternative 4: Soil pile aeration and groundwater extraction followed by air stripping and carbon adsorption. Soil pile aeration would be conducted similar to the description in Alternative 3. Air stripping and carbon adsorption of petroleum-contaminated groundwater would involve pumping contaminated groundwater to the surface, introducing air to evaporate the petroleum contaminants, and passing the water through carbon filters. Long-term groundwater monitoring also would be part of this alternative and is considered in the cost estimate. The cost was based on a 20-year monitoring period; and

- Alternative 5: Soil vapor extraction of petroleum-contaminated soils and air sparging of petroleum-contaminated groundwater. Only soil vapor extraction would be used to remove petroleum hydrocarbons from petroleum-contaminated soil in this alternative. Air sparging would be used to force evaporation of contaminants and capture the resulting vapors with a vapor extraction process. Long-term groundwater monitoring also would be part of this alternative and is considered in the cost estimate. The cost was based on a 20-year monitoring period.

9.6 EVALUATION OF ALTERNATIVES FOR REMEDIAL AREA 3

The following sections summarize the evaluation of each alternative in reference to EPA's nine evaluation criteria.

9.6.1 Overall Protection of Human Health and the Environment

No-action and institutional controls, Alternatives 1 and 2, would not protect human health and the environment because contamination at Remedial Area 3 would remain in place. The institutional controls alternative would not protect the environment because it would not prevent further migration of petroleum contaminants into the nearby wetland.

Alternatives 3, 4, and 5 would protect human health and the environment by reducing risk associated with contaminated groundwater and soil through implementation of active treatment technologies. These alternatives also would eliminate further leaching of contaminants from soil to groundwater and reduce the potential for further migration of contaminated groundwater.

9.6.2 Compliance with Applicable or Relevant and Appropriate Requirements

No action and institutional controls, Alternatives 1 and 2, would not achieve applicable cleanup standards for soil and groundwater until natural degradation of the contaminants occurs; therefore, the two alternatives will not be discussed further.

The groundwater remediation portion of Alternatives 3, 4, and 5 would achieve chemical-specific ARARs, such as federal Safe Drinking Water Act standards, within a reasonable time frame. The soil remediation portion of Alternatives 3, 4, and 5 would achieve chemical-specific ARARs, such as Alaska petroleum-contaminated soil regulations (18 AAC 78), to protect groundwater for drinking water use. All the alternatives would be implemented in compliance with action-specific ARARs, such as the federal Clean Air Act.

9.6.3 Long-Term Effectiveness and Permanence

The groundwater treatment portion of Alternatives 3, 4, and 5 would involve active irreversible reduction of contaminant concentrations and therefore would reduce risk to acceptable levels below chemical-specific ARARs. Current groundwater use restrictions would remain in place during remedial action implementation. Groundwater monitoring also would be required to evaluate the performance of the selected alternative. Vapor samples and air flow readings taken from the soil vapor monitoring probes and system exhaust sampling ports would be necessary to monitor the progress of cleanup, and to estimate the volume of hydrocarbons removed by the system. The soil treatment portion of each alternative would prevent further leaching of contaminants to groundwater.

9.6.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternatives 3, 4, and 5 would include technologies that treat and reduce the toxicity and volume of soil and groundwater contaminants. Furthermore, the groundwater remediation portion of all the alternatives would prevent further migration of contaminated groundwater, while the soil remediation portion would prevent further leaching of contaminants into groundwater. Soil vapor extraction, coupled with air sparging, is a technology that is being used to treat petroleum-contaminated soil and groundwater at other locations on Fort Wainwright. All the technologies are expected to reduce contamination to levels that do not pose risks to human health and the environment.

9.6.5 Short-Term Effectiveness

Alternatives 3 and 4 would involve excavation, removal, and treatment of soil. These alternatives would involve relatively rapid removal of soil contaminants from Remedial Area 3. Alternatives 3 and 4 would involve more severe short-term impacts associated with excavation. All three alternatives would result in short-term impacts, such as dust emissions from heavy operation equipment and temporary disruption to daily operations or normal use of the Remedial Area 3 areas. The impacts would be managed with engineering controls and standard construction methods. Alternatives 3 and 5 are expected to accomplish remediation goals in five to 10 years for soil and groundwater. Alternative 4 is expected to reach the groundwater remediation goals in 10 to 20 years.

9.6.6 Implementability

For treating the contaminated groundwater, Alternative 3 would require extensive hydrogeologic modeling and bioassessment screening studies. Alternative 4 would employ proven wastewater treatment technologies, such as air stripping and carbon adsorption. However, contaminant solubility in groundwater and soil adsorption coefficients may be the limiting factors, especially for removing contaminants in the smear zone. Alternatives 3 and 5 must be controlled properly to ensure that contaminants do not migrate from the site. Each alternative would require temperature-control devices for treatment to be effective because temperature remains an important variable for all three alternatives. Because of the presence of permafrost, the selected technology system will be placed in thaw channels because the treatment systems would be most effective in the thaw channels where the contaminants are most concentrated. Alternative 5 is the preferred alternative because it has been implemented at Fort Wainwright with positive results. Alternatives 3, 4, and 5 would require preliminary testing before full-scale construction.

9.6.7 Cost

Table 35 compares the costs of the alternatives considered for Remedial Area 3. The cost for Alternative 5 is approximately $100,000 less than that for Alternatives 3 and 4. All cost information is based on present worth values with 10% discount rates. The estimated years to achieve Safe Drinking Water Act levels for each technology are based on contaminant levels detected during the RI, soil and groundwater physical data, and efficiency estimates for specific technologies. The estimated costs include those associated with pilot testing of *in situ* remedial technologies. For cost purposes, a 20-year monitoring program is assumed to achieve Alaska Water Quality Standards, as presented in Table 35. Figures 22 and 23 show the approximate location and number of wells used for cost estimation.

9.6.8 State Acceptance

ADEC has been involved with the development of remedial alternatives for OU-3 and concurs with the selected alternative for Remedial Area 3.

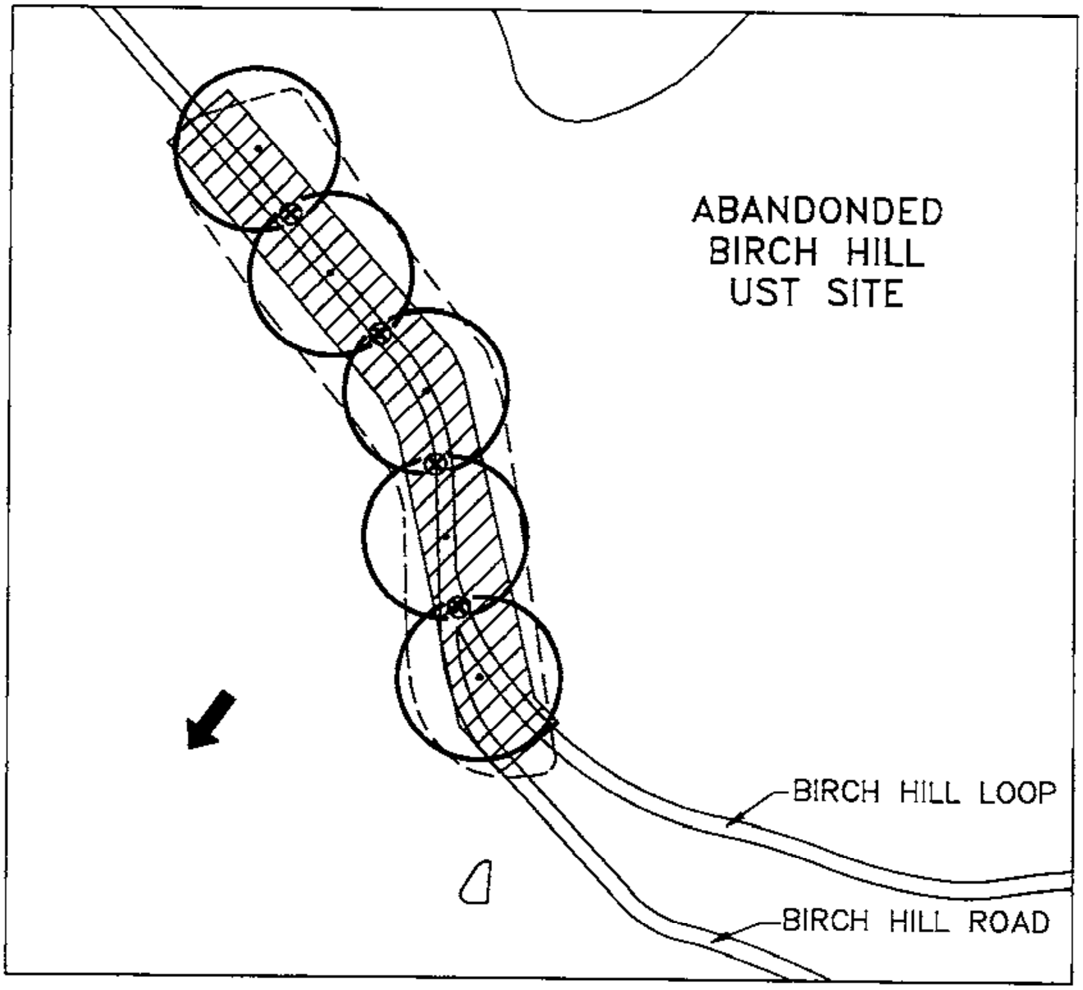
9.6.9 Community Acceptance

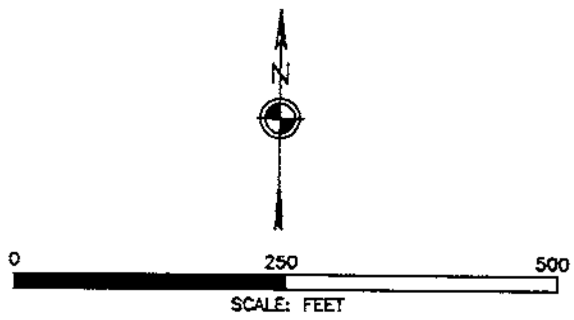
On April 25, 1995, the Army conducted a public meeting to discuss the Proposed Plan for final remedial action at OU-3. Before the public meeting, a Proposed Plan summary fact sheet was sent to all known interested parties, totaling approximately 150. Proposed Plans were available by request. Results of the public meeting indicate that there is no opposition to any of the preferred alternatives.

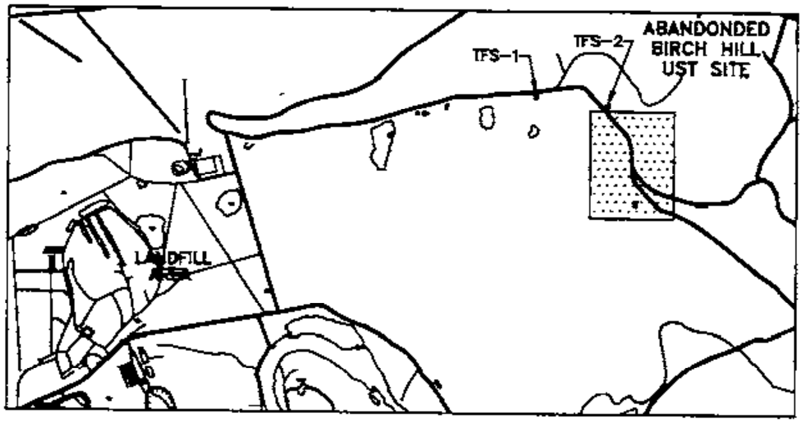
Community responses to the remedial alternatives are presented in the Responsiveness Summary, which addresses comments received during the public comment period (see Appendix A).

Selected Alternative for Remedial Area 3

The selected alternative for Mileposts 2.7, 3.0, and 15.75 in Remedial Area 3 is Alternative 5 (soil vapor extraction and air sparging of groundwater). This alternative was chosen because its effectiveness with similar petroleum contamination has been proven at Fort Wainwright. The groundwater treatment technology will achieve the cleanup goals in a reasonable time frame at locations where MCLs have been exceeded and in the thaw channels where present. This alternative is also a more direct approach at treating the contaminants in the smear zone than the other alternatives. The soil treatment technology will achieve the primary goal of protecting groundwater for drinking water use. In addition to the technologies included in Alternative 5, long-term groundwater monitoring will be conducted at Mileposts 2.7, 3.0, and 15.75 to ensure that the treatment systems reduce contamination in nearby wetlands.







KEY PLAN

LEGEND

- - - APPROXIMATE LIMITS OF GROUNDWATER CONTAMINATION

▨ APPROXIMATE LIMITS OF SOIL CONTAMINATION

○ EXTRACTION WELL AND ZONE OF INFLUENCE

⊗ INJECTION WELL LOCATION

↖ GROUNDWATER FLOW DIRECTION

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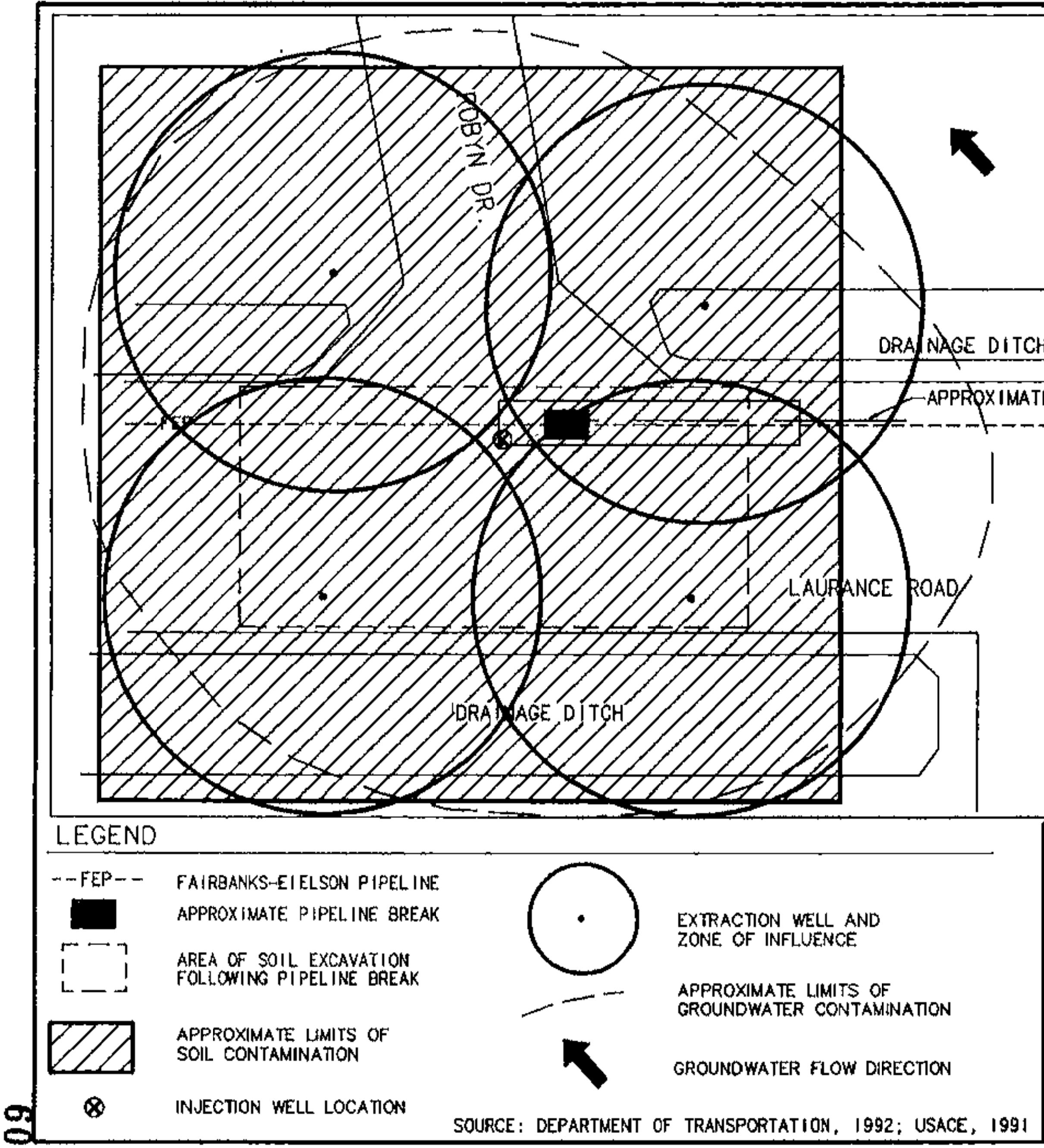
Figure 22

REMEDIAL AREA 3–
GROUNDWATER INJECTION AND
EXTRACTION WELL PLACEMENT
PIPELINE MILEPOST 2.7 & 3.0 SOURCE AREAS
FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
A	JT2101	JY24-5A.DWG	04-04-95	

CORPS OF ENGINEERS U.S. ARMY



SOURCE: DEPARTMENT OF TRANSPORTATION, 1992; USACE, 1991

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International Specialists in the Environment

U.S. ARMY
ENGINEER DISTRICT, ALASKA
CORPS OF ENGINEERS
ANCHORAGE, ALASKA

Figure 23
REMEDIAL AREA 3–
GROUNDWATER INJECTION AND
EXTRACTION WELL PLACEMENT
PIPELINE MILEPOST 15.75
FAIRBANKS ALASKA

SIZE	JOB. NO.	FILE NO.	DATE:	PLATE
A	JY9040	JY94–6A2.DWG	11–08–94	

10.0 SELECTED REMEDIES

Selected remedies were chosen to actively treat contaminated groundwater to meet Safe Drinking Water Act levels and naturally attenuate to meet Alaska Water Quality Standards within a reasonable time frame, and to reduce further migration. These remedies also will prevent further contamination of groundwater and restore it to drinking water quality standards. The selected remedies are:

- Remedial Area 1b: Soil vapor extraction of petroleum-contaminated soil and air sparging of petroleum-contaminated groundwater in permafrost-free areas to achieve Safe Drinking Water Act levels and natural attenuation to meet Alaska Water Quality Standards;

- Remedial Area 2: Soil vapor extraction of petroleum-contaminated soil and air sparging of petroleum-contaminated groundwater at known contaminant sources and at locations where MCLs are exceeded (i.e., "hot spots") to achieve Safe Drinking Water Act levels and natural attenuation to meet Alaska Water Quality Standards; and

- Remedial Area 3: Soil vapor extraction of petroleum-contaminated soils and air sparging 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 Safe Drinking Water Act levels and natural attenuation to meet Alaska Water Quality Standards.

These remedies meet the two threshold criteria because they protect human health and the environment by permanently reducing the risk to an acceptable level for ingestion of groundwater and comply with ARARs. These remedies also best meet the five balancing CERCLA evaluation criteria. They are effective at providing protection in reducing contamination in the short- and long-term, are implementable, cost-effective, and acceptable to the public and the State of Alaska.

Based on the assumption that land use is not anticipated to change in the foreseeable future, the reasonable time frame for remediation at each source area is set for no more than 30 years. Following is a more detailed description of the selected remedies for each remedial area.

Subsurface soils and groundwater contaminated with petroleum fuels at Remedial Areas 1b, 2, and 3 will be treated using a combination of two *in situ* technologies: vapor extraction for soil contamination and air sparging for groundwater contamination. A combination of these two technologies was selected because they are the most cost-effective and implementable technologies available to remediate petroleum-contaminated groundwater and soil at OU-3. Furthermore, it is also the combination of technologies that has been proven effective at Fort Wainwright.

Based on previous experience with the soil VES, approximately 60% to 80% of the total gasoline-range hydrocarbons in soil may be volatilized and the remaining 20% to 40% biodegraded. A removal of more than 80% by volatilization is expected to occur with VOCs like benzene. It is expected that vapor concentration and mass removal will decrease with time as the VOCs are removed. However, soil VESs are effective in promoting biodegradation of the less-volatile compounds. The air sparging system for groundwater employs the same concept as the VES for soil. That is, the air sparging system will remove VOCs via volatilization and will remove the less-volatile compounds by promoting biodegradation in the saturated zone.

Soil conditions at Remedial Areas 1b, 2, and 3 are expected to be conducive to VES treatment based on grain size and soil moisture data generated during the RI. Site-specific design information will be collected in the pilot study.

The goal of the selected remedy is to restore groundwater to Safe Drinking Water Act levels. Based on the information obtained in the RI and on a careful analysis of all remedial alternatives, it is believed that the selected remedy will achieve this goal within a reasonable time frame. It may become apparent, during implementation or operation of the groundwater treatment system and its modifications, that contaminant levels cease to decline and are remaining constant at levels higher than the remediation goal. In such a case, the system performance standards and/or the remedy may be re-evaluated.

The selected remedy of soil VES, coupled with air sparging of groundwater, will be placed at known contaminant source areas and at locations where Safe Drinking Water Act levels are exceeded. For Remedial Areas 1b and 3 where localized areas of permafrost exist, air sparging, and vapor extraction wells will be installed in the permafrost-free areas or thaw channels.

The selected remedy, air sparging and soil VES, is expected to meet the groundwater remediation goals, as established in Sections 7.2 and 7.3, in five to 10 years. The soil VES is estimated to achieve protection of groundwater for drinking water use in approximately five years. After active remediation goals are achieved, additional remediation is expected to occur in groundwater through natural attenuation. It is anticipated that natural attenuation will achieve Alaska Water Quality Standards. Soil cleanup levels will be protective of groundwater as defined in Section 7.0. During the implementation period, the treatment system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modification may include installation of additional treatment units.

Long-term groundwater monitoring is a component of the selected remedy for each of Remedial Areas 1b, 2, and 3. Estimated costs for the selected remedies (see Tables 33, 34, and 35) include groundwater monitoring costs over a 20-year period at monitoring wells presently in place at these remedial areas. Periodic off-post sampling is also part of the remedial action, and additional sampling will be determined on an as-needed basis. For example, the Army will collect groundwater samples from domestic wells located at the two churches west of the Tank Farm on a regular basis while remedial activities at OU-3 are conducted. The Army is currently providing bottled water to the two churches because of exceedances of MCLs. The source of the contamination has not been clearly determined. If contaminant levels increase above MCLs in these wells, and if contamination of the church wells is clearly demonstrated to originate from the Tank Farm, the Army agrees to provide a permanent replacement water supply to the two churches.

In addition to sampling for the petroleum and VOCs for the long-term groundwater monitoring program, lead in groundwater will also be sampled. Groundwater samples collected during the RI showed that dissolved lead concentrations were lower than the MCL of 15 μg/L at all the source areas except for one sample at the ROLF. Total lead concentrations exceeded the lead MCL at all the source areas. Because of the significant difference between dissolved and total lead concentrations, and because total lead samples were visibly turbid during sampling, long-term monitoring of lead in groundwater will employ methods that will reduce or eliminate sample turbidity so that the sampling data will confirm the actual degree of lead that is present in groundwater.

11.0 STATUTORY DETERMINATIONS

The selected remedies satisfy the requirements under Section 121 of CERCLA, as amended by SARA, and to the extent practicable, the NCP. The evaluation criteria, as discussed in this section, are to:

- Protect human health and the environment;
- Attain ARARs of federal and state environmental laws and comply with ARARs;
- Be cost-effective; and
- Utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

11.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedies protect human health and the environment through the removal of the principal sources of groundwater contamination. BTEX and VOC contamination in the groundwater will be reduced to acceptable levels by actively remediating groundwater and soils, which currently act as a continuing source of contamination to the groundwater. Treatment of groundwater will reduce the risk to acceptable levels for human ingestion, reduce the possibility of off-site migration of contaminants, and prevent the potential future exposure to contaminated groundwater.

Before and during the cleanup, institutional controls will be in place to eliminate the threat of exposure to contaminated groundwater.

No unacceptable short-term risks will be caused by implementation of the remedy.

Current points of exposure include on-site workers, burrowing animals, and recreational users' inhalation of carcinogenic vapors in soil. Treatment will reduce the extent of contamination to levels acceptable under federal and state guidelines.

11.2 ATTAINMENT OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS OF ENVIRONMENTAL LAWS

The selected remedies will comply with action-, chemical-, and location-specific ARARs of federal and state environmental and public health laws. The ARARs are listed in the following sections.

11.2.1 Action-Specific Applicable or Relevant and Appropriate Requirements

Remedial treatment activities will meet the action-specific ARAR of 42 United States Code (USC) 7411 Clean Air Act, *Standards of Performance for New Stationary Sources*. This ARAR is applicable for air discharge limits on the soil vapor extraction and air sparging units.

11.2.2 Chemical-Specific Applicable or Relevant and Appropriate Requirements

Remedial treatment activities will meet the following chemical-specific ARARs:

- 40 Code of Federal Regulations 141, *National Primary Drinking Water Standards* regulations, and 18 AAC 80, *State of Alaska Drinking Water Regulations*. These regulations are relevant and appropriate for cleanup of groundwater that may be used for a drinking water supply. MCL, nonzero MCLG, and action levels are established under the Safe Drinking Water Act for groundwater;

- 18 AAC 70, *Alaska Water Quality Standards* for protection of Class 1(A) water supply for groundwater, are applicable. This ARAR will be met through natural attenuation after active remediation achieves MCLs;

- 18 AAC 75, *Alaska Oil and Hazardous Substance Pollution Control* regulations, are applicable. Under these regulations, responsible parties are required to clean up oil or hazardous material releases. The Army anticipates achieving a cleanup level consistent with this regulation; and

- 18 AAC 78, *Alaska Underground Storage Tanks* regulations, are relevant and appropriate. Contaminated surface water or groundwater will have sufficient reduction of all contaminants of concern, if the applicable water quality criteria of 18 AAC 70 are met. The Army intends to meet this requirement through active treatment of soil and groundwater until MCLs and nonzero MCLG are achieved. Natural attenuation will be relied upon until Alaska Water Quality Standards are met.

Additionally, petroleum-contaminated soils that are removed from the source area will be treated to State of Alaska Matrix Level A concentrations before being reused as fill materials for the source area. Actual soil cleanup levels are anticipated to be determined during post-ROD activities and will be based on protecting groundwater in accordance with drinking water standards.

11.2.3 Location-Specific Applicable or Relevant and Appropriate Requirements

Remedial treatment activities will meet the following location-specific ARARs:

- 404 (33 USC 1344) Clean Water Act, Permits for Dredged or Fill Materials, is applicable to protect the wetlands adjacent to the Tank Farm and pipeline areas from fill or dredging operations; and

- Executive Order 11990, Protection of Wetlands, is applicable to prevent damage to the wetlands adjacent to the Tank Farm and pipeline areas from remediation activities.

11.2.4 Information To-Be-Considered

The following information to-be-considered will be used as guidelines when implementing the selected remedy:

- State of Alaska *Interim Guidance for Non-UST Contaminated Soil Cleanup Levels* (July 17, 1991);
- State of Alaska *Guidance for Storage, Remediation, and Disposal of Non-UST Petroleum Contaminated Soils* (July 29, 1991); and
- State of Alaska *Interim Guidance for Surface and Groundwater Cleanup Levels* (September 26, 1990).

11.3 COST EFFECTIVENESS

The selected remedies represent the most cost-effective of the alternatives in comparison to their overall effectiveness proportional to their costs.

11.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The Army, State of Alaska, and EPA determined that the selected remedies represent the maximum extent to which permanent solutions and treatment technologies can be used cost-effectively at OU-3. Of those alternatives that are protective to human health and the environment and comply with ARARs, the Army, State of Alaska, and EPA have determined that the selected remedies provide the best balance of trade-offs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; short-term effectiveness; implementability; cost; and the statutory preference for treatment as a principal element and considering state and community acceptance.

All selected remedies would use readily available technologies and would be feasible to construct.

Installation of soil vapor extraction and air sparging remedial systems will be focused in the areas of highest soil contamination, nonpermafrost soils, and where MCLs have been exceeded. Additionally, the remedial technologies chosen have been used at or near Fort Wainwright and have shown to be the most implementable and effective technologies available.

11.5 USE OF PERMANENT SOLUTIONS, ALTERNATIVE TREATMENT, OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected remedies will provide permanent solutions and alternative treatment technologies for contaminated soil and groundwater. The remedies utilize treatment of the contaminant source and affected soil and groundwater. Soil vapor extraction of petroleum-contaminated soil, in conjunction with air sparging of petroleum-contaminated groundwater, provides a permanent solution by eliminating the source of contaminants and treating the off-site migration pathway.

Risk from petroleum-contaminated soils and groundwater is reduced permanently through treatment. The selected remedies provide the best balance of long-term effectiveness and permanence; reduction in toxicity, mobility, and volume achieved through treatment; short-term effectiveness; implementability; and cost.

11.6 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedies satisfy the statutory preference for treatment by utilizing treatment as a main method to permanently reduce the toxicity, mobility, and volume of contaminated soil and groundwater.

12.0 DOCUMENTATION OF SIGNIFICANT CHANGES

CERCLA Section 117(b) requires an explanation of any significant changes from the preferred alternatives originally presented in the Proposed Plan. The selected remedies were the same as the preferred alternatives presented in the Proposed Plan with the exception of Remedial Area 1a, lead-contaminated soil around the ASTs at the Tank Farm.

12.1 PROPOSED ALTERNATIVE

The original preferred alternative for Remedial Area 1a, lead-contaminated soils around the ASTs located on the Birch Hill portion of the Tank Farm, was excavation and soil washing of lead-contaminated soils. A contingency remedy of off-site disposal would have replaced soil washing as the selected remedy if soil washing did not achieve cleanup goals in a cost-effective manner.

12.2 SIGNIFICANT CHANGES

The Army, EPA, and State of Alaska have agreed to defer selection of a final remedy for Remedial Area 1a at the AST area located on the Birch Hill portion of the Tank Farm. This source area will be addressed in the ROD for OU-5.

12.3 REASON FOR CHANGE

The agencies would like additional time to select an appropriate cleanup level and remediation goal for lead-based paint in soils.

Appendix A

APPENDIX A

RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY FOR THE RECORD OF DECISION FOR REMEDIAL ACTION AT OPERABLE UNIT 3, FORT WAINWRIGHT, ALASKA

OVERVIEW

The United States Army, Alaska (Army), United States Environmental Protection Agency (EPA), and Alaska Department of Environmental Conservation (ADEC), collectively referred to as the Agencies, distributed a Proposed Plan for remedial action at Operable Unit 3 (OU-3), Fort Wainwright, Alaska. OU-3 comprises five source areas: the Tank Farm; Railcar Off-Loading Facility (ROLF); and Mileposts 2.7, 3.0, and 15.75 of the Fairbanks-Eielson Pipeline (FEP). The five source areas were reorganized into four remedial areas based on the type of contamination present. These areas are:

- Remedial Area 1a—Lead-contaminated soil near aboveground storage tanks (ASTs) within the Tank Farm;
- Remedial Area 1b—Petroleum-contaminated soil and groundwater at the base of Birch Hill and near the Truck Fill Stand at the southwest corner of the Tank Farm;
- Remedial Area 2—Petroleum-contaminated soil and groundwater at Valve Pit A and the ROLF; and
- Remedial Area 3—Petroleum-contaminated soil and groundwater at Mileposts 2.7, 3.0, and 15.75 along the FEP.

The Proposed Plan identified preferred remedial alternatives for the four remedial areas within OU-3. The major components of the remedial alternatives are:

- Soil washing of approximately 3,200 tons of lead-contaminated soils at the Tank Farm to reduce the amount of lead-contaminated soil to approximately 1,100 tons, which will be transported off site for treatment and disposal; and
- *In situ* vapor extraction of petroleum-contaminated soil in conjunction with air sparging of petroleum-contaminated groundwater to remove volatile contaminants in the groundwater and vādose zone. This component will be implemented at the Tank Farm, ROLF, and Mileposts 2.7, 3.0, and 15.75. Groundwater monitoring will be conducted for 20 years following the initiation of remedial action.

Two formal comments regarding the Proposed Plan for the OU-3 remedial action were received during the public comment period; these comments are summarized and presented in this Responsiveness Summary. In addition, numerous questions were asked at the public meeting held on April 25, 1995. These questions focused on the results of contamination investigations performed at OU-3, potential impacts to nearby property, the rationale for selection and estimated time frames for preferred remedial alternatives, and issues relating to the cost of cleanup. These questions and Agency responses are available in the Administrative Record.

BACKGROUND OF COMMUNITY INVOLVEMENT

The public was encouraged to participate in the selection of the final remedies for OU-3 during a public comment period from April 19 to May 19, 1995. The *Fort Wainwright Proposed Plan for Operable Unit 3* presented more than 25 combinations of options considered by the Agencies to address contamination in soil and groundwater at OU-3. The Proposed Plan was released to the public on April 19, 1995, and copies of a Proposed Plan summary fact sheet were sent to all known interested parties including approximately 150 elected officials and concerned citizens. An informational fact sheet dated March 1995, providing information about the Army's entire cleanup program at Fort Wainwright, was mailed to the addresses on the same mailing list.

The Proposed Plan summarized available information regarding the OU. Additional materials were placed into two information repositories, one at the Noel Wien Library in Fairbanks and the other at the Fort Wainwright Post Library. An Administrative Record, including all items placed in the information repositories and other documents used in the selection of the remedial actions, was established in Building 3023 on Fort Wainwright. The public was welcome to inspect materials available in the Administrative Record and the information repositories during business hours.

Interested citizens were invited to comment on the Proposed Plan and the remedy selection process by mailing comments to the Fort Wainwright project manager, by calling a toll-free telephone number to record a comment, or by attending and commenting at a public meeting[1] on April 25, 1995, at the Noel Wien Library in Fairbanks.

Basewide community relations activities conducted for Fort Wainwright, which includes OU-3, have included:

- July 1992—Community interviews with local officials and interested parties;
- April 1993—Preparation of the Community Relations Plan;
- July 1993—Distribution of an informational fact sheet covering all OUs at Fort Wainwright;
- July 22, 1993—An informational public meeting covering all OUs; and
- April 22, 1994—Establishment of information repositories at the Noel Wien Library and the Fort Wainwright Post Library and the Administrative Record at Building 3023 on Fort Wainwright.

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[1] The public meeting referred to in this Responsiveness Summary was a joint meeting for final remedial action at OU-3 and interim remedial action at the Chemical Agent Dump Site, a source area in OU-1, Fort Wainwright, Alaska.

Community relations activities specifically conducted for OU-3 included:

- April 12, 16, 19, 23, 24, and 25, 1995—Display advertisement announcing public meeting in the *Fairbanks Daily News-Miner*;
- April 19, 1995—Distribution of Proposed Plan for final remedial action at OU-3;
- April 19 to May 19, 1995—30-day public comment period. No extension was requested;
- April 19 to May 19, 1995—Establishment of a toll-free telephone number for citizens to provide comment. The toll-free telephone number was advertised in the Proposed Plan and the newspaper display advertisement that announced the public meeting; and
- April 25, 1995—Public meeting at the Noel Wien Library to provide information, a forum for questions and answers, and an opportunity for public comment regarding OU-3.

SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND AGENCY RESPONSES

The public comment period on the Proposed Plan for remedial action at OU-3 was from April 19 to May 19, 1995. Two comments were received during the public comment period: one comment was provided during the public meeting, and the second comment was mailed to the Army. Comments received during this time are summarized below.

1. **Public Comment:** The comment received during the public meeting acknowledged the Agencies' commitment during the cleanup process to identify and characterize source areas in OU-3. The commentor, representing an environmental consulting firm, indicated that soil vapor extraction and air sparging to remediate petroleum-contaminated soils and groundwater is an effective remediation technology for the Fairbanks area.

Agency Response: Thanked the responder and noted.

2. **Public Comment:** A letter was received during the public comment period from attorneys representing the Bentley Family Trust (Trust), adjacent landowners. The letter states that the Trust generally is pleased with the Agencies' selected remedy for the Tank Farm source area. However, the letter raises some concerns. One of the concerns, quoted from the letter, states, "If the Army has not completely delineated the size of the contamination, we do not believe that it can competently devise and responsibly implement an adequate remediation plan which will directly and effectively remediate all of the contamination and related health risks and damages to properties." A second concern is related to groundwater monitoring west of the Tank Farm source area. The letter recommends that the Army collect samples from existing monitoring wells concurrently to provide indication whether groundwater quality in this area exceeds regulatory standards.

Agency Response: Based on current information, the Army believes that sufficient data have been generated at OU-3, including the Tank Farm source area, to select the final remedies.

However, additional investigations likely will be performed to aid in the development of remedial design for the site.

The Army has reviewed the list of wells provided in the letter. Several of these wells, including the United States Geological Survey wells, Cold Region Research and Engineering Laboratory (CRREL) MW-C, and the CRREL well points, were not constructed in a manner conducive to collecting representative groundwater samples. For example, the CRREL well points were designed to provide screening-level field data for optimizing placement of standard groundwater monitoring wells. However, the AP wells listed in the letter will be sampled during the installation and operation of the remediation systems planned for OU-3. The Army notes that wells AP-5782 and AP-5785 are part of a groundwater monitoring program and are sampled quarterly. Concurrent sampling of the AP wells referenced in the letter will be conducted as part of the long-term monitoring program associated with the final remedy.

Appendix B

APPENDIX B

ADMINISTRATIVE RECORD INDEX

ADMINISTRATIVE RECORD INDEX
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Start Page	End Page	Date	Title	OU No.	Category No.	Author Name/Affiliation	Recipient Name/Affiliation
26716	26734	9/8/94	Technical Memorandum regarding Operable Unit 3 Feasibility Study, Task 3	3	4.2	Bill Richards/E & E	Ted Bales/COE
26798	26836	9/1/93	Descriptive Inventory of Wildlife and Vegetation, Operable Unit 3	3	3.1.1	Junior D. Kerns/DPW	None given
27170	27189	7/29/94	Technical Memorandum regarding Feasibility Study, Operable Unit 3, Fort Wainwright, Alaska	3	4.2	Bill Richards/E & E	Ted Bales/COE
29771	29772	9/18/93	Operable Unit 3, Fort Wainwright Decision Document	3	3.1.2	None given/None given	None given/None given
29773	29787	9/2/93	Amendment to Operable Unit 3 Remedial Investigation Management Plan, Sampling Analysis Plan for Facility Investigations, Fairbanks-Eielson Pipeline Mile 3.0	3	3.1.1	None given/E & E	None given/None given
31514	34572	9/1/94	Remedial Investigation Report, Operable Unit 3, Fort Wainwright, Alaska; Volumes 1, 2, and 3	3	3.1.2	None given/E & E	None given/None given
34573	34939	2/1/95	Feasibility Study, Operable Unit 3, Fort Wainwright, Alaska	3	4.2	None given/E & E	None given/COE
35956	36634	9/1/94	Risk Assessment Report, Operable Unit 3, Fort Wainwright, Alaska; Human Health Risk Assessment, Ecological Risk Assessment	3	3.1.2	None given/E & E	None given/COE
08305	08391	6/1/83	Pollution Spill Control Plans, Petroleum Division Terminal	3	1.1	Harlan Moore/COE	AFZT-EH-PSE/US Army
08392	08402	4/18/88	Review Comments for Oil Discharge Contingency Plans for FTW Oil Terminal	3	1.1	Dick Warren/ADEC	Col. Alexander John/DEH
08403	08407	8/27/89	Initial Petroleum Pipeline Spill Incident	3	1.1	Chris Putnam/DOL, Petroleum Division	Mr. Walty/Petroleum Division, FTR
08408	08472	6/6/90	Fairbanks Fuel Terminal, FTW, A-E Quality Control Plan	3	1.2.1	None given/E & E	Dave Williams/COE

Key at end of table.

ADMINISTRATIVE RECORD INDEX
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Start Page	End Page	Date	Title	OU No.	Category No.	Author Name/Affiliation	Recipient Name/Affiliation
08473	08718	6/6/90	Fairbanks Fuel Terminal, Part I, Sampling and Analysis, QA/QC Plan, FTW	3	1.2.1	None given/E & E	Dave Williams/COE
08778	08835	11/16/90	DRAFT Work Plan: Part I, Sampling Analysis and QA/QC Plan for Fairbanks-Eielson Pipeline	3	1.2.1	Mat'ls & Instrumentation/COE	Cristal Fosbrook/DPW
08836	08855	11/16/90	DRAFT Work Plan: Part II Site Safety and Health Plan for Fairbanks-Eielson Pipeline	3	1.2.1	Mat'ls & Instrumentation/COE	Cristal Fosbrook/DPW
08856	08984	11/1/91	Chemical Data Acquisition Plan, Fairbanks Fuel Terminal, FTW	3	1.2.1	None given/E & E	Dave Williams/COE
08985	09153	1/1/92	Fairbanks Fuel Terminal Work Plan, Part I, Sampling Analysis Plan	3	1.2.1	None given/E & E	Dave Williams/COE
09154	09210	10/1/89	DRAFT Fairbanks-Eielson POL Pipeline Soil Gas Survey	3	1.2.2	None given/Hart Crowser	Cristal Fosbrook/DPW
09211	09216	12/12/90	USATHAMA Property and Waste Site Report	3	1.2.2	None given/ USATHAMA	None given/None given
09217	09274	9/12/91	Summary of Field Work and Chemical Data for Fairbanks Eielson Pipeline Study	3	1.2.2	Delwyn Thomas/COE	None given/None given
09275	09277	7/12/93	Statement from a Local Resident Concerning the Possibility of Off-Site Migration of Contamination from the Fairbanks-Eielson Multiproduct POL Pipeline	3	1.6	Joe Malen/DEH	None given/None given
09278	09281	3/24/92	USEPA Region 10 Comments on Preliminary Draft Conceptual Model Operable Unit 3	3	2.1.3	Dianne Soderlund/EPA	Cristal Fosbrook/DPW
09282	10072	2/1/93	Final Management Plan for Remedial Investigation/Feasibility Study at Operable Unit 3, FTW	3	3.1.1	None given/E & E	David Williams/COE
10073	10074	8/27/92	Treatability Study Requirements	3	3.2	Lyle Diedeker/E & E	David Williams/COE
10075	10076	9/24/92	Treatability Study Requirements	3	3.2	David Williams/COE	Peter Brokx/E & E

Key at end of table.

ADMINISTRATIVE RECORD INDEX
OPERABLE UNIT 3
FORT WAINWRIGHT, ALASKA

Start Page	End Page	Date	Title	OU No.	Category No.	Author Name/Affiliation	Recipient Name/Affiliation
10077	10113	10/15/92	Review Comments on the Draft Management Plan for Remedial Investigation/Feasibility Study at Operable Unit 3	3	3.3	Marie Jennings/EPA	Cristal Fosbrook/DPW
10114	10122	10/16/92	Review Comments on the Draft Management Plan for Remedial Investigation/Feasibility Study at Operable Unit 3	3	3.3	Rielle Markey/ADEC	Cristal Fosbrook/DPW
10123	10124	6/2/92	Use of the Geoprobe, an Innovative Sampling Device for Operable Unit 3	3	11.2	Marie Jennings/EPA	FTW RPM's/COE
10125	10126	3/9/93	Use of Modified EPA Method 8015 at FTW	3	11.3	Ronan Short/ADEC	Cristal Fosbrook/DPW
TBA	TBA	5/19/95	Letter Re: Remedial Investigation Report, Operable Unit 3, Fort Wainwright	3	TBA	Michael P. Monroe/ Reed McClure	Col. Albert J. Kraus/ DPW

Key:

TBA = To be added.