FINAL

VOLUME I: REPORT & APPENDIX I

REMEDIAL INVESTIGATION REPORT

OPERABLE UNIT B, POLELINE ROAD DISPOSAL AREA FORT RICHARDSON, ALASKA

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Prepared For

U.S. ARMY CORPS OF ENGINEERS
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TABLE OF CONTENTS

Section Page

TABLE OF CONTENTS (continued)

Section **Page**

TABLE OF CONTENTS (continued)

Section **Page**

TABLE OF CONTENTS (continued)

Section **Page**

Section **Page**

TABLE OF CONTENTS (continued)

Section **Page**

LIST OF APPENDIXES

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF FIGURES

EXECUTIVE SUMMARY

Woodward-Clyde conducted a Remedial Investigation (RI) at Operable Unit B (OUB), the Poleline Road Disposal Area (PRDA) at Fort Richardson, Alaska. Previous investigations and removal actions identified four disposal areas that were used between 1950 and 1972 for the disposal of chemical warfare training materials and halogenated solvents. Two of the disposal areas (Areas A-3 and A-4) were excavated in 1993 and 1994 and were backfilled with soil meeting removal action levels. The other two areas (Areas A-1 and A-2) have not been excavated and potentially contain unexploded ordnance.

The RI field work was performed in August and September 1995 and involved the collection and analysis of soil, groundwater, sediment and surface water samples from the site and background areas. Samples were analyzed for halogenated solvents, metals, explosives, and chemical warfare materials and their breakdown products.

Soil samples were collected from borings drilled around the former disposal areas and through the backfill at Areas A-3 and A-4. Concentrations of contaminants in soils are generally well below regulatory levels outside of the disposal areas. None of the samples collected from the backfilled soil in Areas A-3 and A-4 exceeded the cleanup criteria used during the excavation (1,1,2,2-tetrachloroethane, 30 mg/kg; tetrachloroethene, 100 mg/kg; and trichloroethene, 600 mg/kg). However, two soil samples collected beneath the previous excavation in Area A-3 had levels of 1,1,2,2-tetrachloroethane (79 mg/kg and 2,030 mg/kg) which exceeded the cleanup criteria used during the excavation. These samples were collected just below the water table while drilling MW-14. The groundwater sample collected from this monitoring well had higher levels of VOCs than any other groundwater sample collected at the site.

A well point was placed in each of the soil borings where groundwater was encountered. A groundwater sample was collected from each well point and analyzed in an on-site laboratory for halogenated solvents. The results of these analyses were used to select the locations for the permanent monitoring wells. The pattern of solvent detections in the well points and monitoring wells suggests that solvents have migrated in the direction of groundwater flow, to the northeast from Areas A-3 and A-4.

Halogenated solvents were found in both the shallow and deep water bearing intervals. Two solvents, 1,1,2,2-tetrachloroethane and trichloroethene, were found at levels significantly higher than any other volatile organic compounds detected at the site. The Alaska MCL for trichloroethene in water (0.005 mg/L) was exceeded in 10 of the 14 monitoring wells sampled for volatile organic compounds. There is no Alaska MCL for 1,1,2,2-tetrachloroethane. The Alaska MCLs for several other VOCs were exceeded in groundwater samples collected from monitoring wells. Most of these came from the well located in Area A-3 or from wells close to Areas A-3 and A-4.

One groundwater sample (MW-14) had thiodiglycol detected (0.48 mg/L). Thiodiglycol is a breakdown product of mustard. No other samples had any chemical warfare materials or chemical warfare material breakdown products detected. Minor detections of explosives were reported in the wetlands and in one wellpoint groundwater sample, but levels are below ARARs. Metals are generally within or near background.

A risk assessment was performed and is provided as a separate document. The risk assessment concluded that the site poses no imminent threat to human health or the environment, based on a lack of complete exposure pathways. A groundwater model performed using MODFLOW and MT3D estimated that the solvents would take over 100 years to reach the Eagle River.

1.0
INTRODUCTION

The United States Army Corps of Engineers (USACE), Alaska District, retained Woodward-Clyde Federal Services (WC) to perform a Remedial Investigation (RI) at Operable Unit B (OUB) at the Fort Richardson Army post near Anchorage, Alaska. OUB consists of one site, the Poleline Road Disposal Area (PRDA). Fort Richardson is on the United States Environmental Protection Agency's (EPA) National Priority List (NPL), and all work performed for the PRDA was in compliance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Work also was conducted in compliance with the draft Federal Facilities Agreement (FFA) negotiated among the United States (US) Army, the EPA, and the Alaska Department of Environmental Conservation (ADEC). The OUB RI project was assigned Delivery Order Number 013, under terms of USACE contract number DACA85-94-D-0005. The scope of the RI was provided by the USACE in a Statement of Work (SOW) dated May 3, 1995, and a SOW for Delivery Order Modification No. 1 dated July 12, 1995. The SOW includes a risk assessment, which is submitted as a separate document.

This report is presented in two volumes. Volume I contains the report text and Appendix I, site photographs. The report text is presented in 8 sections. Section 1.0 is an introduction to the report which contains a description of the site, waste disposal history, summary of previous investigations, geology, hydrogeology, hydrology, climate, demographics, and site ecology. Section 2.0 presents the field procedures and methods used during the investigation. Section 3.0 is a Quality Assurance/Quality Control review of the data generated during the RI. Section 4.0 presents the results of the site investigation, including the wetlands sampling and background data. Section 5.0 discusses the fate and transport of chemicals detected during the RI. Section 6.0 presents the applicable or relevant and appropriate requirements (ARARs) for evaluating the nature and extent of contamination at the site. Section 7.0 presents the conclusions and recommendations based on the results of the field investigation. Section 8.0 is a list of the references used while preparing the report. Appendix I contains selected photographs of field activities.

Volume II contains the remaining appendixes which include the following information: field logs (Appendix II); boring logs and monitoring well completion logs (Appendix III); survey data (Appendix IV); Quality Assurance Report prepared by WC (Appendix V); Quality Assurance Report prepared by USACE (Appendix VI); analytical data generated by off-site laboratories (Appendix VII); Statement of Work (Appendix VIII); on-site mustard screening report prepared by Battelle (Appendix IX); analytical data generated by the on-site laboratory (Appendix X); Cold Regions Research and Engineering Laboratory (CRREL) geophysical investigation report (Appendix XI); Arctic GeoScience borehole geophysical surveys (Appendix XII); Groundwater Fate and Transport Modeling Report (Appendix XIII); and Quarterly Groundwater Elevation Reports (Appendix XIV).

1.1 SITE BACKGROUND

1.1.1 PRDA Description

The PRDA is located on the Fort Richardson Army Post, approximately 10 miles northeast of Anchorage, Alaska (Figure 1-1). Fort Richardson occupies 61,500 acres of land (Figure 1-2). In 1994 Fort Richardson was added to the EPA's NPL under CERCLA.

The PRDA is located approximately 1 mile south of the Eagle River and 0.6 miles north of the Anchorage Regional Landfill (Figure 1-3). Access to the area is by Poleline Road, a major gravel road that runs northeast-southwest along a power line route and the Eklutna Water Line. The PRDA is bisected by Barrs Boulevard, a gravel road extending from the Glenn Highway to Poleline Road.

The PRDA is a low-lying, relatively flat area which is bordered by a wooded, 80-foot high hill to the northwest, and a wooded hill to the south and southeast. The area where buried waste has been detected by geophysical surveys (the "main disposal area") is approximately 1.5 acres in size. The PRDA, for purposes of this investigation, also includes wetlands located directly south and southwest of the main disposal area. The remaining area bordering the PRDA is relatively flat and wooded. The main disposal area was cleared of vegetation during a 1994 removal action. No significant vegetation has returned.

1.1.2 History

1.1.2.1 Waste Disposal History

The PRDA was identified in 1990 through interviews conducted by the US Army with two ex-soldiers who were stationed at Fort Richardson in the 1950s and who recalled the disposal of chemicals and other materials in the area (USACE 1994c). The disposal area was active from approximately 1950 to 1972. The disposal location was corroborated by a USACE map dated 1954 showing a "Chemical Disposal Area" at the PRDA, and by 1957 aerial photography showing trenches in the area. A 1965 aerial photograph (Aeromap, 1965) obtained by WC shows that a portion of the hill west of the PRDA was cut back. One reference (OHM, 1993c) was found that describes how materials with suspected chemical weapons were disposed. A layer of "bleach/lime" was laid down in the bottom of the trench, and then the materials contaminated with chemical weapons were placed on a pallet in the trench. Diesel fuel was poured on the agent and then ignited with thermal grenades. After burning was complete, a mixture of either bleach or lime, combined with chlorinated solvent carrier (trichloroethene, tetrachloroethene, and 1,1,2,2-tetrachloroethane) was poured over the materials.

Information provided by the ex-soldiers indicated that disposed materials may have included solvents and other decontaminants (such as bleach) that were used to neutralize chemical warfare agents, smoke bombs, and Japanese cluster bombs. Both types of bombs were detonated in pits prior to burial, but there may have been many duds dispersed over the area that were not recovered.

1.1.2.2 Previous Investigations and Remedial Actions

Several investigations and a removal action have been conducted at the PRDA since its discovery in 1990. Environmental Science and Engineering, Inc. (ESE) conducted site investigations between 1990 and 1992. ESE's investigations included a geophysical survey, soil sampling from 10 borings, a soil gas survey, installation of 11 groundwater monitoring wells, groundwater sampling, a water level study, and aquifer (slug) tests. OHM Remediation Services, Inc. (OHM) began a removal action in 1993, but work was halted when chemical agent identification sets (CAIS) and other materials related to chemical warfare training activities were unearthed. CRREL performed a geophysical survey in early 1994, and OHM completed the removal action in October 1994. The 1994 geophysical survey was conducted to better identify the location of buried objects in Areas A-3 and A-4. CRREL performed another geophysical survey in June 1995 to determine whether any suspicious material remained in the recently excavated areas and to define more accurately anomalous zones in areas not excavated in 1994. A brief summary of previous investigations is presented below and in Table 1-1.

The geophysical surveys were conducted to help locate disposal areas within the PRDA. The surveys identified significant anomalies consistent with trenches and buried waste in four areas at the PRDA. CRREL's 1994 geophysical survey is presented in Figure 1-4. Areas A-3 and A-4 showed the greatest evidence of buried waste and trenching, including possible stacked canisters or cylinders. These areas were selected for further investigation and removal actions, which were conducted in 1993 and 1994. A list of solid materials found during excavation at

Areas A-3 and A-4 is provided in Table 1-2, and the locations of excavated areas are shown on Figure 1-5. A second geophysical survey was conducted in 1995, after the removal action, and is presented in Appendix XI.

Chemical analyses confirmed that chlorinated solvents, especially trichloroethene (TCE), tetrachloroethene (PCE), and 1,1,2,2-tetrachloroethane, were disposed at the PRDA. Solvents were detected in soils and in groundwater samples from both the shallow and deep water-bearing zones. Concentrations of metals are within regional background levels as compiled by ESE in their previous investigations (ESE 1991a, Table 3-4). Semivolatile organic compounds have not been detected at the site. The only chemical warfare material (CWM) detected in soils was adamsite. Adamsite is an arsenic-based vomiting agent used in aerosol form for riot control. No CWMs or CWM breakdown products were detected in groundwater during the previous investigations. Explosives were not detected during the previous investigations except for one detection of RDX in a groundwater sample from monitoring well MW-5.

Soils excavated from Areas A-3 and A-4 were sampled and compared to the following removal action concentrations:

Chemical	Removal Action Concentrations
trichloroethene (TCE)	600 mg/kg
tetrachloroethene (PCE)	100 mg/kg
1,1,2,2-tetrachloroethane	30 mg/kg

The removal action concentrations listed above were established for the three solvents that were detected at the most elevated concentrations during OHM's interim removal action. As discussed in OHM's Phase 2 Work Plan (OHM 1994a), the removal action concentrations are based on a residential soil ingestion scenario and are very conservative for the PRDA site. The site is remote, access is restricted, and the disposal area was backfilled. The removal action concentrations were drawn from EPA Region X risk-based concentrations using a 10^{-5} exposure risk, and were approved by the ADEC in a letter dated September 3, 1993. After buried debris was removed, soil sampling was performed on a grid pattern on the bottom and walls of the excavations to confirm that soils exceeding the removal action concentrations had been removed. Soils were excavated to a maximum depth of 14 feet, where water was encountered.

Soils that met the removal action concentrations were mixed with borrow soil and returned to the excavations. No additional soil cover was added to Areas A-3 and A-4. Soils that exceeded the action levels were stockpiled southeast of the site on Barrs Boulevard in lined, plastic-covered piles surrounded by berms. The stockpile area is currently fenced. Remediation of the stockpiles is scheduled for spring 1997.

Areas A-1 and A-2 have not been excavated. Based on the geophysical survey, these areas are expected to contain less significant quantities of buried waste than found in Areas A-3 and A-4. Information from an ex-soldier indicated that undetonated bomblets from cluster bombs may be buried in Areas A-1 and A-2. Approximately 3 feet of soil overlies the apparent disposal horizon (18 inches of soil originally overlying the disposal horizon, plus an 18-inch soil cover added in 1994).

The condition of the wetlands was largely unknown prior to the 1995 RI. Based on the geophysical survey conducted in 1994 by CRREL, the wetlands may contain small dispersed metallic objects.

1.2 AREA OF INVESTIGATION

1.2.1 Geology and Soils

The PRDA is located in the Susitna Lowland physiographic division of south-central Alaska (ESE 1991a). Most of the lowland is below 500 feet (MSL) in elevation, although isolated uplands such as Mt. Susitna reach 4,396 feet. Local relief generally ranges from 50 to 250 feet. The region was glaciated repeatedly in Quaternary time and remains glaciated today. Discontinuous lenses of permafrost exist in the region but continuous permafrost is not present in the area.

A 1979 Soil Survey described most of the soils at PRDA as a Homestead silt loam. The Homestead silt loam is described as a well-drained soil formed over very gravely till. The underlying till varies in compactness, and in some areas is very firm. The Homestead occurs on moraines with slopes ranging from 0 to 75 percent. Soils matching the Homestead series are found over most of the site, except for the wetland areas, which were included in the Salamatof series. The Salamatof is a nearly level, very poorly drained soil consisting of fibrous peat materials that occurs in broad basins and depressions on terraces and moraines. Salamatof series soils are found in the wetlands to the southwest of the site and a small area immediately northeast of Area A-1 (USACE 1979).

The surficial deposits of the region are fluvially reworked glacial sediments and glacial tills. These deposits appear to be up to 30 feet thick at the site and consist of unstratified to poorly stratified clays, silts, sands, gravels, and boulders. A basal till lies below the surficial deposits. Lithologically the units appear similar, except that the basal till is more dense. The shallow ground water interval lies directly above the basal till. The basal till appears to be about 100 feet thick at the site and overlies an advance moraine/till complex. The advance moraine/till complex was deposited in front of the advancing glacier and then overrun. The basal till was deposited over the advance moraine/till complex. The glacial sediments are probably part of the Quaternary age Elmendorf Moraine deposits that were laid down during the latest glaciation phase of the Naptowne Glaciation event. The age of these deposits is between 11,000 and 14,000 years. Individual stratigraphic units are discontinuous and are difficult to correlate between borings. This is typical of glacial deposits.

The subsurface soils collected during the 1995 field investigation were glacial tills, generally described as silty sands with some gravel. These three grain sizes (silt, sand, and gravel) were observed in nearly every sample at various percentages. Clay sized particles were observed in very few samples. The soils beneath the PRDA were difficult to drill through and sample because of the high density. The effect of the density can be seen in the blow counts. It was not unusual for blow counts to exceed 50 blows per 6 inches. Saturated intervals were separated not by lithologic changes, but by zones of higher density tills.

Underlying the glacial sediments is bedrock composed of a hard black fissile claystone with fine sandy siltstone interbeds (ESE 1991a). The bedrock is likely part of the Tertiary age Kenai Group. Bedrock was encountered beneath the PRDA at between 80 and 160 feet below grade, according to boring logs produced from the previous and current investigations. The Border Ranges Fault zone passes approximately one mile east of the PRDA (USGS 1962/1985), and the region is known to be seismically active.

1.2.2 Hydrogeology

Groundwater in the Anchorage-Eagle River area occurs in both glacio-fluvial deposits and fractured bedrock aquifers (ADNR 1992). Individual water bearing zones in the glacio-fluvial deposits are separated by silt and clay intervals and some of the deeper water bearing zones are semi-confined. Groundwater in the fractured bedrock is also semi-confined due to silts and clays overlying the bedrock.

Information concerning site hydrogeology was obtained from several sources. The first was data collected during the 1995 field investigation. These data include observations made during drilling operations, water level measurements, and data collected from the borehole geophysics conducted in the monitoring wells. Additional information concerning the hydrogeology can be found in previous reports which include boring logs, water level measurements, and discussions of the hydrogeology.

Three distinct water bearing units have been identified at the PRDA and evidence of others has been observed. The three identified water bearing units are a perched interval, a shallow interval, and a deep aquifer. These three units appear to be interconnected, but the degree of this interconnection is unknown. Other water bearing units were observed while drilling deep monitoring well MW-16. These other water bearing units are located between the shallow interval and the deep aquifer and are collectively referred to as the intermediate interval.

The perched interval was observed in borings drilled between Areas A-2 and the wetlands, and in Area A-3. The top of the perched interval was encountered at 4 to 10 feet below ground surface (bgs), and the bottom was found at 6 to 12 feet bgs. The average thickness of the perched interval is approximately 5 feet. The perched interval appears to be recharged by infiltration of precipitation and also by surface water from the wetlands draining into the perched interval. The only well installed in the perched interval is MW-14.

The shallow saturated interval is an average of 10 feet thick; the top was encountered at 20 to 25 feet bgs, and the bottom was found at 28 to 36 feet bgs. Shallow groundwater is flowing in a north-northeast direction. There are 11 monitoring wells screened in the shallow interval, including the background well. Because of the localized nature of water-bearing zones in this typical glacio-fluvial geologic setting, it is difficult to tell whether the water-bearing units are hydraulically connected between wells. The shallow interval is recharged by infiltration of precipitation (ESE 1993) and from the perched interval.

Although an earlier report (ESE 1991a) labeled the shallow water-bearing zone a shallow "aquifer", it is questionable whether it meets the definition of a true aquifer (saturated, and sufficiently permeable to transmit economic quantities of water). There is no information on the depth and flow direction of groundwater beneath the wetlands, and it is possible that flow directions may fluctuate seasonally in the area. The interaction between groundwater beneath the main disposal area and the wetlands is unknown.

The deep monitoring wells at the PRDA penetrate bedrock, which was encountered from approximately 80 to 160 feet below surface. The deep wells are screened in both the bedrock and an unconsolidated deposit that lies directly above the bedrock. The saturated thickness of the unconsolidated deposit is between 3 and 40 feet. Groundwater flow in the bedrock is at least partially controlled by the frequency of fractures. The flow direction in the deep aquifer is locally to the northeast and regionally to the northwest. The available data (ESE 1991a, ADNR 1992, USGS 1964) indicate that the bedrock aquifer below the PRDA is not connected with the bedrock aquifers used for drinking water in the community of Eagle River (over one mile to the northeast).

Five wells are installed in the deep aquifer (MW-1, MW-6, MW-7, MW-9, and MW-16). The degree of interconnection between the shallow interval and the deep aquifer is not clear. Solvents were detected in groundwater samples collected from the deep aquifer. Since the solvents had to pass through the shallow interval to reach the deeper aquifer, some interconnection exists between the two.

1.2.3 Hydrology and Area Water Usage

The area around the PRDA is characterized by rolling hills and a poorly developed drainage system. Between the rolling hills a closed depression can usually be found and in the depression a wetland is often found. No flowing water was observed in these closed depressions. No flowing water was observed in the area other than Fossil Creek (1500 feet southeast) and Eagle River (one mile north). All precipitation at the PRDA either evaporates or infiltrates into the soil.

The Eagle River has the largest drainage area of the nearby streams. Five smaller creeks (Clunie, Fossil, Ship, Chester, and North Fork of Campbell) transverse the post (USACE 1994b). Ship Creek, which is located approximately 5.5 miles south of the site, provides industrial water for Anchorage, Fort Richardson, and the adjacent Elmendorf Air Force Base. Ship Creek also provides drinking water for Fort Richardson.

The ultimate discharge of the shallow water-bearing zone at the PRDA is probably the Eagle River, approximately 1 mile north of the PRDA; however, as previously discussed, groundwater flow patterns are uncertain. The Eagle River flows into the Knik Arm of Cook Inlet approximately 5 miles northwest of the PRDA. The river is not used as a drinking water supply.

The cities of Anchorage and Eagle River obtain drinking water from groundwater and from Eklutna Lake. Eklutna Lake is over 15 miles northeast of the PRDA and is approximately 500 feet higher in elevation. Groundwater is obtained from several isolated glacio-fluvial and bedrock aquifers (ADNR 1992). Available data indicate that the drinking water aquifers are not hydraulically connected with groundwater beneath the PRDA.

1.2.4 Nearby Water Wells

A database owned by the State of Alaska Division of Water Management and the United States Geological Survey (USGS) Water Resources Division was used to locate nearby water wells. However, records on wells in this area are incomplete. The closest wells with available location data were plotted on a USGS topographic map (Figure 1-6). According to the database, there are 12 wells within a 1-mile radius of the PRDA, 566 wells within 3 miles and 1083 wells within 5 miles. The database does not contain information on the present status of the wells, or whether the wells are used for municipal, industrial, or residential purposes. Several water wells were abandoned in the 1980s with the merging of water districts in the Eagle River area under the Anchorage Water and Wastewater Utility (AWWU), and with the arrival of treated water from Eklutna Lake.

The closest wells to the PRDA are to the south, and were drilled for the Municipality of Anchorage as a part of the groundwater monitoring system for the Anchorage Regional Landfill. Other nearby wells were drilled for the Alaska Department of Corrections facility off Hiland Road and the Eagle River Campground (both over a mile east of the PRDA), and a subdivision west of the Glenn Highway and east of the Eagle River (northeast of and across the river from the PRDA). None of these wells are considered to be threatened by contaminants at the PRDA, as discussed in Section 7.2 of this report. There are no wells located to the north, between the PRDA and the Eagle River.

1.2.5 Climate

The Anchorage - Eagle River area receives approximately 15 inches of precipitation per year, including about 61 inches of snow (UA, undated). Average summer temperatures range from 46 to 66 degrees Fahrenheit (F), with winter temperatures from 4 to 42 degrees F. Extreme temperatures of -38 and +86 degrees F have been recorded. Average winds in the region are from the south at 7.5 miles per hour. Wind directions at the PRDA are affected by the presence of the two hills bordering the area. The predominant wind direction at the PRDA is from the west (Cansler, pers. comm.).

1.2.6 Demographics and Land Use

Land use surrounding Fort Richardson is dominated by military, State of Alaska, and residential land holdings (ESE 1991a). Elmendorf Air Force Base and Ft. Richardson Army Installation surround the PRDA. The area is currently under the control of the Fort Richardson Range Control Office.

There are two major population centers within 10 miles of the PRDA. The community of Eagle River is approximately 2 miles northeast of the site, and Anchorage is approximately 10 miles to the southwest. The combined population of the Eagle River-Anchorage area is approximately 225,000. The Eagle River area serves as a suburban community for Fort Richardson personnel and also for Anchorage. Directly east of the site lies Chugach State Park, which borders the southern and eastern boundaries of Fort Richardson. The Alaska Railroad passes approximately one mile northwest of the PRDA.

The PRDA area has been used the last several years for outdoor field training by US Army troops. The immediate area surrounding the PRDA is currently closed to training activities (Gardner, pers. comm.), but the site can be accessed by vehicle via Poleline Road. Hunting is not allowed in the area but Fort Richardson allows the public to fish in the nearby Eagle River. Cross-country skiers also use the area.

Future land use includes the potential for closure of Fort Richardson. A pipeline carrying drinking water from Eklutna Lake (over 15 miles from the site) runs through the area. It is unlikely that groundwater would be used for a drinking water supply. The area is not suitable for agricultural purposes. The potential for future residential use of the area is remote, but was considered for screening purposes in the risk assessment.

1.2.7 Ecology

1.2.7.1 Introduction

The following summary of ecological conditions at the PRDA is based on a site visit on July 25, 1995, previous documents describing the site (USACE 1994b, ESE 1991a), aerial photographs, and a review of available ecological literature. The purpose of the site reconnaissance was to characterize the overall site condition, to identify potentially exposed habitats and receptors, and to evaluate habitat suitability for sensitive species.

The PRDA consists of a relatively small clearing of mostly unvegetated ground, surrounded by a large area of forested land with scattered wetlands. The terrain is mostly gently rolling, with two small higher hills immediately northwest and southeast of the site. Elevations in the vicinity range from about 250 to 450 feet above sea level. There are no rivers or streams in the vicinity of the site; the closest are the Eagle River approximately one mile to the north, and Fossil Creek about 1,500 feet to the southeast. There is also no developed surface water drainage system in the vicinity of the PRDA; the wetlands occupy small or large basins in the rolling to hummocky terrain, and appear to be isolated from each other and from the closest rivers and streams.

The site and its surroundings are in an area of the Fort Richardson Army Post currently used as wildlife habitat and for outdoor field training exercises. The closest developed post facilities are a firing range and Anchorage Regional Landfill about 0.6 mile to the southeast. The Glenn Highway is located about one mile to the east, and the community of Eagle River about 2 miles to the northeast.

1.2.7.2 Vegetation/habitat types

The general vegetation type of the PRDA area is interior spruce-hardwood forests and brush (Alaska Department of Fish and Game 1978), and a general vegetation map of the region characterizes it as lowland spruce-hardwood forest (State of Alaska 1974). Four major habitat types are present at and near the Poleline Road site: spruce-hardwood forest, wetland, herbaceous vegetation, and unvegetated areas. All of the vegetation appeared to be normal during the site visit; no dead, dying, damaged, or dwarfed vegetation was observed. However, most vegetation at the PRDA was removed in a 1994 removal action, and the PRDA was mostly unvegetated at the time of the site visit. Vegetation was mapped from field observations and 1:1200 scale color aerial photography dated May 15, 1994. A vegetation map is presented as Figure 1-7.

The PRDA surface was mostly unvegetated in July 1995, as a result of the 1994 removal action. Very small areas of herbaceous vegetation and shrubs were present on the east side of the clearing, apparently in areas not affected by the removal, and included fireweed, yarrow, alder, willows, and dandelion. The PRDA clearing covers about 3 acres.

Spruce-hardwood forest is the predominant vegetation type in upland areas surrounding the PRDA clearing. Most of the forests surrounding the PRDA are dominated by paper birch and aspen, but white spruce is common. Forests mostly have a closed canopy, with a dense shrub and/or herb understory. Most trees are 6 to 8 inches in diameter, but a few 10 to 18-inch diameter birch and aspen trees were observed. Most trees are probably 40 to 50 years old and likely became established after fire or other disturbance. Successional processes will eventually lead to dominance by white spruce, unless additional disturbance restarts the process of succession. Common understory species observed include Sitka alder, Labrador-tea, Barclay willow, blueberry, highbush cranberry, prickly rose, buffaloberry, fireweed, and field horsetail.

A 4 to 5 acre wetland is present immediately south of the PRDA clearing, and several smaller wetlands (< 1 acre) are also present in the vicinity. The large wetland had water about eight inches deep at the time of the field visit, over a peat substrate. Most of this wetland is dominated by russet sedge, with sparse shrub cover of resin birch, Alaska bog willow, and bog rosemary. About one-third of the wetland has shallower water and is dominated by intermediate sedge with moderate to high shrub cover, including crowberry, bog rosemary, resin birch, and some labrador tea. Marginal areas, especially near the PRDA, are dominated by polar grass and marsh five-finger. A few black spruce are present near the east edge. Sphagnum is abundant and sundew is common. The smaller wetlands are dominated by polar grass on the edges, and russet sedge and marsh five-finger.

Narrow transitional areas occur between the forest and some of the smaller wetlands, and are also present as narrow meadows within the forest. These areas are dominated by Beauvard spirea, polar grass, field horsetail, Labrador tea, resin birch, bunchberry and yarrow, and were not wet at the time of the site visit.

The clearing along the powerline and road to the west of the PRDA is dominated by herbaceous and shrub vegetation including Sitka alder, various species of willows, fireweed, yarrow, dandelion, wild geranium, lupines, and others.

1.2.7.3 Wildlife

Relatively little wildlife or its sign was observed during the July 1995 site visit, and assessment of species present is based largely on habitat conditions and ecological literature. No dead or dying animals were observed during the field visit.

Several large game mammals are known or expected to be common in the PRDA vicinity. Moose sign was observed within the PRDA clearing. Moose have annual movements, and primarily occur in the vicinity during the winter. The annual wintering moose population on Fort Richardson is estimated at 450 to 500 animals mainly east of the cantonment area and around the Moose Run Golf course (USACE 1994). Moderate populations of black bear occur in most lowland areas of Fort Richardson (USACE 1994). Grizzly bear are likely to occur occasionally.

Common furbearers in the vicinity of the PRDA include red fox, snowshoe hare, muskrat, mink, short-tailed weasel, least weasel, and wolverine. Other common mammals include red squirrel, red-backed vole, meadow vole, deer mouse, porcupine, and shrews. Large wolf prints were observed in the snow during February and March 1996 site visits. Lynx, marten, and northern flying squirrel may also occur.

Raptors likely to be present in the study area include sharp-shinned hawk, red-tailed hawk, American kestrel, great-horned owl, northern hawk owl, short-eared owl, and boreal owl. No raptor nests were observed at or near the PRDA.

The wetlands provide potential habitat for a number of waterfowl and shorebird species, but do not appear to represent important habitat because of the shallow water and dense vegetation. No waterfowl or shorebirds were observed during the field visit. Species which may occur include green-winged teal, mallard, northern pintail, northern shoveler, American wigeon, common golden eye, Barrow's golden eye, bufflehead, lesser yellow-legs, and common snipe. Least sandpiper and pectoral sandpiper may occur during spring migration. The only upland game bird present is spruce grouse.

Other birds likely to be common in the vicinity of the PRDA include northern flicker, gray jay, black-billed magpie, black-capped chickadee, boreal chickadee, gray cheeked thrush, Swainson's thrush, orange-crowned warbler, yellow warbler, yellow-rumped warbler, blackpoll warbler, Wilson's warbler, fox sparrow, white-crowned sparrow, dark-eyed junco, and common redpoll. The only amphibian likely to be present is the wood frog.

1.2.7.4 Threatened and Endangered Species

No federally listed threatened or endangered species are known or expected to use the PRDA area or vicinity. Peregrine falcon could occasionally fly over the area, but no key habitat features are present at or near the PRDA site.

Two category 2 candidate species for listing may occur, North American lynx and northern goshawk. Category 2 species are those which for which listing as threatened or endangered may be appropriate, but for which further information on threats or rarity is needed to support listing.

Lynx inhabit much of Alaska's forested areas, and use a variety of habitats, including spruce and hardwood forests (Alaska Department of Fish and Game 1989). The best habitat is where there is an abundance of early successional growth, which provides the best habitat for snowshoe hares and other small prey. Lynx are likely to be present in the forests surrounding the PRDA.

Northern goshawk inhabit a large part of Alaska, preferring dense forested areas, especially old growth. Suitable habitat was not observed near the PRDA and northern goshawk are not expected to occur except occasionally on migration.

1.2.7.5 Wetlands

The wetlands present in the PRDA vicinity are classified as palustrine, emergent - persistent and scrub-shrub - broad-leaved deciduous, according to the mapping conventions used in the National Wetlands Inventory. Most of the species observed were facultative wetland (FACW) species, along with some obligate (OBL) and some facultative (FAC) species (Reed 1988). These areas are jurisdictional wetlands under the three-parameter approach of the USACE. They exhibited a preponderance of hydrophytic vegetation and positive evidence of hydric soils and wetland hydrology, including inundation and saturation.

The transitional areas adjacent to wetlands had a mixture of FACW, facultative (FAC) and facultative upland (FACU) species. They did not exhibit evidence of wetlands hydrology at the time of the visit, and soils were not investigated. These areas may include some jurisdictional wetlands.

The wetlands have low functional values. They are isolated, are not a nursery for fish, and have a low diversity of vegetation. They probably function mostly for water collection and ground water recharge. Wildlife habitat values are low. Muskrat trails were observed, and moose and bird use probably occurs. The wetlands appear to be too shallow and densely vegetated to have significant waterfowl use or breeding.

TABLE 1-1
SUMMARY OF PREVIOUS INVESTIGATIONS
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

DATE	INVESTIGATION	FINDINGS	REF.
Jun. 1990	Geophysical survey	Identified two large areas of anomalies, one along toe of hill west of gravel road and one east of gravel road. Less well-defined anomalies were observed in central portions of PRDA.	ESE 1991a
Jul. 1990-Oct. 1990	10 soil borings installed outside identified burial sites. 11, 8-ft composite soil samples, including 1 duplicate, were collected and analyzed.	Low concentrations of chlorinated solvents (generally 0.2 ppm or less). Little evidence of metals contamination: mean concentrations of nickel and zinc slightly exceeded background means; mercury detected near detection limit in 10 of 11 samples.	ESE 1991a
	5 monitoring wells installed: 1 deep (MW-1; 139 ft) and 4 shallow (MWs 2-5; 38 to 62 ft). Two rounds of groundwater samples collected and analyzed.	Significant concentrations of chlorinated solvents (1,1,2,2-tetrachloroethane and TCE) were detected in MW-3, 4, and 5 (up to 47 ppm); highest concentrations were at MW-4. Trace concentrations of chloroform and carbon tetrachloride in MW-1 (deep aquifer).	
	Aquifer (slug) tests	Shallow groundwater results suspect; therefore assumed groundwater velocities of 50 to 100 ft/day for glacial deposits. Estimated hydraulic conductivity in deep aquifer at MW-1 = 139 ft/day.	
	Water level monitoring and groundwater flow direction	Shallow water table at about 19 ft, with apparent flow to NNW and probable discharge to Eagle R. Bottom of interval at about 60 ft. Hydraulic gradient estimated to be 0.08 to 0.12. Bedrock water table at MW-1 at about 120 ft.	
Jul. 1991	Soil gas survey	Benzene, PCE, and TCE in areas near gravel road and toe of hill. TCE defines largest solvent plume extent.	ESE 1992

DATE	INVESTIGATION	FINDINGS	REF.
Sept. 1991	Proposed trenching; 4 samples per trench	Not available.	ESE 1991b
	Proposed 6 new monitoring wells	Installed MW-6 through MW-11 in September and October 1991.	
	Proposed groundwater sampling: 1 round at 11 wells, 2nd round at new wells 30 days later. Analyze for VOCs and also for dissolved metals in upgradient well.	Isoconcentration maps from October 1991 show total volatile organic compounds in shallow interval and deep aquifer.	
	Proposed 72-hr pump test to characterize hydraulic communication between shallow interval and deep aquifer, hydraulic conductivity and transmissivity of deep aquifer.	Pump test was never performed.	
Nov. 1991, May 1992	Water level study	< 2 ft seasonal change in shallow groundwater elevation; hydraulic gradient is to N. About 1 ft seasonal change in deep groundwater elevation; hydraulic gradient is to NE.	ESE 1993
Sept. - Oct., 1993	Partial excavation of Trenches A and B.	Evidence of Chemical Warfare Materials (CWM); work halted; trenches backfilled and capped with soil; site secured.	OHM 1993b
Sept. - Oct., 1993	Soil sampling (stockpiled soil and bottom and sides of Trench A); groundwater sampling from 10 MWs.	TCE and tetrachloroethane in soils and groundwater; adamsite up to 14 ppm in soil samples.	OHM 1993b
Spring 1994	GPR and EMI survey of wetlands and disposal area.	Identified four large areas (A-1 through A-4) of significant anomalies in the disposal area, indicating burial sites. Evidence of minor anomalies in the wetlands.	USACE 1994a
June 1994	Finding of No Significant Impact and Environmental Assessment	Determined the proposed removal action would have no significant impact on wildlife, human health or cultural resources, and an EIS is not needed.	USACE 1994b
Jul.-Oct. 1994	Phase 2 removal action.	Solid waste and contaminated soil in Areas A-3, A-4, and at toe of hill were removed. Areas were backfilled with excavated soil. Areas A-1 and A-2 were covered with borrow soil and fenced.	OHM 1994a; Cansler & Hudson, pers. comm.
Jul.-Oct. 1994	Phase 2 soil confirmation sampling.	Soil action levels are TCE 600 mg/kg, PCE 100 mg/kg, and tetrachloroethane 30 mg/kg.	OHM 1994a
June 1995	GPR and EMI survey of disposal area.	Surveyed Disposal Areas to determine if any suspicious material remained in recently excavated areas and to more accurately define anomalous zones in areas not excavated in 1994.	CRREL, 1995

TABLE 1-2
MATERIALS FOUND BY OHM DURING EXCAVATION OF AREAS A-3 AND A-4

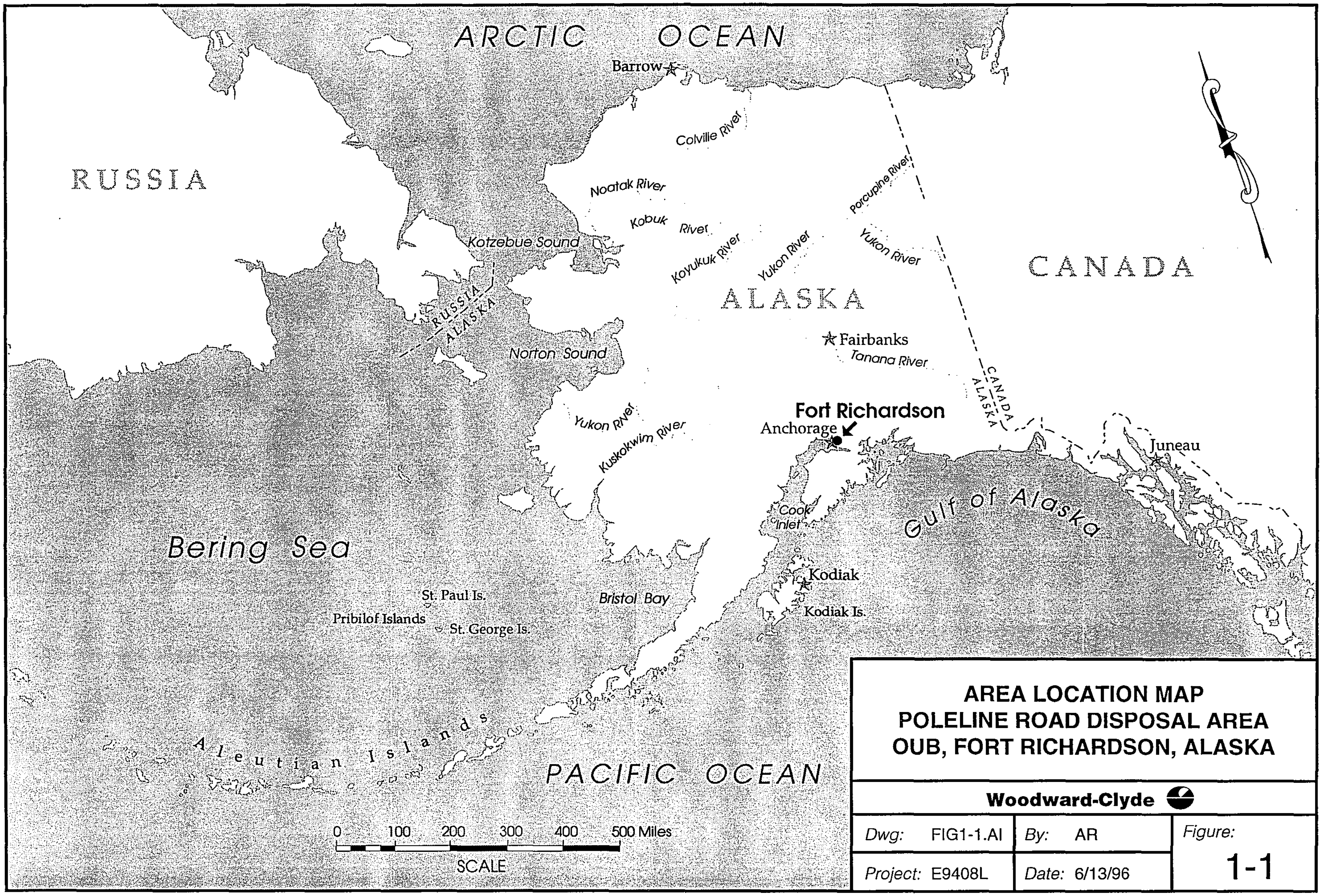
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Quantity	Item Found
1	Radiation Dosimeter Kit
Several	Empty Chemical Agent Identification Set (CAIS) Unit
Several	Carbon Filter Canisters
unk.	Scrap Metal
3	Full CAIS Unit
Several	Rusted Drums and Drum Lids
Several	Wood DANC Crate Parts
3	White Phosphorus Smoke Grenade
11	Lecture Bottle
1	8" x 3" Amber Bottle with 2" of Clear Liquid
	Wood Debris
2	Rusted drums with Unknown Molasses Type Material
1	Full, Unopened Case of HC Smoke Canisters
Several	Small Vials of "Eye Decon Solution"
9	Full or Partially Full Amber Bottles Labeled HD Toxic Gas Set M-1
5	Empty Unmarked Clear Bottles
1	24 oz. Amber Bottle with Small Amount of Clear Liquid
3	Artillery Round Fuses
100's	Small Medicine Vials Containing Aureomycin, Rabies Serum, and Gangrene Serum
3	One-Gallon Size HC Smoke Pot
7	HC Smoke Grenade
Several	Oily Soil, Pails, and Funnels
Several	Flame Thrower Canisters and Parts
Several	Atropine Injection Kits
1	Empty Bakelite CS Grenade
1	Bazooka Rocket Warhead
1	Smoke Grenade Fuses
43	M51 Type Artillery Round Fuses
1	Small Bottle Marked CN
1	76mm Artillery Round Warhead
4	Nose Fuses
8	Rifle Grenades, Intact
6	Empty 105mm Casings
16	Rifle Grenade Tail Booms
27	Aluminum Grenade Bodies
1	Fire Starter
3	Empty 75mm Casings
85	Rifle Smoke Grenades
2	M18 Smoke Grenades

TABLE 1-2 (CONTINUED)

Quantity	Item Found
1	Rifle Grenade Fuse
2	105mm Artillery Rounds with High Explosives
Several	CN ID Set Bottles
1	1/2 Gallon Intact Amber Jar
1	5-Gallon Pail with Water Reactive Granular Solid that Reacts with Moisture in Air
2	M60 Machine Gun Belts with Unfired Blanks
2	Tail Fins for 250 or 500 lb Bombs
24	Small Bottles Marked HCL
1	Wood Crate Marked "Hydride Charge"
1000's	Mustard and Lewsite Detector Kit Tubes

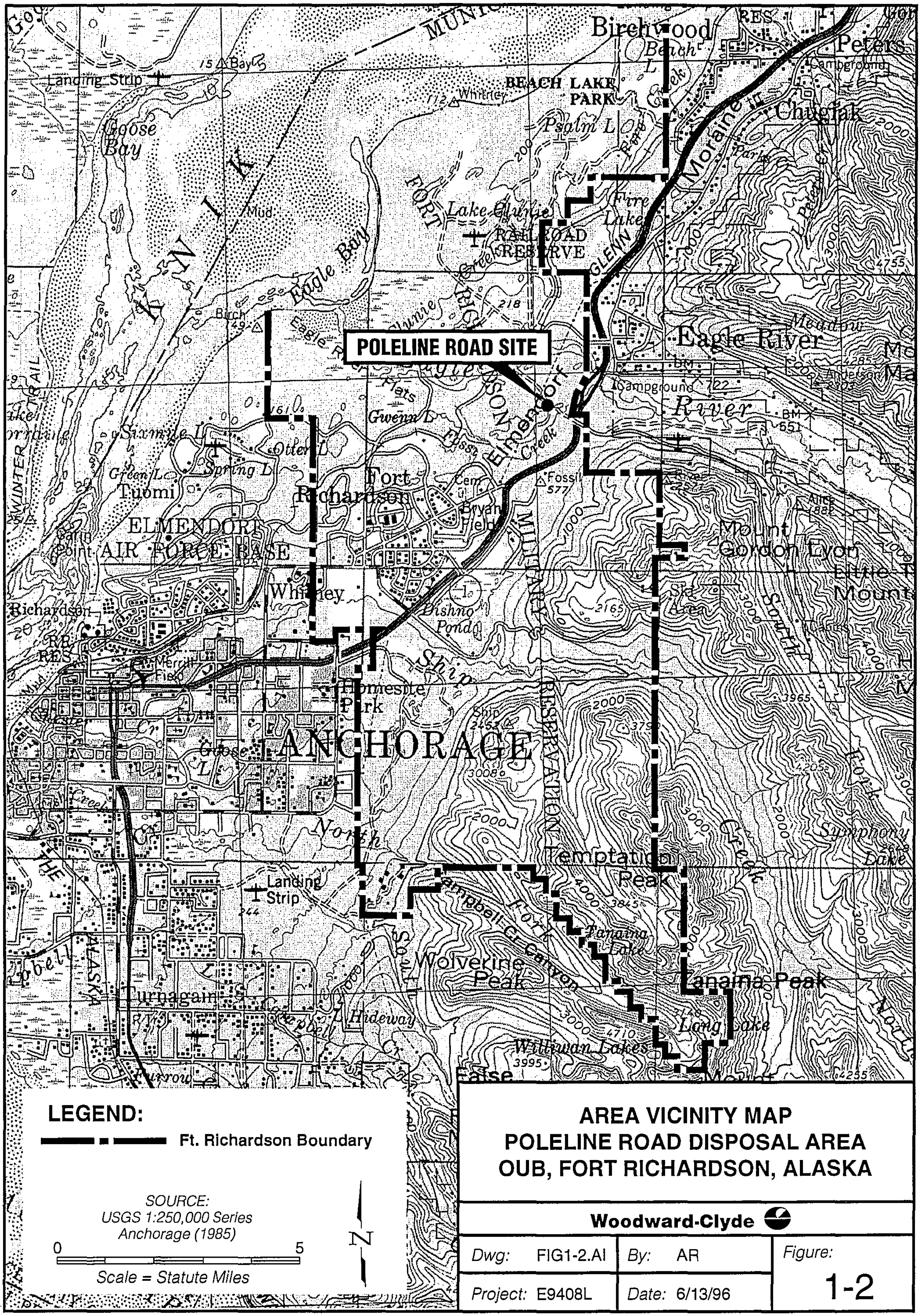
Notes:
" - inch
oz. - ounce
mm - millimeter
lb - pound



AREA LOCATION MAP
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG1-1.AI	*By:* AR	*Figure:* 1-1
Project: E9408L	*Date:* 6/13/96	



LEGEND:

▬ ▪ ▬ Ft. Richardson Boundary

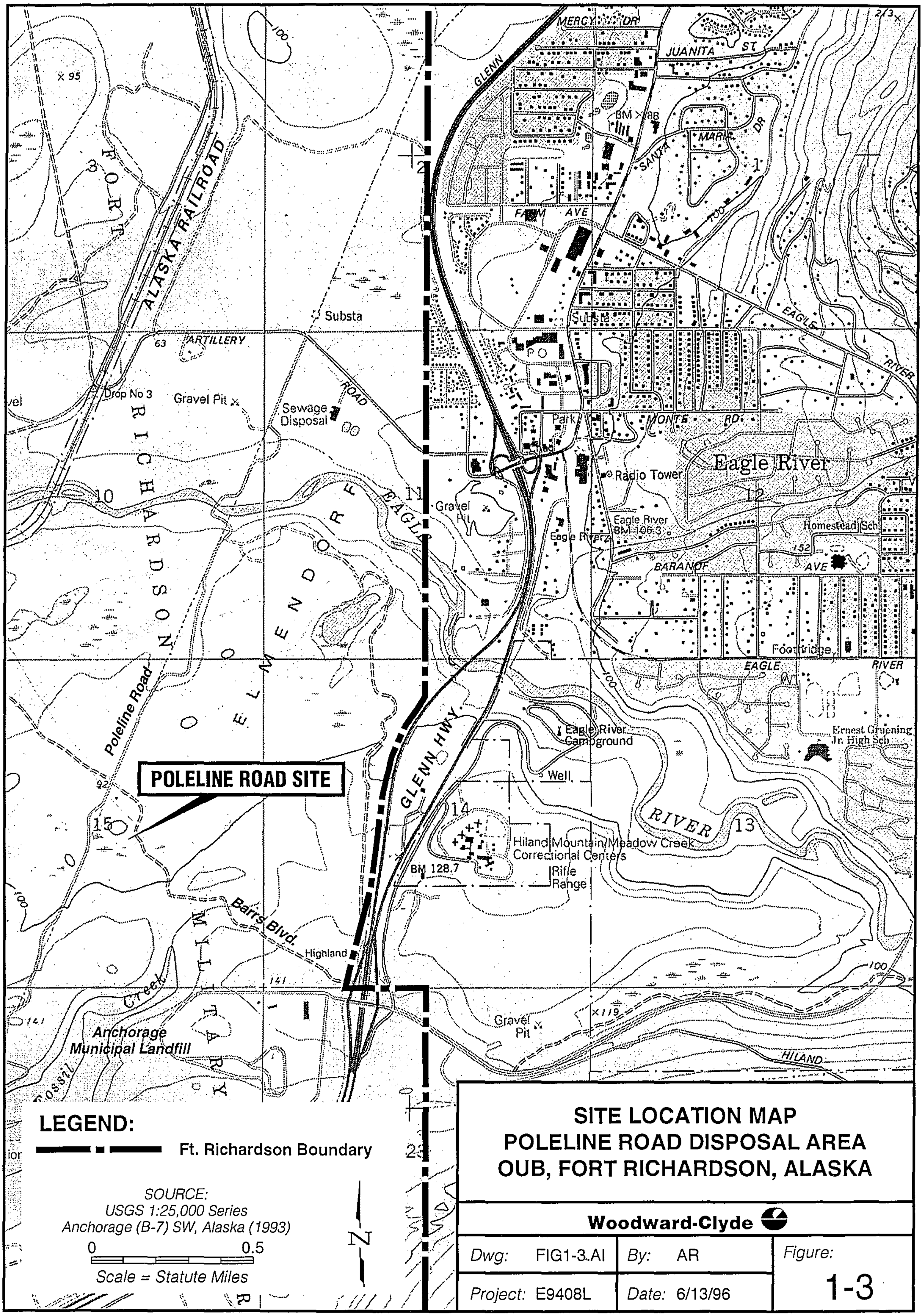
SOURCE:
USGS 1:250,000 Series
Anchorage (1985)

0 5
Scale = Statute Miles

AREA VICINITY MAP
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

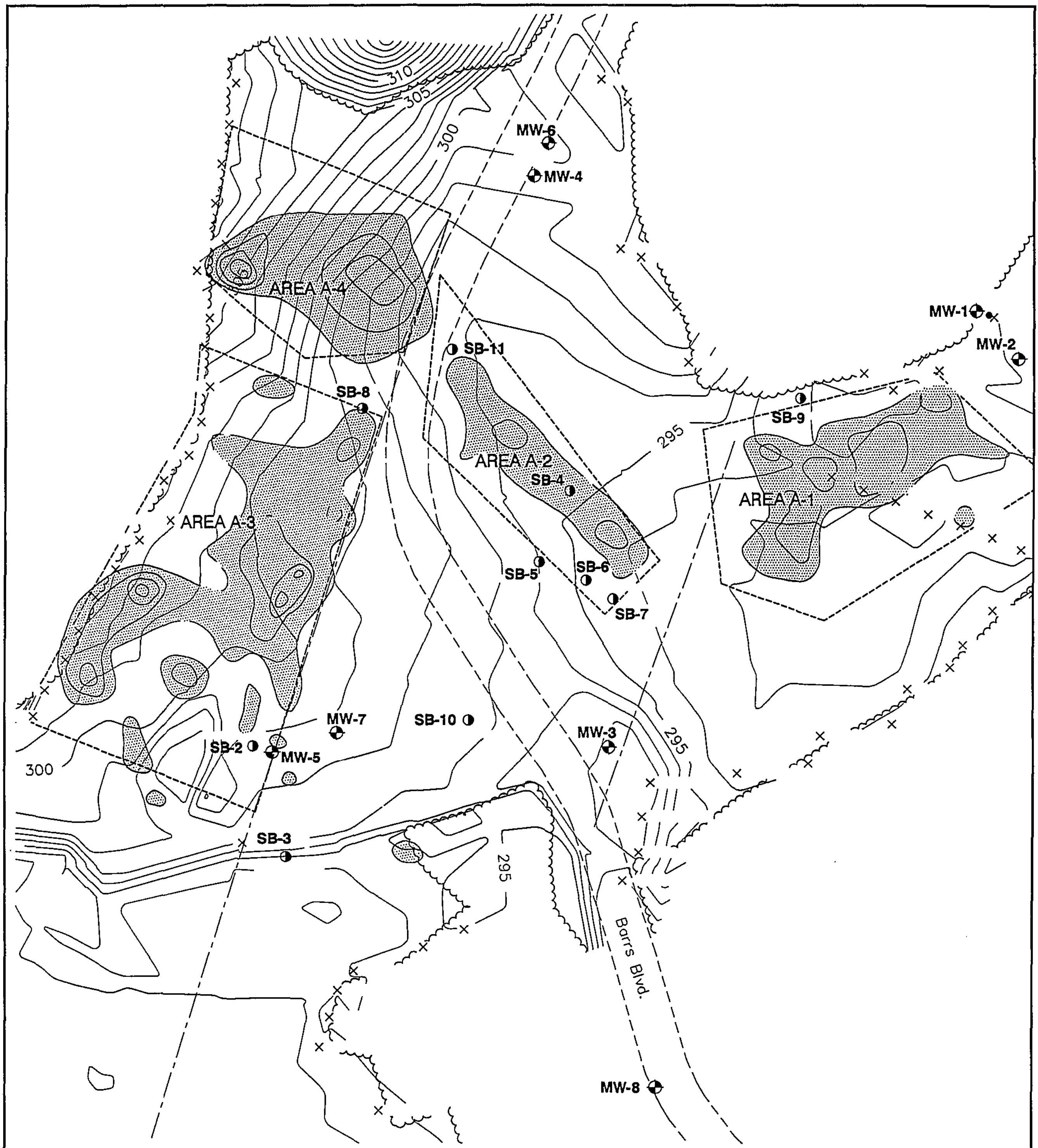
Dwg: FIG1-2.AI	*By:* AR	*Figure:* 1-2
Project: E9408L	*Date:* 6/13/96	



SITE LOCATION MAP
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

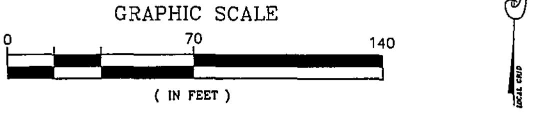
Woodward-Clyde

Dwg: FIG1-3.AI	By: AR	Figure:
Project: E9408L	Date: 6/13/96	1-3



LEGEND:

▨	EMI Anomalies
● MW-8	Monitoring Well
◑ SB-2	Soil Boring
⌒⌒⌒⌒⌒	Treeline
--------	Disposal Area Boundary

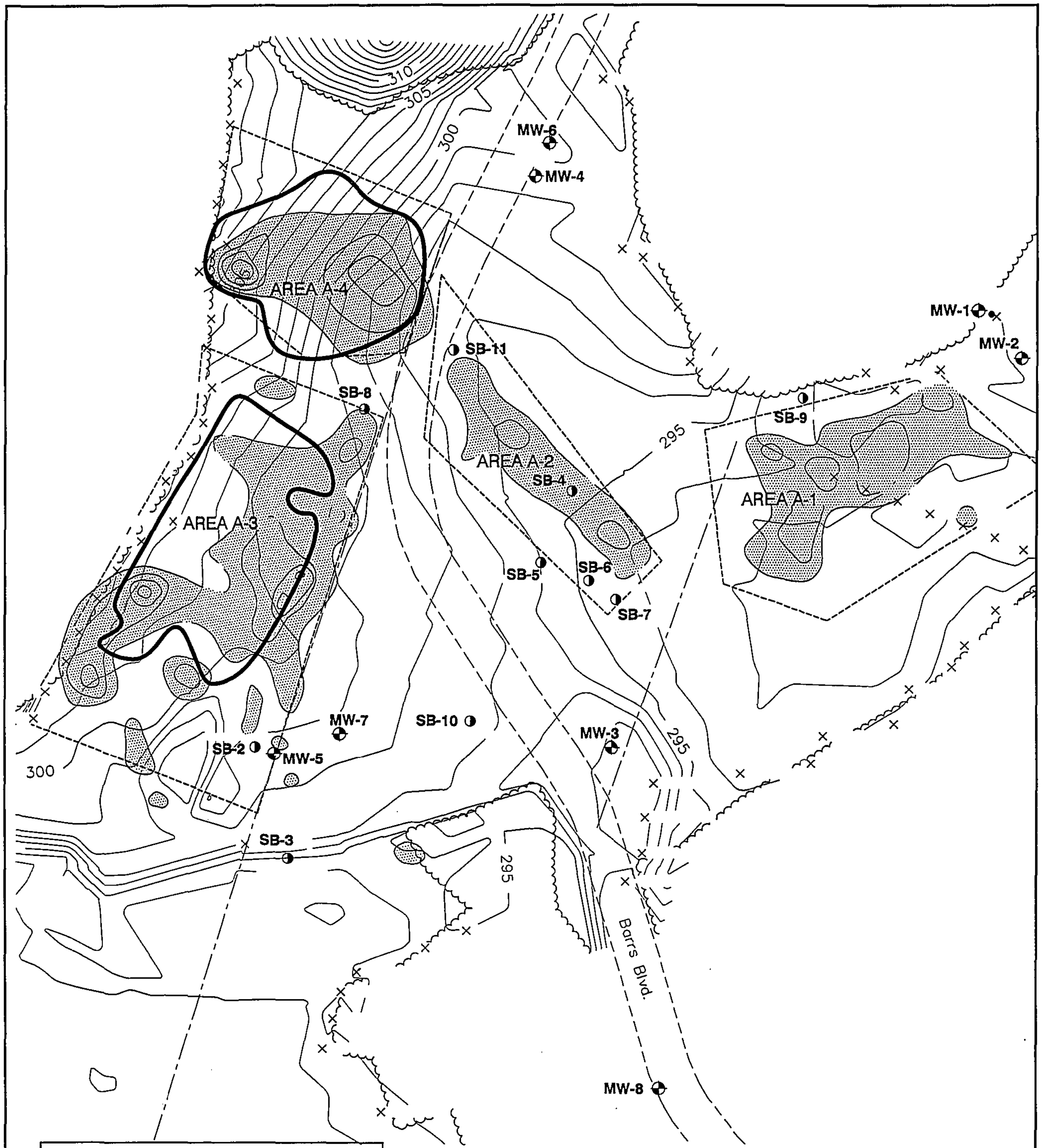


Borings and Wells were installed by ESE, 1990-1991.

1994 CRREL GEOPHYSICAL SURVEY
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG1-4.DWG	*By:* AR	*Figure:* 1-4
Project: E9408L	*Date:* 6-28-96	



LEGEND:

▨	EMI Anomalies
⊕ MW-8	Monitoring Well
◑ SB-2	Soil Boring
⌒⌒⌒⌒	Treeline
-------	Disposal Area Boundary
~	Excavated Area Boundary

GRAPHIC SCALE

0 70 140

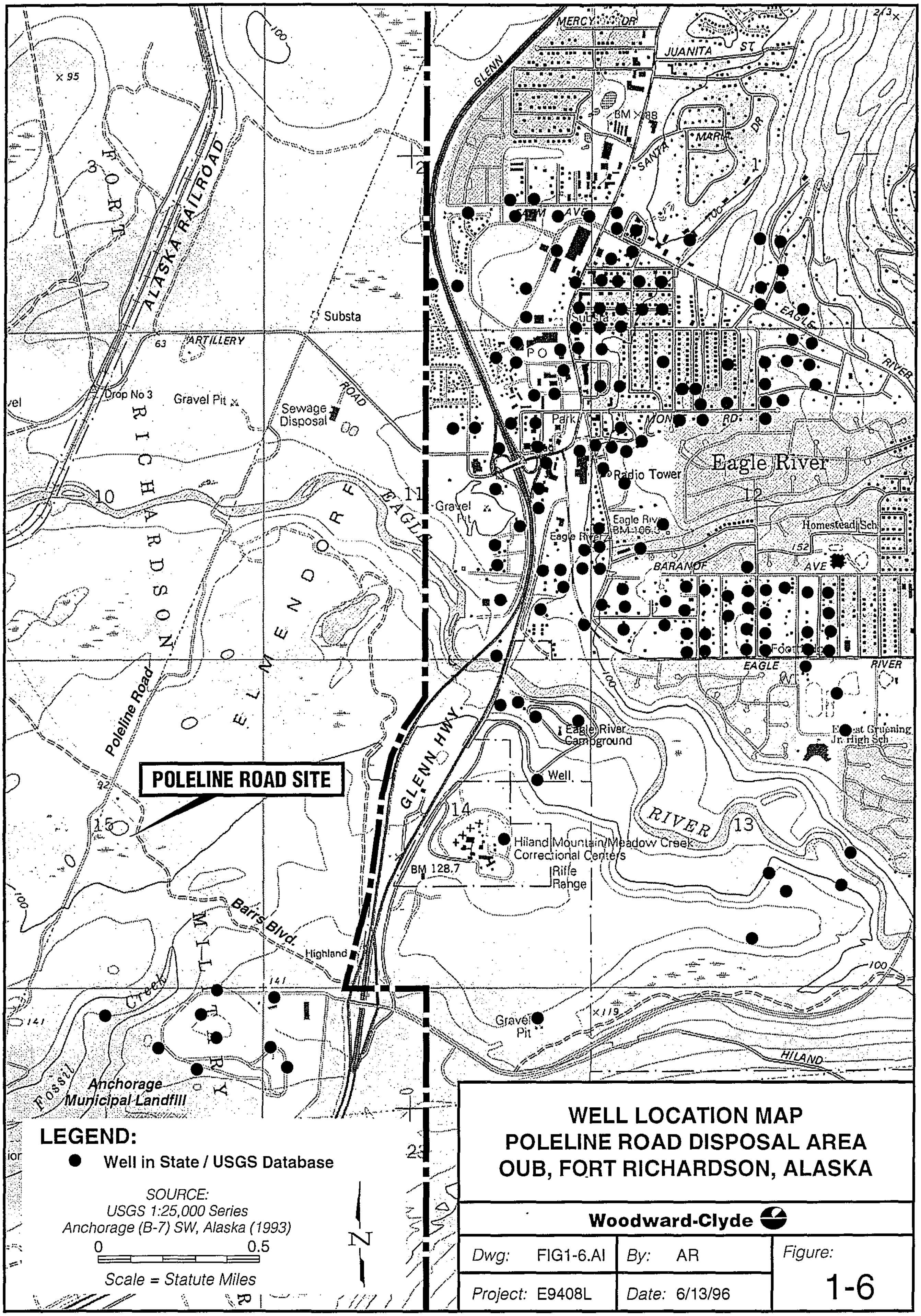
(IN FEET)

Borings and Wells were installed by ESE, 1990-1991.

OUTLINE OF EXCAVATED AREAS
1993-1994 REMOVAL ACTION
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG1-5.DWG	*By:* AR	*Figure:* 1-5
Project: E9408L	*Date:* 6-28-96	



LEGEND:

● Well in State / USGS Database

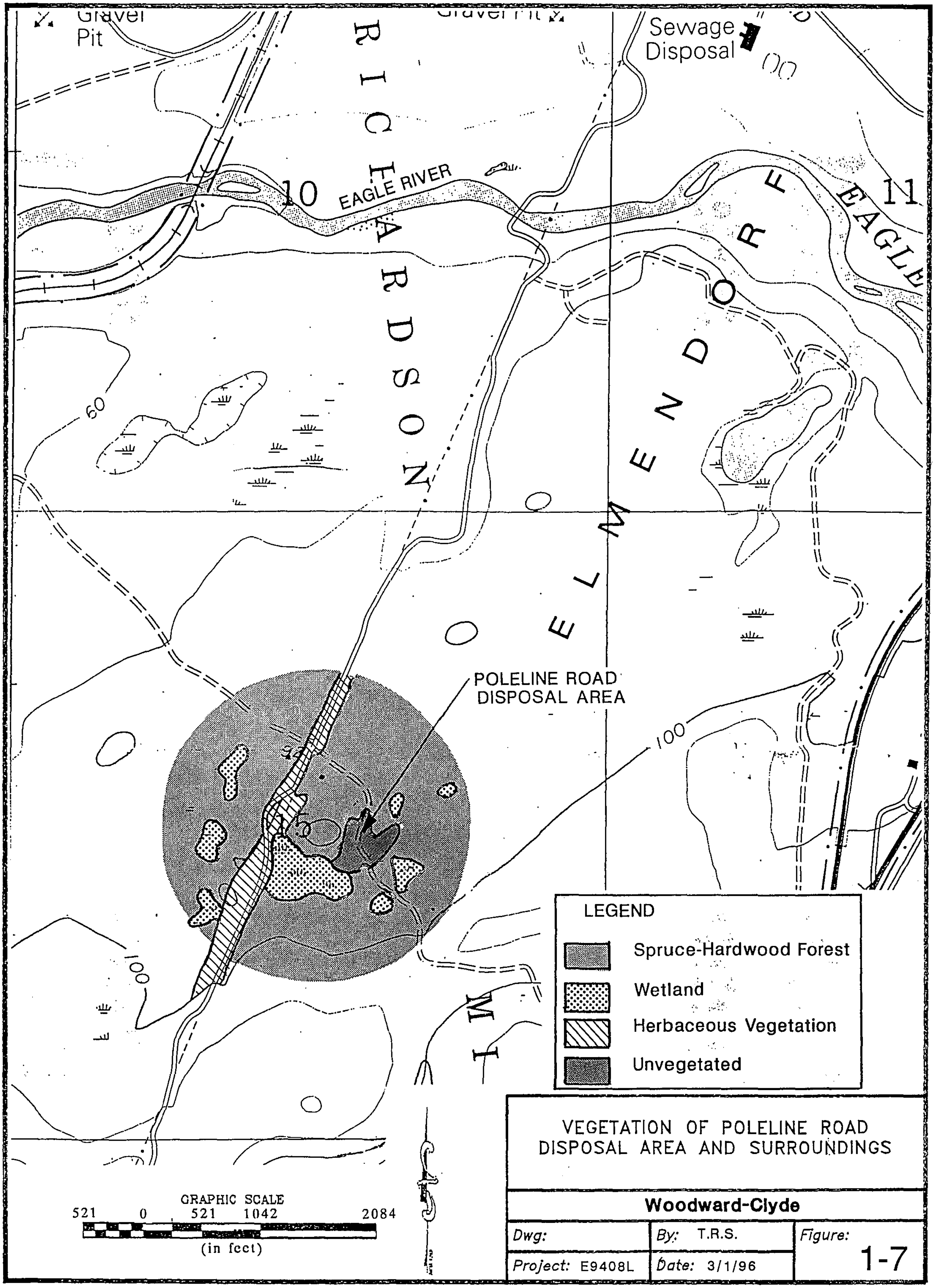
SOURCE:
USGS 1:25,000 Series
Anchorage (B-7) SW, Alaska (1993)

0 0.5
Scale = Statute Miles

WELL LOCATION MAP
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG1-6.AI	By: AR	Figure: 1-6
Project: E9408L	Date: 6/13/96	



VEGETATION OF POLELINE ROAD DISPOSAL AREA AND SURROUNDINGS

Woodward-Clyde

Dwg:	*By:* T.R.S.	*Figure:* 1-7
Project: E9408L	*Date:* 3/1/96	

E9408LTB

2.0
FIELD PROCEDURES AND METHODS

This section describes the procedures and methods used during the field investigation at the PRDA. The field investigation was performed in accordance with the RI Management Plan except where otherwise noted in this section. Section 4.0 discusses the numbers and locations of each type of sample collected.

2.1 SOIL SAMPLE COLLECTION

Subsurface soil samples were collected by advancing hollow-stem augers to the top of the desired sampling depth and then pushing a split spoon through the sampling interval. The split spoon was 24 inches long, 2-1/2 inches in diameter, and made of stainless steel. The split spoon was driven in to the soil using a 140-pound hammer. An 18-inch long split spoon was used to sample soils while drilling the deep well and a 300-pound hammer was used to drive the 18-inch split spoon into the soil. Samples were visually inspected and the geological descriptions logged in the field logbook. Geological descriptions are provided on boring logs in Appendix III. Soil cuttings were collected in steel drums. The split spoon was decontaminated after every penetration attempt regardless of recovery (Section 2.12).

Screening samples were collected at 3- foot intervals. Each sample was first screened with a hand held photo ionization detector (PID) (Section 2.11.3). Each sample was then screened for mustard using a miniature continuous air monitoring system (MINICAMS) (Section 2.11.2) operated by a subcontracted surety laboratory (Battelle). Each sample was screened for chlorinated solvents by a field gas chromatograph with an electrolytic conductivity detector (ELCD), after receiving a negative result for the mustard screen. The field GC was operated by Columbia Analytical Services, Inc. A list of analytes measured by the field GC is included as Table 3-1. Soil samples collected while drilling the deep monitoring well (MW-16) were collected at 5-foot intervals and screened with the PID and field GC only. None of the samples from MW-16 were analyzed for mustard on-site.

Soil intended for nonvolatile analyses was placed into a stainless steel bowl and thoroughly homogenized using a stainless steel spoon. Containers for nonvolatile analyses were filled at least three quarters full when possible. Soil was transferred to the sample containers using a stainless steel spoon. Larger rock fragments were removed from the sample, and only the finer grained matrix material (approximately 1/4-inch diameter and smaller) was submitted for analysis.

The soil intended for analyses of volatile organic compounds (VOCs) was not homogenized because of volatilization that could occur during the process. The soil was instead collected in discrete grab samples. Soils for VOC analyses were the first to be collected from each sample interval, and containers were packed full and tight to limit head space.

Ten percent of screening samples were shipped to an off-site laboratory for analysis. Samples for off-site laboratory analyses were intended to be collected from locations where the presence of solvents was suspected and from areas that were suspected to be clean. However, most of the soil samples outside of Areas A-3 and A-4 did not contain elevated concentrations of solvents. Therefore, off-site laboratory samples were selected from various depths and locations around the site, generally where a sufficient sample volume could be obtained.

2.2 SHALLOW MONITORING WELL INSTALLATION

A hollow-stem auger drill rig was used to install the shallow monitoring wells. Wells were installed and completed by Tester Drilling Services, Inc. Soils were sampled, field-screened, and logged during drilling as described in Section 2.1. Boring locations were screened for unexploded ordnance as described in Section 2.11.1. Soil cuttings from the borings were collected in 55-gallon steel drums. Equipment that came into contact with contaminated soils was decontaminated before and after use (Section 2.12).

Once the augers had been advanced to the desired depth, a 4-inch stainless steel well screen and a riser pipe were lowered into the borehole. The base of the screen was placed at the top of a lower permeability unit to allow potential dense non-aqueous phase liquids (DNAPLs) to enter the screen. Clean silica sand was placed in the annular space between the screen and the augers. The augers were slowly pulled upward, allowing the sand to fill the annular space between the wall of the borehole and the screen. The sand pack was placed so that it extended two feet above the top of the well screen. A bentonite seal was placed above the sand pack to the ground surface. Water was added to hydrate the bentonite seal. An 8-inch diameter protective steel casing was installed around each well and was topped with a locking cap. The riser pipe was capped with a well seal designed for the dedicated sampling pumps. The well seal has a connection for the pump controller, sample outlet port, and a water level measurement port.

Only five of the six planned shallow monitoring wells were installed. The well that was intended for installation in the wetlands was not installed because of the US Army's restrictions on access to and disturbance of the wetlands. Monitoring well construction details are presented on Table 2-1, and monitoring well completion logs are included in Appendix III.

2.3 DEEP MONITORING WELL INSTALLATION

The deep monitoring well (MW-16) was installed using an air rotary drill rig. Soils were sampled, field-screened, and logged during drilling as described in Section 2.1. Drill cuttings from the boring were collected in 55-gallon steel drums. Equipment that came into contact with contaminated soil was decontaminated before and after use (Section 2.12).

The boring was advanced to the top of a lower permeability layer using a 10-inch bit. A 10-inch steel casing was advanced with the bit. The bit was removed and then the casing was grouted in place to isolate the upper water bearing zone from any lower water bearing zones. The grout was allowed to set for over 24 hours. Drilling continued using a 6-inch bit inside the casing until the bit had penetrated approximately 1 foot into bedrock. A small amount of drilling soap was used to lubricate the hole while drilling MW-16. The drill soap was an environmentally safe drill soap, designed for use while drilling groundwater monitoring wells.

A prepacked stainless steel well screen and riser pipe (2-inch diameter) were installed in the boring after removing the drill bit and rods. The well screen was installed slightly above the bedrock to allow the sampling of the same groundwater as in existing deep wells on site. Clean silica sand was placed in the annular space between the screen and the borehole wall to a height of 2 feet above the top of the well screen. A 2-foot thick bentonite seal was placed above the silica sand. The riser pipe was grouted in place with a bentonite slurry. A well seal was placed on the top of the riser pipe and a locking cap was installed on the top of the casing. Monitoring well construction details are presented on Table 2-1, and a monitoring well completion log is included in Appendix III.

2.4 MONITORING WELL DEVELOPMENT

The monitoring wells were developed in accordance with the ADEC document *Recommended Practices for Monitoring Well Design, Installation, and Decommissioning*, (January 1991). Development removes any fluids introduced into the well during installation, stabilizes the filter pack and formation materials opposite the well screen, and minimizes the amount of fine materials entering the well. Development also maximizes the efficiency of the well and the inflow of water to the well.

The monitoring wells were developed by purging with a hand operated pump and surging with a surge block. Water was then pumped from the wells until five well volumes were removed or the water was sediment free. Development water was collected in steel drums.

2.5 GROUNDWATER SAMPLE COLLECTION

Static groundwater level measurements were taken prior to sample collection. An electronic water level indicator was used to measure the distance between a surveyed mark on the top of the well casing, and the water surface. After ground water levels were recorded, each well was checked for the presence of DNAPLs using all three of the following methods, and in the following order:

- An interface probe was slowly lowered into each well. If a phase change was detected, the depth of the phase change was recorded.

- A white cotton string weighted with a steel socket was lowered to the bottom of each well. The string was slowly removed and the bottom of the string was inspected for staining. If present, the length of the staining was measured.

- A clear PVC bailer was lowered to the bottom of each well. The bailer was raised and the contents visually inspected for phase changes. If separate phases were present, the thickness of each phase was measured.

A dedicated submersible pump was install in each monitoring well after checking for DNAPLs. The pumps are 2-inch diameter variable frequency Grundfos Redi-Flo 2 with Teflon leads and Teflon sample tubing. Pumps were not installed in monitoring wells MW-10 and MW-11 because they historically have been dry. Power cables leading from the pump to the ground surface were connected to a seal at the top of the well. The seal has electrical connections for the attachment of a pump controller, and a discharge port for the groundwater.

The volume of water in each well was determined by subtracting the depth to groundwater from the total depth of the well and multiplying that value by 0.16 gallons per foot (gal/ft) for 2-inch wells or 0.66 gal/ft for 4-inch wells. Three well volumes were purged from each well at a rate of approximately 1 liter/minute. Water quality parameters were measured after each well volume by pumping water into clean glass containers and using appropriate field instruments to record specific conductance, dissolved oxygen, and turbidity. If these parameters had not stabilized to approximately 10 percent over two measurements, an additional two well volumes were purged. All purged groundwater was collected in steel drums and stored on pallets.

The pump was turned down to the slowest rate possible after purging was complete. Vials for the volatile analyses were filled at this slow flow rate to avoid turbulence that could volatilize target compounds. The remaining sample jars were filled at a higher flow rate. Metals samples were collected as both total and dissolved metals. The dissolved metals samples were collected by attaching a 0.45 micron in-line filter to the discharge port of the submersible pumps. New filters were used for each sample collected.

2.6 WELL POINT SAMPLE COLLECTION

Stainless steel well points were installed in the shallow borings to collect groundwater samples. The intended procedure as described in the management plan was to push the well points into the soil after the drilling augers reached the water table; however, the soil was too hard to push the wellpoints. Therefore, the borings were drilled just into the water table and the well points were placed in the borings so that the screen was partially submerged.

A clear Teflon bailer was used to purge and sample the groundwater. A new bailer was used for each sample. The groundwater samples were screened for chlorinated solvents using the on-site GC. The groundwater samples were not screened for mustard since mustard hydrolyzes in water. Several samples were selected and sent to the off-site laboratories. These samples were collected from well points that produced sufficient quantities of water to fill the necessary bottles within a reasonable amount of time. Purge water was collected in steel drums. The well point was removed after collecting the groundwater sample and decontaminated prior to use at the next borehole (Section 2.12).

2.7 SURFACE WATER SAMPLE COLLECTION

Surface water samples were collected by dipping a sample bottle directly into the surface of the water. The samples were collected slowly to avoid the entrainment of organic materials and air. When the water depth prevented the direct filling of a sample jar, a stainless steel ladle was used. The ladle was decontaminated prior to each use (Section 2.12).

Surface water samples were collected prior to the sediment samples. Care was taken not to disturb the area around the surface water sample collection point prior to sample collection.

Field measurements, including pH, temperature, and conductivity, were taken on all surface water samples collected in the wetlands area. Mustard screening were not performed on surface water samples because mustard readily hydrolyzes in water. All surface water samples were shipped off-site for laboratory analyses.

2.8 SEDIMENT SAMPLE COLLECTION

Sediment samples were collocated with surface water samples. The surface water sample was collected first at each location. Sediment samples were collected with a hand auger. Vegetation and organic material were removed prior to sediment sampling. Samples for VOC analyses were collected first. The remaining sediment was homogenized in a stainless steel bowl and sampled for the other analyses. The hand auger, stainless steel bowl, and all other equipment used was decontaminated prior to each use (Section 2.12).

Field GC screening and mustard screening were not performed on sediment samples. All sediment samples were shipped off-site for laboratory analysis.

2.9 BOREHOLE GEOPHYSICS

Arctic GeoScience Inc. (AGSI) conducted borehole geophysical surveys in each of the 17 groundwater monitoring wells. Gamma ray surveys were performed on six monitoring wells that were completed with stainless steel casing. Conductivity and gamma ray surveys were performed on 11 groundwater monitoring wells that were completed with PVC casing. All gamma ray and conductivity logs were measured from the top of the well casing to the total depth reached by the measurement point of the tool. The gamma ray measurement point is 2 inches from the bottom of the tool and the conductivity measurement point is 27 inches above the bottom of the tool.

2.10 GEOPHYSICAL SURVEY

A geophysical survey was performed by CRREL in March 1994 (Section 1.1.2.2). The survey was conducted over the main disposal area and the wetlands. Although the survey was successful in delineating disposal Areas A-1 through A-4, small dispersed objects in the adjacent unexcavated areas and in the wetlands could not be positively identified.

A more detailed geophysical survey (using a tighter grid) was performed in June 1995 to better define the sources of geophysical anomalies in Areas A-1 and A-2, and to confirm the removal of buried debris in Areas A-3 and A-4. The survey was conducted by CRREL, and was coordinated by the USACE. A complete detailed description of the methods used in the geophysical survey are provided in Appendix XI.

Ground penetrating radar (GPR) and electromagnetic induction (EMI) methods were used in the geophysical survey. The GPR survey utilized pulses at both 400 and 100 megahertz (MHz) for shallow and deeper probing, respectively. The depth to each target was estimated from the two-way travel time of the radio waves. The EMI survey was used to detect buried metallic objects by measuring the relaxation response of subsurface materials to an electromagnetic pulse. The two methods complimented each other and provided information on the character of subsurface materials.

2.11 FIELD SCREENING

This section describes the field screening procedures used at the site. Field screening was performed for health and safety purposes, and to locate areas with elevated concentrations of VOCs and mustard.

2.11.1 Explosive Ordnance

Boring locations were screened for ordnance to a depth of 6 feet, below which the presence of ordnance was unlikely based on the results of the geophysical surveys. Once a boring location had been marked, ordnance locator personnel screened the area for buried metallic objects. Ordnance locator services were provided by EOD Technology, Inc. If any metal was detected, the boring location was moved and a new site was cleared. After drilling and sampling 3 feet, the drill rig and augers were pulled back from the hole and ordnance personnel screened down the hole for buried metallic objects using a downhole ordnance locator. The drill rig was set back on the hole once the hole had been cleared. This process was repeated at the 6-foot level, clearing the hole to approximately the 9-foot level. If the ordnance personnel cleared the hole at the 6-foot depth, drilling continued with no additional ordnance screening. The results of the ordnance screening were recorded in the log book.

2.11.2 Mustard

Soil samples were screened on-site for mustard by Battelle, a subcontractor, using the MINICAMS. A MINICAMS is a specialized portable GC equipped with a flame photometric detector (FPD) calibrated for the detection of mustard. Water samples were not screened for mustard since mustard hydrolyzes in water. A split of each soil sample was placed in an oven and heated to 70 degrees Celcius (°C) for at least two hours but no longer than four hours. The gasses inside the oven were then analyzed for mustard. Multiple samples were analyzed during each run. A positive result would have required screening each soil sample separately to determine which of the samples were contaminated with mustard.

The additional jars for each sample were not forwarded to the field GC or to any laboratory until the jars for mustard analysis were screened and cleared. If mustard had been detected, the U.S. Army's Explosive Ordnance Division (EOD) would have been notified and the samples held until further notice.

2.11.3 Photoionization Detector

All subsurface soils were screened for VOCs using a PID. The PID was fitted with an 11.7 electron-volt lamp for the detection of chlorinated solvents. Table 3-1 includes analytes measured by the field GC. The PID was calibrated using a 58 parts per million (ppm) isobutylene standard at the beginning of each day. Calibrations results were recorded in the field logbook.

Immediately upon opening a split spoon, several cuts were made in the soil with a decontaminated stainless steel knife. The PID probe was inserted into a cut and a reading was taken. Organic vapor readings were recorded in the field logbook.

2.11.4 Halogenated Solvents

A GC was used to field screen samples for halogenated solvents. Table 3-1 includes analytes measured by the field GC. The GC was equipped with dual electrolytic conductivity detectors (ELCD). Prior to GC injection, the samples were concentrated using a headspace analyzer. Since halogenated solvents are chromatographically represented by a single peak, a second column was used for confirmation.

2.11.4.1 Equipment

An HP5890 temperature programmable GC was equipped with two capillary columns (a DB624 and a VRX). Each column was 30 meters long and 0.45 millimeters (mm) in diameter. A Tekmar 7000 headspace analyzer was used for sample injection into the GC. The data system was a HP Chemstation Chromatography Workstation with multichannel operation.

2.11.4.2 Field Screening Procedures

Concentrated standards were purchased and diluted to working standards in methanol. These working standards were then analyzed at the parts per billion (ppb) concentration level. Standards at ppb concentration levels were prepared daily.

Ten grams of soil (10 milliliters [ml] for water samples) were weighed into a 23 ml headspace vial, 3 grams of sodium chloride were added, and then distilled water was added to bring the aqueous layer up to a consistent level. Surrogate was then added to the vial which was immediately capped with a septum and crimper. The standards and samples were allowed to equilibrate in the headspace analyzer for at least two hours at 90°C prior to injection into the GC. The sample results were calculated by comparing the relative response (area) of the standards to the response of the sample.

2.12 DECONTAMINATION PROCEDURES

Sampling equipment used during the field investigation was decontaminated prior to use. Split spoons were decontaminated after each penetration attempt regardless of recovery. Soil remaining in the split-spoon after sampling was put into a soil cuttings drum. The spoon was then washed in a 5 to 10 percent bleach solution to neutralize potential chemical warfare materials. A scrub brush was used to remove any material remaining on the spoon. A second stage scrubbing in an Alconox (low phosphate, laboratory-grade detergent) solution removed other contaminants. The spoon was rinsed in a bucket of tap water and then with deionized water using a portable sprayer. The stainless steel sampling spoon, the stainless steel homogenizing bowl, stainless steel ladle, and the hand auger were all decontaminated in the above manner. All decontamination fluids were collected and stored in steel drums.

Drilling equipment was decontaminated prior to use at each sampling location. Hollow stem augers, drill bits, drill rods, auger plugs, and other tools were taken to a decontamination pad that had been constructed from lumber and plastic sheeting. The equipment was cleaned using a steam washer. Decontamination water was collected from the pad and stored in steel drums.

Borehole geophysics logging equipment was decontaminated prior to use at each monitoring well. The probes and cable were washed with an Alconox solution followed by a double rinse of tap water and a distilled water rinse. A minimum of 110 percent of the measured well depth of the cable lowered into the well was decontaminated.

2.13 SAMPLE HANDLING AND DOCUMENTATION

This section describes the types of sample containers, the preservation methods, and the holding times for samples collected. This section also includes the procedures for sample storage, packaging, shipping, labeling, and documentation. Also included are the chain-of-custody procedures.

2.13.1 Sample Containers

Soil and water samples were collected in glass and plastic containers. The containers had screw-type lids to assure the adequate sealing of the bottles. The lids included Teflon inserts to prevent sample reaction with the lids and to improve the quality of the seal.

The containers were pre-cleaned and certified under chain-of-custody. Commercially-available precleaned jars were used. A bottle wash analysis was performed on each lot of containers. A certificate of analyses was included in each box of containers. The certificates were reviewed and will be archived in the central project file for a period of five years.

The project laboratories provided containers, including preservatives when necessary. Containers for quality assurance (QA) samples were obtained from Alaska Scientific, Inc. Project and QA laboratories are listed in Section 2.13.3.3. A label was fixed to each sample container. On each label the following information was recorded:

- project number
- type of analysis required
- sample date
- sample time
- name of sampler
- type of preservative

The specific container types, volumes, and number of containers used for each analysis are provided in Table 2-2.

2.13.2 Sample Preservation And Holding Times

All samples were placed in a cooler and refrigerated (on frozen gel-ice) immediately upon sample collection to retard physiochemical and biochemical changes. Holding times, chemical preservation, and sample container type for the analyses performed during the investigation are shown in Table 2-2. Hydrochloric acid (HCl) was not used as a preservative during the project. If mustard breakdown products were present in a sample, the addition of HCl could have produced mustard.

2.13.3 Sample Storage, Packaging, And Shipment

2.13.3.1 Sample Storage

Samples were placed in a secure area or remained in the possession of the sampling personnel for the duration of each sampling phase. After collection, during storage, and during shipment, samples were kept in coolers on gel-ice at approximately 4°C. Samples were stored at 4°C in a locked office trailer while waiting for results of surety analyses.

2.13.3.2 Shipping Containers

All sample containers were placed inside a plastic cooler with a hard plastic liner. The shipping containers were sufficient to prevent any leaks or spills from any broken sample containers. If the cooler contained a drainage hole, the valve was shut and sealed with tape. The shipping container was cleaned between shipments to prevent cross-contamination.

A chain-of-custody form was placed in each shipping container. The lids of the coolers were tightly closed and securely taped shut. Two custody seals were signed and dated, and affixed to each shipping container. One custody seal was placed across the right front of the lid and one seal was placed across the left rear of the lid.

2.13.3.3 Packaging and Shipping Samples

Sample packaging and labeling conformed to the requirements of Appendix F of USACE Environmental Regulation ER-1110-1-263. Glass sample containers were wrapped and cushioned in plastic bubble wrap and then placed in plastic bags that had a minimum thickness of 2-mil. Plastic containers were put in the 2-mil thick plastic bags. All caps were secured tightly. Gel-ice was placed in the coolers in a manner to ensure adequate and equal cooling for all samples. Sample containers were supported with bubble wrap to prevent movement within the cooler during shipping.

Samples were shipped to the project laboratories and to North Pacific Division Laboratory (NPDL) by a commercial air-cargo service or by hand delivery. Samples were shipped or delivered to the laboratories in time to allow for analysis within the specified holding times when possible. The laboratory was notified if any shipments were going to be delayed. The shipping containers were labeled as required by ER-1110-1-263.

The procedure for soil sample screening, storage and distribution was as follows:

- The soil was screened with a PID. If organic vapors were detected, collecting additional soil for laboratory analyses was considered.
- A solvent screening sample for the field GC was collected.
- A jar was filled for mustard screening. The other sample jars were put on ice and locked in a storage trailer while waiting for results of mustard screening.
- After receiving a negative result from mustard screening, the solvent screening sample was delivered to the on-site field GC. If mustard screening would have been positive, EOD would have been called.
- For samples shipped to off-site laboratories: after receiving a negative result from mustard screening, and at same time the sample was being screened for solvents in the field GC, the jars destined for CWM analyses to GP Environmental and Midwest Research Institute (MRI) were shipped. The chain-of-custody was marked that mustard and lewisite analyses must be performed and reported within 5 days of receipt of samples at the laboratory. Reporting was faxed to the WC project manager and to the on-site field office. All other sample jars were held on ice in the locked on-site storage trailer until receipt of negative analytical results for mustard and lewisite.
- Immediately upon receipt of negative analytical results for mustard and lewisite, the remaining sample jars were delivered or shipped to the appropriate laboratory below. If mustard or lewisite had been detected, the sample jars would not have been shipped or in any way handled until given direction from EOD.

The above procedure for screening, storage and distribution of soil samples is also shown on Figure 2-1.

Project Laboratories

1. GP Environmental Services
   202 Perry Parkway
   Gaithersburg, MD 20877
   Phone: 301-926-6802; Fax 301-840-1209

   Shipped samples for CWM and CWM Breakdown Products analyses.

2. Analytical Technologies Inc. (ATI) (Multchem, Inc.)
   2000 W. International Airport Road, Suite C6
   Anchorage, Alaska 99502.
   Phone: 907-248-8273. Fax: 907-248-8274

   Hand-delivered samples for analyses for explosives, metals, volatile organics. ATI Fort Collins analyzed for explosives, and ATI Renton analyzed for metals and VOCs. ATI also analyzed 4 soil samples for total organic carbon (TOC), moisture, ammonia-nitrogen, and orthophosphate.

3. Northern Testing Laboratories
   2505 Fairbanks Street
   Anchorage, Alaska 99503.
   Phone: 907-277-8378. Fax: 907-274-9645

   Hand-delivered 4 samples for microbial characterization (heterotrophic plate count).

4. Alaska Testlab
   4040 B. Street
   Anchorage, Alaska 99503
   Phone: 907-562-2000. Fax: 907-583-3853.

   Hand-delivered 4 samples for sieve analysis, and porosity and permeability estimates.

QA Laboratories

1. North Pacific Division Laboratory (NPDL)
1491 NW Graham Avenue
Troutdale, Oregon 97060-9503
Phone: 503-665-4166. Fax 503-665-0371

Shipped all explosives, metals, and volatile organics QA samples.

2. Midwest Research Institute (MRI)
425 Volker Blvd.
Kansas City, MO 64110-2299
Phone: 816-753-7600

Shipped CWM and CWM Breakdown Products QA samples.

2.13.4 Documentation Procedures

Detailed information regarding the circumstances of collection and subsequent disposition of samples were recorded in the field logbook. Verifiable sample custody was an integral part of all field and laboratory operations. Sufficient documentation was made in the field and laboratory to ensure that all samples were properly acquired, preserved, and identified. The following sections specify the procedures used for field documentation.

2.13.4.1 Field Logbooks

Permanently bound field books with water-proof paper were used as field logbooks. The pages of the logbook were numbered consecutively and no pages were removed. Entries were made in black waterproof indelible ink.

Logbooks documented the procedures performed by field personnel. Each entry was dated, legible, and an accurate description of field activities. Documentation in the field logbook was at a level of detail sufficient to explain and reconstruct field activities without relying on recollection by the field team members.

If an incorrect entry was made, the information was crossed out with a single strike mark and the change initialed and dated by the team member making the change. Each page in the field logbook was signed and dated at the bottom by all persons making entries on that page.

Field logbooks are identified by the project name and a project-specific number (e.g., "Logbook #1") and are stored in the project files. Field logbooks were photocopied and are included in Appendix II.

Entries into the logbook for sampling events included, but not necessarily were limited to, the following:

- Project name and number
- Date and time of sampling
- Sample identification numbers
- Cross-reference of numbers for duplicate, replicate, and blank samples
- Medium sampled
- Location of the sampling point in reference to fixed site features
- Physical location of the sampling point, such as depth below ground surface or water surface
- Field observations of the area, including type of vegetation, any wildlife, and general topography
- Method of sampling, including procedures, equipment, and any departure from the procedures specified in the Management Plan
- Rationale for changes in Work Plan procedures, and documentation of USACE and/or agency approval
- Results of field measurements (i.e., PID, GC)
- Sample preservation

- Type and quantity of container used for each sample
- Weather conditions at the time of sampling and previous events which may influence the representative nature of a sample, such as heavy rains prior to sampling surface waters
- Photographic information: what was photographed and why, the date and time, the approximate compass direction of the picture, number of the frame on the roll, and roll number
- Sketches of all sample locations with reference points tied to existing structures in the area (i.e., trees, fence posts, buildings, roads)
- Analyses requested
- Disposition of the sample (i.e., where it is being shipped)
- Airbill number of sample shipment when applicable
- Other pertinent observations, such as the presence of other persons on the site (those associated with the job or members of the press, special interest groups, or passersby), and actions by others that may affect performance of site tasks
- Type of health and safety clothing/equipment used
- Name(s) of sampling personnel

Additional field information relevant to quality control was recorded in the logbook and on the appropriate field forms. Such information might have included sampling difficulties or discrepancies, unexpected conditions, or abnormal sampling procedures.

2.13.4.2 Chain-of-Custody Procedures

Verifiable sample custody was an integral part of all field and laboratory operations associated with this remedial investigation. The primary purpose of the chain-of-custody procedures was to document the possession of the samples from collection through storage and analysis to reporting. The field team leader or his designee were responsible for monitoring compliance with chain-of-custody procedures.

Field sampling personnel were responsible for the care and security of samples from the time the samples were collected until they had been turned over to the shipping agent or hand delivered. A sample was considered to be in one's custody if it was in plain view at all times, in the physical possession of the sampler, or stored in a locked place where tampering is prevented.

Each cooler containing samples sent to an analytical laboratory was accompanied by a chain-of-custody form. Copies of all chain-of-custody forms were sent to NPDL when samples were sent to the laboratories. Each chain-of-custody form contained the following information:

- Name and address of the laboratory shipped to
- Sample identification number
- Date and time of sampling
- Type of sample and number of sample containers associated with each sampling point
- Indication of preservatives used
- List of analyses requested, including special instructions
- Names and signatures of sampling personnel
- Shipping air bill number, when applicable
- Spaces for transfer of custody acknowledgment
- Required turnaround time, if less than standard 30 days

- Sampler point of contact, phone number, and fax number if available

- Hazardous rank and warning of particularly hazardous substances

When the form was completed or when all samples had been collected that would fit in a single cooler, the field team members cross-checked the form for possible errors and signed the chain-of-custody record. Any corrections were made to the record with a single strike mark that was dated and initialed.

The chain-of-custody form was signed and dated by a contractor representative. Prior to sealing the container for shipment, the time of transfer to the shipping agent or laboratory was entered and the form was sealed in a plastic bag and taped to the inside of the lid of the shipping container. Samples were packaged for shipment and dispatched or transported to the analytical laboratory with a separate chain-of-custody form accompanying each cooler. After the chain-of-custody form was completed and sealed in the cooler, the transferring personnel affixed two signed and dated custody seals to the cooler so that if it was opened, the seals would be broken.

Upon receipt by the laboratory, custody seals were inspected and the chain-of-custody form signed and dated by laboratory personnel. Laboratory personnel verified sample number and conditions. Shipping manifests and chain-of-custody forms signed and dated by laboratory personnel were considered sufficient documentation of sample custody transfer from the sampler, through the shipping agent, to the analyst in the analytical laboratory.

A copy of each chain-of-custody form was retained by the sampling team for the project file and the original was sent with the samples. A copy was also sent to NPDL. The analytical laboratory returned the original or a photocopy of the original chain-of-custody forms with the analytical data reports.

The final cooler of samples shipped to each laboratory was accompanied by a chain-of-custody form that stated "END OF PROJECT" in 1-inch high letters.

2.13.4.3 QA Sample Forms

QA sample forms were completed for each QA sample that was shipped to NPDL or MRI. The form listed cross-references between sample numbers and types of samples (duplicates, rinsates, travel blanks, or MS/MSDs) and the primary and QC samples that corresponded to each QA sample. This form was provided to NPDL only, and was not provided to the project or QA laboratories that received blind samples. An example QA sample form is included as Figure 2-2.

2.13.4.4 Photographs

Representative photographs were taken during the field investigation activities for several reasons; (1) to document a sample location's appearance and proximity to site features; (2) to identify topographic features; and (3) to document field activities or field observations. Selected photographs are provided in Appendix I.

2.14 INVESTIGATION-DERIVED WASTE HANDLING AND DISPOSAL

Soil, water, and other solid wastes were generated at the site during the remedial investigation. The soil cuttings from borehole drilling were containerized in 55-gallon steel drums. Soil samples returned from the mustard screening and the GC field screen were also collected in 55-gallon steel drums. Decontamination water, monitoring well development water, and purge water were collected in 55-gallon and 30-gallon steel drums. Personal protective equipment and trash were bagged and taken to the Anchorage Municipal Landfill.

Waste drums were marked, inventoried, and placed on pallets. All drums were moved to a locked staging area 3/4 of a mile south of the site along Barrs Boulevard. Waste disposal is being coordinated by the U.S. Army.

2.15 SURVEYING

All sampling locations, including previously existing monitoring wells, were surveyed by Del Norte Surveying, Inc. Horizontal locations were measured to the nearest 0.5 feet and elevations were measured to the nearest 0.01 feet. Elevations of monitoring wells were measured at the ground surface and at the top of casing. Survey data were reported in a previously established localized coordinate system.

2.16 HEALTH AND SAFETY

Initial drilling activities were performed in health and safety Level B personal protection, which included supplied breathing air and chemical resistant clothing, boots, and gloves. Approximately half way through the field investigation health and safety requirements were reviewed and approval was granted by the USACE to downgrade to health and safety Level D personal protection. The downgrade was requested because no chemical warfare materials had been detected in the area most likely to be contaminated.

TABLE 2-1
MONITORING WELL CONSTRUCTION DETAILS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Monitoring Well	Interval Screened	Top Casing Elevation	Ground Elevation	Depth to Top Screen	Top Screen Elevation	Bottom Screen Elevation	Screen Interval	Well Material
MW-12	Shallow	300.69 ft.	298.95 ft.	26.5 ft.	272.5 ft.	262.5 ft.	10 ft.	4" Stainless
MW-13	Shallow	296.69 ft.	295.04 ft.	18.0 ft.	277.0 ft.	267.0 ft.	10 ft.	4" Stainless
MW-14	Perched	305.84 ft.	304.13 ft.	9.0 ft.	295.1 ft.	285.1 ft.	10 ft.	4" Stainless
MW-15	Shallow	296.58 ft.	294.66 ft.	20.0 ft.	274.7 ft.	264.7 ft.	10 ft.	4" Stainless
MW-16	Deep	295.17 ft.	291.80 ft.	164.9 ft.	126.9 ft.	121.9 ft.	5 ft.	2" Stainless*
MW-17	Shallow	305.47 ft.	303.44 ft.	12.0 ft.	291.4 ft.	281.4 ft.	10 ft.	4" Stainless

* Monitoring well MW-16, the deep well, was installed with a prepacked screen.

TABLE 2-2
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES
POLELINE ROAD DISPOSAL AREA
FORT RICHARDSON, ALASKA

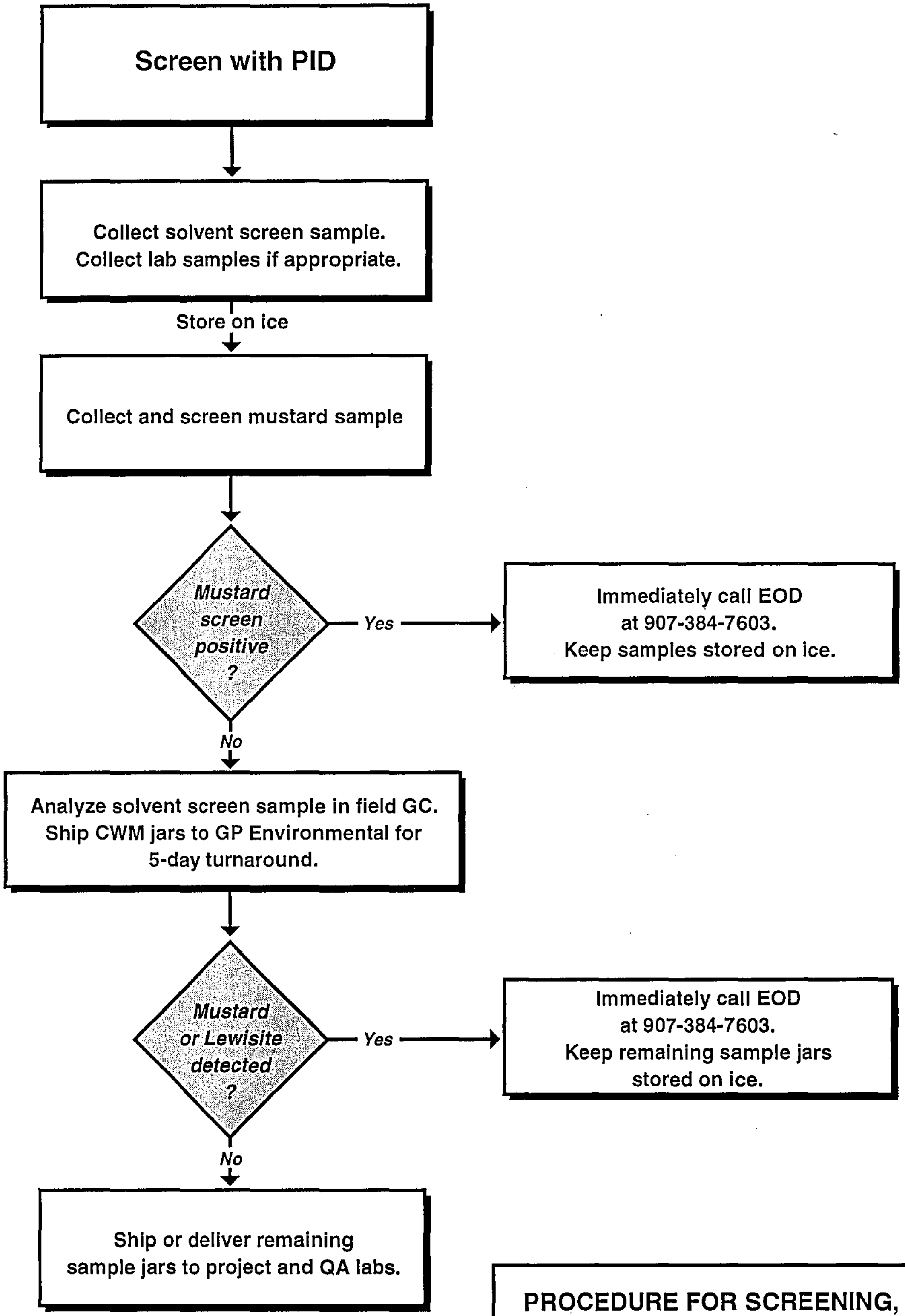
Parameters	Matrix (Soil or Water)	EPA Method	Volume of Container	Container Descrip.	Preservation of Sample*	Maximum Holding Time
CWM	Soil	None	4 oz. amber	Glass		None
	Water	None	1 liter amber	Glass	None	None
CWM Breakdown Products	Soil	None	8 oz. amber	Glass		7 and 14 days
	Water	None	4, 1-liter amber	Glass	None	None
Explosives	Soil	8330	4 oz.	Glass		14 days
	Water	8330	1 liter amber	Glass	None	7 days
VOCs: Volatile Organic Compounds	Soil	8260	2 x 2 oz.	Glass/TLC		14 days
	Water	624	3 x 40 mL	Glass VOA vial w/TLS	None**	7 days
Priority Pollutant Metals	Soil	Antimony - 6010A Arsenic - 7060 Beryllium - 6010A Cadmium - 6010A Chromium - 6010A Copper - 7210 Lead - 6010A Mercury - 7471 Nickel - 7740 Silver - 6010A Thallium - 7841 Zinc - 6010A	4 oz.	Glass/TLC		28 days Hg, 6 months others
	Water	Same as above but lead by 7421	1 liter	HDPE	HNO_3 to <2 pH	28 days Hg, 6 months others
Total Organic Carbon	Soil	415.1	4 oz.	Glass/TLC		14 days
	Water	9060	1 liter amber	Glass w/TLC	None**	7 days

Notes:
TLC= Teflon-lined cap
TLS = Teflon-lined septum cap
HPDE = High density polyethylene
CWM = Chemical Warfare Materials
mL = milliliters

HNO_3 = Nitric acid
HCl = Hydrochloric acid
C = Celcius
oz. = ounces

* All samples were cooled at <4°C

** HCl was not used as a preservative because if mustard breakdown products were present in a sample, the addition of HCl may have produced mustard.



PROCEDURE FOR SCREENING, STORAGE AND DISTRIBUTION OF SOIL SAMPLES POLELINE ROAD DISPOSAL AREA OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG2-1.AI	*By:* AR	*Figure:*
Project: E9408L	*Date:* 2/8/96	2-1

• QA SAMPLE FORM •

COE PROJECT MANAGER Andrea Elconin

PROJECT OUB Remedial Investigation

JOB No. E9408L - 3000

CONTRACT No. DACA-85-94-D-005/013

SAMPLING DATE / / 95

PAGE ______ **OF** ______

BY ______

SAMPLE NUMBER	MATRIX		QA SAMPLE TYPE				
	Soil	Water	Duplicate	Rinsate	Travel Blank	MS	MSD

Figure 2-2

3.0
QUALITY ASSURANCE/QUALITY CONTROL

A quality assurance/quality control (QA/QC) review was completed by WC for sample data generated by ATI, GP, and CAS. QA/QC Review Reports are provided in Appendix V. Sample results from NPDL, MRI, ATI, and GP were reviewed by USACE. The USACE released a separate Quality Assurance Report (QAR) for the project. The QAR is included in Appendix VI.

This section provides an overview of QA/QC measures, the analytical samples collected, and a data validation summary.

3.1 OVERVIEW OF QUALITY CONTROL MEASURES

The purpose of the QA/QC review was to assure high quality data that meet regulatory and project requirements and provide the basis for data interpretation. The following sections describe the validation levels and quality control samples collected.

3.1.1 Levels of Data Analysis and Validation

The analysis of samples met specific QA/QC requirements defined for this USACE project as "Level III" (ER 1110-1-263). Data collected included field screening data and off-site laboratory data. The following approach was used for generation of off-site laboratory data.

- Applicable EPA organic or inorganic methods were used. Where EPA methods were not available, standard industry methods were used.

- Laboratory data packages included complete raw data deliverables and documentation sufficient to perform a USACE Level III data validation.

- QC samples and procedures were utilized by the off-site laboratory.

- A Level III data validation was performed on the off-site laboratory data. Guidelines recommended in the EPA's Laboratory Data Validation Functional

Guidelines for Evaluating Organic or Inorganic Analyses (EPA1994d) were followed.

- Duplicates, which were collected at a frequency of 10 percent, were sent to the USACE Quality Assurance Laboratory (NPDL) for analysis.

The following was used for generation of field screening data:

- Applicable organic methods were used in the field laboratory.

- Quality control samples and procedures were utilized by the field lab. Review of field quality control is included in the back of Appendix V.

3.1.2 Field Quality Control Samples

Rinsate blanks, field duplicates and trip blanks were collected and submitted to the off-site laboratory for analysis. Field quality control data provide a means of assessing the quality of the data. The following sections describe the purpose of the quality control samples and collection procedures. Analytical results are included in Appendix V, QA/QC Review.

3.1.2.1 Rinsate Blanks

Rinsate blanks were used to determine the effectiveness of decontamination procedures. Deionized organic-free water was used for preparation of VOC samples and distilled water was used for preparation of all other samples. Rinsate blanks were collected by running deionized water through and/or over decontaminated sampling equipment into a clean stainless steel bowl. The rinsate water was then transferred from the bowl into the sample containers. Rinsate blanks were collected at a frequency of five percent of the primary laboratory samples collected for each analytical method.

Replicate rinsate blanks were collected and submitted to ATI, GP, NPDL, and/or to MRI. Rinsate blank samples were submitted blind to the laboratory. If an analyte was detected, the action taken followed the EPA's Laboratory Data Validation Functional Guidelines for Evaluating Organic or Inorganic Analyses (EPA1994d).

3.1.2.2 Field Duplicates

Field duplicates and triplicates were used to evaluate sampling and laboratory precision. Field duplicate and triplicate samples were collected simultaneously or sequentially from the same sampling location using identical sampling methods. Samples equally represented, as nearly as possible, the medium being sampled.

Duplicate and triplicate soil and sediment samples were collected side-by-side at a sampling location. Duplicate and triplicate soil samples were collected by thoroughly homogenizing (except for VOCs) soil from the sampling location. Duplicate and triplicate water samples were collected by filling the bottles for each analytical group or analysis sequentially for the original, duplicate, and triplicate sample.

Duplicate samples were sent to the contract laboratories (ATI and GP) and triplicate samples were sent to the USACE QA laboratories (NPDL and MRI). Field duplicates and triplicates were collected at a frequency of ten percent of the primary samples for each analytical method.

3.1.2.3 Travel Blanks

Travel blanks were analyzed for VOCs only and were used to check for contamination of samples or sample bottles during handling, shipping, or storage. Travel blanks were prepared using organic-free water and remained with VOC samples during shipping and storage.

Every cooler that contained water samples to be analyzed for VOCs contained a travel blank. If an analyte was detected in any blank sample, the action taken followed the EPA's Laboratory Data Validation Functional Guidelines for Evaluating Organic or Inorganic Analyses (EPA1994d).

3.2 ANALYTICAL SAMPLES

Samples described in this section were collected and analyzed by various methods. The analytical methods were chosen based on previous investigations or site history.

3.2.1 Soil Samples

Soil samples were collected and field screened for mustard and halogenated solvents. Halogenated solvents analyzed by the field laboratory are listed in Table 3-1. Soil samples were screened at the time of collection for volatile organics using a PID. Four soil samples were analyzed for the geotechnical properties listed in Table 3-2. One soil sample from each boring in Area-1 and Area-2 were analyzed on-site for pH.

Ten percent of the soil samples were sent to contract laboratories and analyzed for VOCs (Table 3-3), explosives (Table 3-4), metals (Table 3-5), CWMs (Table 3-6), and CWM breakdown products (Table 3-7). Soil samples collected from background borings were analyzed for metals only.

3.2.2 Well Point Groundwater Samples

Well point groundwater samples were collected and field screened for halogenated solvents (Table 3-1). Water samples collected at the site were not field screened for mustard, since mustard hydrolyzes in water. Ten percent of the well point samples were sent to contract laboratories and analyzed for VOCs, explosives, total metals, CWMs, and CWM breakdown products.

3.2.3 Monitoring Well Groundwater Samples

Monitoring well groundwater samples were collected and field screened for halogenated solvents (Table 3-1). Water samples collected at the site were not field screened for mustard, since mustard hydrolyzes in water. The off-site laboratory analyzed monitoring well groundwater samples for VOCs, explosives, metals (total and dissolved), CWMs, and CWM breakdown products. The groundwater sample collected from the background monitoring well was analyzed for total and dissolved metals only.

3.2.4 Sediment Samples

The off-site laboratory analyzed wetland sediment samples for VOCs, explosives, metals, CWMs, and CWM breakdown products. Wetland sediment samples collected at background locations were analyzed for metals only.

3.2.5 Surface Water Samples

The off-site laboratory analyzed wetland surface water samples for VOCs, explosives, total metals, CWMs, and CWM breakdown products. Surface water temperature, specific conductivity, and pH were measured and recorded. Surface water samples collected at background locations were analyzed for total metals only.

3.3 DATA VALIDATION SUMMARY

The validation process included data generation, reduction, and review. The laboratory had the initial responsibility for the correctness and completeness of the data. Data were generated and reduced following laboratory protocols.

3.3.1 Off-Site Laboratories

The primary analytical laboratory was ATI, Anchorage, Alaska. Samples were relinquished by WC at the ATI-Anchorage laboratory and shipped to other ATI locations in Renton, Washington; Fort Collins, Colorado; and/or San Diego, California. Samples were analyzed for one or more of the following: VOCs by EPA Method 8260A, Priority Pollutant Metals by EPA Method 6010/7000, Nitroaromatics and Nitramines by EPA Method 8330, Total Organic Carbon by Method ASA 90-3.2 or EPA Method 415.1, Ammonia by EPA Method 350.1, and/or Orthophosphate by EPA Method 365.2. Methods used were consistent with those stated in the WC Sampling and Analysis Plan. Triplicate samples for the above listed analyses were sent to NPDL.

Analysis of chemical warfare compounds required use of a specialized laboratory. Samples were shipped directly to GP in Gaithersburg, Maryland for analysis of semivolatiles (diisopropylmethylphosphonate, dimethylmethyl-phosphonate, p-chlorophenylmethylsulfone, p-chlorophenylmethylsulfoxide) by EPA Method 8270, oxathiane and dithiane by method USATHAMA LL03 (modified), thiodiglycol by method USATHAMA LW18, and isopropylmethylphosphonic acid by method USATHAMA LT03. A subcontract laboratory, GEOMET Technologies, Inc., (also located in Gaithersburg, Maryland) analyzed the samples for adamsite, phosgene, mustard, chloropicrin, and lewsite by various methods. Triplicate samples for the above listed analyses were sent to MRI.

3.3.2 Mobile Laboratories

Battelle performed on-site mustard screening on soil samples. Mustard was not detected in any samples. A QA/QC Report is not provided for mustard data.

CAS performed on-site halogenated solvent screening on soil and groundwater samples. Numerous soil samples were analyzed beyond the recommended holding time and are qualified with a "J" (estimated) or an "R" (rejected). Data are considered useable for screening purposes only. A detailed review of CAS' data is provided at the back of Appendix V.

3.4 DATA QUALITY ASSESSMENT

The USACE's QAR was reviewed by WC. This section discusses data provided by the project laboratories, screening laboratory, and the USACE's laboratory.

ATI and GP submitted laboratory data packages which included all QC data, and WC performed a data review that examined the data summary sheets and supporting QA/QC documentation. This review is presented in Appendix V. The data were reviewed for holding times, blank results, duplicate results, matrix spike/matrix spike duplicate (MS/MSD) results, surrogate results, and reporting limits. The review compared the laboratory QA/QC results and reporting limits to the WC Management Plan QA/QC goals, when available, or to laboratory specified control limits.

The QA/QC review performed by WC indicates that the data are acceptable for project uses. Many of the samples analyzed for VOCs and explosives were qualified as estimated due to missed holding times. Water samples analyzed for VOCs were qualified as rejected if held for more than 14 days; soil samples analyzed for VOCs were qualified as rejected if held for more than 28 days. VOC analyses had holding times missed by as long as thirty-two days and explosives had holding times missed by as long as fifteen days. Only four VOC samples and four orthophosphate samples were qualified as rejected due to missed holding times. The rejected data did not significantly change the understanding of the site or the conclusions of the investigation. The rejected data are scattered horizontally and vertically throughout the site and, in most cases, data exist immediately above or below the rejected data. Holding times were exceeded due to samples not being received by the laboratory in time for analysis. Samples were delayed because they were screened onsite for mustard and off site for CWM prior to analysis by other methods.

The methylene chloride results for many VOC analyses were qualified due to blank contamination. Methylene chloride was repeatedly detected in method, trip, and field blanks; therefore, samples with low levels of methylene chloride were qualified even when associated blanks were non-detect.

Eight trip blanks were contaminated with chloroform and toluene. None of the rinsate or method blanks contained toluene or chloroform contamination. Samples were not qualified for chloroform or toluene contamination as it is suspected that trip blanks were contaminated during preparation by ATI-Anchorage prior to shipment. Samples were not qualified as the trip blank results were not due to cross contamination or contamination during analysis. Isolated method blank detections for metals and explosives analysis did not require sample qualification.

Frequency requirements for collection of rinsate blanks (1 in 20) was met for VOCs, explosives, and CWMs. Only four rinsate blanks were collected for the ninety-three metals samples. Metals rinsate blank data were good; therefore, no data were qualified due to low collection frequency.

3.4.1 Accuracy

Laboratory accuracy is measured in terms of percent recovery. Matrix and blank samples are spiked with known concentrations of an analyte and the recovered amount is compared with the theoretical amount to obtain a percentage. Some methods also require each sample to be spiked with a known surrogate. Surrogate accuracy is also measured in terms of a percent recovery. Overall accuracy is acceptable. Two chemical warfare compounds, DMMP and p-chloromethylsulfoxide, had repeated low matrix and blank spike recoveries. Many samples were qualified as estimated or rejected for these analytes.

3.4.2 Precision

Laboratory precision is measured in terms of relative percent difference (RPD). Laboratory, field, and matrix spike duplicate samples were analyzed and the difference between the two results were calculated. No results are qualified; overall precision is acceptable.

Frequency requirements for collection of duplicates (1 in 10) was met for all methods. No data were qualified due to low collection frequency.

3.4.3 Completeness

Completeness is measured in terms of number of analyses planned versus number of analyses completed. The planned number of samples must be analyzed to properly characterize the site. Analyses can be incomplete due to samples being lost, broken or rejected during the data review. The planned project completeness goal was 90%, which was met.

3.4.4 Comparability

The field and laboratory data were compared. Field and laboratory results are generally comparable within an order of magnitude (Table 3-8). EPA methods were used in the field and fixed laboratory to assure comparability with previous site investigations.

Two analytes were consistently detected at the site: 1,1,2,2-trichloroethane and trichloroethene. The field detection limits for both of these analytes was 0.050 mg/kg. The RBCs for 1,1,2,2-trichloroethane and trichloroethene are 3.2 mg/kg and 58 mg/kg, respectively. The mobile laboratory achieved the requested detection limits for the two primary analytes of concern.

Detection limits for the remaining VOCs reported by the mobile laboratory, with few exceptions, were higher than the MCLs or RBCs. When a VOC was reported as non-detect it can not be assumed that it is less than the MCL or RBC. Therefore, the field screening data for the remaining VOCs reported as non-detect have limited applicability when comparing the well point screening results to Alaska maximum contaminant levels (MCLs) or residential RBCs.

TABLE 3-1
VOCS BY EPA METHOD 3810/8010M

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

trans-1,2-dichloroethene
1,1-dichloroethane
cis-1,2-dichloroethene
chloroform
trichloroethene
1,1,2-trichloroethane
tetrachloroethene
1,1,2,2-tetrachloroethane
dichloromethane
1,1,1-trichloroethane
carbon tetrachloride
1,2-dichloroethane
1,2-dichloropropane
dibromoethane
bromodichloromethane
dibromochloromethane
bromoform
1,1,1,2-tetrachloroethane
1,2,3-trichloropropane

TABLE 3-2
GEOTECHNICAL PROPERTIES - VARIOUS METHODS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

porosity (percent)
permeability (cm/sec)
total organic carbon (percent)
pH
moisture (percent)
ammonia-nitrogen (mg/kg)
orthophosphate (mg/kg)
microbial characterization (#/dry g)

TABLE 3-3
VOCS BY EPA METHOD 8260

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

benzene
bromobenzene
bromochloromethane
bromodichloromethane
bromoform
bromomethane
N-butylbenzene
sec-butylbenzene
tert-butylbenzene
carbon tetrachloride
chlorobenzene
chlorodibromomethane
chloroethane
chloroform
chloromethane
2-chlorotoluene
4-chlorotoluene
1,2-dibromo-3-chloropropane
1,2-dibromoethane (EDB)
Dibromomethane
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
dichlorodifluoromethane
1,1-dichloroethane
1,2-dichloroethane
1,1-dichloroethene
cis-1,2-dichloroethene
trans-1,2-dichloroethene
1,2-dichloropropane
1,3-dichloropropane
2,2-dichloropropane
1,1-dichloropropene
cis-1,3-dichloropropene
trans-1,3-dichloropropene
ethylbenzene
hexachlorobutadiene
isopropylbenzene
p-isopropyltoluene
methylene chloride
naphthalene
n-propylbenzene
styrene
1,1,1,2-tetrachloroethane
1,1,2,2-tetrachloroethane
tetrachloroethene
toluene
1,2,3-trichlorobenzene
1,2,4-trichlorobenzene
1,1,1-trichloroethane
1,1,2-trichloroethane
trichloroethene
trichlorofluoromethane
1,2,3-trichloropropane
1,2,4-trimethlybenzene
1,3,5-trimethylbenzene
vinyl chloride
total xylenes

TABLE 3-4
EXPLOSIVES BY METHOD 8330

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

- octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
- hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
- 1,3,5-trinitrobenzene (1,3,5-TNB)
- 1,3-dinitrobenzene (1,3-DNB)
- nitrobenzene (NB)
- 2,4,6-trinitrotoluene (2,4,6-TNT)
- 2-amino-4,6-dinitrotoluene (DNT)
- 2,4-DNT
- methyl-2,4,6-trinitrophenylnitramine (Tetryl)
- 4-amino-2,6-DNT
- 2,6-DNT
- o-nitrotoluene (2-NT)
- p-nitrotoluene (4-NT)
- m-nitrotoluene (3-NT)

TABLE 3-5
METALS ANALYZED BY VARIOUS METHODS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Metal	Analytical Method (Soil)	Analytical Method (Aqueous)
antimony	EPA 6010	EPA 6010
arsenic	EPA 7060	EPA 7060
beryllium	EPA 6010	EPA 6010
cadmium	EPA 6010	EPA 6010
chromium	EPA 6010	EPA 6010
copper	EPA 6010	EPA 6010
lead	EPA 6010	EPA 7421
mercury	EPA 7471	EPA 7470
nickel	EPA 6010	EPA 6010
selenium	EPA 7740	EPA 7740
silver	EPA 6010	EPA 6010
thallium	EPA7841	EPA7841
zinc	EPA 6010	EPA 6010

TABLE 3-6
CHEMICAL WARFARE MATERIALS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Chemical Warfare Material	Analytical Method
sulfur mustard	GC/FPD
lewisite	GFAA
adamsite	GC/FID
phosgene	GC/ECD
chloropicrin	GC/ECD

Note: Sulfur mustard and phosgene were not analyzed in aqueous samples.

TABLE 3-7
CHEMICAL WARFARE MATERIAL BREAKDOWN PRODUCTS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Chemical Warfare Material Breakdown Products	Analytical Method
dithiane	GC/FPD
oxathiane	GC/FPD
thiodiglycol	HPLC(LW18/UW22)
p-chlorophenylmethylsulfone	GC/MS
p-chlorophenylmethylsulfoxide	GC/MS
di-isopropyl methyl phosphonate	GC/MS
dimethyl methyl phosphonate	GC/MS
isopropyl methyl phosphonate	IC

TABLE 3-8
RELATIVE PERCENT DIFFERENCE
OFF-SITE LABORATORY VS FIELD SCREENING VOC RESULTS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Analyte	Laboratory Result mg/kg	Field Result mg/kg	RPD %
95PRDA-O-194SL	trichloroethene	0.0012	0.05 UJ	NC
95PRDA-O-301SL	trichloroethene	0.0036	0.05 U	NC
95PRDA-O-182SL	trichloroethene	0.0083	0.05 UJ	NC
	1,1,2,2-tetrachloroethane	0.11	0.05 UJ	NC
95PRDA-O-247SL	trichloroethene	0.11	0.05 UJ	NC
	1,1,2,2-tetrachloroethane	0.077	0.05 UJ	NC
95PRDA-O-295SL	trichloroethene	0.093	0.05 U	NC
	1,1,2,2-tetrachloroethane	0.11	0.05 U	NC
95PRDA-O-385SL	1,1,2,2-tetrachloroethane	0.24	0.05 U	NC
95PRDA-D-001SL	trichloroethene	0.73	0.05	174%
95PRDA-D-002SL	chloroform	0.028	0.07	86%
	c-1,2-dichloroethene	0.14	0.05 U	NC
	t-1,2-dichloroethene	0.088	0.05 U	NC
	1,1,2,2-tetrachloroethane	0.23	1.95	158%
	tetrachloroethene	0.039	0.05 U	NC
	trichloroethene	1.8	0.76	81%
95PRDA-D-003SL	c-1,2-dichloroethene	0.004	0.05 U	NC
	t-1,2-dichloroethene	0.0025	0.05 U	NC
	1,1,2,2-tetrachloroethane	0.1	0.41	122%
	tetrachloroethene	0.0024	0.05 U	NC
	trichloroethene	0.032	0.19	142%
95PRDA-D-005SL	chloroform	0.0078	0.05 U	NC
	1,1,2,2-tetrachloroethane	0.16	1.58	163%
	trichloroethene	0.016	0.16	164%
95PRDA-D-007SL	c-1,2-dichloroethene	0.012	0.05 U	NC
	t-1,2-dichloroethene	0.0076	0.05 U	NC
	1,1,2,2-tetrachloroethane	0.16	0.05 U	NC
	tetrachloroethene	0.01	0.05 U	NC
	trichloroethene	0.22	0.12	59%
95PRDA-C-009SL	1,1,2,2-tetrachloroethane	0.0018	0.05 U	NC
	trichloroethene	0.0014	0.05 U	NC
95PRDA-C-010SL	1,1,2,2-tetrachloroethane	4.4	0.67	147%
	trichloroethene	1.1	0.05 U	NC

TABLE 3-8: (CONTINUED)

Sample Number	Analyte	Laboratory Result mg/kg	Field Result mg/kg	RPD %
95PRDA-C-011SL	chloroform	0.0073	0.05 U	NC
	c-1,2-dichloroethene	0.042	0.05 U	NC
	t-1,2-dichloroethene	0.015	0.05 U	NC
	tetrachloroethene	0.071	0.05 U	NC
	1,1,2,2-tetrachloroethane	3.3	0.93	112%
	trichloroethene	0.55	0.05 U	NC
95PRDA-C-013SL	chloroform	0.16	0.05 U	NC
	c-1,2-dichloroethene	0.008	0.05 U	NC
	t-1,2-dichloroethene	0.0039	0.05 U	NC
	1,1,2,2-tetrachloroethane	0.23	1.49	147%
	tetrachloroethene	0.011	0.05 U	NC
	trichloroethene	0.15	0.05 U	NC
95PRDA-C-014SL	chloroform	0.017	0.05 U	NC
	c-1,2-dichloroethene	0.017	0.05 U	NC
	t-1,2-dichloroethene	0.0063	0.05 U	NC
	1,1,2,2-tetrachloroethane	0.51	0.20	87%
	tetrachloroethene	0.0092	0.05 U	NC
	trichloroethene	0.14	0.05 U	NC
95PRDA-C-015SL	chloroform	0.02	0.05 U	NC
	c-1,2-dichloroethene	0.25	0.05 U	NC
	t-1,2-dichloroethene	0.098	0.05 U	NC
	1,1,2,2-tetrachloroethane	3.8	0.48	155%
	tetrachloroethene	0.052	0.05 U	NC
	trichloroethene	0.62	0.05 U	NC
	1,1,2-trichloroethane	0.024	0.05 U	NC
95PRDA-C-017SL	1,1,2,2-tetrachloroethane	0.0045	0.05 U	NC
	trichloroethene	0.0082	0.05 U	NC
95PRDA-C-019SL	c-1,2-dichloroethene	0.006	0.05 U	NC
	t-1,2-dichloroethene	0.0039	0.05 U	NC
	1,1,2,2-tetrachloroethane	0.0073	0.20	186%
	trichloroethene	0.02	0.05 U	NC

TABLE 3-8: (CONTINUED)

Sample Number	Analyte	Laboratory Result mg/kg	Field Result mg/kg	RPD %
95PRDA-O-316SL	benzene	0.28	0.05 U	NC
	carbon tetrachloride	0.046	0.05 U	NC
	bromoform	U	7.93	NC
	chloroform	0.18	0.25	33%
	1,1-dichloroethene	0.015	0.05 U	NC
	c-1,2-dichloroethene	1.1	0.63	54%
	t-1,2-dichloroethene	0.29	0.22	27%
	1,1,1,2-trichloroethane	0.019	0.05 U	NC
	1,1,2,2-tetrachloroethane	79	93.2	16%
	tetrachloroethene	0.65	1.97	101%
	1,1,2-trichloroethane	0.17	11.4	194%
	trichloroethene	22	25.6	15%

NOTES:
U = Non Detect
J = Estimated Value
NC: Not calculated as one of the values was non-detect.

4.0
SITE INVESTIGATION

This section presents the activities performed at the site, a conceptual model, and the analytical results of samples collected at the site. The field activities section describes the locations and numbers of borings and samples collected in different areas at the site. The conceptual site model describes the current understanding of bedrock topography, and the locations and characteristics of saturated intervals above bedrock. The remainder of the report presents the analytical results; the first section describes the soil sampling results, the second describes the groundwater sampling results, and the third describes the wetland sampling results.

4.1 FIELD ACTIVITIES

Soil, groundwater and wetland investigations were performed at the PRDA to meet the following objectives:

- Investigate the presence of chemicals of concern around Areas A-1 and A-2, to evaluate if contaminants have migrated outside of these areas
- Evaluate groundwater flow directions and VOC concentrations in the groundwater
- Verify the concentrations of VOCs remaining in the backfilled soils and beneath the previous excavations in Areas A-3 and A-4
- Investigate the presence of chemicals of concern in the wetlands adjacent the disposal areas

4.1.1 Areas A-1 and A-2

Sixteen soil borings were drilled around Areas A-1 and A-2 (Figure 4-1). Soil samples were collected continuously over 3-foot intervals and groundwater samples were collected from each boring using a well point. A groundwater sample was not collected from SB-B6 or SB-O12 because auger refusal was reached before groundwater was encountered. Groundwater samples were collected by drilling several feet into the saturated zone, placing a well point into the borehole and waiting for water to seep into the borehole. Originally the well points were intended to be pushed into the soil with the hammer on the drill rig, but the soils were too dense and the well points would have been destroyed.

The boring locations around Areas A-1 and A-2 were selected to characterize the types and levels of chemicals of concern that may be found in those areas. The locations were selected to provide data on all sides of A-1 and A-2. Additional boring locations were selected after reviewing field screening results from groundwater samples collected from the well points, to define the contaminated shallow groundwater plume. No borings were drilled inside of Areas A-1 and A-2 because of the dangers from potential unexploded ordnance.

One groundwater monitoring well (MW-13) was installed to the southeast of Area A-2. This location was selected based on the halogenated solvent screening results of the well point groundwater samples. The location of MW-13 was selected to be near the edge of impacted groundwater in the shallow saturated interval. No wells were installed adjacent to Area A-1, other than MW-13. (MW-1 through MW-11 were installed previously by ESE).

4.1.2 Areas A-3 and A-4

Three soil borings were drilled and one groundwater monitoring well installed in Area A-3. Two soil borings were drilled in Area A-4. Figure 4-1 shows the locations of the monitoring well and five soil borings in Areas A-3 and A-4. Soil samples were collected near the top of the backfilled soil, midway through the backfilled soil, and from soil below the backfill. All soil samples were analyzed in the field laboratory and the off-site laboratory. The borings were advanced to the water table where a temporary well point was placed in each boring. Groundwater samples were collected from each of the borings and analyzed in the field laboratory.

The boring locations in Area A-3 and A-4 were selected to evenly cover each area. Three borings were placed in Area A-3 because it is larger than A-4, in which two borings were placed. These five borings were considered sufficient to characterize A-3 and A-4 because these areas had been sampled previously by OHM, and the excavated soils were homogeneously placed back in the excavations. The samples from each boring were collected to verify the concentrations of contaminants in the backfilled soil and in the native soil beneath the backfill.

Three soil borings were drilled between Area A-3 and the wetlands. The purpose of these borings was to evaluate whether contaminants were migrating from Area A-3 toward the wetlands.

4.1.3 Other Areas

Five soil borings were drilled south of Areas A-1 and A-2. Fifteen soil borings were drilled north of Areas A-1 and A-2. Seven of the 15 soil borings are on a road bulldozed through the woods northeast of Disposal Area A-1. Three monitoring wells were installed north of Areas A-1 and A-2. One shallow monitoring well was installed on the bulldozed road (MW-12), one shallow monitoring well adjacent to MW-9 (MW-15), and a deep well (MW-16) northeast of MW-9. Monitoring well locations were selected based on results of well point field screening.

4.1.4 Sample Handling

All of the soil samples collected in August were field screened for mustard with a MINICAMS. The field screening for mustard ended at the end of August because no mustard had been detected and the investigation was moving away from the suspected source areas. Splits of soil samples were analyzed in the field laboratory for VOCs once the MINICAMS operator reported that no mustard had been detected. If a split of the sample was collected for off-site analysis, then the portion of the split needed for CWM and CWM breakdown products analyses were sent to GP. A 5-day turn-around-time was requested for the mustard and lewisite analyses. Once the results of the mustard and lewisite analyses were faxed to the site, the remaining portions of the samples were sent to the off-site laboratories. Figure 2-1 is a flow chart describing how samples were handled.

4.1.5 Sample Frequency

Laboratory samples were collected from predefined locations (Areas A-3 and A-4), and also from locations that provided sufficient sample volume and that represented various depths and locations throughout the site. The laboratory samples were intended to confirm the field screening results and were collected at a rate of 10% (except for within A-3 and A-4, where they were collected at a rate of 100% of screening samples). The laboratory samples were analyzed for VOCs by EPA Method 8260, CWMs and CWM breakdown products by several methods, explosives by EPA Method 8330, and metals by various methods. Selected samples were also analyzed for TOC, pH, moisture, ammonia-nitrogen, orthophosphate, microbial characterization, porosity and permeability. Tables listing the compounds detected by each method are provided in Section 3.

Groundwater samples were collected from well points in all of the soil borings that contained sufficient groundwater. All of the well point groundwater samples were analyzed for VOCs in the field laboratory. All fifteen of the groundwater samples collected from permanent monitoring wells and 10% of the samples collected from the well points were analyzed at the off-site laboratory. Groundwater samples were analyzed for the same analytes as the soil, except groundwater samples were not field screened for mustard gas nor analyzed in the off-site laboratory for mustard gas or phosgene.

4.1.6 Monitoring Well Locations

The groundwater monitoring well locations were selected after reviewing the well point sampling data. The locations were selected so that the wells would be near the edges of the area of impacted groundwater. Because water levels from the monitoring wells are used to evaluate the direction of groundwater flow, the locations were placed widely across the site to aid creation of groundwater contour maps. After most of the new well locations were selected, there still appeared to be limited coverage along the west side of Areas A-3 and A-4. The location for MW-14 was selected to provide data on the groundwater in that area.

4.1.7 Wetlands

Four co-located surface water and sediment samples were collected from the wetlands located south of the disposal areas. Two of the samples were collected on the northeastern edge of the wetlands adjacent to the disposal areas. A third sample was collected approximately 100 feet south of the first two samples and the fourth was collected from the northwestern corner of the wetlands. These samples were located to evaluate if activities at the site have impacted the wetlands. Six co-located surface and sediment samples were collected from three background wetlands. Section 4.5 compares the results from analysis of the background samples to the samples collected from the wetlands adjacent to the disposal area.

4.1.8 Groundwater Discharge

A search was conducted in the area north and northeast of the site for groundwater discharge areas. The search started with the area immediately north of the site. The search team then continued looking to the north of the site, eventually reaching Eagle River. The field team reached Eagle River just downstream of the Glenn Highway Bridge. The team then walked downstream to the Sailey Bridge. While walking, the field team looked for depressions, wet areas, springs, and streams. No springs or streams were found.

A spring was located in January 1996 (Figure 4-5), after consulting with a local geologist (Munter 1996). This spring is located on the south bank of the Eagle River immediately downstream of the Glenn Highway bridge. The spring appears to surface at the top of a bedrock outcrop. The bedrock at this location is a black interbedded claystone and siltstone.

4.1.9 1995 Geophysical Survey

In June 1995, CRREL performed a refined geophysical survey of the PRDA site. The survey included both electromagnetic (EM) and ground penetrating radar (GPR) surveys. Figure 4-2 presents the results of the survey. The survey confirmed that buried debris had been removed successfully from Areas A-3 and A-4. The survey also revealed that the anomalous zone in Area A-2 extends outside of the previously defined boundary, to the south. The sampling grid that was used in the 1995 survey was able to provide more accurate information than was obtained in the 1994 survey.

4.2 CONCEPTUAL MODEL

A conceptual model of the site was prepared to serve as a basis for the groundwater model. The conceptual model ties together the data collected at the site and regional data gathered from other sources. Regional data were gathered from boring logs of wells drilled at the Anchorage Regional Landfill and from a report on the hydrogeology of the Eagle River area (Munter and Allely, 1992). These sources provided data on groundwater elevations and depths to bedrock.

The conceptual model was started by drawing cross-sections of the site using data collected while installing the monitoring wells (Figures 4-3 and 4-4). Four water bearing zones were identified while drilling at the site. These four water bearing zones are described in Section 1.2.2. Only two water bearing zones are included in the conceptual model since the perched interval does not appear to extend north of Disposal Areas A-1 and A-2, and little data are available on the intermediate intervals. A bedrock surface sloping to the north-northeast was also identified at the site. The groundwater flow direction in the deep water bearing zone matched the dip of the bedrock surface at the site.

Figure 4-5 is a map displaying bedrock elevations in the conceptual model. The elevation of the bedrock in the area around the Eagle River community is from the report "Water-Supply Aquifers at Eagle River, Alaska" (Munter and Allely, 1992). Bedrock elevations around the landfill are from borings drilled while installing monitoring wells around the landfill. The contour of the bedrock surface north and west of the site were drawn to fit the known data and regional trends. The model assumes that the north-northeasterly dip of the bedrock and groundwater flow at the site is only a local feature. Regionally, water moves from the mountains towards Knik Arm (in a west or northwesterly direction). The bedrock surface contours were drawn to fit the local observations into the regional pattern.

The conceptual model has two water bearing zones, as discussed above: a shallow unconfined zone and a deeper semi-confined zone which lies directly over the bedrock. Figure 4-6 is a cross-section of the area from Fossil Creek to Eagle River. For the purpose of the conceptual model, both groundwater intervals are assumed to discharge to Eagle River. This assumption is based on groundwater flow directions and elevations measured at the site relative to the river, and is intended to provide a conservative scenario for the groundwater flow model. The assumption that the deep aquifer discharges into the Eagle River is supported by a bedrock outcrop observed immediately west of the Glenn highway bridge along the bank of the Eagle River. Groundwater discharges from the interface between the bedrock and the overlying soils.

The Eagle River is a groundwater divide, separating the groundwater found north and south of the river (Munter and Allely, 1992). Data which support this assumption include groundwater elevations north and south of the Eagle River. Groundwater elevations on both sides of the river are higher than the river, indicating that groundwater flows towards the river from both sides. Therefore, groundwater flow from the site northward toward the Eagle River will not come in contact with groundwater beneath the Eagle River community, north of the divide. Available data from various investigations in the area (Munter and Allely,

1992) indicate that groundwater from the PRDA will not flow beneath the river and cross to the other side, but instead will discharge to the river.

4.3 SOIL SAMPLING RESULTS

Soil samples were collected in and around the disposal areas at the PRDA. The soil samples were analyzed for halogenated solvents in the on-site laboratory. Samples were collected and sent to an off-site laboratory and analyzed for halogenated solvents by Method 8260. All of the samples collected in Areas A-3 and A-4 were sent to the off-site laboratory. The other samples selected for off-site analysis were collected at a rate of roughly one per boring, and an attempt was made to collect samples over a wide depth range. Samples were also collected when it was suspected that contaminated soil was encountered. The samples sent to off-site laboratories were also analyzed for metals, explosives, CWMs and CWM breakdown products. This section presents the results of these analyses.

4.3.1 Halogenated Solvent Screening Results - Soil

All of the subsurface soil samples collected from the PRDA were screened for halogenated solvents in a field laboratory. Samples collected from the background soil borings and monitoring well were not analyzed in the field laboratory. The field laboratory is described in Chapter 2.0. The compounds that could potentially be detected by the field laboratory are listed in Table 3-1 of Section 3.0. Figure 4-7 shows maximum concentrations of 1,1,2,2-tetrachloroethane and TCE and Figures 4-8 and 4-9 are isoconcentration maps of these maximum concentrations.

4.3.1.1 Areas A-1 and A-2

Seventy-four subsurface soil samples were collected from around the perimeter of Areas A-1 and A-2. Samples were collected from borings SB-A1 through SB-A6, SB-B1 through SB-B7, and SB-O12. Screening samples were also collected during the installation of MW-13. The compound 1,1,2,2-tetrachloroethane was detected in six samples. No other VOCs were detected in samples collected around Area A-1 and A-2. The detection limit for the field GC was 0.05 mg/kg. Detected concentrations of 1,1,2,2-tetrachloroethane ranged from a low of 0.12 mg/kg in MW-13 (26-28') to a high of 1.7 mg/kg in SB-B1 (4-6'). The residential soil RBC for 1,1,2,2-tetrachloroethane (3.2 mg/kg) was not exceeded. The results of the analyses are listed in Table 4-1. The detections are summarized in Table 4-2. The maximum concentrations of 1,1,2,2-tetrachloroethane and trichloroethene in each boring are presented in Figure 4-7.

4.3.1.2 Areas A-3 and A-4

Twenty-four subsurface soil samples were collected for halogenated solvent screening within the boundaries of Areas A-3 and A-4. Samples were collected from borings SB-C1, SB-C2, SB-C3, SB-D1, and SB-D2. Screening samples were also collected during the installation of MW-14. VOCs were found in twenty-one of the samples screened. The following compounds were detected: trans-1,2-dichloroethene (2 samples), cis-1,2-dichloroethene (2), chloroform (3), trichloroethene (14), 1,1,2-trichloroethane (2), tetrachloroethene (2), 1,1,2,2-tetrachloroethane (19), carbon tetrachloride (1), bromoform (2), and 1,1,1,2-tetrachloroethane (1). The sample with the highest concentrations of chlorinated solvents was collected from MW-14 (16-18'). The concentration of 1,1,2,2-tetrachloroethane was 2,030 mg/kg and trichloroethene was 384 mg/kg. The results of the above analyses are listed in Table 4-3. Figure 4-7 shows the maximum concentrations of 1,1,2,2-tetrachloroethane and trichloroethene in each of the soil borings drilled in Area A-3 and A-4. Where off-site laboratory results were greater than field screening results, the off-site results are shown and marked with an asterisk (*). Several compounds were detected at concentrations exceeding the RBCs and are discussed further at the end of this section.

MW-14 was installed between the two excavated disposal areas (A-3 and A-4). Although MW-14 is inside the area considered A-3, the actual excavation did not extend to that corner of the area because of potential slope failure. Soil samples collected from MW-14 had the greatest concentrations of chlorinated solvents detected during the RI. One sample collected by OHM from the bottom of the excavation in Area A-3 had 1,1,2,2-tetrachloroethane detected at 2,920 mg/kg. A review of the survey maps of the A-3 excavation shows that this sample is at nearly the same elevation as the sample collected at 16 to 18 feet below ground surface in MW-14 (2,030 mg/kg 1,1,2,2-tetrachloroethane). These data indicate that there is a layer of soil with high concentrations of 1,1,2,2-tetrachloroethane starting at around 16 feet below ground surface. Section 5 includes a discussion of the potential presence of DNAPLs in these saturated soils.

Four screened samples contained VOCs above RBCs. The RBCs for carbon tetrachloride (4.9 mg/kg), tetrachloroethene (12 mg/kg), 1,1,2,2-tetrachloroethane (3.2 mg/kg), trichloroethene (58 mg/kg), and 1,1,2-trichloroethane (11 mg/kg) were exceeded in the sample collected from the 16- to 18-foot interval in MW-14. The RBCs for 1,1,2,2-tetrachloroethane and 1,1,2-trichloroethane were exceeded in the sample collected from the 18- to 20-foot interval in MW-14 and 1,1,2,2-tetrachloroethane in the 20- to 22-foot sample from MW-14. The soil sample collected from the 24- to 27-foot interval in SB-03 exceeded the RBC for 1,1,2,2-tetrachloroethane. No other soil screening samples exceeded RBCs at the site. A summary of the four samples is listed in Table 4-4. The RBCs are based on the residential soil ingestion exposure pathway (EPA, Region III, October 20, 1995).

4.3.1.3 <u>Other Areas</u>

One hundred and seventy samples were collected for halogenated solvent screening at other areas around the site. Samples were collected from borings SB-T1 through SB-T3 (at the "toe of the hill"), SB-O1 through SB-O11, and SB-O13 through SB-O20. Samples were also collected during the installation of monitoring wells MW-12, MW-15, and MW-16. The only two VOCs detected by the field laboratory from this group were trichloroethene (2 samples) and 1,1,2,2-tetrachloroethane (11 samples). The highest levels of VOCs were detected in SB-O3 (24-27'). Trichloroethene was detected at 0.76 mg/kg (58 mg/kg RBC) and 1,1,2,2-tetrachloroethane was detected at 5.75 mg/kg (3.2 mg/kg RBC). The results of the above analyses are listed in Table 4-1 and Table 4-2. Figure 4-7 shows the maximum concentration of trichloroethene and 1,1,2,2-tetrachloroethane in each of the soil borings drilled.

4.3.2 Off-Site Laboratory VOC Results - Soil

In general, ten percent of the subsurface soil samples collected were split and sent to an off-site analytical laboratory to verify the results from the field laboratory. The exceptions were Areas A-3 and A-4 where 100 percent of samples were sent to the off-site laboratory. The samples were analyzed for VOCs by EPA Method 8260. A list of the analytes detected by this method are listed in Table 3-3.

4.3.2.1 Areas A-1 and A-2

Seven subsurface soil samples and two replicate samples were collected around the perimeter of Areas A-1 and A-2 for off-site analysis (Table 4-5). The samples were collected from soil borings SB-A2, SB-A5, SB-B3, SB-B5, SB-B7, and SB-O12. A subsurface soil sample was also collected during the installation of monitoring well MW-13. Chloroform and trichloroethene were the only VOCs detected in the seven samples sent to the off-site laboratory. Chloroform was detected in the sample from SB-B7 (6-9') at 0.0042 mg/kg. Trichloroethene was detected in samples collected from SB-O12 (15-18') and MW-13 (10-12') at 0.0012 mg/kg and 0.0036 mg/kg, respectively. The VOCs were detected well below the RBC values for chloroform (100 mg/kg) and for trichloroethene (58 mg/kg). The detections were also well below the detection limit of the field laboratory.

4.3.2.2 Areas A-3 and A-4

Fourteen samples were collected for VOC analyses inside the boundaries of Areas A-3 and A-4. The samples were taken from soil borings SB-C1, SB-C2, SB-C3, SB-D1, and SB-D2. A sample was also collected during the installation of monitoring well MW-14. The following compounds were detected: benzene (1 sample), carbon tetrachloride (1), chloroform (7), 1,1-dichloroethene (1), cis-1,2-dichloroethene (10), trans-1,2-dichloroethene (10), 1,1,1,2-tetrachloroethane (1), 1,1,2,2-tetrachloroethane (14), tetrachloroethene (9), 1,1,2-trichloroethane (3), and trichloroethene (14). Five samples had detections of 1,1,2,2-tetrachloroethane above the RBC (3.2 mg/kg). No other soil samples from Area A-3 or A-4 had VOCs detected at concentrations exceeding RBCs. The results of the VOC analyses are listed in Table 4-6 and the comparison of the samples to RBCs is listed in Table 4-7.

4.3.2.3 Other Areas

Sixteen subsurface soil samples and four replicate samples were collected for VOC analyses from other areas at the site. Samples were collected from soil borings SB-T1, SB-O1, SB-O4, SB-O7 through SB-O11, SB-O13, SB-O15, SB-O16, SB-O18, and SB-O20. Samples were also collected during the installation of monitoring wells MW-12 and MW-16. Compounds detected included chloroform (1 sample), cis-1,2-dichloroethene (2), trans-1,2-dichloroethene (1), ethylbenzene (1), 1,1,2,2-tetrachloroethane (4), tetrachloroethene (2), toluene (4), trichloroethene (3), and xylenes (1). None of the VOCs detected exceeded the RBC values. Results from the VOC analyses are listed in Table 4-5.

4.3.2.4 Correlation Between Screening and Off-site Laboratory Data

Halogenated solvent screening data and laboratory VOC data correlated to some extent. Although values were rarely similar, high concentrations detected by one method generally matched a high concentration by the other method. In addition, there was no indication of a high/low bias of the field analytical method compared to the lab analytical method. When comparing the two methods, certain limitations must be taken into consideration. Soil was immediately placed into sample jars and not homogenized. This procedure minimized the amount of volatilization of VOCs from the samples, but introduces variability because there may be differences between the samples analyzed in the field laboratory and the off-site laboratory. Holding time exceedances for some screening data may be a significant factor in differences between field screening and off-site laboratory results.

The difference between the field laboratory method (headspace analysis) and off-site laboratory method (purge and trap) also introduces variability. The difference in the detection limit for each method is one result of the different methods. The detection limit for the field laboratory was 0.05 mg/kg while the detection limits for the laboratory analyses averaged around 0.005 mg/kg.

Table 4-6 includes both the results of the off-site laboratory analyses and the detections from the halogenated solvent field screening for Areas A-3 and A-4.

Although values are rarely similar, as discussed above, the data show that the field screening was a good indicator of hot spots: i.e., where off-site laboratory analyses show elevated concentrations of solvents, so do the screening data. The field screening was also a good indicator of the absence of solvents: i.e., in all cases where off-site laboratory results are nondetect, so are field screening results.

Table 4-5 presents off-site laboratory results for Areas A-1, A-2, and Other Areas. All of the samples had corresponding field screening results of nondect for all VOCs. There were only 22 detections of VOCs in the off-site laboratory analyses, and 16 of the 22 off-site laboratory detections were below the 0.05 mg/kg detection limit of the field GC. Therefore, the field screening data were sufficient for detecting elevated concentrations of solvents in soils. Data quality is discussed further in Section 3.

4.3.3 Analytical Results for Metals - Soil

Background soil samples were collected and analyzed for metals. The results from these analyses are used to compare to the results of samples collected in and around the disposal areas.

4.3.3.1 Background

Sixteen subsurface soil samples and two replicate samples were collected from three background locations and analyzed at an off-site laboratory for 13 priority pollutant metals. The samples were collected from soil borings SB-U1 and SB-U2, and also during the installation of monitoring well MW-17 (Figure 4-15). The results of the analyses and the site-specific average background concentrations are listed in Table 4-8.

In this RI report, metals concentrations were considered to be "significantly above background" when they were over twice the site-specific average background concentrations. Site-specific average background concentrations were calculated using half the detection limit for those metals that were not detected. Additional calculations and discussions of the significance of background exceedances are included in the Risk Assessment Report, provided under separate cover (WC, 1996).

The average level of arsenic (10 mg/kg) detected in the background soil samples is less than the RBC for noncarcinogenic effects (23 mg/kg) but exceeds the RBC for carcinogenic effects (0.43 mg/kg). However, the site-specific average background concentration is nearly equal to the average concentration of arsenic in Alaskan soils (9.6 mg/kg, Arbogast 1987). Therefore, the site-specific average background concentration will be used to compare to the arsenic concentrations detected at the site.

The only other background metal concentration that exceeded RBCs is beryllium at 0.29 mg/kg (RBC = 0.15 mg/kg). However, this concentration is below the average concentration of beryllium (0.68 mg/kg) in soils of the Western United States (Shacklette and Boerngen 1984).

4.3.3.2 Areas A-1 and A-2

Seven subsurface soil samples and two replicate samples were collected for metals analyses around the perimeter of Areas A-1 and A-2. The samples were collected from borings SB-A2, SB-A5, SB-B3, SB-B5, SB-B7, and SB-O12. A sample was also collected during the installation of MW-13. The concentration of metals detected in the samples were less than or not significantly higher than the average background concentrations, with the exception of mercury. Although mercury concentrations were up to over three times the average background level of 0.06 mg/kg, they were well below the RBC of 23 mg/kg. The only metal that exceeded RBCs was beryllium. The results of the analyses are listed in Table 4-9.

4.3.3.3 Areas A-3 and A-4

Fourteen subsurface soil samples were collected for metals analyses inside the boundaries of Areas A-3 and A-4. The samples were taken from borings SB-C1, SB-C2, SB-C3, SB-D1, and SB-D2. A subsurface soil sample was also collected during the installation of MW-14. The samples from borings SB-D1 and SB-D2 had concentrations over twice the background concentrations for copper (3 samples), lead (4), mercury (2), silver (2), and zinc (4). The soil sample from SB-D1 (5-7′) had the greatest concentrations of copper (190 mg/kg, 28 mg/kg background), lead (160 mg/kg, 5.5 mg/kg background), silver (1.9 mg/kg, 0.64 mg/kg background), and zinc (1,000 mg/kg, 58 mg/kg background). The soil sample from SB-D2 (0-2′) contained the greatest concentration of mercury (0.58 mg/kg, background 0.06 mg/kg). Although the above concentrations exceeded background levels, all metals were well below RBCs (Table 4-11) except for beryllium. Although beryllium concentrations were above the RBC (0.15 mg/kg), they were near the average background concentration (0.29 mg/kg). All other samples were equal to or near background levels. The results of the analyses are listed in Table 4-10.

4.3.3.4 Other Areas

Seventeen subsurface soil samples and four replicate samples were collected for metals analyses at other areas around the site. Samples were collected from borings SB-T1, SB-O1, SB-O4, SB-O7 through SB-O11, SB-O13, SB-O15, SB-O16, SB-O18, and SB-O20.

Samples were also collected during the installation of MW-12 and MW-16. The concentrations of metals detected in the samples were less than or did not significantly exceed the average background concentrations, with the exception of mercury. The only metal that exceeded RBCs was beryllium, but beryllium concentrations were near background. The results of the analyses are listed in Table 4-9.

4.3.4 Miscellaneous Soil Analyses

Thirty-seven subsurface soil samples were collected from various borings throughout the site and analyzed at off-site laboratories for explosives, CWMs, and CWM breakdown products. The laboratories reported no detections for the above analyses.

One hundred and ninety-eight subsurface soil samples were collected and screened for mustard. A subcontractor, Battelle, performed all mustard screening on-site. No mustard was detected in the soil samples. Chapter 2 includes a summary of the mustard screening method.

Six subsurface soil samples were collected from various borings throughout the site for geotechnical and biological analyses. One sample was collected from SB-C2, three from SB-O2 and two during the installation of MW-17. The analyses included porosity, permeability, TOC, pH, moisture content, ammonia-nitrogen, orthophosphate, microbial characterization, and particle size analysis. Particle size distribution curves are included with analytical data in Appendix VII. Permeability calculations (using Hazen's formula) are included with the curves. The results of the geotechnical analyses are listed in Table 4-12. Some of these results were used in the groundwater model of the site, and some are being used in the feasibility study being performed under a separate scope of work.

Sixteen subsurface soil samples from various borings were collected and analyzed for pH. The pH analyses were conducted in the field. Soil pH averaged 6.40 pH units (arithmetic mean). The highest pH measured was 7.78 at SB-B6 (12-14') . The lowest pH recorded was 5.55 at SB-B4 (3-6'). The results of the pH analyses are listed in Table 4-13.

4.3.5 Soil Summary

VOCs were detected in several different parts of the site. The highest concentrations were found in unexcavated portions of Area A-3 at a depth of 16 to 22 feet. The next highest concentrations were found in the backfilled soil in Areas A-3 and A-4 at depths from 0 to 18 feet. Soils sampled east of Areas A-3 and A-4, around Area A-2 had the next highest concentrations detected. Solvents were detected at depths of 0 to 9 feet at the west end of Area A-2 and at depths of 20 to 28 feet at the east end of Area A-2. The pattern of reducing concentrations of VOCs to the east suggests that Areas A-3 and A-4 were the source areas for VOCs at the site. No VOCs were detected in soil samples collected around the perimeter of Area A-1 and the VOCs detected near the saturated intervals around A-2 appear to have migrated there from Areas A-3 and A-4. There is no evidence that solvents were released in Areas A-1 and A-2 except for potential surface spills, which may have been the source of VOCs detected in shallow soils near A-2. Soils within Areas A-1 and A-2 were not sampled because of the potential for unexploded ordnance.

Soil samples collected from Area A-4 had concentrations of five metals detected significantly above average background concentrations: copper, lead, mercury, silver, and zinc. All metals were well below RBCs except for beryllium; however, background beryllium concentrations were also above the RBC and were below published background concentrations for the Western United States. The levels of metals detected in soil samples from other areas of the site were very similar to average background concentrations except for mercury; however, concentrations of mercury were well below the RBC. No CWMs, CWM breakdown products, or explosives were detected in any of the soil samples analyzed at the off-site laboratories. On-site screening for mustard did not report any detections.

4.4 GROUND WATER SAMPLING RESULTS

Six new monitoring wells were installed at OUB during the field investigation. One of the wells was installed at a background location and screened in a shallow water bearing zone. One well was installed down gradient of the site in the deep aquifer. The remaining four shallow monitoring wells were installed at locations suspected to be at the perimeter of the halogenated solvent-impacted shallow groundwater plume. The location of the perimeter was estimated by analyzing groundwater samples collected from well points installed in soil borings. All of the groundwater samples collected from the well points were analyzed in the field laboratory for halogenated solvents. Four groundwater samples were collected from well points and sent to the off-site laboratory to confirm the results of the field laboratory. Groundwater samples from the monitoring wells were analyzed for VOCs, metals, explosives, CWMs, and CWM breakdown products. This section present the results of groundwater analyses.

4.4.1 Well Point Sampling

4.4.1.1 Halogenated Solvent Screening

Areas A-1 and A-2

Groundwater samples were collected from well points and screened for halogenated solvents in the field laboratory. Twelve groundwater samples were collected from the perimeter of Areas A-1 and A-2. Groundwater samples were collected from borings SB-A1 through SB-A6, SB-B1 through SB-B5, and SB-B7. The following VOCs were detected: trans-1,2-dichloroethene (2 samples), cis-1,2-dichloroethene (2), chloroform (1), trichloroethene (3), 1,1,2-trichloroethane (2), tetrachloroethene (1), 1,1,2,2-tetrachloroethane (3), and carbon tetrachloride (1). Four of the13 groundwater samples collected from the well points around Area A-1 and A-2 had halogenated solvents detected. The Alaska MCL for trichloroethene (0.005 mg/L) was exceeded in samples collected from SB-B1 (31 mg/L), SB-B2 (7.7 mg/L), and SB-B5 (0.057 mg/L). There is no Alaska MCL for 1,1,2,2-tetrachloroethane but there is a tap water RBC (0.000052 mg/L). The tap water RBC for 1,1,2,2-tetrachloroethane was exceeded in groundwater samples collected from SB-B1 (68 mg/L) and SB-B2 (29 mg/L). Several other VOCs were detected (cis-1,2-dichloroethene, trans-1,2-dichloroethene, 1,1,2-trichloroethane, tetrachloroethene, and carbon tetrachloride) at concentrations which exceed Alaska MCLs and tap water RBCs. No solvents were detected in well point samples collected from around Area A-1 except for 0.071 mg/L of 1,1,2,2-tetrachloroethane in SB-A6. The halogenated solvent screening results are listed in Table 4-14 and presented in Figure 4-10.

Areas A-3 and A-4

Five well point groundwater samples were collected within the boundaries of Areas A-3 and A-4 for halogenated solvent screening. Samples were collected from well points at SB-C1 through SB-C3, SB-D1, and SB-D2. The following VOCs were detected: trans-1,2-dichloroethene (4 samples), cis-1,2-dichloroethene (4), chloroform (2), trichloroethene (4), 1,1,2-trichloroethane (3), tetrachloroethene (3), 1,1,2,2-tetrachloroethane (5), and carbon tetrachloride (2). The tap water RBC for 1,1,2,2-tetrachloroethane (0.000052 mg/L) was exceeded in each of the groundwater samples collected from Area A-3 and A-4. The highest concentration of 1,1,2,2-tetrachloroethane was detected in Area A-4 at SB-D2 (93 mg/L) and next highest in SB-D1 (89 mg/L). The levels of 1,1,2,2-tetrachloroethane detected in Area A-3 are highest in the northern portion of the area (52 mg/L) and then decrease to the south (5.7 mg/L in SB-C2 and 0.122 mg/L in SB-C3). The other VOCs detected had concentrations in nearly the same pattern as 1,1,2,2-tetrachloroethane except at lower levels. Alaska MCLs and tap water RBCs were exceeded by all of the VOCs detected except trans-1,2-dichloroethene in one sample (SB-C2) and chloroform in one sample (SB-D2). The results of these analyses are listed in Table 4-14 and presented in Figure 4-10.

Other Areas

Seventeen well point groundwater samples were collected from other areas around the site for halogenated solvent screening. Solvents were detected in six of the fourteen groundwater samples collected from well points at SB-T1 through SB-T3, SB-O1 through SB-O4, SB-O6 through SB-O9, SB-O11, SB-O13, SB-O14, SB-O16, SB-O17 , and SB-O19. The following VOCs were detected: trans-1,2-dichloroethene (2 samples), cis-1,2-dichloroethene (5), trichloroethene (5), tetrachloroethene (1), and 1,1,2,2-tetrachloroethane (6). 1,1,2,2-tetrachloroethane was detected in SB-O1 (6.1 mg/L), SB-O3 (2.69 mg/L), SB-O11 (0.115 mg/L), SB-O13 (13 mg/L), SB-O14 (1.64 mg/L), and SB-O17 (0.175 mg/L). Each of these detections exceeded the tap water RBC of 1,1,2,2-tetrachloroethane (0.000052 mg/L) Trichloroethene was detected in SB-O1 (4.5 mg/L), SB-O3 (1.14 mg/L), SB-O13 (9.163 mg/L), SB-O14 (0.662 mg/L), and SB-O17 (0.998 mg/L). Each of these detections exceeded the Alaska MCL (0.005 mg/L) and the tap water RBC (0.0016 mg/L). Cis-1,2-dichloroethene was detected in SB-O1 (0.472 mg/L), SB-O13 (1.7 mg/L), SB-O14 (0.11 mg/L) and SB-O17 (0.073mg/L) above the Alaska MCL (0.07 mg/L), and in SB-O13 (0.062 mg/L), above the tap water RBC (0.061 mg/L). Tetrachloroethene was detected in SB-O13 (0.147 mg/L) above the Alaska MCL (0.005 mg/L). Trans-1,2-dichloroethene was detected in SB-O13 (0.629 mg/L) above the Alaska MCL (0.1 mg/L). The results of the analyses are listed in Table 4-14 and presented in Figure 4-10.

4.4.1.2 Groundwater VOC Analytical Results

Groundwater samples were collected from four well points (SB-T1, SB-B4, SB-A5, and SB-O13) and sent to an off-site laboratory for VOC analysis by EPA Method 8260 (Table 3-4). Several liters of water were needed for all of the analyses (VOCs, metals, CWMs, CWM breakdown products, and explosives) performed at the off-site laboratories. Those well points which had good recharge and were located in key areas were selected for laboratory samples. The well points needed to recharge quickly to fill all of the sample bottles. The recharge time was critical when the field crew was sampling in Level B personal protection equipment.

The results of off-site laboratory analysis for VOCs of groundwater collected from well points are listed in Table 4-15. Toluene was detected in samples collected from SB-T1 and SB-A5. Chloroform was also detected in the groundwater sample collected from SB-A5. The concentration of chloroform detected (0.00046 mg/L) was well below the Alaska MCL (0.1 mg/L).

The groundwater sample taken from SB-O13 had the highest levels of VOCs detected. The following VOCs were detected: cis-1,2-dichloroethene (3.1 mg/L), trans-1,3-dichloroethene (1 mg/L), 1,1,2,2-tetrachloroethane (34 mg/L), and trichloroethene (12 mg/L). These concentrations are above the Alaska MCLs and Residential RBCs. Applicable Alaska MCLs and Residential RBCs are given in Table 4-16.

4.4.1.3 Correlation Between Screening and Off-Site Laboratory Data

Table 4-15 presents off-site laboratory and field screening results for the four well points sampled for off-site laboratory analyses. All of the off-site laboratory results that were nondetect or below the 0.05 mg/kg detection limit of the field GC, had corresponding field screening results of nondetect for all VOCs. Similarly, all of the elevated detections by the off-site laboratory (boring SB-013) had elevated detections on the field GC. These data indicate that the field screening data were good indicators of the presence of elevated concentrations of solvents in groundwater.

4.4.1.4 Metals Analysis

Four groundwater samples were collected from well points and sent to an off-site analytical laboratory for total metals analyses. Groundwater samples were collected from well points located at SB-T1, SB-B4, SB-A5, and SB-O13. The following metals were detected at concentrations above Alaska MCLs: antimony (3 well points), arsenic (3), beryllium (3), chromium (4), copper (2), lead (4), mercury (2), nickel (4), silver (2) and zinc (2). Some detection limits were elevated above their respective Alaska MCLs because of matrix interferences. The Alaska MCLs are listed in Table 4-16. The results from the above metals analyses are listed in Table 4-17.

4.4.1.5 Explosives Analysis

Four groundwater samples were collected from well points (SB-T1, SB-B4, SB-A5, and SB-O13) and sent to an off-site laboratory for explosives analyses. 2,4-dinitrotoluene (0.0003 mg/L) was the only explosive detected in a wellpoint groundwater sample (SB-B4). The concentration of the explosive was well below the RBC value for tap water (0.073 mg/L). The results of the explosives analyses are listed in Table 4-18.

4.4.1.6 CWMs and CWM Breakdown Products Analysis

Four groundwater samples were collected from well points (SB-T1, SB-B4, SB-A5, and SB-O13) and sent to an off-site laboratory and analyzed for CWMs and CWM breakdown products. The laboratory reported no detections for any of the above analyses.

4.4.2 Monitoring Well Sampling

4.4.2.1 Groundwater VOC Analytical Results

Fourteen groundwater samples were collected from monitoring wells at the site and sent to an off-site laboratory for analysis. Monitoring wells MW-10 and MW-11 were dry and MW-17, the background well, was only sampled for metals. Thirteen different VOCs, mostly chlorinated solvents, were detected in the groundwater samples. 1,1,2,2-tetrachloroethene was detected in 10 of the wells at concentrations exceeding the tap water RBC (0.000052 mg/L). Trichloroethene was detected in 12 of the wells and exceeded the Alaska MCL

(0.005 mg/L) in 10 of the samples. The groundwater sample collected from monitoring well MW-14 had the highest concentrations of VOCs detected at the site and all were detected at concentrations exceeding Alaska MCLs or tap water RBCs. Benzene was detected at 2.9 mg/L (Alaska MCL, 0.005mg/L), 1,1,2,2-tetrachloroethane at 1,900 mg/L (RBC, 0.000052 mg/L), and trichloroethene at 220 mg/L (Alaska MCL, 0.005 mg/L). The groundwater sample from monitoring well MW-4 contained the second highest concentrations of 1,1,2,2-tetrachloroethane (71 mg/L) and trichloroethene (14 mg/L). The VOC analytical results for all the groundwater samples are listed in Table 4-19 and presented in Figure 4-11.

4.4.2.2 Metals Analysis

A groundwater sample from background monitoring well MW-17 was analyzed for total and dissolved priority pollutant metals to determine background levels of metals in groundwater. Chromium (0.036 mg/L), copper (0.02 mg/L), lead (0.0037 mg/L), nickel (0.037 mg/L), and zinc (0.027 mg/L) were detected in the total metals analyses. None of the priority pollutant metals were detected during the dissolved metals analyses of the background monitoring well sample.

Fourteen on-site monitoring wells were sampled and analyzed at an off-site laboratory for total metals. The following metals were detected: arsenic (1 well), chromium (5), copper (3), lead (2), nickel (6), and zinc (5). All total metals were below Alaska MCLs. Three of the metals detected (copper, lead, and zinc) in the sample collected from MW-6 for total metals analysis were over twice the background concentrations. Total arsenic and chromium were over twice the background concentrations for MW-7. All other metals were below or near background. The results of the total metals analyses are listed in Table 4-20.

Filtered groundwater samples were also collected for analysis of dissolved metals concentrations. Arsenic was detected (0.0071 mg/L) in the groundwater sample collected from MW-7. Nickel was detected in MW-5 (0.018 mg/L) and MW-14 (0.015 mg/L). Zinc was detected in MW-4 (0.023 mg/L), MW-9 (0.068 mg/L), and MW-15 (0.16 mg/L). The concentrations of all dissolved priority pollutant metals detected in the groundwater samples were below Alaska MCLs but above background. The only dissolved metal that was over twice the background detection limit was zinc. The results of the dissolved metals analyses are listed in Table 4-21.

4.4.2.3 Miscellaneous Groundwater Analyses

Fourteen groundwater samples were collected from the monitoring wells, sent to off-site laboratories, and analyzed for explosives, CWMs, and CWM breakdown products. Except for thiodiglycol (0.48 mg/L) in MW-14, the laboratory reported no detections for any of the above analyses. Thiodiglycol is a breakdown product of mustard.

All monitoring wells were checked for the presence of DNAPLs, as described in Section 2. No evidence of DNAPLs was found. In June 1996, MW-14 was rechecked for DNAPLs and again, no evidence was found. A discussion of the potential for the presence of DNAPLs is included in Section 5.0.

4.4.2.4 Groundwater Levels

The groundwater flow directions estimated from water level measurements indicate that groundwater is flowing north-northeast through the site, both in the deep and shallow water bearing zones (Figures 4-12 and 4-13). Water levels are being measured monthly for all 17 monitoring wells. Quarterly groundwater elevation reports are provided in Appendix XIV.

4.4.2.5 Groundwater Summary

Halogenated solvents were detected in the perched and shallow water bearing zones at concentrations above Alaska MCLs and tap water RBCs. 1,1,2,2-tetrachloroethane and trichloroethene were the two most common solvents detected in groundwater samples and were detected at the highest concentrations. Solvents were also detected in all of the samples collected from the deep monitoring wells, but at lower concentrations. The pattern of solvent detections suggests that the solvents are moving from Areas A-3 and A-4 to the northeast, in both the shallow and deep water bearing zones. This pattern matches the groundwater flow directions calculated from the groundwater elevations. Only two wells did not have solvents detected in groundwater samples (MW-2 and MW-8).

There was not a high correlation between the field screened groundwater samples and laboratory analyzed groundwater samples collected from well points. There were differences in the handling, preparation and analysis between the two methods that could introduce variability in the results. However, the comparison of results did indicate that the field screening results were adequate for identifying groundwater with elevated concentrations of solvents, which led to the successful selection of the permanent monitoring wells.

4.5 WETLANDS SAMPLING RESULTS

A wetland area is located south and southwest of the main disposal area. Four sediment and four surface water samples were collected from this wetland. These samples were analyzed for halogenated solvents, metals, explosives, CWMs, and CWM breakdown products. Sediment and surface water samples were also collected from six background locations. These samples were analyzed for metals and the results were compared to the metals results of the on-site wetland samples. This section presents the results of these samples.

4.5.1 Surface Water Sampling

4.5.1.1 Surface Water VOC Results

Four surface water samples were collected from separate locations within the wetlands area and sent to an off-site laboratory for VOC analyses. Samples were collected from locations SED-1 through SED-4 (Figure 4-14). Toluene was detected (0.0045 mg/L) in the surface water sample collected from SED-2. This concentration is less than the Alaska MCL for toluene (1 mg/L) and the Alaska water quality criteria for aromatic hydrocarbons (0.010 mg/L). No other VOCs were detected (Table 4-22).

4.5.1.2 Surface Water Metals

Six surface water samples and two replicates samples were collected at background locations and sent to an off-site laboratory. The laboratory analyzed the samples for 13 priority pollutant metals. Samples were collected from locations SEDB-1 through SEDB-6 (Figure 4-15). Zinc was the only metal detected and it was detected in all six background samples. The results of the metals analyses are listed in Table 4-23.

Four surface water samples and two replicate samples were collected within the wetlands area and sent to an off-site laboratory. The laboratory analyzed the samples for priority pollutant metals. Samples were collected from locations SED-1 through SED-4 (Figure 4-14). The analyses detected copper (2 samples), lead (4), nickel (2), and zinc (4). Copper, lead, and nickel were not detected in the background samples. Therefore, these metals are above background concentrations when detected. Zinc concentrations in the surface water samples from the wetland are below the average background concentration. The only metals that were over twice the background concentrations were copper and lead in sample SED-2. All priority pollutant metals concentrations were well below Alaska MCLs. Alaska MCLs are listed in Table 4-16. The results of the metals analyses are given in Table 4-23.

4.5.1.3 Surface Water Explosives

Four surface water samples and two replicate samples were collected within the wetlands area and sent to an off-site laboratory for explosives analyses. Samples were collected from locations SED-1 through SED-4 (Figure 4-14). 1,3-dinitrobenzene was detected in samples collected from SED-1 (0.0034 mg/L) and SED-2 (0.00048 mg/L). However, the analysis of two duplicate samples from SED-1 did not detect any 1,3-dinitrobenzene. The concentrations of 1,3-dinitrobenzene in both samples were below the RBC value for tap water (0.0037 mg/L). The results of the explosives analyses are listed in Table 4-24.

4.5.1.4 Surface Water CWMs and CWM Breakdown Products

Four surface water samples and two replicate samples were collected within the wetlands area and sent to an off-site laboratory. The laboratory analyzed the samples for CWMs and CWM breakdown products. Samples were collected from locations SED-1 through SED-4 (Figure 4-14). The laboratory reported no detections of CWMs or CWM breakdown products.

4.5.1.5 Surface Water Sampling Summary

No halogenated solvents were detected in the surface water samples collected from the wetland. Toluene was detected in one sample but the concentration was below regulatory levels. Several metals were detected in the surface water samples collected from the wetlands that were not detected in the background surface water samples. None of the metals detected in the surface water samples were greater than Alaska MCLs. 1,3-dinitrobenzene was detected in two surface water samples at concentrations below the RBC for tap water. No CWMs or CWM breakdown products were detected in the surface water samples.

4.5.2 Sediment Sampling

4.5.2.1 Sediment VOC Results

Four sediment samples and two replicate samples were collected within the wetlands area adjacent to the site and sent to an off-site laboratory for VOCs analysis by Method 8260. Samples were collected from locations SED-1 through SED-4 (Figure 4-14). No VOCs were detected in the sediment samples. Background samples were not analyzed for VOCs.

4.5.2.2 Sediment Metals

Six sediment samples and two replicate samples were collected at background locations and sent to an off-site laboratory. The laboratory analyzed the samples for priority pollutant metals. Samples were collected from locations SEDB-1 through SEDB-6 (Figure 4-15). Nine metals were detected including antimony (2 samples), arsenic (6), chromium (6), copper (6), lead (3), nickel (6), selenium (1), silver (1), and zinc (6). The results of the background metals analyses are listed in Table 4-25.

Four sediment samples and two replicate samples were collected within the wetlands area adjacent to the site and sent to an off-site laboratory to be analyzed for priority pollutant metals. Samples were collected from locations SED-1 through SED-4 (Figure 4-14). Arsenic, chromium, copper, nickel, and zinc were detected in the sediment samples. All metals were at or below average site-specific background concentrations and below residential RBCs for soil ingestion. Beryllium was not detected in any sediment samples, but the detection limits were higher than the RBC. Residential RBCs are listed in Table 4-11. The results of the above metals analyses are listed in Table 4-25.

4.5.2.3 Sediment Explosives

Four sediment samples and two replicate samples were collected within the wetlands area adjacent to the site and sent to an off-site laboratory to be analyzed for explosives. Samples were collected from location SED-1 through SED-4 (Figure 4-14). The three explosives detected included 1,3,5-trinitrobenzene (4 samples), 2,4,6-trinitrotoluene (1), and m-nitrotoluene (1). The sample with the highest levels of explosives was collected from SED-2 and had 1,3,5-trinitrobenzene (0.74 mg/L), 2,4,6-trinitrotoluene (0.48 mg/L), and m-nitrotoluene (3 mg/L). All explosive concentrations were well below residential soil RBCs. RBCs are listed in Table 4-11. The results of the above explosives analyses are listed Table 4-26.

4.5.2.4 Sediment CWMs and CWM Breakdown Products

Four sediment samples and two replicates samples were collected within the wetlands area and sent to an off-site laboratory. The laboratory analyzed the samples for CWMs and CWM breakdown products. Samples were collected from locations SED-1 through SED-4 (Figure 4-14). The laboratory reported no detections of CWMs or CWM breakdown products.

4.5.2.5 Sediment Sampling Summary

No VOCs were detected in the sediment samples. All metals were at or below average site-specific background concentrations. Three explosives (1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, and m-nitrotoluene) were detected in the sediment samples. All detected explosive concentrations were less than the residential soil RBCs. No CWMs or CWM breakdown products were detected in the sediment samples.

TABLE 4-1
HALOGENATED SOLVENT SCREENING - SOILS
AREAS A-1, A-2, AND OTHER AREAS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location Boring (Depth)	trichloroethene mg/kg	1,1,2,2-tetrachloroethane mg/kg
Area A-1:			
95PRDA-A-060SL	SB-A1 (0-3')	ND (0.05)	ND (0.05)
95PRDA-A-061SL	SB-A1 (3-6')	ND (0.05)	ND (0.05)
95PRDA-A-063SL	SB-A2 (0-2')	ND (0.05)	ND (0.05)
95PRDA-A-064SL	SB-A2 (3.5-7')	ND (0.05)	ND (0.05)
95PRDA-A-066SL	SB-A3 (0-3')	ND (0.05)	ND (0.05)
95PRDA-A-067SL	SB-A3 (3-6')	ND (0.05)	ND (0.05)
95PRDA-A-068SL	SB-A3 (8-12')	ND (0.05)	ND (0.05)
95PRDA-A-069SL	SB-A3 (12-15')	ND (0.05)	ND (0.05)
95PRDA-A-070SL	SB-A3 (16-19')	ND (0.05)	ND (0.05)
95PRDA-A-073SL	SB-A4 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-A-074SL	SB-A4 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-A-076SL	SB-A4 (6-9')	ND (0.05)	ND (0.05)
95PRDA-A-077SL	SB-A4 (9-12')	ND (0.05)	ND (0.05)
95PRDA-A-078SL	SB-A4 (12-15')	ND (0.05) J	ND (0.05) J
95PRDA-A-079SL	SB-A4 (15-17')	ND (0.05) J	ND (0.05) J
95PRDA-A-081SL	SB-A5(8-10')	ND (0.05)	ND (0.05)
95PRDA-A-082SL	SB-A5 (12.5-13.5')	ND (0.05)	ND (0.05)
95PRDA-A-083SL	SB-A5 (14-17')	ND (0.05)	ND (0.05)
95PRDA-A-084SL	SB-A5 (20.5-22.5')	ND (0.05)	ND (0.05)
95PRDA-A-089SL	SB-A6 (0-3')	ND (0.05)	ND (0.05)
95PRDA-A-090SL	SB-A6 (3-6')	ND (0.05)	ND (0.05)
95PRDA-A-091SL	SB-A6 (6-9')	ND (0.05)	ND (0.05)
95PRDA-A-092SL	SB-A6 (9-12')	ND (0.05)	ND (0.05)
95PRDA-A-093SL	SB-A6 (12-15')	ND (0.05)	ND (0.05)
95PRDA-A-094SL	SB-A6 (15-18')	ND (0.05)	ND (0.05)
95PRDA-A-095SL	SB-A6 (18-21')	ND (0.05)	ND (0.05)
Area A-2:			
95PRDA-B-033SL	SB-B1 (0-3')	ND (0.05)	0.47 J
95PRDA-B-034SL	SB-B1 (4-6')	ND (0.05)	1.7
95PRDA-B-036SL	SB-B2 (0-3')	ND (0.05)	0.15
95PRDA-B-037SL	SB-B2 (3-6')	ND (0.05)	ND (0.05)
95PRDA-B-038SL	SB-B2 (7-10')	ND (0.05)	ND (0.05)
95PRDA-B-039SL	SB-B2 (10-12')	ND (0.05)	ND (0.05)
95PRDA-B-040SL	SB-B2 (14-17')	ND (0.05)	ND (0.05)
95PRDA-B-041SL	SB-B2 (20-22')	ND (0.05)	ND (0.05)
95PRDA-B-043SL	SB-B3 (0-3')	ND (0.05)	ND (0.05)

TABLE 4-1: (CONTINUED)

Sample Number	Sample Location Boring (Depth)	trichloroethene mg/kg	1,1,2,2-tetrachloroethane mg/kg
95PRDA-B-044SL	SB-B3 (4-7')	ND (0.05)	ND (0.05)
95PRDA-B-045SL	SB-B3 (7-10')	ND (0.05)	ND (0.05)
95PRDA-B-047SL	SB-B4 (0-3')	ND (0.05)	ND (0.05)
95PRDA-B-048SL	SB-B4 (3-6')	ND (0.05)	ND (0.05)
95PRDA-B-049SL	SB-B4 (6-9')	ND (0.05)	ND (0.05)
95PRDA-B-052SL	SB-B5 (0-3')	ND (0.05)	ND (0.05)
95PRDA-B-053SL	SB-B5 (3-6')	ND (0.05)	ND (0.05)
95PRDA-B-056SL	SB-B5 (14-14.5')	ND (0.05)	ND (0.05)
95PRDA-B-058SL	SB-B5 (6-9')	ND (0.05)	ND (0.05)
95PRDA-B-059SL	SB-B5 (9-10.5')	ND (0.05) J	ND (0.05) J
95PRDA-B-097SL	SB-B6 (0-3')	ND (0.05)	ND (0.05)
95PRDA-B-098SL	SB-B6 (3-6')	ND (0.05)	ND (0.05)
95PRDA-B-099SL	SB-B6 (6-9')	ND (0.05)	ND (0.05)
95PRDA-B-100SL	SB-B6 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-B-101SL	SB-B6 (12-14')	ND (0.05)	ND (0.05)
95PRDA-B-104SL	SB-B7 (1-3')	ND (0.05) J	ND (0.05) J
95PRDA-B-105SL	SB-B7 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-B-106SL	SB-B7 (6-9')	ND (0.05)	ND (0.05)
95PRDA-B-107SL	SB-B7 (13-15')	ND (0.05)	ND (0.05)
95PRDA-B-108SL	SB-B7 (15-17')	ND (0.05)	ND (0.05)
95PRDA-O-189SL	SB-O12 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-190SL	SB-O12 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-O-191SL	SB-O12 (6-9')	ND (0.05) J	0.72 J
95PRDA-O-192SL	SB-O12 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-O-193SL	SB-O12 (12-15')	ND (0.05) R	ND (0.05) R
95PRDA-O-194SL	SB-O12 (15-18')	ND (0.05) J	ND (0.05) J
95PRDA-O-263SL	MW-13 (0-2')	ND (0.05)	ND (0.05) J
95PRDA-O-264SL	MW-13 (3-5')	ND (0.05) R	ND (0.05) R
95PRDA-O-299SL	MW-13 (6-8')	ND (0.05)	ND (0.05)
95PRDA-O-300SL	MW-13 (8-10')	ND (0.05)	ND (0.05)
95PRDA-O-301SL	MW-13 (10-12')	ND (0.05)	ND (0.05)
95PRDA-O-302SL	MW-13 (12-14')	ND (0.05)	ND (0.05)
95PRDA-O-303SL	MW-13 (14-16')	ND (0.05)	ND (0.05)
95PRDA-O-304SL	MW-13 (16-18')	ND (0.05)	ND (0.05)
95PRDA-O-305SL	MW-13 (18-20')	ND (0.05)	ND (0.05)
95PRDA-O-306SL	MW-13 (20-21')	ND (0.05) J	0.52 J
95PRDA-O-307SL	MW-13 (24-26')	ND (0.05)	ND (0.05)
95PRDA-O-308SL	MW-13 (26-28')	ND (0.05) J	0.12 J
95PRDA-O-309SL	MW-13 (28-28.5')	ND (0.05)	ND (0.05)
Toe of Hill:			
95PRDA-T-021SL	SB-T1 (0-2')	ND (0.05) J	ND (0.05) J
95PRDA-T-024SL	SB-T1 (2-4')	ND (0.05) J	ND (0.05) J
95PRDA-T-029SL	SB-T2 (0-2')	ND (0.05) J	ND (0.05) J
95PRDA-T-031SL	SB-T3 (0-2')	ND (0.05) J	ND (0.05) J

TABLE 4-1: (CONTINUED)

Sample Number	Sample Location Boring (Depth)	trichloroethene mg/kg	1,1,2,2-tetrachloroethane mg/kg
Areas South of Disposal Areas:			
95PRDA-O-110SL	SB-O1 (0-2')	ND (0.05)	0.07
95PRDA-O-111SL	SB-O1 (3-5')	ND (0.05) J	ND (0.05) J
95PRDA-O-112SL	SB-O1 (6-8')	ND (0.05) J	ND (0.05) J
95PRDA-O-113SL	SB-O1 (16-19')	ND (0.05) J	ND (0.05) J
95PRDA-O-114SL	SB-O1 (19-21')	ND (0.05) J	ND (0.05) J
95PRDA-O-116SL	SB-O2 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-117SL	SB-O2 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-O-118SL	SB-O2 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-O-119SL	SB-O2 (12-15')	ND (0.05) J	ND (0.05) J
95PRDA-O-120SL	SB-O2 (15-25')	ND (0.05) J	ND (0.05) J
95PRDA-O-233SL	SB-O8 (0-3')	ND (0.05) R	0.07 J
95PRDA-O-164SL	SB-O8 (3-5')	ND (0.05) J	ND (0.05) J
95PRDA-O-165SL	SB-O8 (5-8')	ND (0.05) J	ND (0.05) J
95PRDA-O-166SL	SB-O8 (8-11')	ND (0.05) J	ND (0.05) J
95PRDA-O-167SL	SB-O8 (11-14')	ND (0.05) J	ND (0.05) J
95PRDA-O-168SL	SB-O8 (14-17')	ND (0.05) J	ND (0.05) J
95PRDA-O-169SL	SB-O8 (17-21')	ND (0.05) J	ND (0.05) J
95PRDA-O-171SL	SB-O9 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-172SL	SB-O9 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-O-173SL	SB-O9 (6-9')	ND (0.05) J	ND (0.05) J
95PRDA-O-174SL	SB-O9 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-O-177SL	SB-O10 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-178SL	SB-O10 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-O-179SL	SB-O10 (6-9')	ND (0.05) J	ND (0.05) J
95PRDA-O-180SL	SB-O11 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-181SL	SB-O11 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-O-182SL	SB-O11 (6-9')	ND (0.05) J	ND (0.05) J
95PRDA-O-183SL	SB-O11 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-O-184SL	SB-O11 (12-15')	ND (0.05) J	ND (0.05) J
95PRDA-O-185SL	SB-O11 (15-18')	ND (0.05) J	ND (0.05) J
95PRDA-O-186SL	SB-O11 (18-21')	ND (0.05) J	ND (0.05) J
95PRDA-O-226SL	SB-O16 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-227SL	SB-O16 (3-6')	ND (0.05) R	0.07 J
95PRDA-O-228SL	SB-O16 (6-9')	ND (0.05) J	ND (0.05) J
95PRDA-O-229SL	SB-O16 (9-12')	ND (0.05) R	ND (0.05) R
95PRDA-O-230SL	SB-O16 (12-15')	ND (0.05) R	ND (0.05) R
95PRDA-O-231SL	SB-O16 (15-18')	ND (0.05) J	ND (0.05) J
Areas North of Disposal Areas:			
95PRDA-O-122SL	SB-O3 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-123SL	SB-O3 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-O-124SL	SB-O3 (6-9')	ND (0.05) J	ND (0.05) J
95PRDA-O-125SL	SB-O3 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-O-126SL	SB-O3 (12-15')	ND (0.05) J	ND (0.05) J

TABLE 4-1: (CONTINUED)

Sample Number	Sample Location Boring (Depth)	trichloroethene mg/kg	1,1,2,2-tetrachloroethane mg/kg
95PRDA-O-127SL	SB-O3 (15-18')	ND (0.05) J	ND (0.05) J
95PRDA-O-128SL	SB-O3 (18-21')	ND (0.05) J	ND (0.05) J
95PRDA-O-129SL	SB-O3 (21-24')	ND (0.05) J	ND (0.05) J
95PRDA-O-130SL	SB-O3 (24-27')	0.76 J	5.75 J
95PRDA-O-132SL	SB-O4 (0-3')	ND (0.05)	ND (0.05)
95PRDA-O-133SL	SB-O4 (3-6')	ND (0.05)	ND (0.05)
95PRDA-O-134SL	SB-O4 (6-9')	ND (0.05)	ND (0.05)
95PRDA-O-135SL	SB-O4 (9-12')	ND (0.05)	ND (0.05)
95PRDA-O-136SL	SB-O4 (12-14.5')	ND (0.05)	ND (0.05)
95PRDA-O-137SL	SB-O4 (15-18')	ND (0.05)	ND (0.05)
95PRDA-O-138SL	SB-O4 (18-21')	ND (0.05)	ND (0.05)
95PRDA-O-141SL	SB-O5 (1-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-142SL	SB-O5 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-O-143SL	SB-O5 (6-9')	ND (0.05) J	ND (0.05) J
95PRDA-O-144SL	SB-O5 (10-13')	ND (0.05) J	ND (0.05) J
95PRDA-O-145SL	SB-O5 (13-16')	ND (0.05) J	ND (0.05) J
95PRDA-O-147SL	SB-O6 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-148SL	SB-O6 (4-6')	ND (0.05) J	ND (0.05) J
95PRDA-O-149SL	SB-O6 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-O-150SL	SB-O6 (12-16')	ND (0.05) J	ND (0.05) J
95PRDA-O-151SL	SB-O6 (16-19')	ND (0.05) J	ND (0.05) J
95PRDA-O-152SL	SB-O6 (19-22')	ND (0.05) J	ND (0.05) J
95PRDA-O-153SL	SB-O6 (22-22.5')	ND (0.05) J	ND (0.05) J
95PRDA-O-155SL	SB-O7 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-156SL	SB-O7 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-O-157SL	SB-O7 (6-9')	ND (0.05) R	ND (0.05) R
95PRDA-O-158SL	SB-O7 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-O-159SL	SB-O7 (12-14')	ND (0.05) J	ND (0.05) J
95PRDA-O-160SL	SB-O7 (18-21')	ND (0.05) R	ND (0.05) R
95PRDA-O-161SL	SB-O7 (21-24')	ND (0.05) R	ND (0.05) R
95PRDA-O-195SL	SB-O13 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-196SL	SB-O13 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-O-197SL	SB-O13 (6-9')	ND (0.05) J	ND (0.05) J
95PRDA-O-198SL	SB-O13 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-O-200SL	SB-O13 (15-18')	ND (0.05) J	ND (0.05) J
95PRDA-O-201SL	SB-O13 (18-21')	ND (0.05) J	0.141 J
95PRDA-O-202SL	SB-O13 (21-24')	ND (0.05) J	0.269 J
95PRDA-O-203SL	SB-O13 (24-26')	0.214 J	0.541 J
95PRDA-O-204SL	SB-O13 (12-15')	ND (0.05) J	ND (0.05) J
95PRDA-O-205SL	SB-O14 (0-3')	ND (0.05) J	0.179 J
95PRDA-O-206SL	SB-O14 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-O-207SL	SB-O14 (6-9')	ND (0.05) J	ND (0.05) J
95PRDA-O-208SL	SB-O14 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-O-209SL	SB-O14 (13.5-14.5)	ND (0.05) J	ND (0.05) J

TABLE 4-1: (CONTINUED)

Sample Number	Sample Location Boring (Depth)	trichloroethene mg/kg	1,1,2,2-tetrachloroethane mg/kg
95PRDA-O-210SL	SB-O14 (18-19.5')	ND (0.05) J	ND (0.05) J
95PRDA-O-211SL	SB-O14 (24-24.5')	ND (0.05) J	ND (0.05) J
95PRDA-O-212SL	SB-O14 (25-27.5')	ND (0.05) J	ND (0.05) J
95PRDA-O-214SL	SB-O15 (0-3')	ND (0.05) R	ND (0.05) R
95PRDA-O-215SL	SB-O15 (3-6')	ND (0.05) R	ND (0.05) R
95PRDA-O-216SL	SB-O15 (6-9')	ND (0.05) J	ND (0.05) J
95PRDA-O-217SL	SB-O15 (9-12')	ND (0.05) R	ND (0.05) R
95PRDA-O-218SL	SB-O15 (12-15')	ND (0.05) J	ND (0.05) J
95PRDA-O-219SL	SB-O15 (15-18')	ND (0.05) J	ND (0.05) J
95PRDA-O-220SL	SB-O15 (18-21')	ND (0.05) J	ND (0.05) J
95PRDA-O-221SL	SB-O15 (21-24')	ND (0.05) J	ND (0.05) J
95PRDA-O-222SL	SB-O15 (24-27')	ND (0.05) J	ND (0.05) J
95PRDA-O-223SL	SB-O15 (27-30')	ND (0.05) R	ND (0.05) R
95PRDA-O-224SL	SB-O15 (30-33')	ND (0.05) R	ND (0.05) R
95PRDA-O-225SL	SB-O15 (33-36')	ND (0.05) R	ND (0.05) R
95PRDA-O-234SL	SB-O17 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-235SL	SB-O17 (3-6')	ND (0.05) R	ND (0.05) R
95PRDA-O-236SL	SB-O17 (6-9')	ND (0.05) R	ND (0.05) R
95PRDA-O-237SL	SB-O17 (9-11')	ND (0.05) J	ND (0.05) J
95PRDA-O-238SL	SB-O17 (14-15')	ND (0.05) R	ND (0.05) R
95PRDA-O-239SL	SB-O17 (17-18')	ND (0.05) R	0.07 J
95PRDA-O-241SL	SB-O18 (0-3')	ND (0.05) R	ND (0.05) R
95PRDA-O-242SL	SB-O18 (3-6')	ND (0.05) J	ND (0.05) J
95PRDA-O-243SL	SB-O18 (6-6.5')	ND (0.05) R	ND (0.05) R
95PRDA-O-244SL	SB-O18 (9-12')	ND (0.05) J	ND (0.05) J
95PRDA-O-245SL	SB-O18 (12-14')	ND (0.05) J	ND (0.05) J
95PRDA-O-246SL	SB-O18 (15-18')	ND (0.05) R	ND (0.05) R
95PRDA-O-247SL	SB-O18 (18-20')	ND (0.05) R	ND (0.05) R
95PRDA-O-248SL	SB-O19 (0-3')	ND (0.05) J	ND (0.05) J
95PRDA-O-249SL	SB-O19 (3-6')	ND (0.05) R	ND (0.05) R
95PRDA-O-250SL	SB-O19 (6-9')	ND (0.05) R	ND (0.05) R
95PRDA-O-251SL	SB-O19 (9-11')	ND (0.05) J	ND (0.05) J
95PRDA-O-252SL	SB-O19 (12-15')	ND (0.05) J	ND (0.05) J
95PRDA-O-254SL	SB-O19 (15-18')	ND (0.05)	ND (0.05) J
95PRDA-O-255SL	SB-O19 (18-21')	ND (0.05) R	0.06 J
95PRDA-O-256SL	SB-O19 (23-26')	ND (0.05)	ND (0.05) J
95PRDA-O-257SL	SB-O19 (26-28')	ND (0.05)	ND (0.05) J
95PRDA-O-261SL	MW-12 (0-2')	ND (0.05)	ND (0.05) J
95PRDA-O-262SL	MW-12 (3-5')	ND (0.05)	ND (0.05) J
95PRDA-O-289SL	MW-12 (7-7.5')	ND (0.05)	ND (0.05)
95PRDA-O-290SL	MW-12 (11-13')	ND (0.05)	ND (0.05)
95PRDA-O-291SL	MW-12 (14-14.5')	ND (0.05)	ND (0.05)
95PRDA-O-292SL	MW-12 (16-16.5')	ND (0.05)	ND (0.05)
95PRDA-O-293SL	MW-12 (18-18.5')	ND (0.05)	ND (0.05)

TABLE 4-1: (CONTINUED)

Sample Number	Sample Location Boring (Depth)	trichloroethene mg/kg	1,1,2,2-tetrachloroethane mg/kg
95PRDA-O-294SL	MW-12 (20-22')	ND (0.05)	ND (0.05)
95PRDA-O-295SL	MW-12 (22-24')	ND (0.05)	ND (0.05)
95PRDA-O-296SL	MW-12 (27-29')	ND (0.05)	ND (0.05)
95PRDA-O-297SL	MW-12 (31-33')	ND (0.05)	ND (0.05)
95PRDA-O-298SL	MW-12 (36.5-37')	ND (0.05)	ND (0.05)
95PRDA-O-258SL	SB-O20 (0-2')	ND (0.05)	ND (0.05) J
95PRDA-O-259SL	SB-O20 (3-5')	ND (0.05)	ND (0.05) J
95PRDA-O-260SL	SB-O20 (6-8')	ND (0.05) R	ND (0.05) R
95PRDA-O-267SL	SB-O20 (12-12.5')	ND (0.05) J	ND (0.05) J
95PRDA-O-270SL	SB-O20 (24-26')	ND (0.05) J	ND (0.05) J
95PRDA-O-271SL	SB-O20 (26-28')	ND (0.05) J	ND (0.05) J
95PRDA-O-272SL	SB-O20 (28-30')	ND (0.05) J	ND (0.05) J
95PRDA-O-318SL	MW-16 (4-6')	ND (0.05)	ND (0.05)
95PRDA-O-319SL	MW-16 (9-11')	ND (0.05)	0.56
95PRDA-O-320SL	MW-16 (14-16')	ND (0.05)	ND (0.05)
95PRDA-O-321SL	MW-16 (19-21')	ND (0.05)	ND (0.05)
95PRDA-O-365SL	MW-16 (17-18')	ND (0.05)	ND (0.05)
95PRDA-O-366SL	MW-16 (22-23.5')	ND (0.05)	ND (0.05)
95PRDA-O-367SL	MW-16 (27-28.5')	ND (0.05)	ND (0.05)
95PRDA-O-368SL	MW-16 (32-33.5')	ND (0.05)	ND (0.05)
95PRDA-O-369SL	MW-16 (37-38.5')	ND (0.05)	ND (0.05)
95PRDA-O-370SL	MW-16 (42-43.5')	ND (0.05)	ND (0.05)
95PRDA-O-371SL	MW-16 (47-48.5')	ND (0.05)	ND (0.05)
95PRDA-O-372SL	MW-16 (52-53.5')	ND (0.05)	ND (0.05)
95PRDA-O-374SL	MW-16 (62-63.5')	ND (0.05)	ND (0.05)
95PRDA-O-375SL	MW-16 (67-68.5')	ND (0.05)	ND (0.05)
95PRDA-O-376SL	MW-16 (72-73')	ND (0.05)	ND (0.05)
95PRDA-O-377SL	MW-16 (87-88')	ND (0.05)	ND (0.05)
95PRDA-O-378SL	MW-16 (101.4-102')	ND (0.05)	ND (0.05)
95PRDA-O-379SL	MW-16 (106-107')	ND (0.05)	ND (0.05)
95PRDA-O-380SL	MW-16 (115.4-116')	ND (0.05)	ND (0.05)
95PRDA-O-381SL	MW-16 (120.4-122')	ND (0.05)	ND (0.05)
95PRDA-O-382SL	MW-16 (125.4-127')	ND (0.05)	ND (0.05)
95PRDA-O-383SL	MW-16 (131.4-133')	ND (0.05)	ND (0.05)
95PRDA-O-384SL	MW-16 (135.4-137')	ND (0.05)	ND (0.05)
95PRDA-O-385SL	MW-16 (156.4-163')	ND (0.05)	ND (0.05)
95PRDA-O-386SL	MW-16 (166.4-167')	ND (0.05)	ND (0.05)

Notes:
ND = Non Detect
( ) = Detection Limit
J = Estimated Value
R = Rejected Data

TABLE 4-2
SUMMARY OF HALOGENATED SOLVENT SCREENING - SOILS
AREAS A-1, A-2, AND OTHER AREAS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location Boring (Depth)	trichloroethene mg/kg	1,1,2,2-tetrachloroethane mg/kg
Area A-2			
95PRDA-B-033SL	SB-B1 (0-3')	ND (0.05)	0.47
95PRDA-B-034SL	SB-B1 (4-6')	ND (0.05)	1.7
95PRDA-B-036SL	SB-B2 (0-3')	ND (0.05)	0.15
95PRDA-O-191SL	SB-O12 (6-9')	ND (0.05) J	0.72 J
95PRDA-O-306SL	MW-13 (20-21')	ND (0.05) J	0.52 J
95PRDA-O-308SL	MW-13 (26-28')	ND (0.05) J	0.12 J
Areas South of Disposal Areas:			
95PRDA-O-110SL	SB-O1 (0-2')	ND (0.05)	0.07
95PRDA-O-233SL	SB-O8 (0-3')	ND (0.05) R	0.07 J
95PRDA-O-227SL	SB-O16 (3-6')	ND (0.05) R	0.07 J
Areas North of Disposal Areas:			
95PRDA-O-130SL	SB-O3 (24-27')	0.76 J	5.75 J
95PRDA-O-201SL	SB-O13 (18-21')	ND (0.05) J	0.141 J
95PRDA-O-202SL	SB-O13 (21-24')	ND (0.05) J	0.269 J
95PRDA-O-203SL	SB-O13 (24-26')	0.214 J	0.541 J
95PRDA-O-205SL	SB-O14 (0-3')	ND (0.05) J	0.179 J
95PRDA-O-239SL	SB-O17 (17-18')	ND (0.05) R	0.07 J
95PRDA-O-255SL	SB-O19* (18-21')	ND (0.05) R	0.06 J
95PRDA-O-319SL	MW-16 (9-11')	ND (0.05)	0.56

Notes:
J = Estimate Value
( ) = Detection Limit
R = Rejected Data
*SB-O19 is the same as MW-15

TABLE 4-3
HALOGENATED SOLVENT SCREENING - SOILS
AREAS A-3 AND A-4

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location Boring (Depth)	trans-1,2-dichloroethene mg/kg	cis-1,2-dichloroethene mg/kg	chloroform mg/kg	trichloroethene mg/kg	1,1,2-trichloroethane mg/kg
Area A-3						
95PRDA-C-009SL	SB-C1 (0-2')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-010SL	SB-C1 (9-11')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-011SL	SB-C1 (13-15')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-013SL	SB-C2 (0-2')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-014SL	SB-C2 (9-12')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-015SL	SB-C2 (17-18')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-017SL	SB-C3 (0-2')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-019SL	SB-C3 (8-10')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-265SL	MW-14 (0-2')	ND (0.05) J	ND (0.05) J	ND (0.05) J	ND (0.05) J	ND (0.05) J
95PRDA-O-266SL	MW-14 (4-6')	ND (0.05) R	ND (0.05) R	ND (0.05) R	ND (0.05) R	ND (0.05) R
95PRDA-O-310SL	MW-14 (6-8')	ND (0.05)	ND (0.05)	ND (0.05)	0.94	ND (0.05)
95PRDA-O-311SL	MW-14 (8-10')	ND (0.05)	ND (0.05)	ND (0.05)	0.16	ND (0.05)
95PRDA-O-312SL	MW-14 (10-12')	ND (0.05)	ND (0.05)	ND (0.05)	0.15	ND (0.05)
95PRDA-O-313SL	MW-14 (12-14')	ND (0.05)	ND (0.05)	ND (0.05)	0.11	ND (0.05)
95PRDA-O-314SL	MW-14 (14-15')	ND (0.05)	ND (0.05)	ND (0.05)	0.82	ND (0.05)
95PRDA-O-315SL	MW-14 (16-18')	0.54	1.54	1.12	384 J	11.4 J
95PRDA-O-316SL	MW-14 (18-20')	0.22	0.63	0.25	25.6 J	11.4
95PRDA-O-317SL	MW-14 (20-22')	ND (0.05)	ND (0.05)	ND (0.05)	1.47	ND (0.05)

TABLE 4-3: (CONTINUED)

Sample Number	Sample Location Boring (Depth)	tetrachloroethene mg/kg	1,1,2,2-tetrachloroethane mg/kg	carbon tetrachloride mg/kg	bromoform mg/kg	1,1,1,2-tetrachloroethane mg/kg
Area A-3						
95PRDA-C-009SL	SB-C1 (0-2')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-010SL	SB-C1 (9-11')	ND (0.05)	0.67	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-011SL	SB-C1 (13-15')	ND (0.05)	0.93	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-013SL	SB-C2 (0-2')	ND (0.05)	1.49	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-014SL	SB-C2 (9-12')	ND (0.05)	0.2	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-015SL	SB-C2 (17-18')	ND (0.05)	0.48	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-017SL	SB-C3 (0-2')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-C-019SL	SB-C3 (8-10')	ND (0.05)	0.2	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-265SL	MW-14 (0-2')	ND (0.05) J	ND (0.05) J	ND (0.05) J	ND (0.05) J	ND (0.05) J
95PRDA-O-266SL	MW-14 (4-6')	ND (0.05) R	1.37 J	ND (0.05) R	ND (0.05) R	ND (0.05) R
95PRDA-O-310SL	MW-14 (6-8')	ND (0.05)	1.45	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-311SL	MW-14 (8-10')	ND (0.05)	0.48	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-312SL	MW-14 (10-12')	ND (0.05)	0.123	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-313SL	MW-14 (12-14')	ND (0.05)	0.98	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-314SL	MW-14 (14-15')	ND (0.05)	1.63	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-315SL	MW-14 (16-18')	159 J	2030 J	13.5	ND (0.05)	2.06
95PRDA-O-316SL	MW-14 (18-20')	1.97	93.2 J	ND (0.05)	7.93 J	ND (0.05)
95PRDA-O-317SL	MW-14 (20-22')	ND (0.05)	10.1	ND (0.05)	4.1 J	ND (0.05)

TABLE 4-3: (CONTINUED)

Sample Number	Sample Location Boring (Depth)	trans-1,2-dichloroethene mg/kg	cis-1,2-dichloroethene mg/kg	chloroform mg/kg	trichloroethene mg/kg	1,1,2-trichloroethane mg/kg
Area A-4						
95PRDA-D-001SL	SB-D1 (0-2')	ND (0.05)	ND (0.05)	ND (0.05)	0.05	ND (0.05)
95PRDA-D-002SL	SB-D1 (5-7')	ND (0.05)	ND (0.05)	0.07	0.76	ND (0.05)
95PRDA-D-003SL	SB-D1 (10-12')	ND (0.05)	ND (0.05)	ND (0.05)	0.19	ND (0.05)
95PRDA-D-005SL	SB-D2 (0-2')	ND (0.05)	ND (0.05)	ND (0.05)	0.16	ND (0.05)
95PRDA-D-006SL	SB-D2 (5-7')	ND (0.05)	ND (0.05)	ND (0.05)	0.2	ND (0.05)
95PRDA-D-007SL	SB-D2 (10-13')	ND (0.05)	ND (0.05)	ND (0.05)	0.12	ND (0.05)

ND = Non Detect
( ) = Reporting Limit
J = Estimated Value
R = Rejected Data

TABLE 4-3: (CONTINUED)

Sample Number	Sample Location Boring (Depth)	tetrachloroethene mg/kg	1,1,2,2-tetrachloroethane mg/kg	carbon tetrachloride mg/kg	bromoform mg/kg	1,1,1,2-tetrachloroethane mg/kg
Area A-4						
95PRDA-D-001SL	SB-D1 (0-2')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-D-002SL	SB-D1 (5-7')	ND (0.05)	1.95	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-D-003SL	SB-D1 (10-12')	ND (0.05)	0.41	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-D-005SL	SB-D2 (0-2')	ND (0.05)	1.58	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-D-006SL	SB-D2 (5-7')	ND (0.05)	0.41	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-D-007SL	SB-D2 (10-13')	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)

ND = Non Detect
( ) = Reporting Limit
J = Estimated Value
R = Rejected Data

TABLE 4-4
HALOGENATED SOLVENT SCREENING - SOIL SAMPLES EXCEEDING RBCS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

		Location:	MW-14 (16-18')	MW-14 (18-20')	MW-14 (20'-22)	SB-O3 (24-27')
		Sample ID:	95PRDA-O-315SL	95PRDA-O-316SL	95PRDA-O-317SL	95PRDA-O-130SL
		Area:	Area A-4	Area A-4	Area A-4	North of Areas
Compounds	**RBC mg/kg**		**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
carbon tetrachloride	4.9		**13.5**	ND (0.05)	ND (0.05)	ND (0.05)
tetrachloroethene	12		**159 J**	1.97	ND (0.05)	ND (0.05)
1,1,2,2-tetrachloroethane	3.2		**2030 J**	**93.2 J**	**10.1**	**5.75 J**
trichloroethene	58		**384 J**	25.6 J	1.47	ND (0.05)
1,1,2-trichloroethane	11		**11.4 J**	**11.4**	ND (0.05)	ND (0.05)

ND = Non Detect
( ) = Detection Limit
J = Estimated Value
RBC values taken from EPA, Region II, October 20, 1995.
Bold text indicates value exceeds RBC.

TABLE 4-5
LABORATORY VOC ANALYSIS - SOIL
AREAS A-1, A-2 AND OTHER AREAS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	chloroform mg/kg	cis-1,2-dichloroethene mg/kg	trans 1,2-dichloroethene mg/kg	ethylbenzene mg/kg
Area A-1					
95PRDA-A-064SL	SB-A2 (3.5-7')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-A-084SL	SB-A5 (20.5-22.5')	ND (0.0012) J	ND (0.0012) J	ND (0.0012) J	ND (0.0012) J
Area A-2					
95PRDA-B-045SL	SB-B3 (7-10')	ND (0.0012)	ND (0.0012)	ND (0.0012)	ND (0.0012)
95PRDA-B-053SL	SB-B5 (3-6')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-B-054SL	Duplicate of 053	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-B-055SL	Triplicate of 053	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-B-106SL	SB-B7 (6-9')	0.0042	ND (0.0012)	ND (0.0012)	ND (0.0012)
95PRDA-O-194SL	SB-O12 (15-18')	ND (0.001) J	ND (0.001) J	ND (0.001) J	ND (0.001) J
95PRDA-O-301SL	MW-13 (10-12')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
Toe of Hill					
95PRDA-T-021SL	SB-T1 (0-2')	ND (0.0073)	ND (0.0073)	ND (0.0073)	ND (0.0073)
95PRDA-T-022SL	Duplicate of 021	0.013	ND (0.0014)	ND (0.0014)	ND (0.0014)
95PRDA-T-023SL	Triplicate of 021	ND (0.006)	ND (0.006)	ND (0.006)	ND (0.006)
Other Areas					
95PRDA-O-112SL	SB-O1 (6-8')	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-133SL	SB-O4 (3-6')	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-155SL	SB-O7 (0-3')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-O-165SL	SB-O8 (5-8')	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-174SL	SB-O9 (9-12')	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-179SL	SB-O10 (6-9')	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-182SL	SB-O11 (6-9')	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-204SL	SB-O13 (12-15')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-O-218SL	SB-O15 (12-15')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-O-231SL	SB-O16 (15-18')	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-247SL	SB-O18 (18-20')	ND (0.0011) J	0.0058 J	0.0027 J	0.0016 J

TABLE 4-5: (CONTINUED)

Sample Number	Sample Location	1,1,2,2-tetrachloroethane mg/kg	tetrachloroethene mg/kg	toluene mg/kg	trichloroethene mg/kg	total xylenes mg/kg
Area A-1						
95PRDA-A-064SL	SB-A2 (3.5-7')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-A-084SL	SB-A5 (20.5-22.5')	ND (0.0012) J	ND (0.0012) J	ND (0.0012) J	ND (0.0012) J	ND (0.0012) J
Area A-2						
95PRDA-B-045SL	SB-B3 (7-10')	ND (0.0012)	ND (0.0012)	ND (0.0012)	ND (0.0012)	ND (0.0012)
95PRDA-B-053SL	SB-B5 (3-6')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-B-054SL	Duplicate of 053	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-B-055SL	Triplicate of 053	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-B-106SL	SB-B7 (6-9')	ND (0.0012)	ND (0.0012)	ND (0.0012)	ND (0.0012)	ND (0.0012)
95PRDA-O-194SL	SB-O12 (15-18')	ND (0.001) J	ND (0.001) J	ND (0.001) J	0.0012 J	ND (0.001) J
95PRDA-O-301SL	MW-13 (10-12')	ND (0.0011)	ND (0.0011)	ND (0.0011)	0.0036	ND (0.0011)
Toe of Hill						
95PRDA-T-021SL	SB-T1 (0-2')	ND (0.0073)	ND (0.0073)	ND (0.0073)	ND (0.0073)	ND (0.0073)
95PRDA-T-022SL	Duplicate of 021	ND (0.0014)	ND (0.0014)	ND (0.0014)	ND (0.0014)	ND (0.0014)
95PRDA-T-023SL	Triplicate of 021	ND (0.006)	ND (0.006)	ND (0.006)	ND (0.006)	0.004 J
Other Areas						
95PRDA-O-112SL	SB-O1 (6-8')	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-133SL	SB-O4 (3-6')	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-155SL	SB-O7 (0-3')	ND (0.0011)	ND (0.0011)	0.0024	ND (0.0011)	ND (0.0011)
95PRDA-O-165SL	SB-O8 (5-8')	ND (0.0011) J	ND (0.0011) J	0.0014 J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-174SL	SB-O9 (9-12')	ND (0.0011) J	ND (0.0011) J	0.0018 J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-179SL	SB-O10 (6-9')	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-182SL	SB-O11 (6-9')	0.11 J	ND (0.0011) J	ND (0.0011) J	0.0083 J	ND (0.0011) J
95PRDA-O-204SL	SB-O13 (12-15')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-O-218SL	SB-O15 (12-15')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-O-231SL	SB-O16 (15-18')	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-247SL	SB-O18 (18-20')	0.077 J	0.0054 J	0.0023 J	0.11 J	0.0017 J

TABLE 4-5: (CONTINUED)

Sample Number	Sample Location	chloroform mg/kg	cis-1,2-dichloroethene mg/kg	trans 1,2-dichloroethene mg/kg	ethylbenzene mg/kg
(Other Areas)					
95PRDA-O-267SL	SB-O20 (12-22.5')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011) J
95PRDA-O-268SL	Duplicate of 267	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-269SL	Triplicate of 269	ND (0.05)	ND (0.05)	ND (0.007)	ND (0.05)
95PRDA-O-270SL	SB-O20 (24-26')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-O-295SL	MW-12 (22-24')	ND (0.0011)	0.0027	ND (0.0011)	ND (0.0011)
95PRDA-O-385SL	MW-16 (156.4-163')	ND (0.55) J	ND (0.55) J	ND (0.55) J	ND (0.55) J

ND = Non Detect
J = Estimated Value
( ) = Detection Limit

TABLE 4-5: (CONTINUED)

Sample Number	Sample Location	1,1,2,2-tetrachloroethane mg/kg	tetrachloroethene mg/kg	toluene mg/kg	trichloroethene mg/kg	total xylenes mg/kg
(Other Areas)						
95PRDA-O-267SL	SB-O20 (12-22.5')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-O-268SL	Duplicate of 267	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J	ND (0.0011) J
95PRDA-O-269SL	Triplicate of 269	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-270SL	SB-O20 (24-26')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-O-295SL	MW-12 (22-24')	0.11	0.0018	ND (0.0011)	0.093	ND (0.0011)
95PRDA-O-385SL	MW-16 (156.4-163')	0.24 J	ND (0.55) J	ND (0.55) J	ND (0.55) J	ND (0.55) J

ND = Non Detect
J = Estimated Value
( ) = Detection Limit

TABLE 4-6
LABORATORY VOC ANALYSIS - SOIL
AREAS A-3 AND A-4

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	benzene mg/kg	carbon tetrachloride mg/kg	chloroform mg/kg	1,1-dichloroethene mg/kg	cis-1,2-dichloroethene mg/kg	trans-1,2-dichloroethene mg/kg
95PRDA-D-001SL	SB-D1 (0-2')	ND (0.0055)	ND (0.0055)	ND (0.0055)	ND (0.0055)	0.026	0.011
95PRDA-D-002SL	SB-D1 (5-7')	ND (0.0056)	ND (0.0056)	0.028 [0.07]	ND (0.0056)	0.14	0.088
95PRDA-D-003SL	SB-D1 (10-12')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	0.004	0.0025
95PRDA-D-005SL	SB-D2 (0-2')	ND (0.0041)	ND (0.0041)	0.0078	ND (0.0041)	ND (0.0041)	ND (0.0041)
95PRDA-D-007SL	SB-D2 (10-13')	ND (0.0052)	ND (0.0052)	ND (0.0052)	ND (0.0052)	0.012	0.0076
95PRDA-C-009SL	SB-C1 (0-2')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-C-010SL	SB-C1 (9-11')	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)
95PRDA-C-011SL	SB-C1 (13-15')	ND (0.0057)	ND (0.0057)	0.0073	ND (0.0057)	0.042	0.015
95PRDA-C-013SL	SB-C2 (0-2')	ND (0.0011) J	ND (0.0055) J	0.16 J	ND (0.0055) J	0.008 J	0.0039 J
95PRDA-C-014SL	SB-C2 (9-12')	ND (0.0045) J	ND (0.0045) J	0.017 J	ND (0.0045) J	0.017 J	0.0063 J
95PRDA-C-015SL	SB-C2 (17-18')	ND (0.0048) J	ND (0.0048) J	0.02 J	ND (0.0048) J	0.25 J	0.098 J
95PRDA-C-017SL	SB-C3 (0-2')	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)	ND (0.0011)
95PRDA-C-019SL	SB-C3 (8-10')	ND (0.0012)	ND (0.0012)	ND (0.0012)	ND (0.0012)	0.006	0.0039
95PRDA-O-316SL	MW-14 (18-20')	0.28	0.046	0.18 [0.25]	0.015	1.1 [0.63]	0.29 [0.22]

ND = Non Detect
J = Estimated Value
( ) = Detection Limit
[ ] = Field GC Screen value
The absence of a Field GC Screen value indicates that the screen was ND with a detection limit of 0.05 mg/kg.

TABLE 4-6: (CONTINUED)

Sample Number	Sample Location	1,1,1,2-tetrachloroethane mg/kg	1,1,2,2-tetrachloroethane mg/kg	tetrachloroethene mg/kg	1,1,2-trichloroethane mg/kg	trichloroethene mg/kg
95PRDA-D-001SL	SB-D1 (0-2')	ND (0.0055)	8.1	0.056	0.0099	0.73 [0.05]
95PRDA-D-002SL	SB-D1 (5-7')	ND (0.0056)	0.23 [1.95]	0.039	ND (0.0056)	1.8 [0.76]
95PRDA-D-003SL	SB-D1 (10-12')	ND (0.0011)	0.1 [0.41]	0.0024	ND (0.0011)	0.032 [0.19]
95PRDA-D-005SL	SB-D2 (0-2')	ND (0.0041)	0.16 [1.58]	ND (0.0041)	ND (0.0041)	0.016 [0.16]
95PRDA-D-007SL	SB-D2 (10-13')	ND (0.0052)	0.16	0.01	ND (0.0052)	0.22 [0.12]
95PRDA-C-009SL	SB-C1 (0-2')	ND (0.0011)	0.0018	ND (0.0011)	ND (0.0011)	0.0014
95PRDA-C-010SL	SB-C1 (9-11')	ND (0.55)	4.4 [0.670]	ND (0.55)	ND (0.55)	1.1
95PRDA-C-011SL	SB-C1 (13-15')	ND (0.0057)	3.3 [0.930]	0.071	ND (0.0057)	0.55
95PRDA-C-013SL	SB-C2 (0-2')	ND (0.0055) J	0.23 J [1.49]	0.11 J	ND (0.0011) J	0.15 J
95PRDA-C-014SL	SB-C2 (9-12')	ND (0.0045) J	0.51 J [0.2]	0.0092 J	ND (0.0045) J	0.14 J
95PRDA-C-015SL	SB-C2 (17-18')	ND (0.0048) J	3.8 J [4.8]	0.052 J	0.024 J	0.62 J
95PRDA-C-017SL	SB-C3 (0-2')	ND (0.0011)	0.0045	ND (0.0011)	ND (0.0011)	0.0082
95PRDA-C-019SL	SB-C3 (8-10')	ND (0.0012)	0.0073 [0.2]	ND (0.0012)	ND (0.0012)	0.02
95PRDA-O-316SL	MW-14 (18-20')	0.019	79 J [93.2 J]	0.65 [1.97]	0.17 [11.4]	22 J [25.6 J]

ND = Non Detect
J = Estimated Value
( ) = Detection Limit
[ ] = Field GC Screen value
The absence of a Field GC Screen value indicates that the screen was ND with a detection limit of 0.05 mg/kg.

TABLE 4-7
LABORATORY VOC ANALYSIS - SOIL SAMPLES EXCEEDING RBCS
AREAS A-3 AND A-4

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Compound	**RBC** **mg/kg**	**SB-D1 (0-2')** **95PRDA-D-001SL** **mg/kg**	**SB-C1 (9-11')** **95PRDA-D-010SL** **mg/kg**	**SB-C1 (13-15')** **95PRDA-D-011SL** **mg/kg**	**SB-C2 (17-18')** **95PRDA-D-015SL** **mg/kg**	**MW-14 (18-20')** **95PRDA-D-316SL** **mg/kg**
1,1,2,2-tetrachloroethane	3.2	**8.1**	**4.4**	**3.3**	**3.8 J**	**79 J**

J = Estimated Value
RBC values taken from EPA, Region III, October 20, 1995.
Bold text indicates value exceeds RBC.

TABLE 4-8
METALS ANALYSIS - BACKGROUND SOIL

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	**Antimony EPA 6010 mg/kg**	**Arsenic EPA 7060 mg/kg**	**Beryllium EPA 6010 mg/kg**	**Cadmium EPA 6010 mg/kg**	**Chromium EPA 6010 mg/kg**	**Copper EPA 6010 mg/kg**	**Lead EPA 6020 mg/kg**
95PRDA-U-273SL	SB-U1 (0-3')	11	5.4	0.34	ND (1.4)	32	28	5.4
95PRDA-U-274SL	SB-U1 (3-5')	11	7.0	0.36	ND (1.4)	34	27	5.5
95PRDA-U-275SL	SB-U1 (6-8')	11	7.2	0.29	ND (2.8)	30	31	5.0
95PRDA-U-276SL	SB-U1 (9-9.5')	7.6	12	0.35	ND (1.4)	40	31	6.0
95PRDA-U-277SL	SB-U1 (13-16')	7.6	9.8	0.29	ND (1.3)	33	26	5.2
95PRDA-U-278SL	SB-U2 (0-3')	8.2	10	0.34	ND (1.5)	33	23	5.8
95PRDA-U-279SL	SB-U2 (3-6')	7.6	39	0.39	ND (1.4)	33	31	9.0
95PRDA-U-280SL	SB-U2 (6-10')	9.2	14	0.34	ND (1.5)	39	33	6.8
95PRDA-U-281SL	SB-U2 (17-18.5')	7.7	7.2	ND (0.30)	ND (1.5)	30	26	3.7
95PRDA-U-282SL	Duplicate of 281	5.9	8.5	ND (0.28)	ND (1.4)	32	27	3.4
95PRDA-U-283SL	Triplicate of 281	2.3	5.2	0.42	ND (0.55)	43	34	9.4
95PRDA-U-284SL	SB-U2 (19-19.5')	6.0	7.5	ND (0.30)	ND (1.5)	33	28	3.5
95PRDA-U-322SL	MW-17 (0-3')	9.6	8.9	0.32	ND (1.5)	29	23	6.2
95PRDA-U-323SL	MW-17 (3-6')	11	7.5	0.36	ND (2.6)	32	29	7.3
95PRDA-U-324SL	MW-17 (6-9')	9.9	8.1	0.39	ND (2.7)	34	30	7.2
95PRDA-U-325SL	MW-17 (10-13.5')	12	9.2	0.35	ND (1.5)	38	38	6.4
95PRDA-U-327SL	MW-17 (16-20')	6.1	3.9	ND (0.28)	ND (1.4)	24	22	3.0
95PRDA-U-330SL	MW-17 (23-25')	7.1	6.8	ND (0.30)	ND (1.5)	25	23	3.6
Average* Background Concentration		8.7	10.1	0.29	ND (1.7)	32	28	5.5
Risk Based Concentration		31 (N)	0.43 (C), 23 (N)	0.15 (C)	39 (N)	390 (N)**	3100 (N)	-

Notes:

ND = Non Detect
( ) = Detection Limit
C = as a carcinogen

N = non-carcinogenic effects
*Averages include NDs at half the detection limit.
**RBC for chromium VI = 390 mg/kg, and chromium III = 78000 mg/kg

TABLE 4-8: (CONTINUED)

Sample Number	Sample Location	**Mercury EPA 7471 mg/kg**	**Nickel EPA 6010 mg/kg**	**Selenium EPA 7740 mg/kg**	**Silver EPA 6010 mg/kg**	**Thallium EPA 7841 mg/kg**	**Zinc EPA 6010 mg/kg**
95PRDA-U-273SL	SB-U1 (0-3')	ND (0.11)	46 J	ND (0.30)	0.65	ND (0.30)	51
95PRDA-U-274SL	SB-U1 (3-5')	ND (0.11)	45	ND (0.27)	0.67	ND (0.27)	50
95PRDA-U-275SL	SB-U1 (6-8')	0.11	43	ND (0.28)	0.65	ND (0.28)	59
95PRDA-U-276SL	SB-U1 (9-9.5')	ND (0.11)	44	ND (0.29)	0.63	ND (0.29)	57
95PRDA-U-277SL	SB-U1 (13-16')	ND (0.10)	29	ND (0.27)	0.71	ND (0.27)	55
95PRDA-U-278SL	SB-U2 (0-3')	ND (0.11)	42	ND (0.29)	0.55	ND (0.29)	45
95PRDA-U-279SL	SB-U2 (3-6')	ND (0.11)	41	ND (0.28)	0.81	ND (0.28)	70
95PRDA-U-280SL	SB-U2 (6-10')	ND (0.11)	38	ND (0.30)	0.75	ND (0.30)	59
95PRDA-U-281SL	SB-U2 (17-18.5')	ND (0.11)	50	ND (0.30)	0.45	ND (0.30)	43
95PRDA-U-282SL	Duplicate of 281	ND (0.11)	52	ND (0.28)	0.44	ND (0.28)	45
95PRDA-U-283SL	Triplicate of 281	ND (0.088)	67	0.066	ND (0.55)	ND (0.11)	67
95PRDA-U-284SL	SB-U2 (19-19.5')	ND (0.11)	52	ND (0.27)	0.65	ND (0.27)	42
95PRDA-U-322SL	MW-17 (0-3')	ND (0.10)	36	ND (0.30)	0.65	ND (0.30)	85
95PRDA-U-323SL	MW-17 (3-6')	0.12	40	ND (0.27)	0.68	ND (0.27)	71
95PRDA-U-324SL	MW-17 (6-9')	ND (0.11)	39	ND (0.27)	0.73	ND (0.27)	87
95PRDA-U-325SL	MW-17 (10-13.5')	ND (0.12)	49	ND (0.29)	0.76	ND (0.29)	65
95PRDA-U-327SL	MW-17 (16-20')	ND (0.099)	29	ND (0.28)	0.49	ND (0.28)	38
95PRDA-U-330SL	MW-17 (23-25')	ND (0.11)	30	ND (0.29)	0.53	ND (0.29)	47
Average* Background Concentration		0.06	41	ND (0.28)	0.64	ND (0.28)	57
Risk Based Concentration		23 (N)	1600 (N)	390 (N)	390 (N)	-	23000 (N)

Notes:

ND = Non Detect	N = non-carcinogenic effects
( ) = Detection Limit	*Averages include NDs at half the detection limit.
C = as a carcinogen	**RBC for chromium VI = 390 mg/kg, and chromium III = 78000 mg/kg

TABLE 4-9
METALS ANALYSIS - SOIL
AREAS A-1, A-2 AND OTHER AREAS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	Antimony EPA 6010 mg/kg	Arsenic EPA 7060 mg/kg	Beryllium EPA 6010 mg/kg	Cadmium EPA 6010 mg/kg	Chromium EPA 6010 mg/kg	Copper EPA 6010 mg/kg	Lead EPA 6020 mg/kg
Area A-1								
95PRDA-A-064SL	SB-A2 (3.5-7')	11	8.3	0.37	ND (1.5)	34	39	6.5
95PRDA-A-084SL	SB-A5 (20.5-22.5')	9.1	9.0	ND (0.32)	ND (3.2)	33	27	4.8
Area A-2								
95PRDA-B-045SL	SB-B3 (7-10')	9.9	12	0.45	ND (3.0)	36	42	15
95PRDA-B-053SL	SB-B5 (3-6')	7.4	8.1	0.32	ND (3.1)	30	34	6.5
95PRDA-B-054SL	Duplicate of 053	7.5	11	0.37	ND (2.8)	34	38	6.5
95PRDA-B-055SL	Triplicate of 053	ND (2.2)	8.2	0.41	ND (0.55)	38	44	12
95PRDA-B-106SL	SB-B7 (6-9')	8.7	8.1	0.37	ND (3.2)	33	36	9.3
95PRDA-O-194SL	SB-O12 (15-18')	6.6	14	0.34	ND (1.4)	34	33	7.3
95PRDA-O-301SL	MW-13 (10-12')	10	7.0	ND (0.30)	ND (1.5)	27	26	2.9
Toe of Hill								
95PRDA-T-021SL	SB-T1 (0-2')	6.3	6.0	ND (0.40)	ND (2.0)	30	24	7.0
95PRDA-T-022SL	Duplicate of 021	5.2	5.6	ND (0.35)	ND (1.7)	23	25	7.9
95PRDA-T-023SL	Triplicate of 021	ND (2.5)	4.3	0.27	ND (0.37)	26	22	8.6
South of Disposal Area								
95PRDA-O-112SL	SB-O1 (6-8')	6.8	6.1	ND (0.26)	ND (2.6)	27	28	4.5
95PRDA-O-165SL	SB-O8 (5-8')	9.4	9.8	0.39	ND (1.4)	41	38	8.5
95PRDA-O-174SL	SB-O9 (9-12')	5.8	12	ND (0.30)	ND (0.60)	28	24	4.4
95PRDA-O-179SL	SB-O10 (6-9')	8.9	10	0.30	ND (1.5)	28	35	7.1
95PRDA-O-182SL	SB-O11 (6-9')	9.5	15	0.37	ND (1.5)	30	42	8.2
95PRDA-O-231SL	SB-O16 (15-18')	7.7	7.2	ND (0.28)	ND (1.4)	26	23	2.3
North of Disposal Area								
95PRDA-O-133SL	SB-O4 (3-6')	12	9.0	0.34	ND (3.0)	35	26	6.1
95PRDA-O-155SL	SB-O7 (0-3')	10	7.0	0.45	ND (2.8)	33	37	6.6
95PRDA-O-204SL	SB-O13 (12-15')	9.2	13	0.40	ND (1.5)	37	40	8.6
95PRDA-O-218SL	SB-O15 (12-15')	9.1	15	0.30	ND (1.5)	28	32	6.4
95PRDA-O-247SL	SB-O18 (18-20')	5.8	4.1	ND (0.27)	ND (0.54)	23	21	2.2
95PRDA-O-267SL	SB-O20 (12-22.5')	6.6	6.1	0.28	ND (1.4)	27	25	4.4
95PRDA-O-268SL	Duplicate of 267	7.4	7.4	ND (0.28)	ND (1.4)	24	23	3.8
95PRDA-O-269SL	Triplicate of 269	ND (2.1)	9.6	0.43	ND (0.54)	31	29	11

TABLE 4-9: (CONTINUED)

Sample Number	Sample Location	Mercury EPA 7471 mg/kg	Nickel EPA 6010 mg/kg	Selenium EPA 7740 mg/kg	Silver EPA 6010 mg/kg	Thallium EPA 7841 mg/kg	Zinc EPA 6010 mg/kg
Area A-1							
95PRDA-A-064SL	SB-A2 (3.5-7')	0.19	36	ND (0.30)	ND (0.29)	ND (0.30)	70
95PRDA-A-084SL	SB-A5 (20.5-22.5')	ND (0.12)	41	ND (0.30)	ND (0.32)	ND (0.30)	49
Area A-2							
95PRDA-B-045SL	SB-B3 (7-10')	0.15	43	ND (0.32)	ND (0.30)	ND (0.32)	83
95PRDA-B-053SL	SB-B5 (3-6')	0.20	39	ND (0.29)	ND (0.31)	ND (0.29)	55
95PRDA-B-054SL	Duplicate of 053	0.14	43	ND (0.30)	ND (0.28)	ND (0.30)	65
95PRDA-B-055SL	Triplicate of 053	0.096	56	0.097	ND (0.55)	ND (0.11)	84
95PRDA-B-106SL	SB-B7 (6-9')	ND (0.12)	42	ND (0.31)	ND (0.32)	ND (0.32)	66
95PRDA-O-194SL	SB-O12 (15-18')	0.12	40	ND (0.27)	0.63	ND (0.27)	65
95PRDA-O-301SL	MW-13 (10-12')	ND (0.11)	43	ND (0.28)	0.58	ND (0.28)	45
Toe of Hill							
95PRDA-T-021SL	SB-T1 (0-2')	ND (0.16)	37	ND (0.41)	ND (0.40)	ND (0.41)	57
95PRDA-T-022SL	Duplicate of 021	ND (0.13)	30	ND (0.35)	ND (0.35)	ND (0.35)	58
95PRDA-T-023SL	Triplicate of 021	ND (0.098)	35	0.16	ND (0.62)	ND (0.12)	56
South of Disposal Area							
95PRDA-O-112SL	SB-O1 (6-8')	0.16	44	ND (0.27)	0.41	ND (0.27)	49
95PRDA-O-165SL	SB-O8 (5-8')	ND (0.11)	47	ND (0.31)	0.99	ND (0.31)	70
95PRDA-O-174SL	SB-O9 (9-12')	0.13	35	ND (0.28)	0.40	ND (0.28)	44
95PRDA-O-179SL	SB-O10 (6-9')	0.18	36	ND (0.30)	0.75	ND (0.30)	62
95PRDA-O-182SL	SB-O11 (6-9')	0.16	39	ND (0.29)	0.69	ND (0.29)	79
95PRDA-O-231SL	SB-O16 (15-18')	ND (0.11)	43	ND (0.30)	0.60	ND (0.30)	37
North of Disposal Area							
95PRDA-O-133SL	SB-O4 (3-6')	ND (0.11)	35	ND (0.31)	0.68	ND (0.31)	58
95PRDA-O-155SL	SB-O7 (0-3')	0.17	40	ND (0.28)	0.46	ND (0.28)	67
95PRDA-O-204SL	SB-O13 (12-15')	0.21	43	ND (0.28)	0.86	ND (0.28)	74
95PRDA-O-218SL	SB-O15 (12-15')	0.11	43	ND (0.30)	0.75	ND (0.30)	60
95PRDA-O-247SL	SB-O18 (18-20')	ND (0.10)	27	ND (0.27)	ND (0.27)	ND (0.27)	38
95PRDA-O-267SL	SB-O20 (12-22.5')	ND (0.10)	28	ND (0.26)	ND (0.28)	ND (0.28)	52
95PRDA-O-268SL	Duplicate of 267	0.13	26	ND (0.28)	0.34	ND (2.8) *	45
95PRDA-O-269SL	Triplicate of 269	ND (0.085)	34	ND (0.054)	1.2	ND (0.11)	66

TABLE 4-9: (CONTINUED)

Sample Number	Sample Location	Antimony EPA 6010 mg/kg	Arsenic EPA 7060 mg/kg	Beryllium EPA 6010 mg/kg	Cadmium EPA 6010 mg/kg	Chromium EPA 6010 mg/kg	Copper EPA 6010 mg/kg	Lead EPA 6020 mg/kg
(North of Disposal Area)								
95PRDA-O-270SL	SB-O20 (24-26')	7.3	6.9	ND (0.26)	ND (1.3)	23	28	5.3
95PRDA-O-295SL	MW-12 (22-24')	7.0	5.9	ND (0.29)	ND (1.4)	21	27	3.5
95PRDA-O-381SL	MW-16 (120.4-122)	11.0	4.6	ND (0.28)	ND (2.8)	18	20	3.7
95PRDA-O-385SL	MW-16 (156.4-163')	8.6	4.6	ND (0.27)	ND (2.7)	19	18	3.3
Average A-1, A-2 and Other Areas Concentration		8.3	8.6	0.26	1.0	29	30	6.0
Average Background Concentration		8.7	10.1	0.29	ND (1.7)	32	28	5.5

ND = Non Detect
( ) = Detection Limit   * = Detection limit elevated due to matrix interference.

TABLE 4-9: (CONTINUED)

Sample Number	Sample Location	Mercury EPA 7471 mg/kg	Nickel EPA 6010 mg/kg	Selenium EPA 7740 mg/kg	Silver EPA 6010 mg/kg	Thallium EPA 7841 mg/kg	Zinc EPA 6010 mg/kg
(North of Disposal Area)							
95PRDA-O-270SL	SB-O20 (24-26')	0.11	22	ND (0.27)	0.54	ND (0.27)	53
95PRDA-O-295SL	MW-12 (22-24')	ND (0.11)	32	0.27	0.50	ND (0.27)	39
95PRDA-O-381SL	MW-16 (120.4-122)	ND (0.091)	16	ND (0.27)	ND (0.28)	ND (0.27)	45
95PRDA-O-385SL	MW-16 (156.4-163')	ND (0.092)	14	ND (0.29)	ND (0.27)	ND (0.29)	39
Average A-1, A-2 and Other Areas Concentration		0.11	36	0.15	0.41	0.15	56
Average Background Concentration		0.06	41	ND (0.28)	0.64	ND (0.28)	57

ND = Non Detect

( ) = Detection Limit   * = Detection limit elevated due to matrix interference.

TABLE 4-10
METALS ANALYSIS - SOIL
AREAS A-3 AND A-4

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	Antimony EPA 6010 mg/kg	Arsenic EPA 7060 mg/kg	Beryllium EPA 6010 mg/kg	Cadmium EPA 6010 mg/kg	Chromium EPA 6010 mg/kg	Copper EPA 6010 mg/kg	Lead EPA 6020 mg/kg
Area A-3								
95PRDA-C-009SL	SB-C1 (0-2')	7.7	6.0	ND (0.28)	ND (0.55)	29	31	8.7
95PRDA-C-010SL	SB-C1 (9-11')	6.2	5.8	ND (0.29)	ND (0.29)	27	22	5.4
95PRDA-C-011SL	SB-C1 (13-15')	7.2	4.0	ND (0.30)	ND (0.61)	23	22	5.3
95PRDA-C-013SL	SB-C2 (0-2')	7.4	8.3	ND (0.30)	ND (3.0)	25	33	12
95PRDA-C-014SL	SB-C2 (9-12')	9.8	7.9	0.32	ND (3.2)	32	35	13
95PRDA-C-015SL	SB-C2 (17-18')	6.8	5.9	ND (0.31)	ND (3.1)	29	27	5.6
95PRDA-C-017SL	SB-C3 (0-2')	8.1	6.8	ND (0.28)	ND (2.8)	31	28	5.9
95PRDA-C-019SL	SB-C3 (8-10')	8.2	7.1	ND (0.32)	ND (3.2)	33	32	4.6
95PRDA-O-316SL	MW-14 (18-20')	12	10	0.35	ND (2.8)	31	30	4.9
Area A-4								
95PRDA-D-001SL	SB-D1 (0-2')	10	9.2	0.39	ND (1.5)	39	48	17
95PRDA-D-002SL	SB-D1 (5-7')	13	11	0.38	ND (1.4)	51	190	160
95PRDA-D-003SL	SB-D1 (10-12')	12	9.6	0.37	ND (1.5)	49	130	39
95PRDA-D-005SL	SB-D2 (0-2')	9.3	9.0	0.30	ND (0.28)	30	57	25
95PRDA-D-007SL	SB-D2 (10-13')	8.0	8.9	ND (0.29)	ND (0.59)	29	37	11
Average A-3 and A-4 Concentration		9.0	7.8	0.24	0.9	33	52	22.7
Average Background Concentration		8.7	10.1	0.29	ND (1.7)	32	28	5.5

ND = Non Detect
( ) = Detection Limit

TABLE 4-10: (CONTINUED)

Sample Number	Sample Location	Mercury EPA 7471 mg/kg	Nickel EPA 6010 mg/kg	Selenium EPA 7740 mg/kg	Silver EPA 6010 mg/kg	Thallium EPA 7841 mg/kg	Zinc EPA 6010 mg/kg
Area A-3							
95PRDA-C-009SL	SB-C1 (0-2')	ND (0.11)	40	ND (0.29)	0.38	ND (0.29)	59
95PRDA-C-010SL	SB-C1 (9-11')	ND (0.10)	37	ND (0.30)	ND (0.29)	ND (0.30)	48
95PRDA-C-011SL	SB-C1 (13-15')	ND (0.11)	29	ND (0.29)	ND (0.30)	ND (0.29)	45
95PRDA-C-013SL	SB-C2 (0-2')	ND (0.11)	32	ND (0.29)	ND (0.30)	ND (0.29)	100
95PRDA-C-014SL	SB-C2 (9-12')	ND (0.11)	44	ND (0.29)	ND (0.32)	ND (0.29)	82
95PRDA-C-015SL	SB-C2 (17-18')	ND (0.11)	38	ND (0.30)	ND (0.31)	ND (0.30)	97
95PRDA-C-017SL	SB-C3 (0-2')	ND (0.11)	39	ND (0.28)	ND (0.28)	ND (0.28)	51
95PRDA-C-019SL	SB-C3 (8-10')	ND (0.11)	47	ND (0.29)	ND (0.32)	ND (0.29)	65
95PRDA-O-316SL	MW-14 (18-20')	ND (0.11)	46	ND (0.29)	0.97	ND (0.29)	100
Area A-4							
95PRDA-D-001SL	SB-D1 (0-2')	ND (0.10)	49	ND (0.28)	0.33	ND (1.4)	260
95PRDA-D-002SL	SB-D1 (5-7')	ND (0.11)	44	ND (0.30)	1.9	ND (3.0)	1000
95PRDA-D-003SL	SB-D1 (10-12')	ND (0.11)	44	ND (0.29)	1.7	ND (2.9)	650
95PRDA-D-005SL	SB-D2 (0-2')	0.58	36	ND (0.31)	0.49	ND (0.31)	390
95PRDA-D-007SL	SB-D2 (10-13')	0.17	34	ND (0.29)	0.51	ND (0.29)	110
Average A-3 and A-4 Concentration		0.10	39.9	0.15	0.35	0.34	218.4
Average Background Concentration		0.06	41	ND (0.28)	0.64	ND (0.28)	57

ND = Non Detect
( ) = Detection Limit

TABLE 4-11
RESIDENTIAL SOIL RBCS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Compounds	RCRA TCLP (1) (mg/L)	Residential Soil RBCs (2) (mg/kg)
Organics:		
benzene	0.5	22
bromoform	-	81
carbon tetrachloride	0.5	4.9
chloroform	6.0	100
1,1-dichloroethene	0.7	1.1
cis-1,2-dichloroethene	-	780
trans-1,2-dichloroethene	-	1600
ethylbenzene	-	7800
m-nitrotoluene	-	780
1,1,1,2-tetrachloroethane	-	25
1,1,2,2-tetrachloroethane	-	3.2
tetrachloroethene	0.7	12
toluene	-	16000
1,1,2-trichloroethane	-	11
trichloroethene	0.5	58
1,3,5-trinitrobenzene	-	3.9
2,4,6-trinitrotoluene	-	21
xylenes	-	160000
Metals:		
antimony	-	31
arsenic	5.0	0.43, 23 (4)
beryllium	-	0.15
cadmium	1.0	39
chromium	5.0	390 (3)
copper	-	3100
lead	5.0	-
mercury	0.2	23
nickel	-	1600
selenium	1.0	390
silver	5.0	390
thallium	-	-
zinc	-	23000

(1) TCLP data from 40 CFR 261.24.

(2) RBC data from EPA, Region III, October 20, 1995.

(3) RBC for Chromium VI = 390 mg/kg
RBC for Chromium III = 78000 mg/kg

(4) 0.43 carcinogenic, 23 noncarcinogenic

TABLE 4-12
GEOTECHNICAL AND BIOLOGICAL SAMPLE RESULTS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Parameter	Method	**SB-C2 (17-18')** 95PRDA-C-015SL	**SB-O2 (9-12')** 95PRDA-O-118SL	**SB-O2 (15-25')** 95PRDA-O-120SL
Porosity (percent)	Estimated from Grain Size	27	27	27
Permeability (cm/sec)	Estimated from Grain Size	1.E-04	1.E-05	1.E-04
Total Organic Carbon (percent)	ASA 90-3.2	0.34	0.55	0.19
pH	EPA 9045	6.45	6.08	6.59
Moisture (percent)	Method 7-2.2*	11.4	13.7	13.9
Ammonia-nitrogen (mg/kg)	EPA 350.3	3.1	3.0	14.1
Orthophosphate (mg/kg)	EPA 365.2	ND (0.50) R	ND (0.50) R	ND (0.50) R
Microbial Characterization (#/dry g)	Std. Method 9015	4.3E+06	4.0E+07	7.3E+06

Parameter	Method	**MW-17 (16-17')** 95PRDA-U-326SL	**MW-17 (16-21')** 95PRDA-U-328SL	**MW-17 (18-20')** 95PRDA-U-329SL
Porosity (percent)	Estimated from Grain Size	NA	21	NA
Permeability (cm/sec)	Estimated from Grain Size	NA	1.E-01	NA
Total Organic Carbon (percent)	ASA 90-3.2	0.66	NA	NA
pH	EPA 9045	NA	NA	7.26
Moisture (percent)	Method 7-2.2*	7.3	NA	8.4
Ammonia-nitrogen (mg/kg)	EPA 350.3	NA	NA	2.0
Orthophosphate (mg/kg)	EPA 365.2	NA	NA	ND (0.50) R
Microbial Characterization (#/dry g)	Std. Method 9015	NA	NA	70

Notes:
NA = Not Analyzed
( ) = Detection Limit
ND = Not Detected
R = Rejected Data
* Method 7-2.2, Methods of Soil Analysis

TABLE 4-13
SOIL pH RESULTS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location Boring (Depth)	pH
Area A-1	SB-C2 (17-18')	6.45
95PRDA-A-061SL	SB-A1 (0-3')	5.98
95PRDA-A-063SL	SB-A2 (0-2')	6.06
95PRDA-A-069SL	SB-A3 (12-15')	5.65
95PRDA-A-079SL	SB-A4 (15-17')	6.22
95PRDA-A-082SL	SB-A5 (20.5-22.5')	5.82
95PRDA-A-093SL	SB-A6 (15-18')	6.42
Area A-2		
95PRDA-B-040SL	SB-B2 (14-17')	7.41
95PRDA-B-043SL	SB-B3 (0-3')	6.28
95PRDA-B-048SL	SB-B4 (3-6')	5.55
95PRDA-B-052SL	SB-B5 (0-3')	5.89
95PRDA-A-101SL	SB-B6 (12-14')	7.78
95PRDA-B-108SL	SB-B7 (15-17')	6.96
South of Area A-1		
95PRDA-B-118SL	SB-O2 (9-12')	6.08
95PRDA-B-120SL	SB-O2 (15-25')	6.59
Area A-3		
95PRDA-U-329SL	MW-17 (18-20')	7.26
Arithmetic Mean		6.40

TABLE 4-14
HALOGENATED SOLVENT SCREENING - GROUNDWATER FROM WELL POINTS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	trans-1,2-dichloroethene mg/L	cis-1,2-dichloroethene mg/L	chloroform mg/L	trichloroethene mg/L	1,1,2-trichloroethane mg/L	tetrachloro-ethene mg/L	1,1,2,2-tetrachloroethane mg/L	carbon tetrachloride mg/L
Area A-1									
95PRDA-A-062GW	SB-A1	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-A-065GW	SB-A2	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-A-071GW	SB-A3	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-A-080GW	SB-A4	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-A-085GW	SB-A5	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-A-096GW	SB-A6	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.071	ND (0.05)
Area A-2									
95PRDA-B-035GW	SB-B1	0.948	3.1	0.094	31	0.219	0.632	68	0.071
95PRDA-B-042GW	SB-B2	0.198	0.779	ND (0.05)	7.7	0.115	ND (0.05)	29	ND (0.05)
95PRDA-B-046GW	SB-B3	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-B-050GW	SB-B4	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-B-057GW	SB-B5	ND (0.05)	ND (0.05)	ND (0.05)	0.057	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-B-109GW	SB-B7	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Area A-3									
95PRDA-O-012GW	SB-C1	0.21	0.55	ND (0.05)	15	0.06	0.19	52	ND (0.05)
95PRDA-O-016GW	SB-C2	0.072	0.182	ND (0.05)	0.519	ND (0.05)	ND (0.05)	5.7	ND (0.05)
95PRDA-O-020GW	SB-C3	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.122	ND (0.05)
Area A-4									
95PRDA-O-004GW	SB-D1	0.55	1.72	0.14	43	0.28	0.9	89 J	0.3
95PRDA-O-008GW	SB-D2	0.315	0.947	0.087	46	0.129	0.483	93	0.146
Toe of Hill									
95PRDA-T-025GW	SB-T1	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-T-030GW	SB-T2	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-T-032GW	SB-T3	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
South of Disposal Areas									
95PRDA-O-115GW	SB-O1	0.086	0.472	ND (0.05)	4.5	ND (0.05)	ND (0.05)	6.1	ND (0.05)
95PRDA-O-121GW	SB-O2	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-170GW	SB-O8	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-175GW	SB-O9	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-187GW	SB-O11	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.115	ND (0.05)
95PRDA-O-232GW	SB-O16	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)

TABLE 4-14: (CONTINUED)

Sample Number	Sample Location	trans-1,2-dichloroethene mg/L	cis-1,2-dichloroethene mg/L	chloroform mg/L	trichloroethene mg/L	1,1,2-trichloroethane mg/L	tetrachloro-ethene mg/L	1,1,2,2-tetrachloroethane mg/L	carbon tetrachloride mg/L
North of Disposal Areas									
95PRDA-O-131GW	SB-O3	ND (0.05)	0.062	ND (0.05)	1.14	ND (0.05)	ND (0.05)	2.69	ND (0.05)
95PRDA-O-139GW	SB-O4	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-154GW	SB-O6	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-162GW	SB-O7	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
95PRDA-O-199GW	SB-O13	0.629	1.7	ND (0.05)	9.163	ND (0.05)	0.147	13	ND (0.05)
95PRDA-O-213GW	SB-O14	ND (0.05)	0.11	ND (0.05)	0.662	ND (0.05)	ND (0.05)	1.64	ND (0.05)
95PRDA-O-240GW	SB-O17	ND (0.05)	0.073	ND (0.05)	0.998	ND (0.05)	ND (0.05)	0.175	ND (0.05)
95PRDA-O-253GW	SB-O19	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)

ND = Non Detect
( ) = Reporting Limit

TABLE 4-15

LABORATORY VOC ANALYSIS - GROUNDWATER FROM WELL POINTS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	chloroform mg/L	cis-1,2-dichloroethene mg/L	trans-1,2-dichloroethene mg/L
95PRDA-T-026GW	SB-T1	ND (0.0002) R	ND (0.0002) R	ND (0.0002) R
95PRDA-T-027GW	Duplicate of 026	ND (0.0002) R	ND (0.0002) R	ND (0.0002) R
95PRDA-T-028GW	Triplicate of 026	NA	NA	NA
95PRDA-B-051GW	SB-B4	ND (0.0002) R	ND (0.0002) R	ND (0.0002) R
95PRDA-A-085GW	SB-A5	0.00046	ND (0.0002)	ND (0.0002)
95PRDA-O-199GW	SB-O13	ND (0.5) R	3.1 J [1700]	1 J [629]

Sample Number	Sample Location	1,1,2,2-tetrachloroethane mg/L	toluene mg/L	trichloroethene mg/L
95PRDA-T-026GW	SB-T1	ND (0.0005) R	0.00022 J	ND (0.0002) R
95PRDA-T-027GW	Duplicate of 026	ND (0.0005) R	0.00021 J	ND (0.0002) R
95PRDA-T-028GW	Triplicate of 026	NA	NA	NA
95PRDA-B-051GW	SB-B4	ND (0.0005) R	ND (0.0002) R	ND (0.0002) R
95PRDA-A-085GW	SB-A5	ND (0.0005)	0.00043	ND (0.0002)
95PRDA-O-199GW	SB-O13	34 J [13]	ND (0.5) R	12 J [9.163]

Notes:

ND = Non Detect	J = Estimated Value
( ) = Detection Limit	[ ] = Field GC Screen value
NA = Not Analyzed	R = Rejected Data

The absence of a Field GC Screen value indicates that the screen was ND with a detection limit of 0.05 mg/kg.

Two samples were collected from SB-T1: 95PRDA-T-025GW (Field Screened) and 95PRDA-T-026GW (Laboratory analyzed).
Two samples were collected from SB-B4: 95PRDA-B-050GW (Field Screened) and 95PRDA-B-051GW (Laboratory analyzed).

TABLE 4-16
ALASKA MCLS AND RESIDENTIAL RBCS FOR TAP WATER

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

	Alaska MCLs (1) (mg/L)	RCRA TCLP (2) (mg/L)	Residential Tap Water RBCs (3) (mg/L)
Organics:			
benzene	0.005	0.5	0.00036
carbon tetrachloride	0.005	0.5	0.00016
chloroform	0.1	6	0.00015
chlorobenzene	-	100	0.039
1,1-dichloroethene	0.007	0.7	0.000044
cis-1,2-dichloroethene	0.07	-	0.061
trans-1,2-dichloroethene	0.1	-	0.12
1,3-dinitrobenzene	-	-	0.0037
2,4-dinitrotoluene	-	0.13	0.073
1,1,2,2-tetrachloroethane	-	-	0.000052
tetrachloroethene	0.005	0.7	0.0011
toluene	1	-	0.75
1,1,2-trichloroethane	0.005	-	0.00019
trichloroethene	0.005	0.5	0.0016
Metals:			
Antimony	0.006	-	0.015
Arsenic	0.05	5	0.000045, 0.011*
Beryllium	0.004	-	0.000016
Cadmium	0.005	1	0.018
Chromium	0.1	5	0.18 (4)
Copper	1 (5)	-	1.5
Lead	0.05 (6)	5	-
Mercury	0.002	0.2	0.011
Nickel	0.1	-	0.73
Selenium	0.05	1	0.18
Silver	0.1 (5)	5	0.18
Thallium	0.002	-	-
Zinc	5 (5)	-	11

(1) Alaska Department of Environmental Conservation, 18 AAC 80. In all cases, state MCLs are equivalent to federal MCLs.

(2) EPA 40 CFR 261

(3) EPA Region III, October 20 1995. RBCs are based on residential tap water ingestion.

(4) RBC for chromium VI = 0.18 mg/L
RBC for chromium III = 37 mg/L

(5) Secondary MCL

(6) ADEC Interim Guidance for Surface and Groundwater Cleanup Levels, September, 26, 1990.

* 0.000045 carcinogenic, 0.011 noncarcinogenic

TABLE 4-17
TOTAL METALS - GROUNDWATER FROM WELL POINTS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	Antimony EPA 6010 mg/L	Arsenic EPA 7060 mg/L	Beryllium EPA 6010 mg/L	Cadmium EPA 6010 mg/L	Chromium EPA 6010 mg/L	Copper EPA 6010 mg/L	Lead EPA 7421 mg/L
95PRDA-T-026GW	SB-T1	ND (0.1)	0.073	ND (0.01)	ND (0.025)	0.66	0.55	0.11
95PRDA-T-027GW	Duplicate of 026	ND (0.1)	0.038	ND (0.005)	ND (0.01)	0.28	0.26	0.054
95PRDA-T-028GW	Triplicate of 026	0.024	0.024	0.0022	ND (0.03)	0.2	0.19	0.028
95PRDA-B-051GW	SB-B4	0.095	0.066	0.0051	ND (0.025)	0.38	0.62	0.094
95PRDA-A-085GW	SB-A5	1.5	ND (0.05)	0.093	ND (0.25)	6.4	13	0.79
95PRDA-O-199GW	SB-O13	2.5	0.15	0.057	ND (0.5)	7.5	12	0.89

Sample Number	Sample Location	Mercury EPA 7470 mg/L	Nickel EPA 6010 mg/L	Selenium EPA 7740 mg/L	Silver EPA 6010 mg/L	Thallium EPA 7841 mg/L	Zinc EPA 6010 mg/L
95PRDA-T-026GW	SB-T1	0.001	1	ND (0.01)	ND (0.01)	ND (0.005)	1.4
95PRDA-T-027GW	Duplicate of 026	0.00064	0.42	ND (0.005)	ND (0.005)	ND (0.005)	0.57
95PRDA-T-028GW	Triplicate of 026	0.00048	0.32	0.0015	ND (0.005)	ND (0.001)	0.42
95PRDA-B-051GW	SB-B4	0.0019	0.66	ND (0.005)	ND (0.005)	ND (0.005)	0.93
95PRDA-A-085GW	SB-A5	0.072 J	19	ND (0.050)	0.16	ND (0.005)	17
95PRDA-O-199GW	SB-O13	0.016	14	ND (0.050)	0.25	ND (0.005)	13

Notes:
ND = Non Detect
( ) = Reporting Limit

TABLE 4-18
EXPLOSIVES - GROUNDWATER FROM WELL POINTS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	2,4-dinitrotoluene mg/L
95PRDA-T-026GW	SB-T1	ND (0.00025) J
95PRDA-T-027GW	Duplicate of 026	ND (0.00025) J
95PRDA-T-028GW	Triplicate of 026	ND (0.00050)
95PRDA-B-051GW	SB-B4	0.00030 J
95PRDA-A-085GW	SB-A5	ND (0.00025) J
95PRDA-O-199GW	SB-O13	ND (0.00025) J

ND = Non Detect
( ) = Detection Limit
J = Estimated Value

TABLE 4-19
LABORATORY VOC ANALYSIS - GROUNDWATER FROM MONITORING WELLS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	benzene mg/L	carbon tetrachloride mg/L	chlorobenzene mg/L	chloroform mg/L	1,1-dichloroethene mg/L	cis-1,2-dichloroethene mg/L
95PRDA-O-406GW	MW-1	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	0.0053
95PRDA-O-397GW	MW-2	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)
95PRDA-O-400GW	MW-3	ND (0.0002)	ND (0.0002)	ND (0.0002)	0.00053	ND (0.00019)	0.028
95PRDA-O-405GW	MW-4	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	1.6
95PRDA-O-403GW	MW-5	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
95PRDA-O-404GW	MW-6	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	0.0035
95PRDA-O-402GW	MW-7	ND (0.02) J	ND (0.02) J	ND (0.02) J	ND (0.02) J	ND (0.02) J	0.28 J
95PRDA-O-399GW	MW-8	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)
95PRDA-O-390GW	MW-9	0.00073	ND (0.0002)	0.00055	ND (0.0002)	0.0012	ND (0.0002)
95PRDA-O-391GW	Duplicate of 390	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)
95PRDA-O-392GW	Triplicate of 390	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
95PRDA-O-393GW	MW-12	ND (0.0002)	0.0022	ND (0.0002)	0.0011	0.00014 J	0.0091
95PRDA-O-394GW	Duplicate of 393*	ND (0.0002)	0.0022	ND (0.0002)	0.0011	ND (0.0002)	0.0099
95PRDA-O-395GW	Triplicate of 393*	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.009
95PRDA-O-398GW	MW-13	0.00034	0.00038	0.00038	ND (0.0002)	0.00026	ND (0.0002)
95PRDA-O-401GW	MW-14	2.9 J	2.6 J	ND (0.5) J	1.4 J	ND (0.5) J	37 J
95PRDA-O-387GW	MW-15	ND (0.0002)	0.0014	ND (0.0002)	0.0016	0.00071	0.015
95PRDA-O-388GW	Duplicate of 387	ND (0.0002)	0.0017	ND (0.0002)	0.002	0.00086	0.019
95PRDA-O-389GW	Triplicate of 387	ND (0.005)	ND (0.005)	ND (0.005)	0.002 J	ND (0.005)	0.014
95PRDA-O-407GW	MW-16	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)

ND = Non Detect
( ) = Reporting Limit
J = Estimated value
* Duplicate and triplicate of VOCs only.

TABLE 4-19: (CONTINUED)

Sample Number	Sample Location	trans-1,2-dichloroethene mg/L	1,1,2,2-tetrachloroethane mg/L	tetrachloroethene mg/L	toluene mg/L	1,1,2-trichloroethane mg/L	trichloroethene mg/L
95PRDA-O-406GW	MW-1	ND (0.002)	0.082	ND (0.002)	ND (0.002)	ND (0.005)	0.043
95PRDA-O-397GW	MW-2	ND (0.0002)	ND (0.50)	ND (0.0002)	ND (0.0002)	ND (0.50)	ND (0.0002)
95PRDA-O-400GW	MW-3	0.0038	0.54	0.00062	ND (0.0002)	0.0023	0.26
95PRDA-O-405GW	MW-4	0.41	71	0.31	ND (0.2)	ND (0.5)	14
95PRDA-O-403GW	MW-5	ND (0.2) J	21 J	ND (0.2) J	ND (0.2) J	ND (0.5) J	4.8 J
95PRDA-O-404GW	MW-6	ND (0.002)	0.52	ND (0.002)	ND (0.002)	ND (0.005)	0.13
95PRDA-O-402GW	MW-7	0.058 J	3.1 J	ND (0.02) J	ND (0.02) J	ND (0.05) J	1 J
95PRDA-O-399GW	MW-8	ND (0.0002)	ND (0.50)	ND (0.0002)	ND (0.0002)	ND (0.50)	ND (0.0002)
95PRDA-O-390GW	MW-9	ND (0.0002)	ND (0.50)	ND (0.0002)	0.00073	ND (0.50)	0.00091
95PRDA-O-391GW	Duplicate of 390	ND (0.0002)	ND (0.50)	ND (0.0002)	ND (0.0002)	ND (0.50)	ND (0.0002)
95PRDA-O-392GW	Triplicate of 390	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
95PRDA-O-393GW	MW-12	0.001	0.49 J	0.00035	ND (0.0002)	0.00078	0.16 J
95PRDA-O-394GW	Duplicate of 393*	0.001	0.3 J	0.00034	ND (0.0002)	0.00094	0.16 J
95PRDA-O-395GW	Triplicate of 393*	ND (0.005)	0.097	ND (0.005)	ND (0.005)	ND (0.005)	0.14
95PRDA-O-398GW	MW-13	ND (0.0002)	0.0011	ND (0.0002)	0.00032	ND (0.50)	0.0067
95PRDA-O-401GW	MW-14	12 J	1900 J	11 J	ND (0.5) J	ND (1.3) J	220 J
95PRDA-O-387GW	MW-15	0.0041	0.0063	0.0021	0.00018 J	0.0013	0.27 J
95PRDA-O-388GW	Duplicate of 387	0.0052	0.0074	0.0025	ND (0.0002)	0.0016	0.27 J
95PRDA-O-389GW	Triplicate of 387	0.003 J	0.006	0.002 J	ND (0.005)	ND (0.005)	0.3
95PRDA-O-407GW	MW-16	ND (0.0002)	ND (0.002)	ND (0.0002)	ND (0.0002)	ND (0.50)	0.00031

ND = Non Detect
( ) = Reporting Limit
J = Estimated value
* Duplicate and triplicate of VOCs only.

TABLE 4-20
TOTAL (UNFILTERED) METALS - GROUNDWATER FROM MONITORING WELLS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	Arsenic EPA 7060 mg/L	Chromium EPA 6010 mg/L	Copper EPA 6010 mg/L	Lead EPA 7421 mg/L	Nickel EPA 6010 mg/L	Zinc EPA 6010 mg/L
95PRDA-O-406GW	MW-1	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	ND (0.01)
95PRDA-O-397GW	MW-2	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	ND (0.01)
95PRDA-O-400GW	MW-3	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	ND (0.01)
95PRDA-O-405GW	MW-4	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	0.024
95PRDA-O-403GW	MW-5	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	0.020	ND (0.01)
95PRDA-O-404GW	MW-6	ND (0.005)	0.062	0.058	0.012	0.046	0.095
95PRDA-O-402GW	MW-7	0.012	0.086	0.024	0.0031	0.057	0.038
95PRDA-O-399GW	MW-8	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	ND (0.01)
95PRDA-O-390GW	MW-9	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	0.015
95PRDA-O-391GW	Duplicate of 390	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	ND (0.01)
95PRDA-O-392GW	Triplicate of 390	0.00057	ND (0.005)	ND (0.005)	0.0022	ND (20)	ND (0.005)
95PRDA-O-393GW	MW-12	ND (0.005)	0.017	ND (0.01)	ND (0.003)	0.021	ND (0.01)
95PRDA-O-398GW	MW-13	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	ND (0.01)
95PRDA-O-401GW	MW-14	ND (0.005)	0.020	0.015	ND (0.003)	0.028	0.016
95PRDA-O-387GW	MW-15	ND (0.005)	0.018	ND (0.01)	ND (0.003)	0.012	ND (0.01)
95PRDA-O-388GW	Duplicate of 387	ND (0.005)	0.013	ND (0.01)	ND (0.003)	ND (0.01)	ND (0.01)
95PRDA-O-389GW	Triplicate of 387	0.0012	0.014	0.0053	0.0028	ND (0.02)	0.012
95PRDA-O-407GW	MW-16	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	ND (0.01)
95PRDA-O-396GW	MW-17*	ND (0.005)	0.036	0.020	0.0037	0.037	0.027

ND = Non Detect
( ) = Reporting Limit
* MW-17 is the background well.

TABLE 4-21
DISSOLVED (FILTERED) METALS - GROUNDWATER FROM MONITORING WELLS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	Arsenic EPA 7060 mg/L	Nickel EPA 6010 mg/L	Selenium EPA 7740 mg/L	Zinc EPA 6010 mg/L
95PRDA-O-406GW	MW-1	ND (0.005)	ND (0.01)	ND (0.005)	ND (0.01)
95PRDA-O-397GW	MW-2	ND (0.005)	ND (0.01)	ND (0.005)	ND (0.01)
95PRDA-O-400GW	MW-3	ND (0.005)	ND (0.01)	ND (0.005)	ND (0.01)
95PRDA-O-405GW	MW-4	ND (0.005)	ND (0.01)	ND (0.005)	0.023
95PRDA-O-403GW	MW-5	ND (0.005)	0.018	ND (0.005)	ND (0.01)
95PRDA-O-404GW	MW-6	ND (0.005)	ND (0.01)	ND (0.005)	ND (0.01)
95PRDA-O-402GW	MW-7	0.0071	ND (0.01)	ND (0.005)	ND (0.01)
95PRDA-O-399GW	MW-8	ND (0.005)	ND (0.01)	ND (0.005)	ND (0.01)
95PRDA-O-390GW	MW-9	ND (0.005)	ND (0.01)	ND (0.005)	0.068
95PRDA-O-391GW	Duplicate of 390	ND (0.005)	ND (0.01)	ND (0.005)	0.018
95PRDA-O-392GW	Triplicate of 390	0.0005	ND (20)	0.00074	ND (0.005)
95PRDA-O-393GW	MW-12	ND (0.005)	ND (0.01)	ND (0.005)	ND (0.01)
95PRDA-O-398GW	MW-13	ND (0.005)	ND (0.01)	ND (0.005)	ND (0.01)
95PRDA-O-401GW	MW-14	ND (0.005)	0.015	ND (0.005)	ND (0.01)
95PRDA-O-387GW	MW-15	ND (0.005)	ND (0.01)	ND (0.005)	0.16
95PRDA-O-388GW	Duplicate of 387	ND (0.005)	ND (0.01)	ND (0.005)	0.091
95PRDA-O-389GW	Triplicate of 387	ND (0.00050)	ND (0.020)	ND (0.0005)	ND (0.0050)
95PRDA-O-407GW	MW-16	ND (0.005)	ND (0.01)	ND (0.005)	ND (0.01)
95PRDA-O-396GW	MW-17*	ND (0.005)	ND (0.01)	ND (0.005)	ND (0.01)

ND = Non Detect
( ) = Reporting Limit
* MW-17 is the background well.

TABLE 4-22
LABORATORY VOC ANALYSIS - WETLAND SURFACE WATER

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	toluene mg/L
95PRDA-W-332SW	SED-1	ND (0.001)
95PRDA-W-334SW	Duplicate of 332	ND (0.001)
95PRDA-W-336SW	Triplicate of 332	ND (0.005)
95PRDA-W-338SW	SED-2	0.0045
95PRDA-W-340SW	SED-3	ND (0.005)
95PRDA-W-342SW	SED-4	ND (0.0002)

Notes:
ND = Non Detect
( ) = Reporting Limit

TABLE 4-23
TOTAL (UNFILTERED) METALS ANALYSIS - WETLAND SURFACE WATER

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	Arsenic EPA 7060 mg/L	Chromium EPA 6010 mg/L	Copper EPA 6010 mg/L	Lead EPA 7421 mg/L	Nickel EPA 6010 mg/L	Zinc EPA 6010 mg/L
Wetlands							
95PRDA-W-332SW	SED-1	ND (0.005)	ND (0.01)	0.013	0.0057	0.014	0.064
95PRDA-W-334SW	Duplicate of 332	ND (0.005)	ND (0.01)	0.013	0.0041	0.019	0.055
95PRDA-W-336SW	Triplicate of 332	0.0005	0.015	0.017	0.0067	ND (0.020)	0.072
95PRDA-W-338SW	SED-2	ND (0.005)	ND (0.01)	0.099	0.0081	0.000014	0.170
95PRDA-W-340SW	SED-3	ND (0.005)	ND (0.01)	ND (0.01)	0.004	ND (0.01)	0.042
95PRDA-W-342SW	SED-4	ND (0.005)	ND (0.01)	ND (0.01)	0.0045	ND (0.01)	0.053
Background Wetlands							
95PRDA-U-348SW	SEDB-1	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	0.047
95PRDA-U-350SW	Duplicate of 348	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	0.027
95PRDA-U-352SW	Triplicate of 348	0.00097	ND (0.005)	0.014	0.0036	ND (0.020)	0.028
95PRDA-U-354SW	SEDB-2	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	0.160
95PRDA-U-356SW	SEDB-3	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	0.220
95PRDA-U-358SW	SEDB-4	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	0.260
95PRDA-U-360SW	SEDB-5	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	0.078
95PRDA-U-362SW	SEDB-6	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	0.026
	Average Background	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	0.117

Notes:
ND = Non Detect
( ) = Detection Limit

TABLE 4-24
EXPLOSIVES ANALYSIS - WETLAND SURFACE WATER

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	1,3,5-trinitrobenzene mg/L	1,3-dinitrobenzene mg/L	2,4,6-trinitrotoluene mg/L	m-nitrotoluene mg/L
95PRDA-W-332SW	SED-1	ND (0.00026)	0.0034	ND (0.00025)	ND (0.001)
95PRDA-W-334SW	Duplicate of 332	ND (0.00026)	ND (0.00025)	ND (0.00025)	ND (0.001)
95PRDA-W-336SW	Triplicate of 332	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
95PRDA-W-338SW	SED-2	ND (0.00026)	0.00048	ND (0.00025)	ND (0.001)
95PRDA-W-340SW	SED-3	ND (0.00026)	ND (0.00025)	ND (0.00025)	ND (0.001)
95PRDA-W-342SW	SED-4	ND (0.00026)	ND (0.00025)	ND (0.00025)	ND (0.001)

ND = Non Detect
( ) = Reporting Limit

TABLE 4-25
METALS ANALYSIS - WETLAND SEDIMENT

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	Antimony EPA 6010 mg/kg	Arsenic EPA 7060 mg/kg	Beryllium EPA 6010 mg/kg	Cadmium EPA 6010 mg/kg	Chromium EPA 6010 mg/kg	Copper EPA 6010 mg/kg	Lead EPA 6020 mg/kg
Wetlands								
95PRDA-W-331SD	SED-1	ND (16)	ND (1.5)	ND (1.6)	ND (1.6)	6.0	17	ND (9.5)
95PRDA-W-333SD	Duplicate of 332	ND (16)	1.7	ND (1.6)	ND (1.6)	6.8	18	ND (9.3)
95PRDA-W-335SD	Triplicate of 332	ND (11)	0.88	ND (0.55)	ND (2.8)	7.2	17	ND (14)
95PRDA-W-337SD	SED-2	ND (2.7)	1.4	ND (0.27)	ND (0.27)	1.2	4.5	ND (1.6)
95PRDA-W-339SD	SED-3	ND (15)	2.6	ND (1.5)	ND (1.5)	5.7	19	ND (9.1)
95PRDA-W-341SD	SED-4	ND (15)	3.5	ND (1.5)	ND (1.5)	6.4	12	ND (8.9)
Background Wetlands								
95RDA-U-347SD	SEDB-1	ND (12)	1.6	ND (1.2)	ND (1.2)	8.2	25	ND (7.3)
95RDA-U-349SD	Duplicate of 347	ND (11)	21	ND (1.1)	ND (1.1)	8.2	21	ND (6.5)
95RDA-U-351SD	Triplicate of 348	ND (8.4)	0.56	ND (0.42)	ND (2.1)	6.5	21	ND (11)
95RDA-U-353SD	SEDB-2	ND (9.2)	1.5	ND (0.92)	ND (0.92)	5.4	18	ND (5.5)
95RDA-U-355SD	SEDB-3	ND (10)	3.7	ND (1.0)	ND (1.0)	21	17	ND (6.1)
95RDA-U-357SD	SEDB-4	7.1	5.5	ND (0.65)	ND (1.3)	34	28	6.2
95RDA-U-359SD	SEDB-5	8.7	5.5	ND (0.34)	ND (3.4)	25	13	7.1
95RDA-U-361SD	SEDB-6	ND (7.7)	1.7	ND (0.77)	ND (0.77)	4.7	11	4.8
Average Background Concentration		5.8*	5.8	ND (0.85)	ND (1.4)	15	19	3.1*

ND = Non Detect
( ) = Detection Limit
*Averages include NDs at half of the detection limit.

TABLE 4-25: (CONTINUED)

Sample Number	Sample Location	Mercury EPA 7471 mg/kg	Nickel EPA 6010 mg/kg	Selenium EPA 7740 mg/kg	Silver EPA 6010 mg/kg	Thallium EPA 7841 mg/kg	Zinc EPA 6010 mg/kg
Wetlands							
95PRDA-W-331SD	SED-1	ND (0.58)	3.8	ND (1.5)	ND (1.6)	ND (1.5)	14
95PRDA-W-333SD	Duplicate of 332	ND (0.53)	4.4	ND (1.5)	ND (1.6)	ND (1.5)	16
95PRDA-W-335SD	Triplicate of 332	ND (0.44)	ND (11)	0.78	ND (2.8)	ND (0.55)	16
95PRDA-W-337SD	SED-2	ND (0.49)	1.5	ND (1.3)	ND (0.54)	ND (1.3)	3.7
95PRDA-W-339SD	SED-3	ND (0.56)	5.8	ND (1.5)	ND (1.5)	ND (1.5)	20
95PRDA-W-341SD	SED-4	ND (0.54)	5.4	ND (1.5)	ND (1.5)	ND (1.5)	23
Background Wetlands							
95RDA-U-347SD	SEDB-1	ND (0.43)	4.9	ND (1.1)	ND (1.2)	ND (1.1)	27
95RDA-U-349SD	Duplicate of 347	ND (0.40)	5.6	ND (1.1)	ND (1.1)	ND (1.1)	29
95RDA-U-351SD	Triplicate of 348	ND (0.33)	11	0.29	ND (2.1)	ND (0.42)	27
95RDA-U-353SD	SEDB-2	ND (0.36)	3.4	ND (0.90)	ND (0.92)	ND (1.1)	11
95RDA-U-355SD	SEDB-3	ND (0.41)	9.6	1.3	ND (1.0)	ND (0.63)	26
95RDA-U-357SD	SEDB-4	ND (0.22)	16	ND (0.62)	ND (0.65)	ND (0.33)	79
95RDA-U-359SD	SEDB-5	ND (0.12)	18	ND (0.33)	0.39	ND (0.77)	37
95RDA-U-361SD	SEDB-6	ND (0.29)	3.5	ND (0.77)	ND (0.77)	ND (0.25)	9.5
Average Background Concentration		ND (0.32)	8.7	0.53*	0.46*	ND (0.75)	31

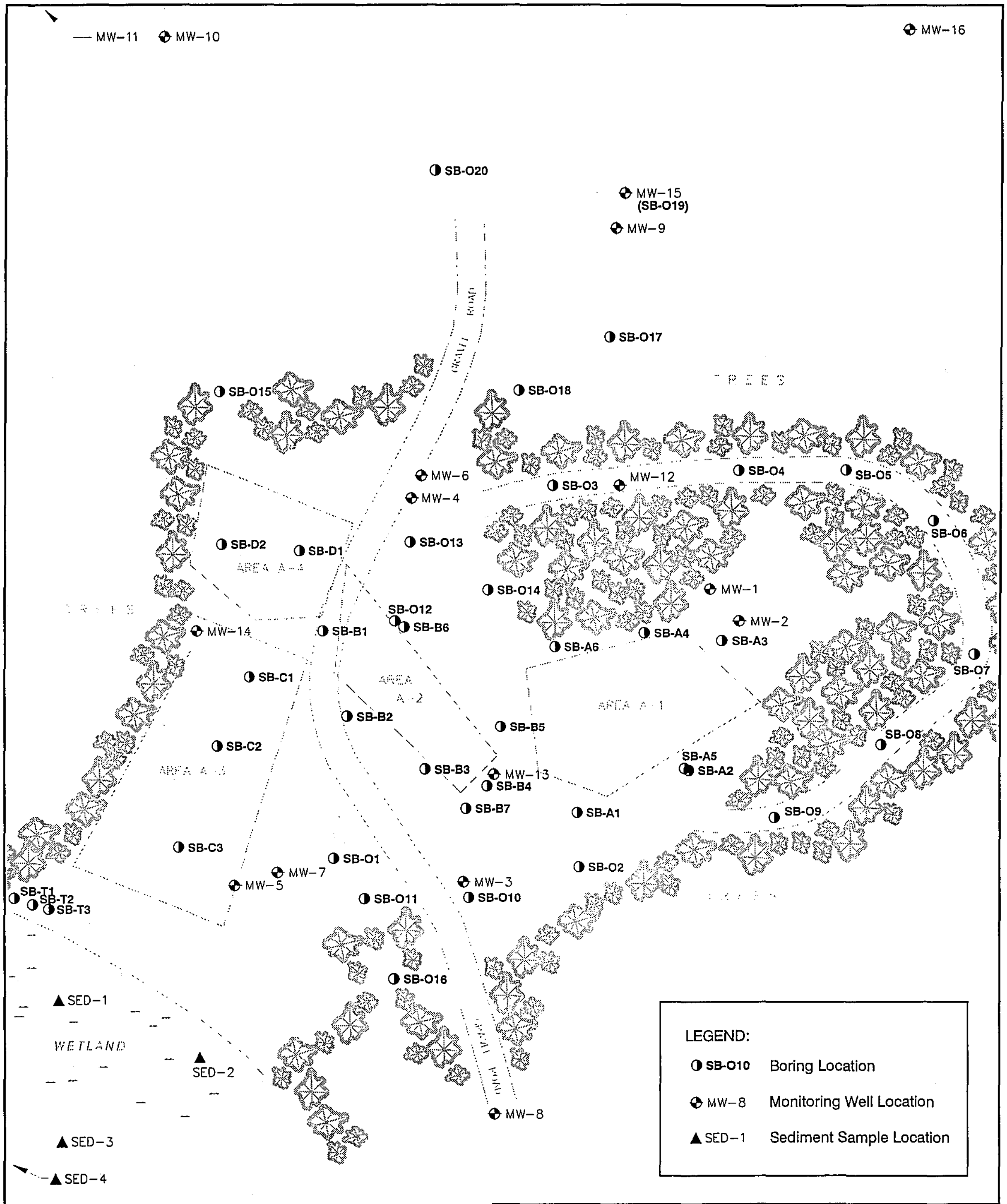
ND = Non Detect
( ) = Detection Limit
*Averages include NDs at half of the detection limit.

TABLE 4-26
EXPLOSIVES ANALYSIS - WETLAND SEDIMENT

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Sample Number	Sample Location	1,3,5-trinitrobenzene mg/kg	1,3-dinitrobenzene mg/kg	2,4,6-trinitrotoluene mg/kg	m-nitrotoluene mg/kg
95PRDA-W-331SD	SED-1	0.76	ND (0.25)	ND (0.25)	ND (0.25)
95PRDA-W-333SD	Duplicate of 331	0.78	ND (0.25)	ND (0.25)	ND (0.25)
95PRDA-W-335SD	Triplicate of 331	ND (14)	ND (14)	ND (14)	ND (14)
95PRDA-W-337SD	SED-2	0.74	ND (0.25)	0.48	3
95PRDA-W-339SD	SED-3	0.53	ND (0.25)	ND (0.25)	ND (0.25)
95PRDA-W-341SD	SED-4	0.65	ND (0.25)	ND (0.25)	ND (0.25)

ND = Non Detect
( ) = Reporting Limit



MW-17 is shown on Figure 4-15.

GRAPHIC SCALE

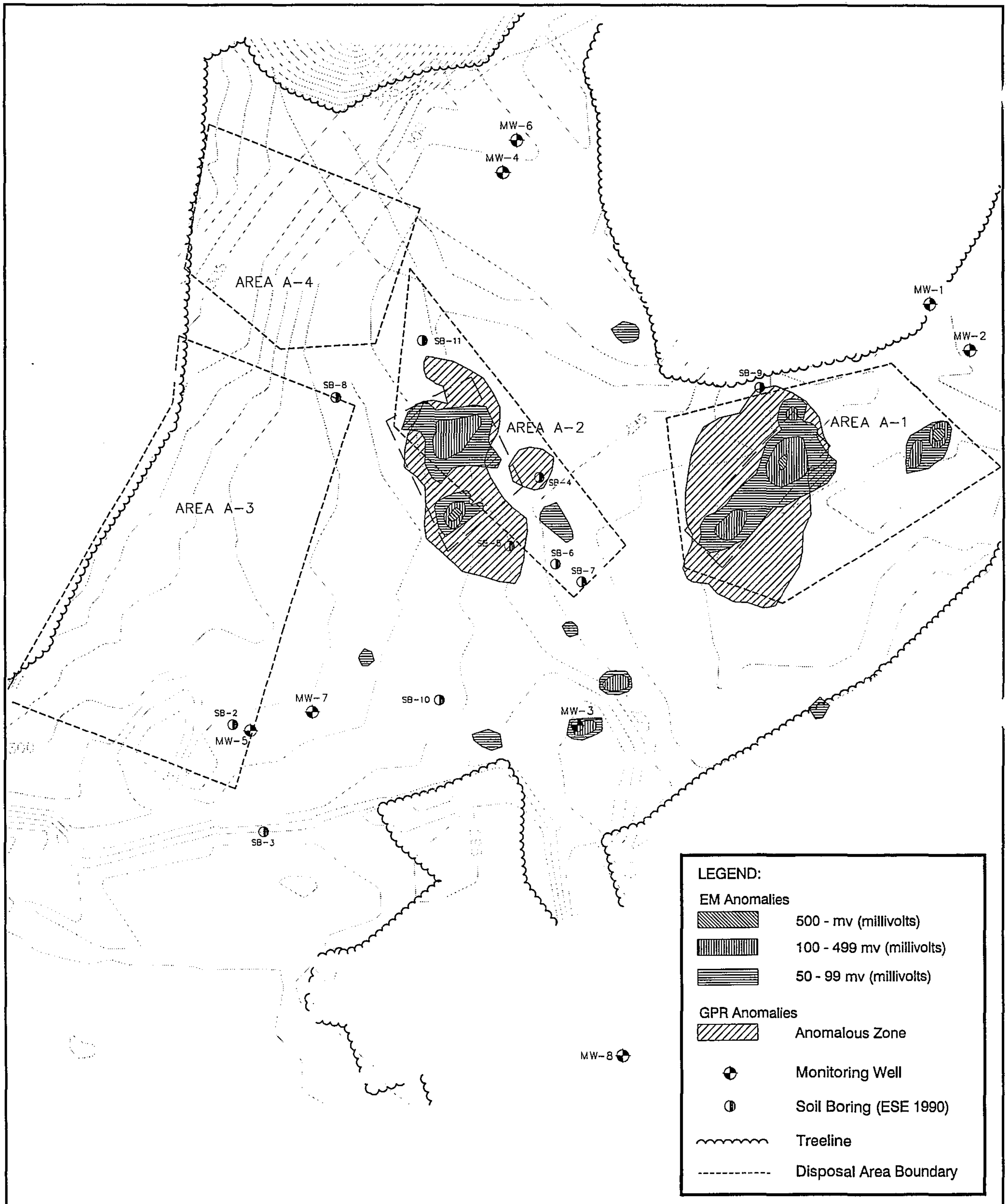
50 0 50 100 200

(IN FEET)
1 inch = 100 ft.

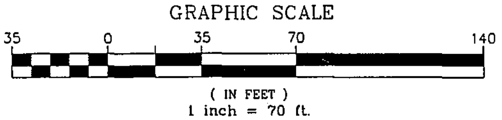
BORING AND MONITORING WELL LOCATIONS
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-1.DWG	*By:* AR	*Figure:* 4-1
Project: E9408L	*Date:* 6-28-96	



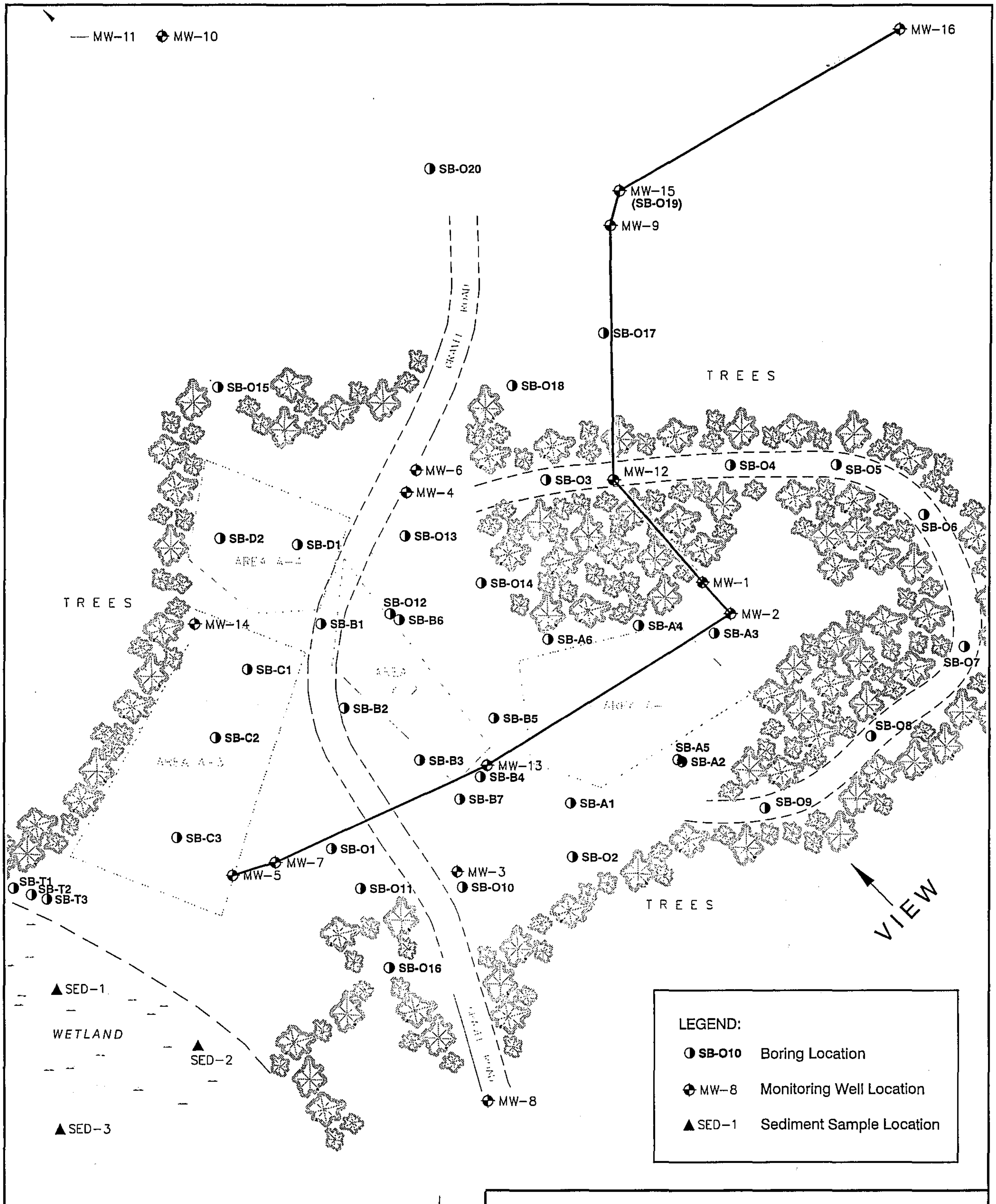
SOURCE:
US Army Cold Regions Research &
Engineering Laboratory (CRREL),
August 8, 1995



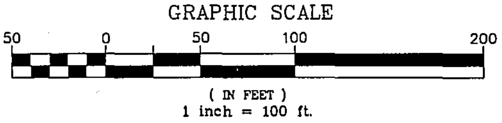
1995 SURFACE GEOPHYSICS
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-2.DWG	*By:-* AR	*Figure:* 4-2
Project: E9408L	*Date:* 6-28-96	



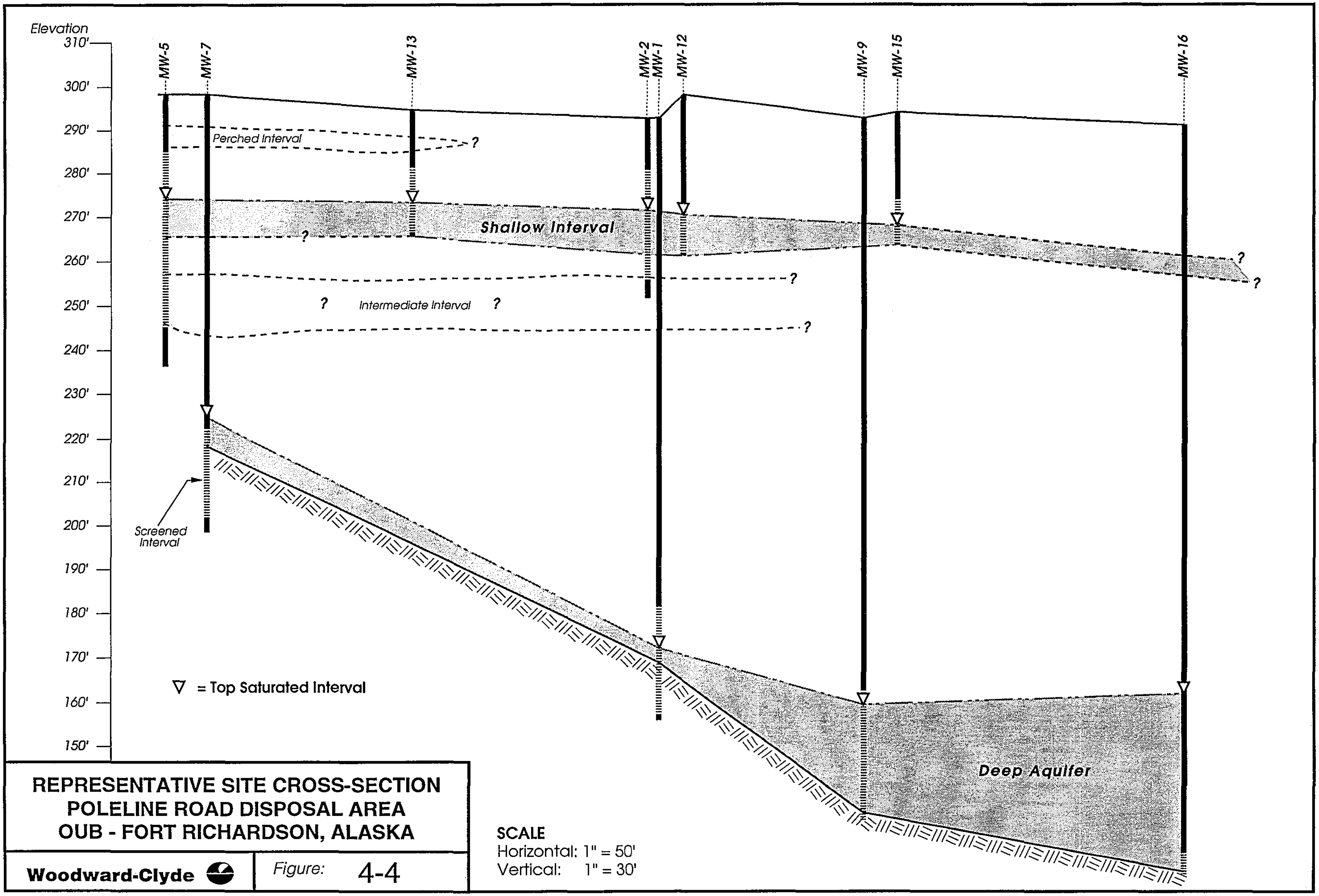
MW-17 is shown on Figure 4-15.



LOCATION OF SITE CROSS-SECTION
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

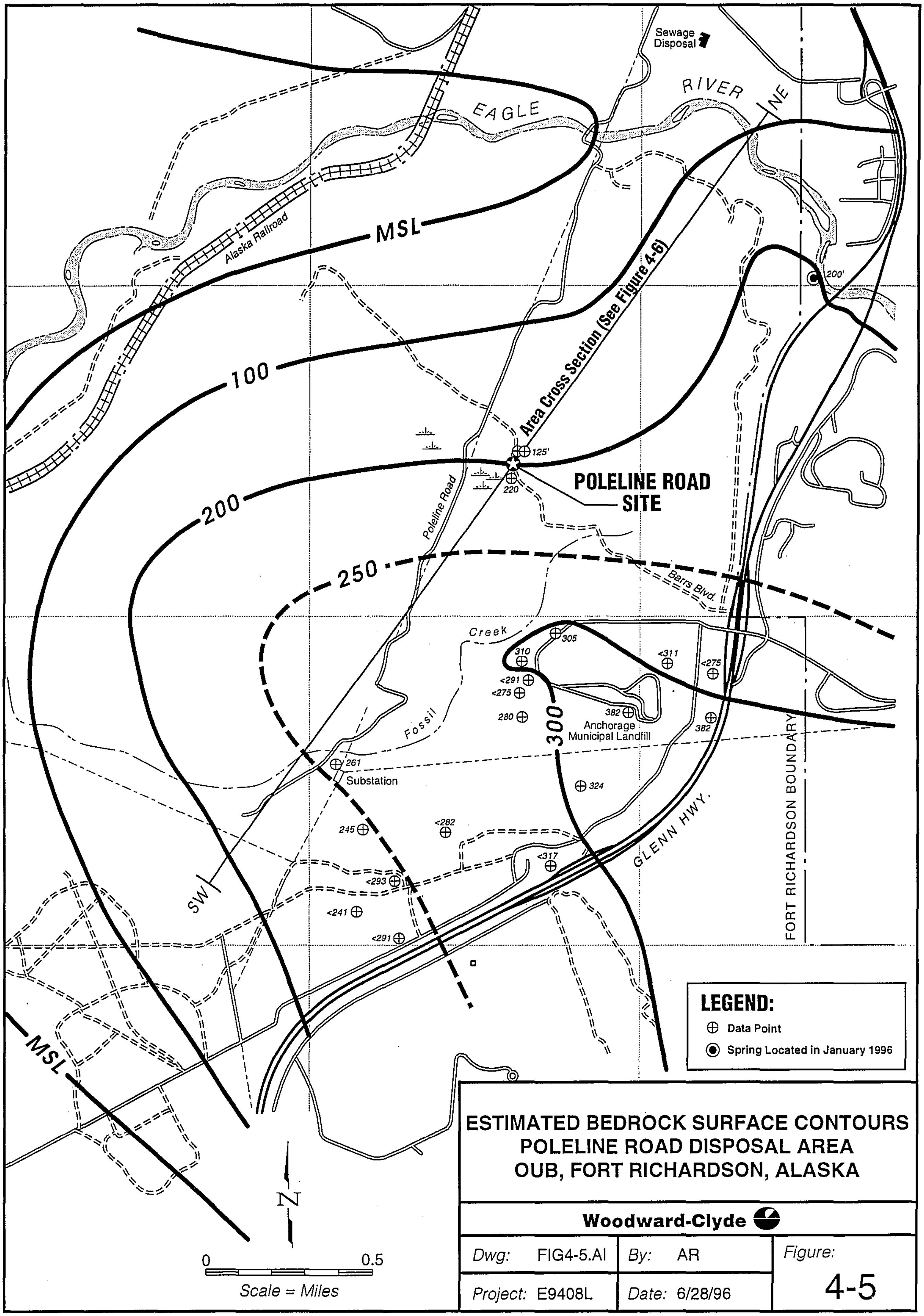
Dwg: FIG4-3.DWG	*By:* AR	*Figure:* 4-3
Project: E9408L	*Date:* 6-28-96	



REPRESENTATIVE SITE CROSS-SECTION
POLELINE ROAD DISPOSAL AREA
OUB - FORT RICHARDSON, ALASKA

Woodward-Clyde | *Figure:* 4-4

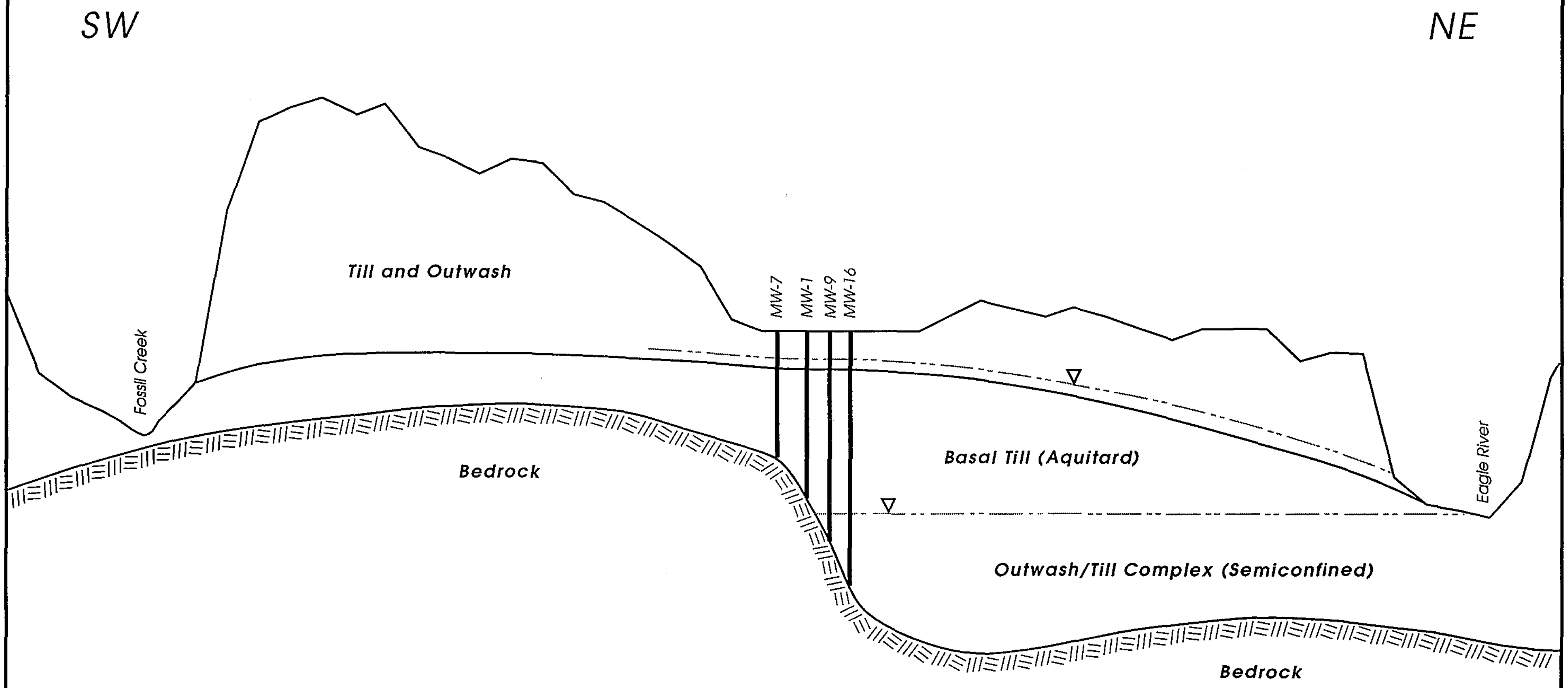
SCALE
Horizontal: 1" = 50'
Vertical: 1" = 30'



ESTIMATED BEDROCK SURFACE CONTOURS
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-5.AI	By: AR	Figure:
Project: E9408L	Date: 6/28/96	4-5

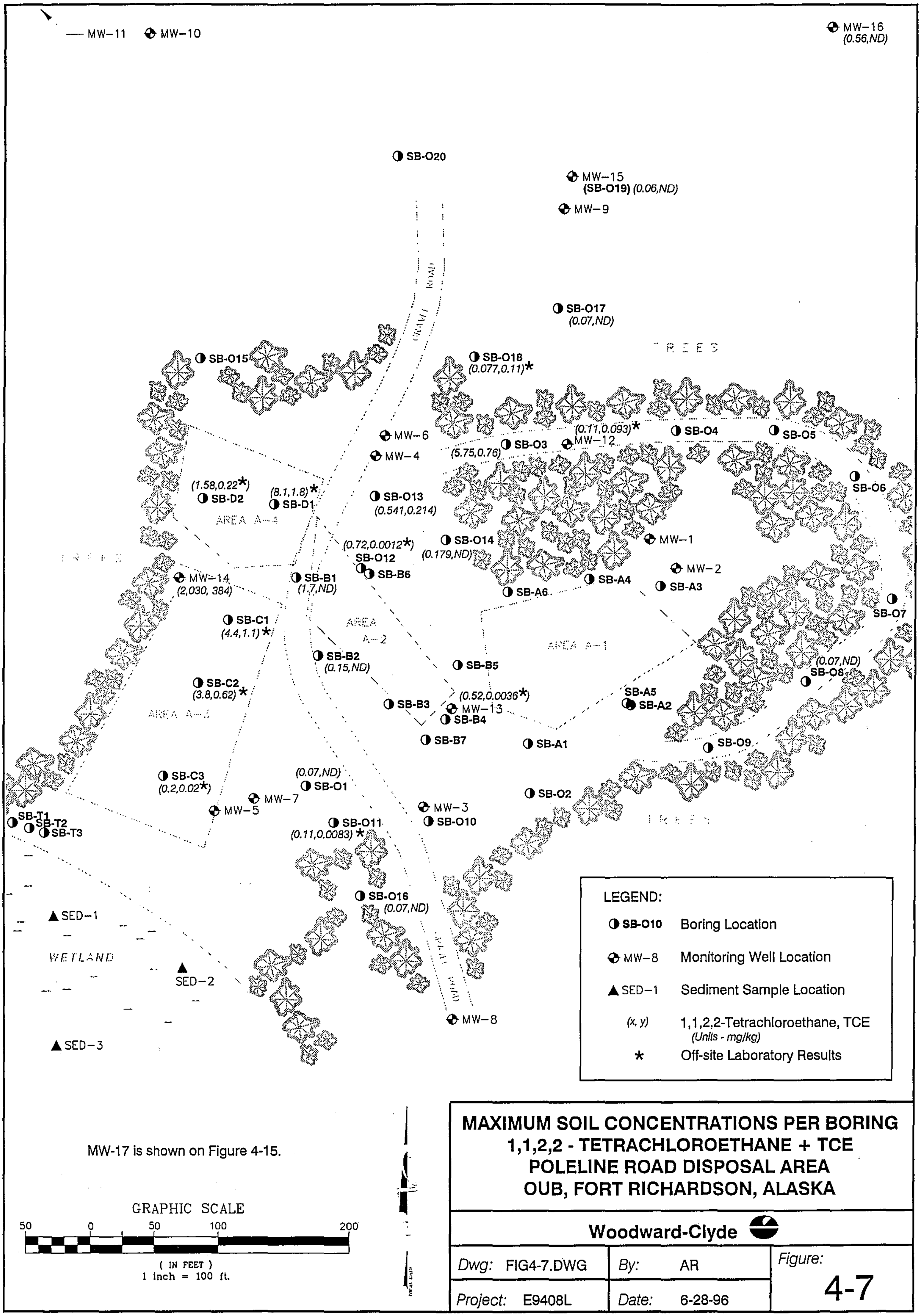


AREA CROSS-SECTION
POLELINE ROAD DISPOSAL AREA
OUB - FORT RICHARDSON, ALASKA

Woodward-Clyde

Figure: 4-6

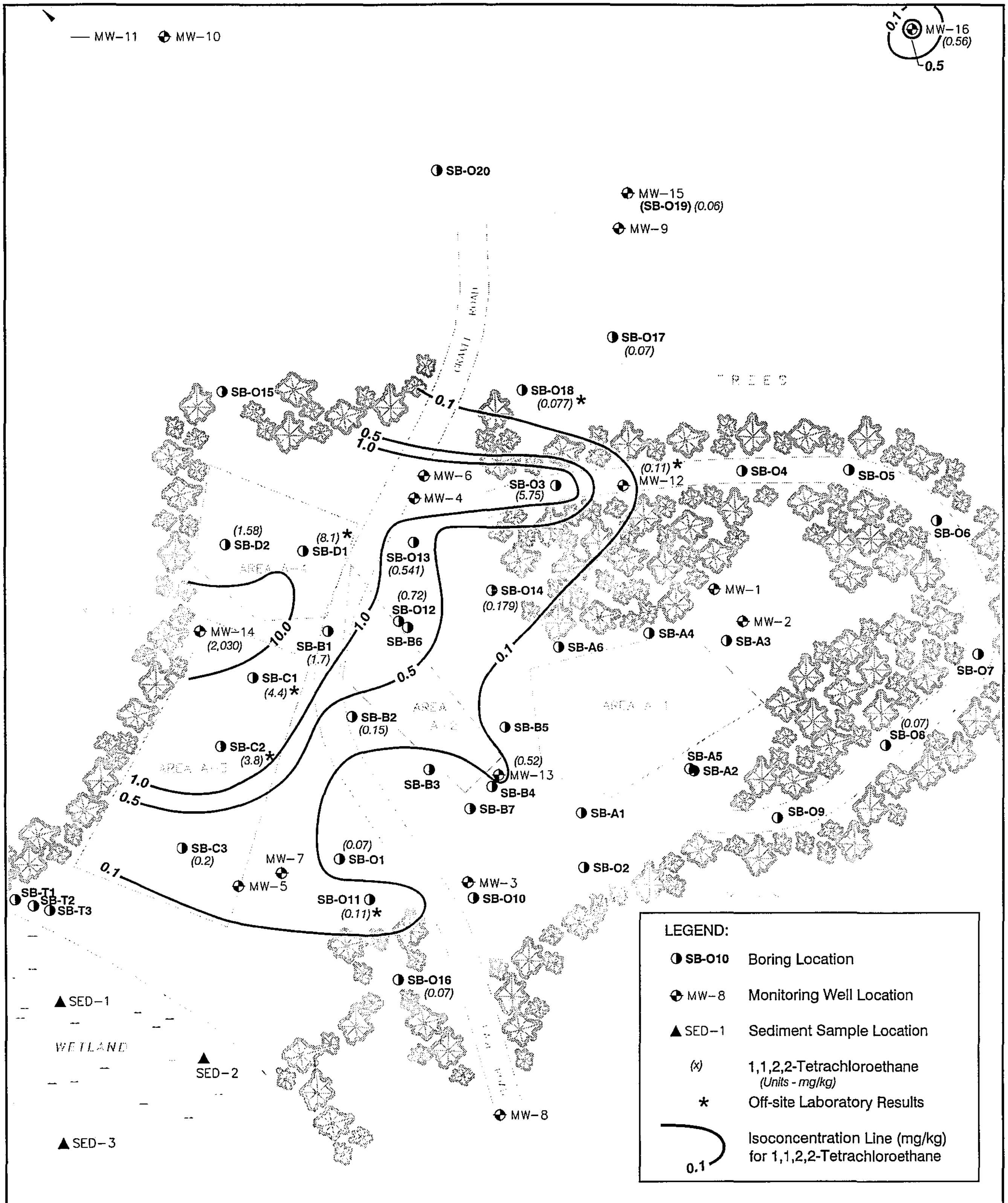
SCALE
Horizontal: 1" = 1500'
Vertical: 1" = 100'



MAXIMUM SOIL CONCENTRATIONS PER BORING 1,1,2,2 - TETRACHLOROETHANE + TCE POLELINE ROAD DISPOSAL AREA OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-7.DWG	By: AR	Figure: 4-7
Project: E9408L	Date: 6-28-96	



MW-17 is shown on Figure 4-15.

GRAPHIC SCALE

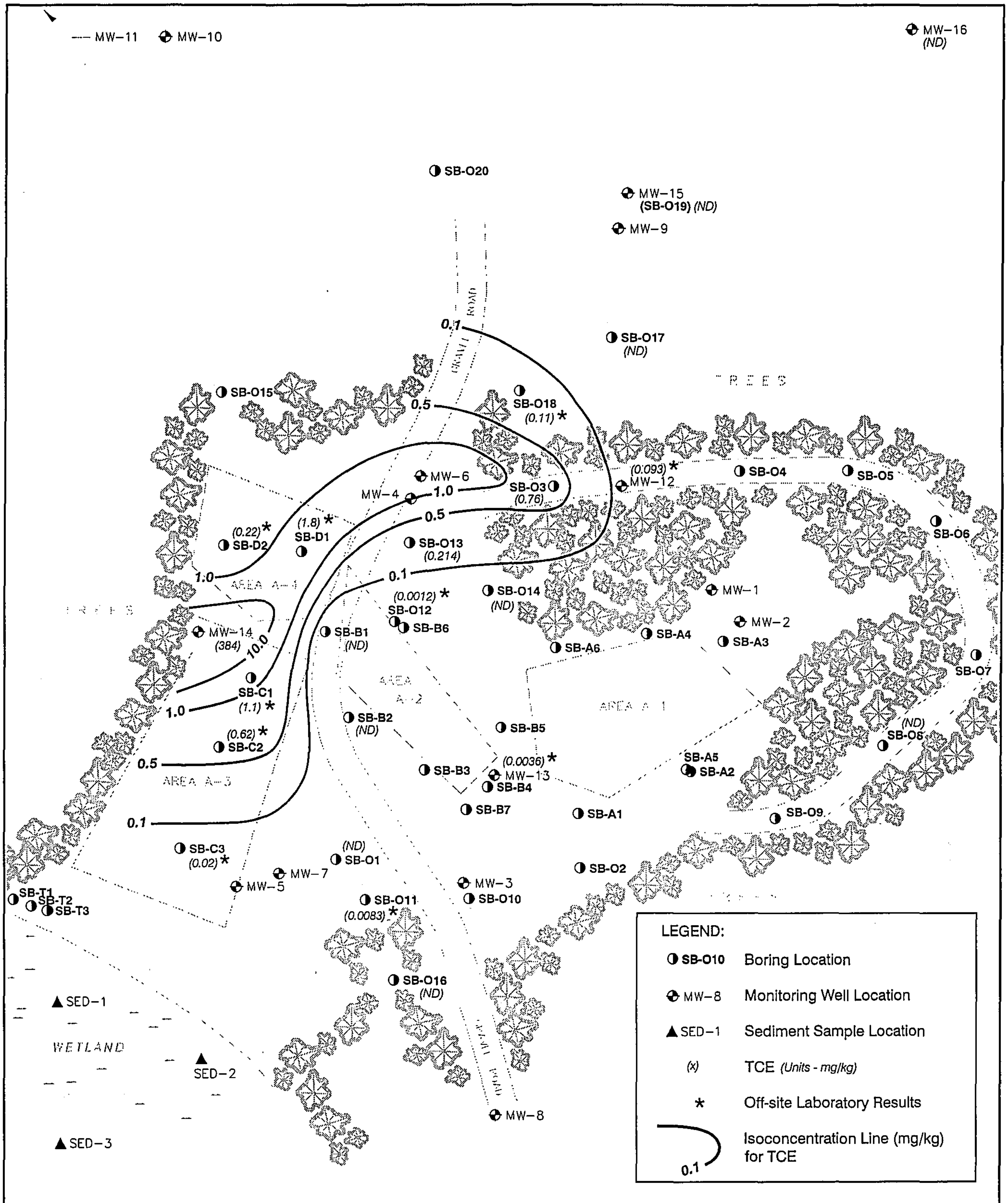
50 0 50 100 200

(IN FEET)
1 inch = 100 ft.

1,1,2,2 - TETRACHLOROETHANE ISOCONCENTRATION MAP
MAXIMUM SOIL CONCENTRATIONS PER BORING
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-8.DWG	By: AR	Figure: 4-8
Project: E9408L	Date: 7-1-96	



LEGEND:

◑ SB-O10	Boring Location
MW-8	Monitoring Well Location
▲ SED-1	Sediment Sample Location
(x)	TCE *(Units - mg/kg)*
*	Off-site Laboratory Results
0.1	Isoconcentration Line (mg/kg) for TCE

MW-17 is shown on Figure 4-15.

GRAPHIC SCALE

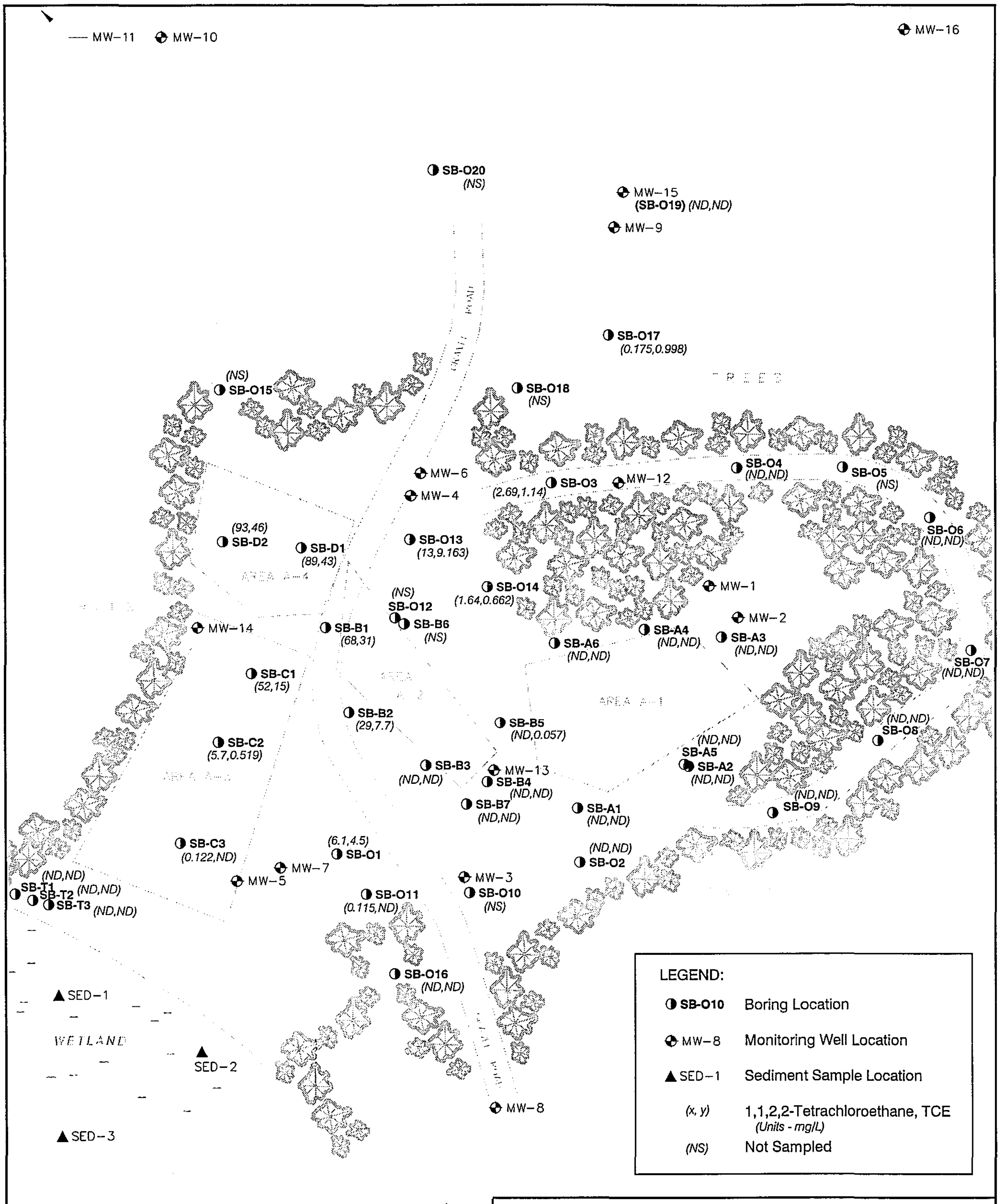
50 0 50 100 200

(IN FEET)
1 inch = 100 ft.

TCE ISOCONCENTRATION MAP
MAXIMUM SOIL CONCENTRATIONS PER BORING
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-9.DWG	*By:* AR	*Figure:* 4-9
Project: E9408L	*Date:* 7-1-96	



MW-17 is shown on Figure 4-15.

GRAPHIC SCALE

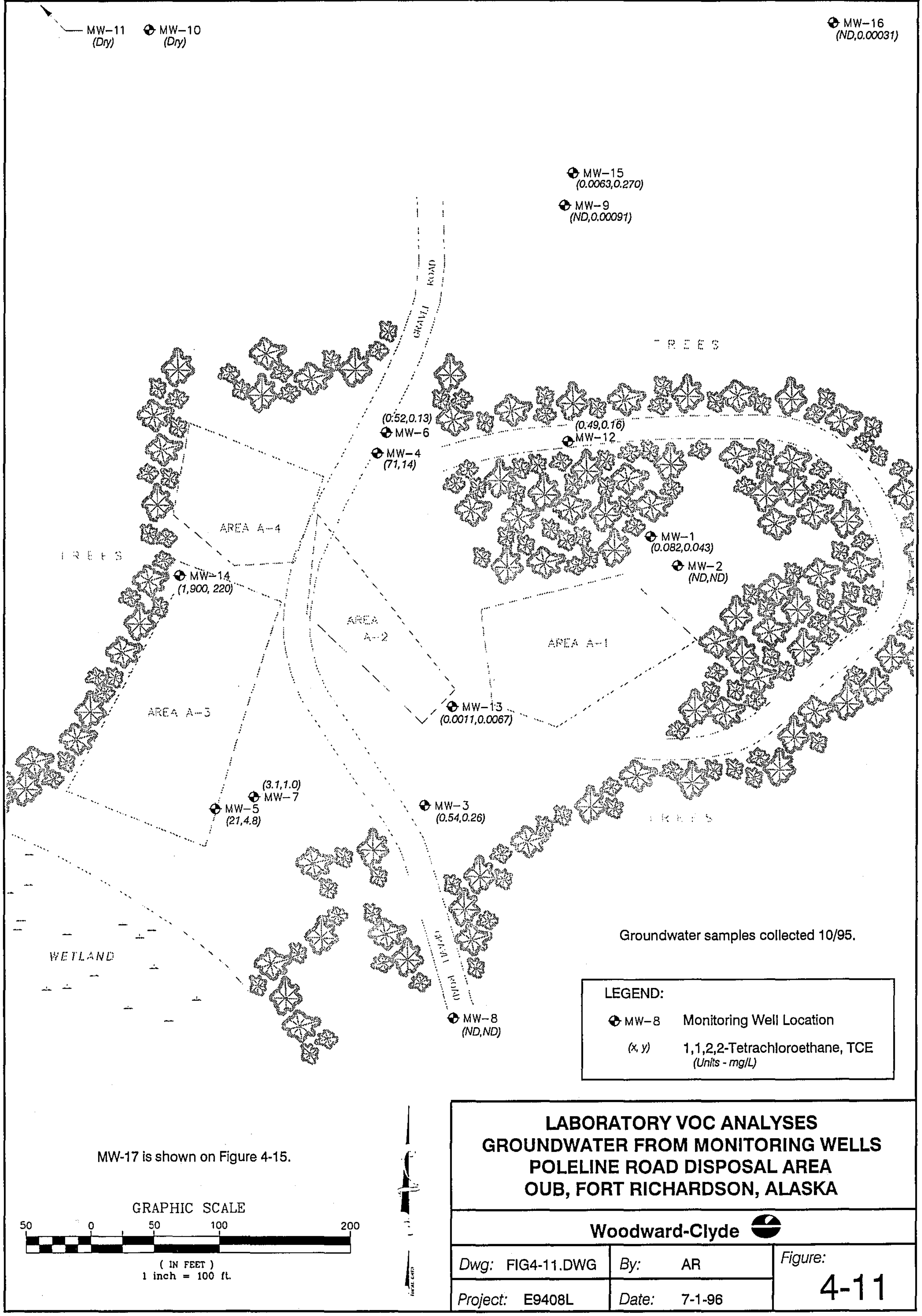
50 0 50 100 200

(IN FEET)
1 inch = 100 ft.

HALOGENATED SOLVENT SCREENING RESULTS GROUNDWATER FROM WELLPOINTS POLELINE ROAD DISPOSAL AREA OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-10.DWG	By: AR	Figure: 4-10
Project: E9408L	Date: 7-1-96	



Groundwater samples collected 10/95.

LEGEND:

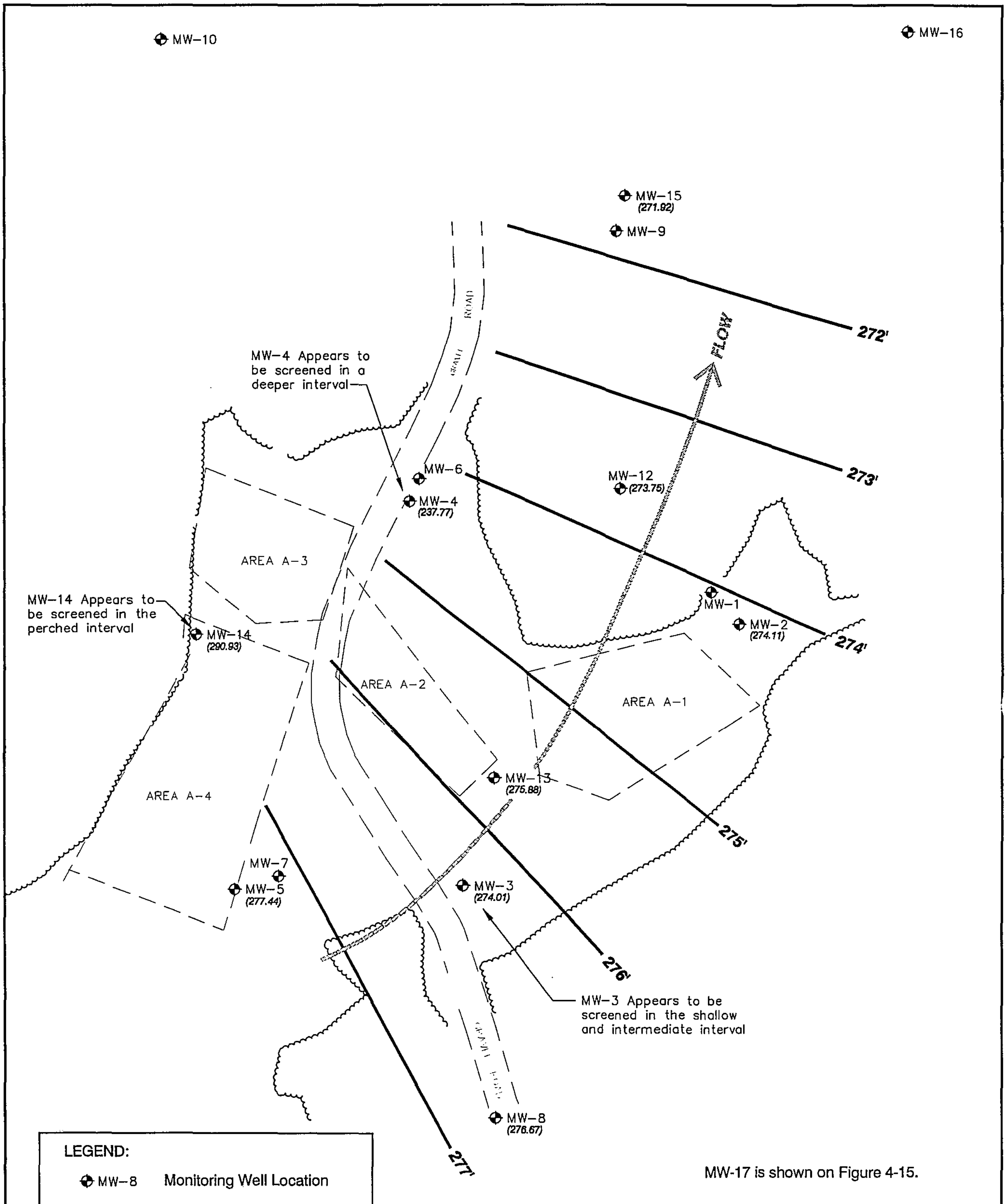
MW-8	Monitoring Well Location
(x, y)	1,1,2,2-Tetrachloroethane, TCE *(Units - mg/L)*

MW-17 is shown on Figure 4-15.

LABORATORY VOC ANALYSES GROUNDWATER FROM MONITORING WELLS POLELINE ROAD DISPOSAL AREA OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-11.DWG	*By:* AR	*Figure:* 4-11
Project: E9408L	*Date:* 7-1-96	



MW-17 is shown on Figure 4-15.

LEGEND:

⊕ MW-8	Monitoring Well Location
(274.01)	Groundwater Elevation
━ 275'	Groundwater Contour in feet
⇢	Estimated Flow Direction

GRAPHIC SCALE

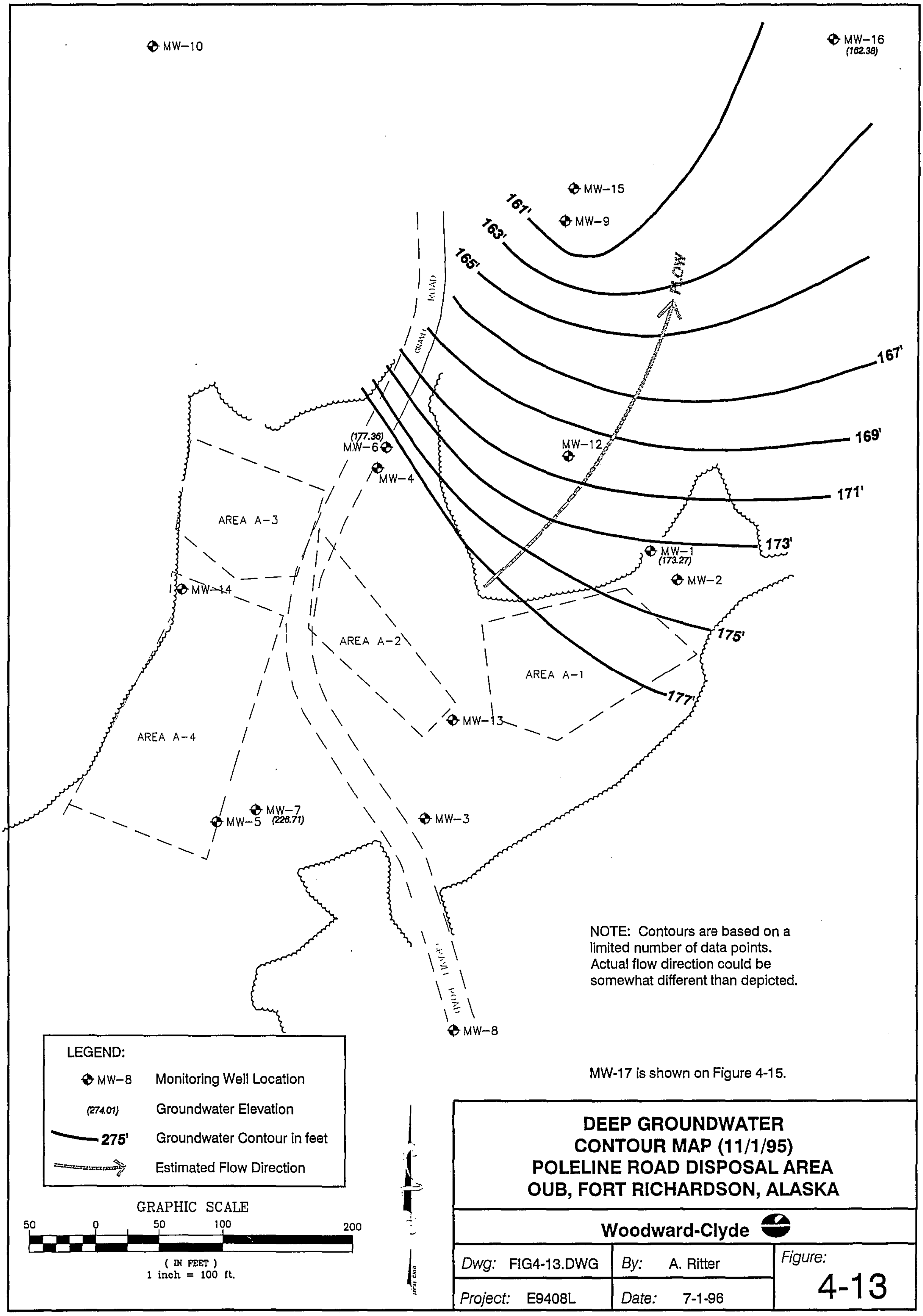
50 0 50 100 200

(IN FEET)
1 inch = 100 ft.

SHALLOW GROUNDWATER CONTOUR MAP (11/1/95)
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-10.DWG	By: A. Ritter	Figure: 4-12
Project: E9408L	Date: 6-28-96	



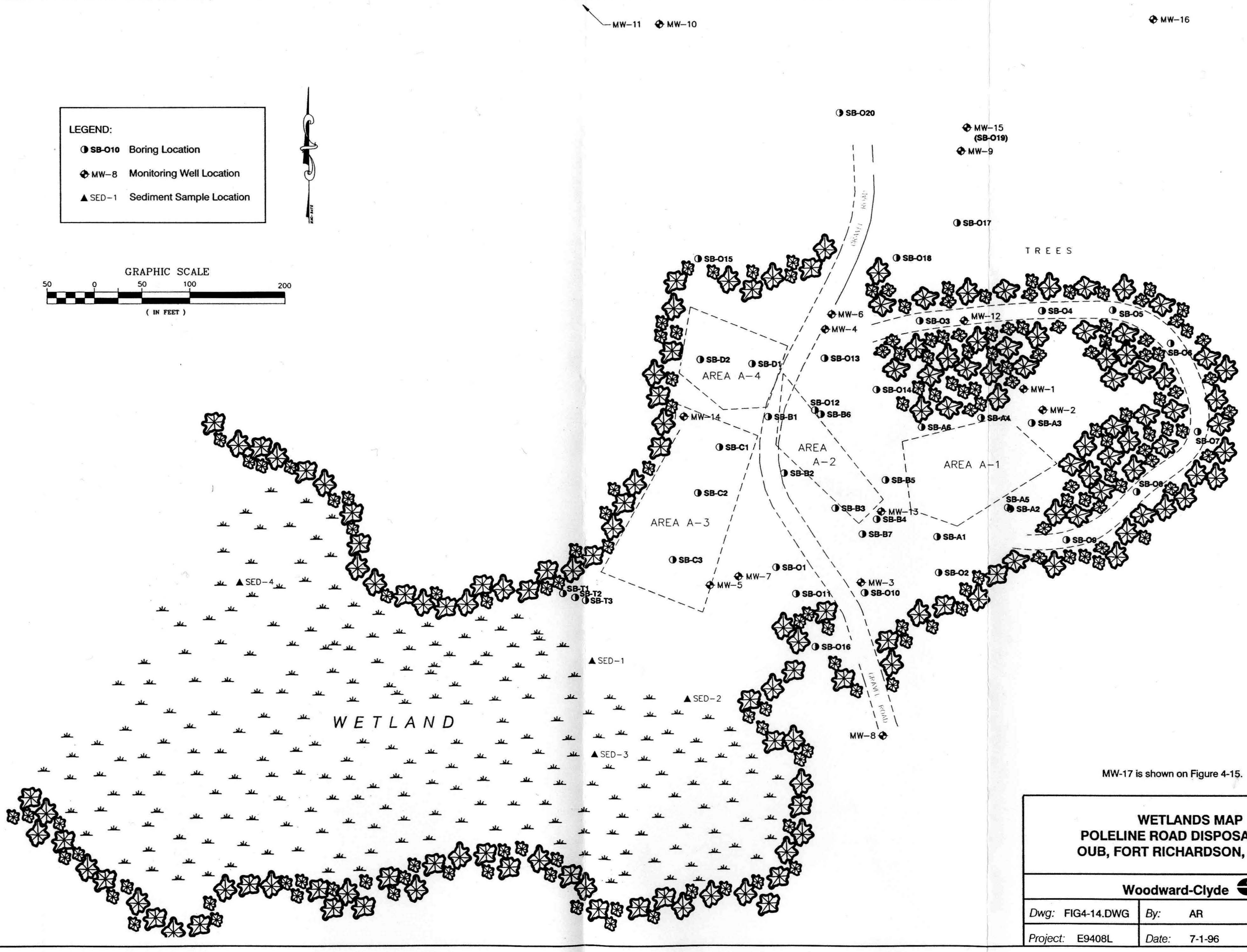
NOTE: Contours are based on a limited number of data points. Actual flow direction could be somewhat different than depicted.

MW-17 is shown on Figure 4-15.

DEEP GROUNDWATER CONTOUR MAP (11/1/95) POLELINE ROAD DISPOSAL AREA OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-13.DWG	*By:* A. Ritter	*Figure:* 4-13
Project: E9408L	*Date:* 7-1-96	

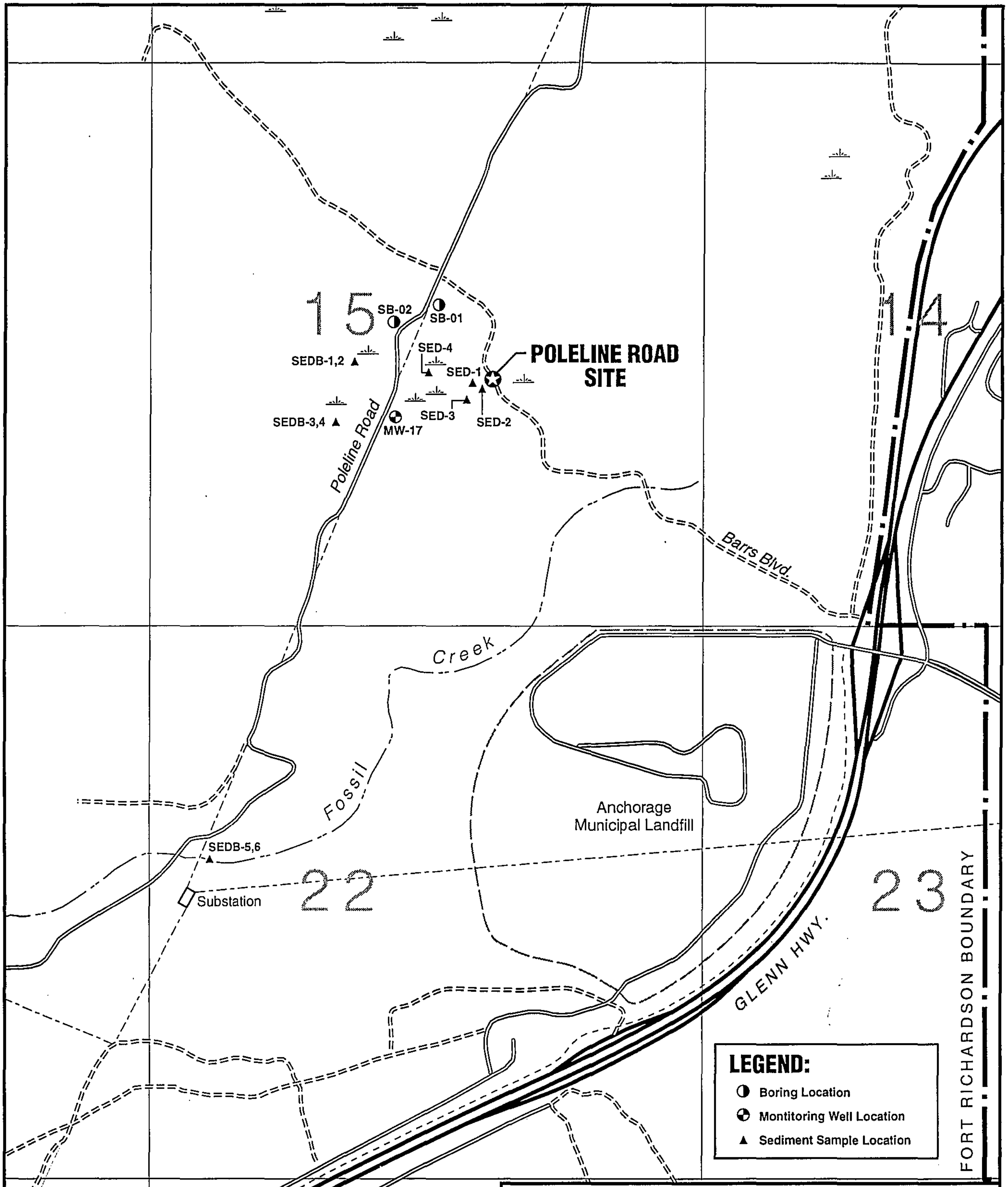


MW-17 is shown on Figure 4-15.

WETLANDS MAP
POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-14.DWG	*By:* AR	*Figure:* 4-14
Project: E9408L	*Date:* 7-1-96	



BACKGROUND SAMPLING LOCATIONS POLELINE ROAD DISPOSAL AREA OUB, FORT RICHARDSON, ALASKA

Woodward-Clyde

Dwg: FIG4-15.AI	*By:* AR	*Figure:* 4-15
Project: E9408L	*Date:* 6/28/96	

5.0

CONTAMINANT FATE AND TRANSPORT

This section discusses the fate and transport of the chemicals of concern identified during the remedial investigation. The fate and transport discussion, together with the description of the site and the analytical results (Section 4.0), provides a basis for detailed examination of pathways. The fate and transport section reviews potential pathways (e.g., air, surface water, groundwater) that may have relevance to the PRDA. The physical and chemical properties of the chemicals of concern are presented and their importance to transport mechanisms is discussed.

This section first presents briefly the transport mechanisms identified for the PRDA. Next the physical and chemical properties which control fate and transport are presented. Finally, the mobility and/or persistence of the chemicals of concern in those specific media are assessed. The chemicals of concern are halogenated solvents.

5.1 POTENTIAL CONTAMINANT TRANSPORT MECHANISMS

5.1.1 Air

Air transport mechanisms include the volatilization of contaminants from water or soil, and wind transport. Air transport could potentially change contaminant concentrations in surface soils, subsurface soils, and surface water bodies on site (e.g., the wetlands).

Volatilization is a process where a compound is transferred from soil or water, into gas. The focus of this transport mechanism is on the upward migration and dispersion of soil gases into the atmosphere. Volatilization will influence the migration of volatile organic compounds.

Volatilization to the atmosphere is not a significant pathway for contaminant transport at the PRDA. Most of the VOCs detected in soil and groundwater at PRDA are well beneath the ground surface. Analyses of split spoon samples taken from the first two to three feet of soil revealed little or no contamination of surface soil (Tables 4-1 and 4-3). Therefore, the migration of VOCs to the atmosphere is unlikely. The migration of volatile contaminants in soil gas is evaluated in the risk assessment.

5.1.2 Surface Water

Potential contaminants can be transported in surface waters via adsorption onto displaced soil particles, or in solution during storm events. Organics transported in storm runoff, either in solution or adsorbed to sediments, may be redeposited elsewhere, infiltrate into the subsurface, or be carried into a surface body of water. Some of the more volatile organics may be mobilized to the atmosphere during this transport mechanism.

Storm water at the PRDA does not flow off the site. Water collects in pools on the site during periods of heavy rainfall. Surface water was not observed to flow off site or into the wetlands from the site. Most surface water infiltrates into the groundwater. Soil permeability, the slope of the ground surface and vegetation significantly affect whether contaminants are mobilized by surface water runoff or infiltrate into groundwater.

5.1.3 Groundwater

Surface water infiltrating into the surface soils has the potential to transport contaminants into groundwater. The mobility of a contaminant depends on how readily the contaminant will partition from soil to groundwater. Solubility and adsorption characteristics are the primary physical properties that determine the extent of transport in this manner.

The most significant transport mechanism at OUB is the groundwater. Four separate groundwater intervals were identified while drilling and sampling soils at the site. Halogenated solvents were detected in groundwater samples collected from monitoring wells screened in each of the four saturated intervals (perched, shallow, intermediate and deep). Groundwater concentrations of 1,1,2,2-tetrachloroethane and TCE have generally increased between September 1990 and August 1995, as shown in Table 5-1. Detections of 1,1,2-TCA are limited, and a comparison of the historical groundwater data to the data collected during the RI is inconclusive.

Halogenated solvents can be transported by groundwater either as a dissolved phase liquid or a non-aqueous phase liquid (NAPL). Since halogenated solvents have a higher specific gravity than water, they are called dense non-aqueous phase liquids (DNAPLs). DNAPLs in groundwater are very difficult to detect and track, compared to dissolved solvents in water. Due to the high levels of halogenated solvents detected in some wells at the site, DNAPLs are suspected and attempts to detect their presence have been made. An interface probe, bailer, and cotton string (looking for discoloration) were used on each well to check for

DNAPLs. None were found. Dissolved phase transport of the halogenated solvents is suspected to be the predominant mode of movement. The mobility of dissolved halogenated solvents is directly related to the groundwater velocity and flow direction. Appendix XIII is a report on the results of a groundwater model used to evaluate groundwater flow and contaminant transport.

5.1.4 Direct Contact

Direct contact with contaminated soils is an unlikely transport mechanism at OUB. Surface and near surface soils have low concentrations of halogenated solvents, and the site is covered by snow for most of the year. A risk assessment was completed for the site and concluded that the risk to human health at the site is negligible. The risk assessment used a conservative residential exposure scenario. Currently, and most likely in the future, access to the site is limited to occasional military personnel or recreational users.

5.2 PHYSICAL AND CHEMICAL PROPERTIES

This section provides some discussion of physical and chemical properties which affect the fate and transport of selected halogenated solvents. These properties are summarized in Table 5-2. This discussion provides insights on transport mechanisms.

5.2.1 Volatilization

Volatilization affects volatile organic compound concentrations in water and soil. Organics influenced by this process will be transferred into a gaseous phase, soil gas and/or the atmosphere. Assuming that a free non-aqueous phase does not exist, volatilization will be principally controlled by a chemical's solubility, vapor pressure, Henry's Law constant, and adsorption. Water content of a soil, temperature, and atmospheric conditions (i.e., wind and sunlight) may also influence volatilization from a soil (Lyman et al. 1990).

Volatilization is a complex process that is dependent upon site-specific conditions. Nevertheless, some appreciation of an organic chemical's volatility can be made by considering the Henry's Law constant and vapor pressure values. Henry's Law constant is directly proportional to a chemical's vapor pressure and molecular weight and inversely proportional to its water solubility and temperature. Henry's Law constant values greater than 10^{-3} atm-m^3/mol (cubic meters of atmosphere per mole) are considered to have a high volatility while those with values less than 10^{-7} atm-m^3/mol are less volatile than water and will tend to concentrate in water as it evaporates (Lyman et al. 1990). Organic vapor pressures of greater than 10^{-2} mm Hg (milliliters of mercury) are indicative of high volatility while values of less than 10^{-6} mm Hg suggest low volatility. Dragun (1988) and Olsen and Davis (1990) suggest comparable though slightly different values for high and low volatility. All of the solvents on Table 5-1 have high volatility, with 1,1,2,2-tetrachloroethane as the least volatile and trichloroethene as the most volatile.

5.2.2 Aqueous Solubility

Solubility is one of the most important factors influencing the fate and transport of organic chemicals. [Aqueous solubility of organics is typically considered with respect to the K_{ow} (octanol/water partition coefficient). The K_{ow} value is defined as "... the ratio of a chemical's concentration in the octanol phase to its concentration in the aqueous phase of a two-phase system." (Lyman et al. 1990).] Factors which can affect organic compound solubility include adsorption, volatilization, and presence of organic carbon. According to Lyman et al. (1990), values of K_{ow} greater than 10,000 indicate the organic is very hydrophobic and would have a low water solubility, high soil/sediment adsorption coefficients, lower mobility, and higher potential to bioaccumulate. Conversely, values of K_{ow} less than 10 suggest high solubilities and greater mobility, but small soil/sediment adsorption coefficients, and decreased potential for bioaccumulation. The K_{ow} for 1,1,2,2-tetrachloroethane, tetrachloroethene, TCE, and 1,1,2-TCA vary between 151 ml/gm and 398 ml/gm, as shown in Table 5-2. For the solvents on Table 5-2, 1,1,2-trichloroethane is the most soluble and tetrachloroethene is the least soluble.

5.2.3 Adsorption

Adsorption is also an important factor which influences the fate and transport of organics. Typically, adsorption is expressed in terms of an adsorption coefficient and it can be defined as the ratio to which a metal or organic chemical partitions itself between the solid and solution phases. This can apply to water-saturated or unsaturated soils, storm water, sediment, or aquifer materials. Adsorption is often referred to in terms of the soil-water distribution coefficient - K_d, or distribution coefficient. K_d is defined as the ratio of concentration adsorbed on soil surfaces to the concentration in water. For organics, K_d has been strongly correlated with the fraction of total organic carbons in the solid matrix (f_{oc}) which has been used to define the organic carbon partition coefficient - K_{oc} (Olsen and Davis 1990). K_{oc} is defined as the ratio of K_d to f_{oc} (i.e., chemical adsorbed per unit weight of organic carbon (oc) in the soil/sediment/aquifer to the concentration of the chemical in solution at equilibrium). This correlation appears to hold over a wide range of organic carbon content values (i.e., 0.1 to 2 percent TOC) as reported by Lyman et al. (1990). For organics, a critical fraction of organic carbon can be defined (i.e., less than 0.1 percent TOC), below which inorganic clay surface reactions dominate the adsorption process (Olsen and Davis 1990). A qualitative assessment of chemical mobility based on K_d values has been made by Dragun (1988) as follows: greater than 10 immobile, 2 to 10 low mobility, 0.5 to 2 intermediate mobility, 0.1 to 0.5 mobile, and less than 0.1 very mobile. According to Adams (1972), K_{oc} values can range from 1 to 10^7; the higher the value, the less mobile the organic. For the solvents on Table 5-2, 1,1,2-trichloroethane is the most mobile, and tetrachloroethene the least mobile compound.

5.2.4 Biotic and Abiotic Degradation

Degradation can be induced by living organisms (biotic degradation) or can occur in the absence of living organisms (abiotic degradation). Biodegradation (biotic degradation), including biotransformation, occurs via microorganisms that may be either attached to the soil, present in the soil pores, or in solution. Biodegradation of ethenes and ethanes is a process of reductive chlorination, which occurs under anaerobic conditions. The degradation pathways for the chemicals of concern are shown in Figure 5-1. The abiotic degradation pathway of 1,1,2,2-tetrachloroethane to TCE can occur under aerobic or anaerobic conditions. Factors affecting degradation rates include: soil acidity and alkalinity; soil temperature and moisture; chemical concentration; oxygen availability; redox-potential and adsorption. Additional factors affecting biodegradation rates include: composition and size of the microbial population; presence of a suitable and available substrate (i.e., energy source) and presence of essential inorganic elements (Dragun 1988).

Typically, biodegradation rates are measured in half-lives which are defined as the time required for microbial degradation to reduce a chemical concentration by one-half. Frequently, the half-lives cited for organics can vary greatly. This variation is likely due to reductions below optimum in at least one of the above referenced factors which can thereby control the reaction rate (Dragun 1988). Biodegradation of 1,1,2,2-tetrachloroethane was evaluated in Appendix XIII. The groundwater model results indicate that the biodegradation rate of 1,1,2,2-tetrachloroethane at this site is significantly less than the available literature values. Biodegradation at this site will be evaluated in the feasibility study.

5.2.5 Other Physical and Chemical Properties

The four processes previously discussed in this section are typically the most important controls on the fate and transport of chemicals of concern at the PRDA. A more detailed assessment of fate and transport properties and processes was beyond the scope of this investigation. However, it is important to recognize that other properties or processes also exist which could contribute to contaminant mobility and fate. These properties and processes include bioconcentration, complexation, dehydrohalogenation, diffusion, oxidation, photolysis, precipitation, reduction, and solubility in solvents. These alternatives were not discussed because, individually, they are not considered to be as significant as the volatilization, aqueous solubility, adsorption, and degradation processes.

5.3 CONTAMINANT PERSISTENCE

The halogenated solvents at OUB are expected to be persistent and have moderate transport potential. This conclusion is based on the following factors:

- Halogenated solvents were detected in groundwater at the site at high concentrations (up to 1,900 mg/L 1,1,2,2-tetrachloroethane) even after releases at the site ended over 20 years ago. DNAPL was not detected during the RI. The high concentrations of halogenated solvents in the perched and shallow groundwater in the vicinity of Areas A-3 and A-4 may be attributed to the presence of DNAPL. The highest detected concentration of 1,1,2,2-tetrachloroethane (1,900 mg/L) is approximately equal to 64% of the solubility limit of 2,970 mg/L. According to the EPA quick reference fact sheet titled, *Estimating Potential for Occurrence of DNAPL at Superfund Sites* (EPA 1992), a concentration greater than or equal to 1 percent of the effective solubility, may indicate that DNAPL is present.

- Based on the available data, no processes other than dilution and dispersion are reducing the concentrations of halogenated solvents in the groundwater.

- The halogenated solvents found at the site have moderate K_{ow} values, which contribute to moderate chemical mobility. Low permeability soils at this site result in reducing the groundwater flow velocity and the mobility of the contaminants of concern in groundwater.

5.4 FATE AND TRANSPORT SUMMARY

Halogenated solvents have been identified as chemicals of concern at OUB. A risk assessment was conducted to evaluate the risk posed to human health and the environment by the site. A groundwater model was used to predict the time needed for halogenated solvents at the site to reach one receptor, the Eagle River. The groundwater model predicted a time of over 100 years for groundwater with a concentration of 0.005 mg/L to reach the Eagle River. The risk assessment concluded that the contaminants at OUB do not pose an imminent threat to human health or the environment under current and likely future exposure scenarios. Concentrations of contaminants are relatively low except in soils at depths greater then 15 feet bgs and in groundwater, for which there are currently no complete exposure pathways. The complete groundwater model report is found in Appendix XIII of Volume II of this report. The risk assessment is a separate document titled "Final Risk Assessment Report, Operable Unit B, Poleline Road Disposal Area, Fort Richardson, Alaska, September 1996."

TABLE 5-1
HISTORICAL GROUNDWATER QUALITY DATA (mg/L)
OUB, FORT RICHARDSON, ALASKA

Analytes	1,1,2,2-Tetrachloroethane					Trichloroethene					1,1,2-Trichloroethane				
SHALLOW WELLS															
	Sep-90	**Oct-90**	**Oct-93**	**Jul-94**	**Aug-95**	**Sep-90**	**Oct-90**	**Oct-93**	**Jul-94**	**Aug-95**	**Sep-90**	**Oct-90**	**Oct-93**	**Jul-94**	**Aug-95**
MW-2			<0.0005	<0.002	<0.0005	<0.0005	<0.0005	<0.0005	<0.002	<0.0002	<0.0012	<0.0012	<0.0005	<0.002	<0.0005
MW-3	0.048	0.049	0.5	0.18	0.54	0.0281	0.0369	0.29	0.085	0.26	<0.0012	<0.0012	0.022	<0.002	0.0023
MW-5	7.5	17		17	21J	3.39	5.87		4.2	4.8	0.035	<0.24		0.094	<0.5
MW-8			<0.0005	<0.002	<0.0005			<0.0005	<0.002	<0.0002			<0.0005	<0.002	<0.0005
MW-12					0.490J					0.16					0.00078
MW-13					0.0011					0.0067					<0.0005
MW-15					0.0063					0.27J					0.0013
INTEMEDIATE WELLS															
	Sep-90	**Oct-90**	**Oct-93**	**Jul-94**	**Aug-95**	**Sep-90**	**Oct-90**	**Oct-93**	**Jul-94**	**Aug-95**	**Sep-90**	**Oct-90**	**Oct-93**	**Jul-94**	**Aug-95**
MW-4	47	44			71	9.99	11.2			14	0.23	<0.6			<0.05
MW-7			3.4		3.1J			1.8		1J			0.033		<0.05
DEEP WELLS															
	Sep-90	**Oct-90**	**Oct-93**	**Jul-94**	**Aug-95**	**Sep-90**	**Oct-90**	**Oct-93**	**Jul-94**	**Aug-95**	**Sep-90**	**Oct-90**	**Oct-93**	**Jul-94**	**Aug-95**
MW-1	<0.0005	0.0056	0.005		0.082	<0.0005	<0.0005	0.047		0.043	<0.0012	<0.0012	<0.005		<0.005
MW-6			4.9		0.52			0.7		0.13			0.028		<0.005
MW-9					<0.0005					0.00091					<0.0005
MW-16					<0.002					0.00031					<0.0005

J estimated value
<0.0005 = Not detected at Method Reporting Limit of 0.0005 mg/L

TABLE 5-2
PHYSICAL AND CHEMICAL PROPERTIES OF SELECTED ORGANIC CHEMICALS OF CONCERN
POLELINE ROAD DISPOSAL AREA

Analyte	Molecular Formula	Molecular Weight (g/mole)	Water Solubility (mg/L)	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m^3/mole)	Log K_{ow}	K_{ow} (ml/gm)	Log K_{oc}	K_{oc} (ml/gm)
1,1,2,2-tetrachloroethane	$C_2H_2Cl_4$	168	2970 @ 25°	6 @ 25°C	7.1x10^{-4} @ 37°C	2.56	363	2.07	118
tetrachloroethene	C_2Cl_4	166	150 @ 25°C	19 @ 25°C	.0153 @ 37°C	2.60	398	2.42	263
trichloroethene	C_2HCl_3	132	1100 @ 25°	57.8 @ 20°	.0196 @ 37°C	2.53	339	1.81	65
1,1,2-trichloroethane	$C_2H_3Cl_3$	133	4500 @ 20°	19 @ 20°C	1.5x10^{-3} @ 37°C	2.18	151	1.75	56

See text for description of properties.

Notes:

g/mole = grams per mole

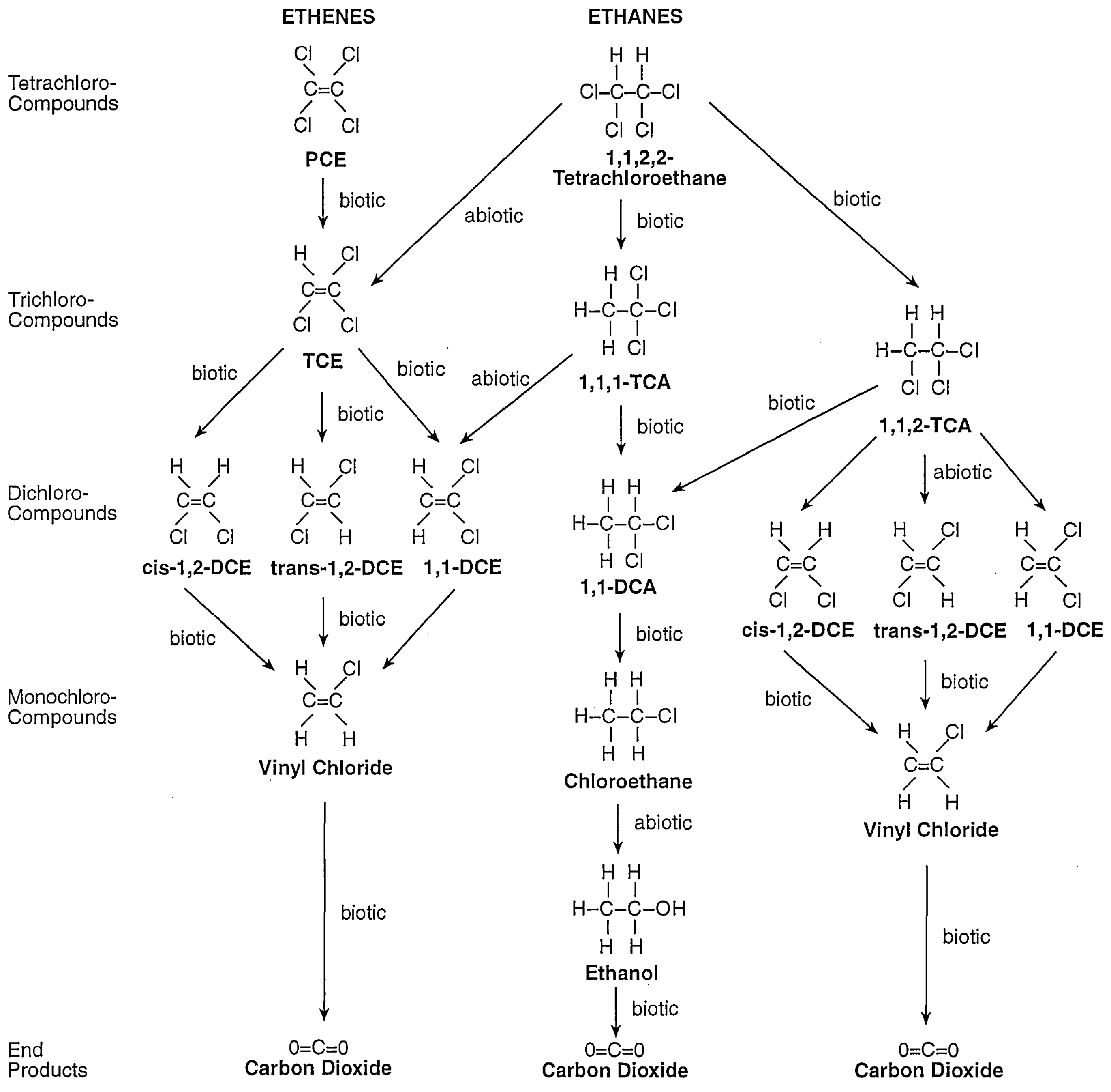
mg/L = milligrams per mole

mmHg = millimeters of Mercury

atm-m^3/mole = cubic meters of atmosphere per mole

Kow = octanol water partition coefficient

Koc = organic carbon partition coefficient



DEGRADATION PATHWAYS OF CHEMICALS OF CONCERN

OUB Fort Richardson, Alaska

Woodward-Clyde

Dwg: GR065.2a	*By:* JW	*Figure:* 5-1
Project: E9408L	*Date:* 9/21/96	

6.0
ARARs AND TBCs

6.1 INTRODUCTION

The RI was conducted in accordance with the requirements of CERCLA, 42 USC 9601 et seq., as amended. CERCLA Section 120, added by the Superfund Amendments and Reauthorization Act (SARA), PL 99-499, establishes the obligations and responsibilities for federal facilities under CERCLA.

CERCLA Section 121 establishes a procedure for determining cleanup standards for remedial actions at CERCLA sites that are protective of human health and the environment. Federal, state and local statutes, regulations, and other requirements are to be reviewed by the lead agency to identify those which are either legally applicable or are relevant and appropriate under the circumstances present at the site. Such circumstances include the potential risk to human health and the environment posed by the site. A risk assessment was performed for the PRDA and is presented in a Final Risk Assessment Report, provided as a separate document.

The National Contingency Plan (NCP), 40 CFR 300, contains implementation regulations for the conduct of hazardous substance response and remedial actions. For hazardous substance response actions, the NCP addresses permit requirements (40 CFR 300.400[e]). No federal, state, or local permits are required for on-site actions.

The NCP also established a process for determining applicable or relevant and appropriate requirements (ARARs) for response and remedial actions at CERCLA sites (40 CFR 300.400[g]). The lead agency for the response or remedial action is responsible for identifying and selecting ARARs. Additional details regarding the process for identifying ARARs are provided by the EPA in *CERCLA Compliance with Other Laws Manual* (EPA 1988a), and *CERCLA Compliance with Other Laws Manual, Part II, Clean Air Act and Other Environmental Statues and State Requirements* (EPA 1989e).

6.2 DEFINITION OF ARARS

Cleanup standards for remedial action must attain a general standard of cleanup that assures protection of human health and the environment, is cost-effective, and uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, SARA requires that any hazardous substance or pollutant remaining on site meet the level or standard of control established by standards, requirements, criteria or limitations that have been established under federal environmental law, or any more stringent standards, requirements, criteria, or limitations promulgated in accordance with a state environmental statute.

A requirement may be either applicable or relevant and appropriate to remedial activities at a site, but not necessarily both. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a site.

If a regulation is not applicable, it may still be relevant and appropriate. The basic considerations are whether the requirement (1) regulates or addresses problems or situations sufficiently similar to those encountered at the site (i.e., relevance), and (2) is appropriate to the circumstances of the release or threatened release, such that its use is well suited to the particular site. Determining whether a requirement is relevant and appropriate is site-specific and must be based on best professional judgment. This judgment is based on a number of factors, including the characteristics of the site and of the release, as compared to the statutory or regulatory requirement.

In some situations, a promulgated regulation does not address a particular issue. In the case when there is not a promulgated regulation, a state or federal advisory, proposed rules, criteria, or guidance documents may be "to be considered" (TBC) to establish remediation cleanup levels or procedures. TBCs are not enforceable and their use may not be economically feasible.

There are three types of ARARs: (1) chemical-specific ARARs, (2) location-specific ARARs, and (3) action-specific ARARs. Generally, potential chemical-specific ARARs and location-specific ARARs are identified during the site characterization phase of a project and the potential action-specific ARARS are identified during the development of remedial alternatives in the feasibility study. However, at the request of EPA, action-specific ARARs for a variety of remediation technologies were included in the Management Plan and are also included here. As remedial action alternatives are refined in the feasibility study, a more detailed list of action-specific ARARs will be prepared.

6.2.1 Chemical-Specific ARARs

Chemical-specific requirements are based on health or risk-based concentration limitations in environmental media (i.e., water, air, soil) for specific hazardous chemicals. These requirements may be used to set cleanup levels for the chemicals of concern in the designated media, or to set a safe level of discharge where discharge occurs as part of the remedial activity.

Sources for potential target cleanup levels include selected standards, criteria, and guidelines that are typically considered as ARARs for remedial actions conducted under CERCLA. In addition, EPA Region III RBCs, developed as guidance for determining groundwater and soil action levels, are presented and should be regarded as TBCs.

6.2.1.1 Maximum Contaminant Levels for Drinking Water

For groundwater, Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act (SDWA) and codified in 40 CFR 141 are often accepted by regulatory agencies as cleanup levels for groundwater remedial activities, especially if the groundwater is or could be a drinking water source. The state MCLs (18 AAC 80) for chemicals and metals found at the site are the same as the federal MCLs, and are listed on Table 6-1.

MCLs are applicable where the water will be provided directly to 25 or more people or will be supplied to 15 or more service connections. Since the PRDA at Fort Richardson is a remote site, the ADEC *Interim Guidance for Surface and Groundwater Cleanup Levels* (ADEC 1990) allows for the adoption of alternative cleanup levels (ACLs) if an approved risk assessment is performed and achieving MCLs is technically unfeasible. The decision to allow development of ACLs must be made by the ADEC.

6.2.1.2 RCRA TCLP for Groundwater

The RCRA toxicity characteristic leaching procedure (TCLP) (40 CFR 261.24) is commonly used to determine whether a solid material, if disposed of on the land, will leach chemical contaminants into the groundwater and therefore make the solid material a hazardous waste. Concentrations of contaminants in groundwater may be compared to TCLP values where other regulatory levels do not exist. When compared directly to groundwater concentrations, the regulatory levels do not exist. When compared directly to groundwater concentrations, the TCLP limits are used as guidance only. TCLP values for chemicals detected at Fort Richardson OUB are shown on Table 6-1.

6.2.1.3 Risk-Based Concentrations for Groundwater

Risk-based concentrations (RBCs) established by EPA Region III (1995) may be used as TBC for groundwater where no other ARARs exist. The RBCs are meant to serve as benchmarks for evaluating site data and developing preliminary remediation goals. Since the RBCs are not site-specific and based on very conservative exposure assumptions that do not reflect site conditions, the RBCs are used as a screening level evaluation. As an additional conservative measure, residential RBCs are used for groundwater. RBCs for residential use of groundwater are shown on Table 6-1.

6.2.1.4 Water Quality Criteria

The *Interim Guidance for Surface and Groundwater Cleanup Levels* (ADEC 1990) states that, for contaminants that have not been assigned a final or proposed MCL, cleanup levels should be based on ambient water quality criteria (AWQC). AWQC are non-enforceable guidelines developed under the Clean Water Act Section 304, and used by the state to establish water quality standards for specific bodies of water or stream segments. The ADEC Water Quality Standards (18 AAC 70) are a combination of the Alaska drinking water standards (18 AAC 80), federal drinking water standards (40 CFR 141), and 96-hour lethal concentrations (LC50) for the most sensitive species in the area (including a safety factor of 0.01). Table 6-2 reproduces the potentially applicable parts of the criteria for toxic substances and petroleum hydrocarbons as stated in 18 AAC 70 (April 1995).

6.2.1.5 RCRA TCLP for Soils

RCRA TCLP (40 CFR 261.24) is used to determine whether contaminated soil could leach chemicals into the groundwater at concentrations such that, if the soil became a waste, it would be considered a RCRA hazardous waste. TCLP values may be estimated for soil based on the detected concentrations in soil. If the soil fails the TCLP and the soil becomes a waste, then it would be considered a characteristic RCRA hazardous waste until the "characteristic" is removed (i.e., treated so that it no longer exhibits the characteristic). RCRA requirements for storage, treatment, and disposal will be applicable if the soil is determined to be RCRA hazardous waste by the toxicity characteristic and the activity at the site constitutes treatment, storage or disposal of hazardous waste. Therefore, the TCLP standard is potentially applicable to soil. RCRA TCLP values for soils are shown on Table 6-3.

6.2.1.6 Risk-Based Concentrations for Soils

EPA Region III has also developed RBCs for soils (EPA Region III 1995) which may be used as TBCs where no ARARs exist. The RBCs are based on very conservative assumptions that may not reflect actual site conditions. Therefore, the RBCs should only be used to determine potential chemicals of concern and to develop preliminary remediation goals. As an additional conservative measure, residential soil RBCs are used although probable future land use is more likely industrial or recreational. Soil RBCs are shown on Table 6-3.

6.2.1.7 ADEC Interim Guidance for Non-UST Contaminated Soil Cleanup Levels

The soil contamination at the PRDA is not related to underground storage tanks. Therefore, the *Interim Guidance for Non-UST Contaminated Soil Cleanup Levels* (ADEC 1991) is TBC for soils at the PRDA. The guidance states that for hazardous substances other than petroleum fuel products, the soil must be cleaned to background levels or levels that, as shown through a contaminant leaching assessment, will not lead to groundwater contamination or pose a risk to potential surface receptors.

6.2.1.8 Ambient Air Quality Standards

Federal ambient air quality standards are implemented by each state through the State Implementation Plan (SIP) (codified in 18 AAC 50), which established air quality control regions and attainment and non-attainment areas. The Anchorage Metropolitan Area is a non-attainment area for particulate matter, therefore activity related to the investigation or remediation of the PRDA may not increase the amount of particulate matter in the air. This activity includes the use of gasoline or diesel powered vehicles such as construction equipment. In addition, the state sets an annual average and 24-hour and 3-hour maximums for priority pollutants that may not be exceeded in the ambient air. The priority pollutants include: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen oxides, and lead.

Additional sections of the Alaska Air Quality Regulations that regulate specific processes may also be applicable to specific remedial actions and are listed in the action-specific ARARs.

6.2.2 Location-Specific ARARs

Location-specific ARARs are restrictions placed on the types of activities that may occur in particular locations. The location of a site may be an important characteristic in determining its impact on human health and the environment. These ARARs may restrict or preclude certain remedial actions. Examples of location-specific ARARs include federal and state requirements for preservation of historic landmarks, wetlands protection and siting of a hazardous waste management facility.

Due to site specific characteristics a number of location-specific standards are not considered ARAR and are mentioned here as an assurance that they were not overlooked. The PRDA is not in the 100-year floodplain nor is its location close to a Wild and Scenic River to require compliance with Floodplain Management requirements or the Wild and Scenic Rivers Act. There are no endangered species that reside at or in the vicinity of Fort Richardson nor is the area a critical habitat for endangered species; therefore, the Endangered Species Act is not applicable. In addition, the PRDA is not in a wilderness area or in an area designated as a National Wildlife Refuge; therefore, the Wilderness Act is also not applicable. The PRDA is not located within 200 feet of a fault displaced in Holocene time or within a 100-year floodplain, and bulk liquid waste will not be stored below ground; therefore, the location standards of RCRA subtitle C (hazardous waste, 40 CFR 264.18) do not apply.

6.2.2.1 Executive Order 11990 Protection of Wetlands

The PRDA is located near a wetland so standards that apply to the protection of wetlands are potentially applicable. Executive Order 11990 as implemented by 40 CFR 6 and Appendix A on Protection of Wetlands are applicable. The regulations require federal agencies to avoid, as much as possible, the destruction or loss of wetlands and avoid new construction in wetlands. If alternatives are not practicable, an environmental assessment or environmental impact statement must be conducted to avoid long and short-term adverse impacts associated with the modification or destruction of wetlands.

6.2.2.2 Clean Water Act Section 404

Disposal of contaminated soil, waste material or dredged material into surface water, including wetlands, and capping of a site are activities that may be considered dredge-and-fill operations. They must be evaluated for alternatives pursuant to Section 404 of the Clean Water Act as codified in 40 CFR 230.10 and 33 CFR 320 to 330. These regulations are implemented by the EPA and the USACE and prohibit the discharge of dredge or fill material into the waters of the United States or wetlands without a permit. Although permits are not required for CERCLA on-site actions, the substantive requirements of Section 404 and the implementing regulations are potential ARARs for remedial actions that could impact wetlands.

6.2.2.3 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (16 USC 703) protects the migratory residence and range of all migratory birds including species not on the Endangered Species List. There are many migratory birds that reside in the area surrounding the PRDA. Coordination with the U.S. Fish and Wildlife Service may be required to prevent damage to the habitat of migratory birds, if the species or their habitat are impacted by remedial activities.

6.2.2.4 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 USC 661 et seq.) is considered applicable if remedial activities impact fish or wildlife habitat in the vicinity of or downstream from the PRDA. Such impacts could include sediment loading in streams or destruction of animal burrows or food sources. Coordination with the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game may be necessary to discuss mitigation measures to prevent loss or damage to these resources.

6.2.2.5 National Historic Preservation Act

The National Historic Preservation Act (NHPA) (16 USC 470) as codified in 36 CFR 800 requires that federal agencies consider the effect of remedial activities on historic properties included on or eligible for inclusion on the National Register of Historic Places. The National Register is a list of districts, sites, buildings, structures, and objects that are significant in American history, architecture, archaeology, engineering, and culture. Although most provisions of the Act are considered to be administrative and therefore not ARARs (i.e. documentation and consultation with regulatory agencies), EPA strongly recommends that these procedures be followed if such cultural resources are found at the site.

6.2.2.6 The Historic and Archaeological Data Preservation Act of 1974

The Historic and Archaeological Data Preservation Act of 1974 (16 USC 469) provides for the preservation of historical and archeological data that might otherwise be lost as a result of terrain alterations. If any remedial actions that are part of a federal construction project or a federally licensed activity may cause irreparable loss to significant scientific, prehistoric or archaeological data, the act requires that the agency undertaking the project preserve the data or request the U.S. Department of Interior to do so. This act encompasses a broader range of resources than the NHPA and mandates only the preservation of the data, not the preservation of the site. Although most provisions of this Act are administrative, EPA strongly recommends that the administrative procedures be followed.

6.2.2.7 The Archaeological Resource Protection Act of 1979

The Archaeological Resource Protection Act of 1979 (16 USC 470) provides for the protection of archaeological resources on public and Indian lands. If remedial activities require the removal of archeological resources, the substantive requirements of this act would be applicable.

6.2.3 Action-Specific ARARs

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous waste. These requirements are triggered by the particular activities that are selected to accomplish a remedy. Since there are usually several alternative actions for any remedial site, different requirements may be identified to implement a specific alternative. These action-specific requirements do not in themselves determine the remedial alternative: rather, they indicate how a selected alternative can be achieved.

Table 6-4 lists general federal and state action-specific ARARs. This table presents the regulations that may serve as action-specific ARARs for on-site activities generally encountered in hazardous waste site remediation (e.g., generation, storage, on-site disposal, etc.). Additional requirements address general closure standards, and the need to manage contaminated wastes and wastes generated during site activities. This list of action-specific ARARs will need to be modified when more specific remedial alternatives are established in the feasibility study.

6.2.3.1 Solid Waste Disposal Act and Resource Conservation and Recovery Act

Solid Waste Disposal Facilities and Practices

RCRA Subtitle D regulates the disposal of non-hazardous solid waste from municipal and industrial sources. Disposal is defined as "the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters." 40 CFR 257 establishes standards that are protective of floodplain, endangered species, surface water, groundwater, disease prevention, air, and safety. These standards are considered applicable if any non-hazardous solid wastes are generated and disposed of on site. This standard is not applicable to uncontaminated soils and sediments which may be used in the remedial activities.

RCRA Standards for Hazardous Waste Generators

RCRA Subtitle C regulates the generation, transportation, treatment, storage and disposal of hazardous waste. Hazardous waste is defined in 40 CFR 261. It is the waste generator's responsibility to determine if their waste is RCRA-hazardous either due to a characteristic or because it is specifically listed as a hazardous waste. The generator standards in 40 CFR 262 establish the duties of the generator to obtain an EPA identification number, manifesting for waste sent off-site, pre-transport requirements, short-term storage requirements, and recordkeeping and reporting requirements. The substantive requirements in 40 CFR 262 are applicable if the soil is determined to be RCRA-hazardous due to the toxicity characteristic.

Standards for Hazardous Waste Treatment, Storage or Disposal

Specific waste management requirements governing the treatment, storage, and disposal of RCRA hazardous waste are codified in 40 CFR 264. These requirements are normally associated with facilities that have received a RCRA operating permit; however, since CERCLA waives the administrative requirements of regulations, the substantive requirements of these regulations are applicable to on-site remedial actions that treat, store or dispose RCRA hazardous waste and are relevant and appropriate for contaminated wastes that do not meet the definition of RCRA hazardous waste. Only those hazardous waste management options that may potentially be included in the remedial activity are identified and briefly described below:

- Management of waste in containers (40 CFR 264 Subpart I) regulates long-term storage of waste in portable containers such as drums or portable liquid storage vessels. Subpart I may be applicable if contaminated soil is stored in drums prior to treatment or disposal.
- Management of waste in tank systems (40 CFR 264 Subpart J) regulates long-term storage of liquid waste in permanent tanks or tank systems. Subpart J may be applicable or relevant and appropriate if contaminated groundwater is stored in tanks prior to treatment or disposal.
- Management of waste in waste piles (40 CFR 264 Subpart L) regulates storage of contaminated soil without using containers. Subpart L may be applicable if contaminated soil is stockpiled in waste piles prior to treatment or disposal or as a means of ex-situ bioremediation.
- Disposal of waste in an on-site landfill (40 CFR 264 Subpart N) regulates the design and operation of an on-site hazardous waste landfill. Subpart N may be applicable if contaminated debris and soil are treated and then disposed of in an on-site hazardous waste landfill.
- Treatment of waste in an incinerator (40 CFR Subpart O) regulates the design and operation of an on-site hazardous waste incinerator. Subpart O will be applicable if hazardous waste will be thermally treated in an on-site incinerator prior to disposal. An incinerator is defined as any enclosed device that uses controlled flame combustion and neither meets the criteria for a boiler, sludge dryer, or carbon regeneration unit, nor is listed as an industrial furnace; or meets the definition of an infrared or plasma arc incinerator.

RCRA Air Emission Standards for Process Vents and Equipment Leaks

40 CFR 264 Subpart AA contains action-specific organic air emission standards for process vents from distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam

stripping equipment that is in hazardous waste service and processes hazardous waste that contains 10 ppm by weight (ppmw) organic constituents. This Subpart may be applicable to air or steam stripping associated with groundwater pump and treat systems, vacuum extraction, chemically enhanced recovery, thermally enhanced recovery, radio frequency heating extraction or incineration.

40 CFR 264 Subpart BB requires fugitive emission monitoring of equipment that is in hazardous waste service and contacts waste with organic concentrations of at least 10 percent by weight. Although it is unlikely that any waste would have such high organic concentrations, this regulation may be applicable if air stripping or incineration operations tend to concentrate VOCs in any part of their process.

RCRA Closure and Post Closure Requirements

Specific requirements are contained in 40 CFR 264 governing the closure and post-closure care of RCRA hazardous waste management units. The location in the regulations for closure requirements for each type of hazardous waste management unit explained above are as follows:

- General Closure and Post-Closure: 40 CFR 264.110 to 120,
- Containers: 40 CFR 264.178,
- Tank Systems: 40 CFR 264.197,
- Waste Piles: 40 CFR 264.258,
- Landfills: 40 CFR 264.310, and
- Incinerators: 40 CFR 264.351.

These requirements are potential ARARs for closure of units used to treat, store, or dispose of wastes. The requirements are applicable if the waste stored, treated or disposed in these units is classified as RCRA hazardous waste; and relevant and appropriate if the units managed non-RCRA wastes.

Land Disposal Restrictions

An issue that is pertinent to the application of the land disposal restrictions is discussed in the National Contingency Plan (NCP). The NCP discusses when a CERCLA action constitutes "land disposal," which is defined as placement into land disposal units under section 3004(K) of RCRA. This definition is critical because several significant requirements are triggered when placement occurs onto a land disposal unit. One requirement that is triggered when placement occurs is the land disposal restrictions (LDR). LDR requires that RCRA-hazardous waste be treated in accordance with best demonstrated available technology (BDAT) or be treated to a specific numerical standard prior to placement in a land-based unit such as a landfill.

The NCP equates an area of contamination (AOC) to a single RCRA land disposal unit and states that movement within the unit does not constitute placement. The NCP also states that placement occurs when waste is redeposited after treatment in a separate unit or when waste is moved from one AOC to another. Placement does not occur when waste is consolidated within an AOC, when it is treated in-situ, or when it is left in place.

6.2.3.2 National Pollutant Discharge Elimination System (NPDES)

This regulation covers the provision of the NPDES program specified in Sections 318, 402, and 405 of the Clean Water Act. This regulation specifies that a permit is required for discharge of any pollutants from an point source into waters of the United States. Since obtaining a permit is an administrative requirement waived under CERCLA, any remedial action at the PRDA must meet substantive federal effluent limitations.

6.2.3.3 Alaska Air Quality Control Regulations

Although remedial actions that involve air emissions would not require a permit, the substantive requirements of ADEC's Air Quality Control Program (18 AAC 50) would have to be met. The following provisions from the Air Quality Control Program are action-specific ARARs for remedial actions that involve air emissions from a stationary source such as air stripping and incineration:

- Alaska Incinerator Standards: 18 AAC 50.040
- Source Testing: 18 AAC 50.500.
- Ambient Analysis Methods: 18 AAC 50.510 and
- Emission and Ambient Monitoring: 18 AAC 50.520.

6.2.3.4 Alaska Solid Waste Management Regulations

The substantive provisions of Alaska's Solid Waste Management regulations (18 AAC 60) may be applicable to the management of wastes that do not meet the definition of RCRA hazardous waste but contain contaminants that exceed other non-RCRA cleanup levels. These regulations are more specific than federal regulations. The following sections are potential ARARs for remedial actions that involve storage, treatment, or disposal of non-RCRA waste that exceed cleanup levels:

- Accumulation and Storage: 18 AAC 60.015,
- General Requirements for a Solid Waste Disposal Facility: 18 AAC 60.035,
- Landfills: 18 AAC 60.045,
- Transfer Stations: 18 AAC 60.065,
- Monitoring Requirements: 18 AAC 60.310, and
- Closure: 18 AAC 60.410.

6.2.3.5 Alaska Hazardous Waste Regulations

Alaska is not authorized to oversee the federal RCRA regulations, and their regulations codified in 18 AAC 62 primarily incorporate federal RCRA regulations by reference. Therefore, Alaska hazardous waste regulations are not specifically cited in this document.

6.2.3.6 Siting of Hazardous Waste Management Facilities

18 AAC 63.040 presents the substantive provisions of the regulations regarding siting of hazardous waste management facilities. If any on-site hazardous waste management facilities, as defined by this regulation, are part of a remedial action, the substantive portion of these regulations are applicable.

6.2.3.7 Alaska Water Quality Standards

18 AAC 70 sets water quality standards which specify the degree of degradation that may not be exceeded in a water body as a result of human actions. The regulation defines different water classes (industrial, drinking, etc.) and the water quality criteria which apply to each class.

6.2.3.8 Alaska Waste Water Disposal Regulations

Chapter 72 of 18 AAC covers domestic and nondomestic waste water systems. 18 AAC 72.600 requires a person who operates a nondomestic disposal system to first have written department approval of engineering plans. Article 9 of the regulation describes the procedures for applying for a general waste water disposal permit.

6.2.3.9 Alaska Oil and Hazardous Substances Pollution Control Requirements

18 AAC 75 describes requirements for reporting cleanup and disposal of any discharge of an oil or hazardous substance. Determination of the adequacy of the cleanup rests with the ADEC, unless the EPA orders the cleanup operation to cease. Article 5 of the regulation describes the civil penalties which can be levied as a result of a discharge.

TABLE 6-1
ALASKA MCLS AND RESIDENTIAL RBCS FOR TAP WATER

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

	Alaska MCLs (1) (mg/L)	RCRA TCLP (2) (mg/L)	Residential Tap Water RBCs (3) (mg/L)
Organic Compounds:			
benzene	0.005	0.5	0.00036
carbon tetrachloride	0.005	0.5	0.00016
chloroform	0.1	6	0.00015
chlorobenzene	-	100	0.039
1,1-dichloroethene	0.007	0.7	0.000044
cis-1,2-dichloroethene	0.07	-	0.061
trans-1,2-dichloroethene	0.1	-	0.12
1,3-dinitrobenzene	-	-	0.0037
2,4-dinitrotoluene	-	0.13	0.073
1,1,2,2-tetrachloroethane	-	-	0.000052
tetrachloroethene	0.005	0.7	0.0011
toluene	1	-	0.75
1,1,2-trichloroethane	0.005	-	0.00019
trichloroethene	0.005	0.5	0.0016
Metals:			
Antimony	0.006	-	0.015
Arsenic	0.05	5	0.000045, 0.011*
Beryllium	0.004	-	0.000016
Cadmium	0.005	1	0.018
Chromium	0.1	5	0.180 (4)
Copper	1 (5)	-	1.5
Lead	0.05 (6)	5	-
Mercury	0.002	0.2	0.011
Nickel	0.1	-	0.73
Selenium	0.05	1	0.18
Silver	0.1 (5)	5	0.18
Thallium	0.002	-	-
Zinc	5 (5)	-	11

NOTES:

(1) Alaska Department of Environmental Conservation, 18 AAC 80. In all cases, state MCLs are equivalent to federal MCLs.
(2) EPA 40 CFR 261
(3) EPA Region III, October 20 1995. RBCs are based on residential tap water ingestion.
(4) RBC for chromium VI = 0.18 mg/L
RBC for chromium III = 37 mg/L
(5) Secondary MCL
(6) ADEC Interim Guidance for Surface and Groundwater Cleanup Levels, September, 26, 1990.
* 0.000045 carcinogenic, 0.011 noncarcinogenic
mg/L = micrograms per liter

TABLE 6-2
WATER QUALITY CRITERIA (18 AAC 70)
APRIL 1995

1. FRESH WATER USES		TOXIC AND OTHER DELETERIOUS ORGANIC AND INORGANIC SUBSTANCES	PETROLEUM HYDROCARBONS, OILS, AND GREASE
(A)	Water Supply (i) drinking, culinary, and food processing	Substances may not exceed Alaska Drinking Water Standards (18 AAC 80) or where those standards do not exist, EPA Quality Criteria for Water (See Note 1)	May not cause a visible sheen upon the surface of the water. May not exceed concentrations that individually or in combination impart odor or taste as determined by organoleptic tests.
(A)	Water Supply (ii) agriculture, including irrigation and stock watering	Same as (1) (A) (i) where contact with a product destined for human consumption is present. Same as (1) (C) or Federal Water Pollution Control Administration, Water Quality Criteria (WQC/FWPCA) as applicable to substances for stockwaters: concentrations for irrigation waters may not exceed WQC/FWPCA or WQC 1972 (See Notes 2 and 3)	May not cause a visible sheen upon the surface of the water.
(A)	Water Supply (iii) aquaculture	Same as 1(c)	Total aqueous hydrocarbons (TAqH) in the water column may not exceed 15 ug/l (See Note 4). Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 ug/l (See Note 4). There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.
(A)	Water Supply (iv) industrial	Substances that pose hazards to worker contact may not be present.	May not make the water unfit or unsafe for the use.
(B)	Water Recreation (i) contact recreation	Same as (1) (A) (i).	May not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters must be virtually free from floating oils.
(B)	Water Recreation (ii) secondary recreation	Substances that pose hazards to incidental human contact may not be present.	May not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters must be virtually free from floating oils.

TABLE 6-2 (CONTINUED)

1. FRESH WATER USES	TOXIC AND OTHER DELETERIOUS ORGANIC AND INORGANIC SUBSTANCES	PETROLEUM HYDROCARBONS, OILS, AND GREASE
(C) Growth and Propagation of Fish. Shellfish, other Aquatic Life and Wildlife	Individual substances may not exceed criteria in EPA, Quality Criteria for Water (See Note 1) or, if those criteria do not exist, may not exceed the Primary Maximum Contaminant levels of the Alaska Drinking Water Standards (18 AAC 80). If those criteria are absent, or if the department finds that the criteria are not appropriate for sensitive resident Alaskan species, the department will, in its discretion, establish in regulation chronic and acute criteria to protect sensitive and biologically important life stages of resident Alaskan species, using methods approved by EPA or alternate methods approved by the department. There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that singly or in combination, cause, or reasonably can be expected to cause, toxic effects on aquatic life, except as authorized by this chapter. Substances may not be present in concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassay or organoleptic tests (See Note 1).	Same as 1(A)(iii)

NOTES:

1. The term "EPA Quality Criteria for Water" includes Quality Criteria for Water, July 1976, U.S. Environmental rotection Agency, Washington, D.C. 20460, U.S. Government Printing Office: 1977 0-222-904, The Ambient Water Quality Criteria for the 64 toxic pollutants listed in the Federal Register, Vol. 45, No. 231, pg. 79318, November 1980, the Ambient Water Quality Criteria Document for 2, 3, 7, 8-tetrachlorodibenzopdioxin (TCDD) listed in the Federal Register, Vol. 49, No. 32, pg. 5831, February 1984, and the final ambient water quality criteria documents listed in the Federal Register, Vol. 50, No. 145, pg. 30784, July 1985. These documents may be seen at the central office of the department or may be purchased through the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

2. The Report of the Committee on Water Quality Criteria, Federal Water Pollution Control Administration, Washington, D.C., April 1, 1968, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. See Note 5.

3. Water Quality Criteria 1972, Environmental Studies Board of the National Academy of Sciences and the National Academy of Engineering, Washington, D.C., 1972, USEPA-R3-73-033, March 1973, is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20204 (Stock No. 5501-00520). See Note 5.

4. Total aromatic hydrocarbons (TAH) and total aqueous hydrocarbons (TAqH) must be determined using the following sampling procedures: (see 18 AAC 70 for the continuation of this note).

5. The cited document is on file in the lieutenant governor's office and may be seen at any department office.

TABLE 6-3
RESIDENTIAL SOIL RBCS

POLELINE ROAD DISPOSAL AREA
OUB, FORT RICHARDSON, ALASKA

Compounds	RCRA TCLP (1) (mg/L)	Residential Soil RBCs (2) (mg/kg)
Organic Compounds:		
benzene	0.5	22
bromoform	-	81
carbon tetrachloride	0.5	4.9
chloroform	6.0	100
1,1-dichloroethene	0.7	1.1
cis-1,2-dichloroethene	-	780
trans-1,2-dichloroethene	-	1600
ethylbenzene	-	7800
m-nitrotoluene	-	780
1,1,1,2-tetrachloroethane	-	25
1,1,2,2-tetrachloroethane	-	3.2
tetrachloroethene	0.7	12
toluene	-	16000
1,1,2-trichloroethane	-	11
trichloroethene	0.5	58
1,3,5-trinitrobenzene	-	3.9
2,4,6-trinitrotoluene	-	21
xylenes	-	160000
Metals:		
antimony	-	31
arsenic	5.0	0.43, 23 (4)
beryllium	-	0.15
cadmium	1.0	39
chromium	5.0	390 (3)
copper	-	3100
lead	5.0	-
mercury	0.2	23
nickel	-	1600
selenium	1.0	390
silver	5.0	390
thallium	-	-
zinc	-	23000

NOTES:

(1) TCLP data from 40 CFR 261.24.
(2) RBC data from EPA, Region III, October 20, 1995.
(3) RBC for Chromium VI = 390 mg/kg
RBC for Chromium III = 78000 mg/kg
(4) 0.43 carcinogenic, 23 noncarcinogenic

TABLE 6

SUMMARY OF POTENTIAL ACTION-SPECIFIC ARARs
OUB, FORT RICHARDSON, ALASKA

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
FEDERAL			
Solid Waste Disposal Act (SWDA) as amended by the Resource Conservation and Recovery Act (RCRA) 1976)	42-USC Sect 6901-6987		
Criteria for Classification of Solid waste Disposal Facilities and Practices (Subtitle D)	40 CFR 257	Establishes criteria for use in determining which solid waste disposal facilities pose a reasonable probability of adverse effects on health.	Applicable to land disposal of non-hazardous solid waste. May be relevant and appropriate to stockpiling treatment and disposal of non-hazardous solid wastes.
Identification and Listing of Hazardous Waste	40 CFR 261	Establishes criteria for use in determining if a waste is hazardous	Applicable to disposal requirements.
Standards Applicable to Generators of Hazardous Waste	40 CFR 262	Establishes temporary storage, transportation, and recordkeeping and reporting requirements for generators of hazardous waste.	Applicable if soil is contaminated and determined to be RCRA hazardous by characteristic.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 264	Regulates on-site storage, treatment, or disposal of hazardous waste and closure of hazardous waste units.	No permit required, but substantive requirements for on-site storage or disposal of hazardous waste in the following units and closure and post-closure care.
Storage in Containers	Subpart I		Applicable if hazardous waste is stored in portable man-made containers.
Storage in Tanks	Subpart J		Applicable if hazardous waste is stored in tanks
Storage in Waste Piles	Subpart L		Applicable if hazardous waste is stored in waste piles
Landfills	Subpart N	Regulates design and operation of hazardous waste landfills	Applicable if hazardous waste is disposed of in on-site landfills

TABLE 6-4 (continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Incineration	Subpart O	Regulates operation of hazardous waste incinerators including air emissions	Applicable if hazardous waste is treated in an on-site incinerator.
Emission Standards for Process Vents	Subpart AA	Regulates process emissions from specified hazardous waste treatment units.	Applicable if air or steam stripping is used to treat process vents from hazardous waste treatment units.
Equipment Leak Standards	Subpart BB	Regulates fugitive emissions from hazardous waste treatment units	Applicable if incineration is used to treat hazardous waste
Land Disposal Restrictions	40 CFR 268	Sets treatment standards for hazardous waste that must be met prior to disposal on the land.	Applicable if hazardous waste is disposed of in a landfill both on and off-site).
STATE			
Alaska Air Quality Control Regulations	18 AAC 50	Regulates emission from incinerators and sets numerical limits on pollutants in the ambient air. Also requires source testing of motor vehicles including diesel-powered equipment.	Ambient air quality standards are applicable to all remedial actions. Incinerator standards are applicable to on-site incineration of wastes.
Alaska Solid Waste Management Regulations	18 AAC 60	Regulates storage, treatment and disposal of non hazardous waste.	Applicable if non-hazardous waste is generated as a result of remedial actions.
Accumulation and storage	18 AAC 60.015		Applicable if non-hazardous waste is stored on site.
General Requirements for a Solid Waste Disposal Facility	18 AAC 60.035		Applicable if any waste storage, treatment or disposal occurs on-site.
Landfills	18 AAC 60.045		Applicable if any non-hazardous waste landfill is used.
Transfer Stations	18 AAC 60.065		Applicable to on-site transfer stations.

TABLE 6-4 (continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Monitoring Requirements	18 AAC 60.310		Applicable to all remedial actions involving on-site storage, treatment or disposal.
Closure	18 AAC 60.410		Applicable if any on-site storage, treatment or disposal units were used during the remedial actions
<u>Siting of Hazardous Waste Management Facilities</u>	18 AAC 63.040	Regulates siting of hazardous waste disposal facilities	Applicable if hazardous waste management facilities are built on-site.
<u>Alaska Water Quality Standards</u>	18 AAC 70	Regulates the quality of surface waters	Applicable to human actions which cause degradation of a water body.
<u>Alaska Wastewater Disposal Regulations</u>	18 AAC 72	Regulates disposal of wastewater	Applicable to disposal of investigation-derived purge or decontamination water.
Requirements for ADEC approval of wastewater systems	18 AAC 72.600	Regulates engineering plans for wastewater treatment works and disposal systems	Applicable if a wastewater system is constructed and operated on site.
<u>Alaska Oil and Hazardous Substances Pollution Control</u>	18 AAC 75	Regulates discharge, prevention, and cleanup of hazardous substances	Applicable if hazardous substances are discharged on site.

7.0

CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the findings of the RI and provides a brief summary of the conclusions of the risk assessment, which is provided as a separate document. This section also presents the uncertainties and limitations of the data, and the effects that the limitations have on the conclusions that can be drawn from the RI data. Recommendations are provided at the end of this section.

7.1 CONCLUSIONS

Subsurface investigations have revealed at least four separate saturated intervals which are composed of fluvially reworked glacial sediments above a claystone bedrock unit. A perched interval located just north of the wetlands appears to be recharged by the wetlands, and discharges vertically to the shallow interval. Intermediate saturated intervals occur between the shallow interval and deep aquifer. The lateral extents of the saturated intervals are unknown, but it is assumed that groundwater eventually discharges to the Eagle River. Groundwater flow in the shallow interval and deep aquifer are towards the north-northeast.

Past practices at the PRDA resulted in releases of halogenated solvents into the environment. These releases have impacted the soil and groundwater at PRDA. Areas A-3 and A-4 were excavated in 1994 to remove solvent-impacted soils and buried debris. This removal action eliminated the major source of contaminants migrating to the groundwater. However, two sources may remain; solvent-contaminated soils beneath and potentially west of the previous excavations, and DNAPLs. Although no physical evidence of DNAPLs was found during the RI, the dissolved phase concentrations of solvents indicate that DNAPLs are probably present (see discussion in Section 5).

Two solvents, 1,1,2,2-tetrachloroethane and trichloroethene, were found at concentrations significantly higher than any other VOC detected at the site. These two solvents were also detected over the largest area. It is not clear whether both 1,1,2,2-tetrachloroethane and trichloroethene were released at the site or whether only 1,1,2,2-tetrachloroethane was released. Some references indicate that 1,1,2,2-tetrachloroethane degrades to trichloroethene (Maskarinec 1990, Haag 1988). The other halogenated solvents detected at the site are either impurities in the solvent mixture poured on the site, or breakdown products.

The highest concentrations of halogenated solvents detected in soil and groundwater samples were found in Areas A-3 and A-4. Soil samples collected from the backfilled soil had concentrations of 1,1,2,2-tetrachloroethane, trichloroethene, and tetrachloroethene well below the removal action criteria established for the previous removal action; however, soil samples collected from the bottom of the excavation in 1994 and soil samples collected below the backfilled soil in 1995 had some of the highest concentrations of chlorinated solvents detected at the site (> 2000 mg/kg 1,1,2,2-tetrachloroethane).

Lower concentrations of halogenated solvents were detected in the soils and groundwater near Areas A-1 and A-2 (soils and groundwater within A-1 and A-2 were not sampled because of the potential for unexploded ordnance). The levels of halogenated solvents detected decreased from west to east across Areas A-1 and A-2. The pattern suggests that the halogenated solvents detected near saturated intervals in Areas A-1 and A-2 migrated there from Areas A-3 and A-4. It does not appear that halogenated solvents were released in Areas A-1 or A-2 except for potential surface spills, which may have been the source for solvents detected in shallow soils near A-2. Since no solvents appear to have been released in the subsurface in Areas A-1 and A-2, it is unlikely that CWMs were disposed of in these areas (solvents were poured on the CWMs in Areas A-3 and A-4 for neutralization). It appears that contaminants in the groundwater migrated north-northeast from Areas A-3 and A-4, in the direction of groundwater flow.

Halogenated solvents were detected in each of the four saturated intervals. A well installed in Area A-3 and screened in the perched interval had the highest concentrations of 1,1,2,2-tetrachloroethane (1,900 mg/L) and trichloroethene (220 mg/L) detected. Most of the wells are installed in the shallow and intermediate intervals. These wells had the next highest concentrations of 1,1,2,2-tetrachloroethane (71 mg/L maximum) and trichloroethene (14 mg/L maximum). Halogenated solvents were also detected in each of the wells screened in the deep aquifer. The monitoring well furthest downgradient had 0.00031 mg/L of trichloroethene detected in the groundwater sample collected from that well. The results indicate that there is interconnection between the saturated intervals which allows the solvents to migrate vertically.

Alaska MCLs were exceeded for several solvents. The Alaska MCL for benzene and carbon tetrachloride (0.005 mg/L) was exceeded in the groundwater sample collected from MW-14 (2.9 mg/L and 2.6 mg/L, respectively). The Alaska MCL for cis-1,2-dichloroethene (0.07 mg/L) was exceeded in the groundwater sample collected from MW-4 (1.6 mg/L), MW-7

(0.28 mg/L) and MW-14 (37 mg/L). The Alaska MCL for trans-1,2-dichloroethene (0.1 mg/L) was exceeded in the groundwater sample collected from MW-4 (0.41 mg/L) and MW-14 (12 mg/L). The Alaska MCL for tetrachloroethene (0.005 mg/L) was exceeded in the groundwater sample collected from MW-4 (0.31 mg/L) and MW-14 (11 mg/L). The Alaska MCL for trichloroethene (0.005 mg/L) was exceeded in the groundwater samples collected from nearly all the monitoring wells sampled, except for MW-2, MW-8, MW-9, and MW-16. There is no Alaska MCL for 1,1,2,2-tetrachloroethane.

Several soil samples were collected from background locations and analyzed for metals. The average concentrations of metals in the background soil samples were compared to the levels of metals detected in soil samples collected at the site. Three metals were detected in Areas A-3 and A-4 at concentrations twice the average background concentrations: copper, lead and zinc. Other metals detected in Areas A-3 and A-4, and all metals detected in other areas of the site, were within or near background levels.

One groundwater sample (MW-14) had thiodiglycol detected (0.48 mg/L). Thiodiglycol is a breakdown product of mustard. No other samples had any CWMs or CWM breakdown products detected. Minor detections of explosives were reported in the wetlands and in one wellpoint groundwater sample, but levels are below ARARs.

None of the constituents analyzed for in wetlands sediment and surface water exceeded ARARs.

7.2 SUMMARY OF SITE RISK

Solvents were released at the site over 20 years ago. During this time the solvents have traveled a relatively short distance. The groundwater model estimated that solvents would take over 100 years to reach the Eagle River, one mile north of the site. The regional groundwater flow direction is toward the northwest, which carries site contaminants away from water wells located over a mile east and northeast of the site. The Eagle River acts as a groundwater discharge area, preventing groundwater from crossing under the river and into the community of Eagle River.

The U.S. Army owns all of the land between the site and the Eagle River and also north of the Eagle River, and probable future land use is most likely industrial or recreational. A risk assessment based on a conservative residential use scenario concluded that the site poses no imminent threat to human health or the environment, based on the lack of complete exposure pathways. (The risk assessment is provided as a separate document.)

7.3 UNCERTAINTIES AND LIMITATIONS

The hydrogeologic setting of the PRDA is complex. The saturated intervals are probably localized, as is common in glacial settings, but the groundwater model assumed that the shallow interval and deep aquifer are continuous to, and discharge into, the Eagle River. This assumption was made for the purpose of producing a conservative groundwater model. The uncertainties with respect to the extents of the saturated intervals were compensated for in the model.

Monitoring wells could not be installed in the wetlands south of the site because of access restrictions. However, groundwater flow directions appear to be moving northward away from the wetlands, and groundwater is not suspected to be contaminated there.

The extent of the plume west of the site could not be defined because a hill prevented access of a drill rig. High levels of solvents were detected in monitoring well MW-14 near the base of the hill. Well screens were placed at the top of low permeability layers to facilitate collection of DNAPLs. Although DNAPLs were not observed, concentrations and solubilities of dissolved phase solvents indicate that DNAPLs are likely to be present in the subsurface as discussed in Section 5.

Soils and groundwater within Areas A-1 and A-2 were not sampled because of the potential for unexploded ordnance.

7.4 RECOMMENDATIONS

Groundwater should be monitored yearly for VOCs. Remedial alternatives should be evaluated for solvent-contaminated groundwater and the highly contaminated soil layer beneath the perched interval. A feasibility study (FS) is being prepared under a separate scope of work. The initial stages of the FS will include an analysis of the limitations discussed above (Section 7.3) to evaluate whether additional data are necessary to develop remedial alternatives for the contaminated groundwater. Recommendations for additional data collection and/or treatability studies, if necessary, will then be presented to the USACE. This approach is supported by regulatory authorities and by the Federal Facilities Agreement under which this project is regulated.

Solvent levels are generally low in site soils except for beneath the previous excavations in Areas A-3 and A-4. These areas of high soil concentrations are below the depth to which human or ecological receptors would likely be exposed; however, they will be further evaluated in the feasibility study.

Stockpiled soils along Barrs Boulevard should be remediated. Remediation of the stockpiled soils are being coordinated by the USACE under a separate scope of work. These soils are considered a waste because they have been removed from the subsurface and therefore they must be treated before being disposed (40 CFR 268).

No further investigation is recommended for the wetlands because contaminants were not detected above levels of concern in sediments or surface water.

8.0
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PHOTO 1: Preparing to drill soil boring in Area A-4.
Field personnel are wearing Level B PPE.

PHOTO 2: Health & Safety Officer observes activities from
Staging Area.

FORT RICHARDSON, ALASKA - Poleline Road Disposal Area

PHOTO 3: Drillers hammer spilt-spoon to collect first sample from boring.

PHOTO 4: The split-spoon is being cleaned and reassembled. EOD specialist is standing by in background.

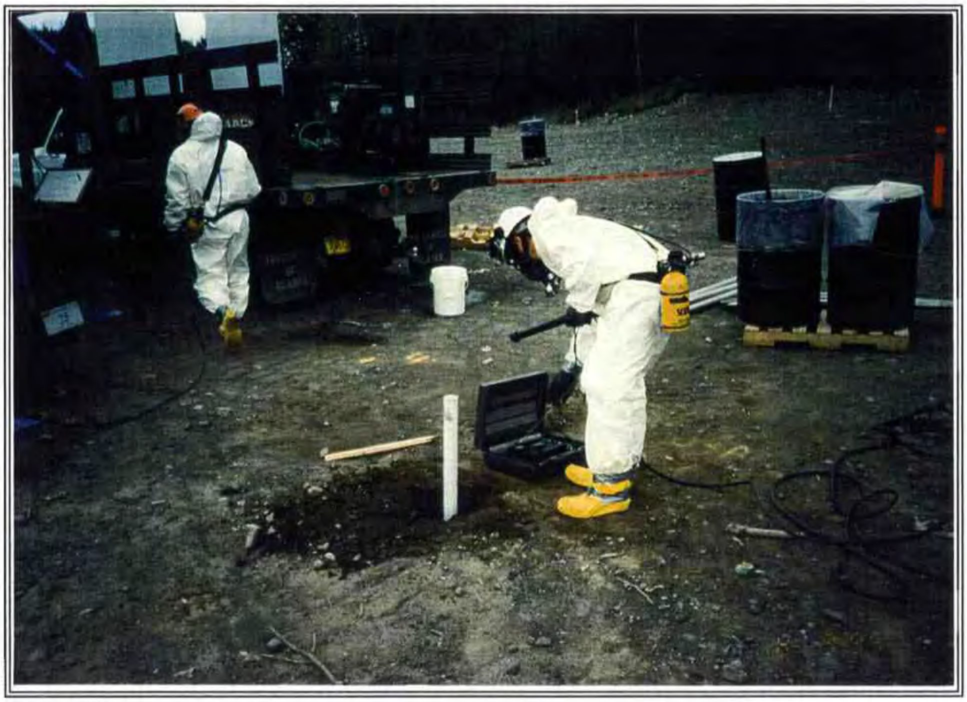

PHOTO 5: The EOD specialist prepares to screen the boring for ordnance.

PHOTO 6: EOD specialist clears hole while geologist collects sample and split-spoon is cleaned.

PHOTO 7: Health & Safety Officer checks pressure in supplied air tanks.

PHOTO 8: Chemist from Battelle sets up the MINICAMS for mustard screening.

PHOTO 9: Drilling soil boring while in Level D PPE.

PHOTO 10:
The tripod is supporting a natural gamma ray instrument. The instrument is about to be lowered into the well by the downhole geophysical contractor.

PHOTO 11: The downhole geophysical contractor is lowering an instrument into a well and observing the readings on the computer.

PHOTO 12: Rough drafts of the downhole geophysics logs could be printed out and reviewed in the field.

PHOTO 13: A dedicated pump is being lowered into a well. The pump is connected to a power cable and a sampling tube.

PHOTO 14: The well cap is being attached to the sampling tube.

PHOTO 15: The power cable is being pulled through the well cap. A connector will be wired to the end of the cable for quick connection while sampling.

PHOTO 16: Water quality measurements were collected while purging the monitoring wells. The wells were sampled when the water quality parameters stabilized.