Proposed Plan for Final Remedial Actions
Groundwater Zone 1 - OT027

King Salmon Airport
King Salmon, Alaska

COMMENT PERIOD: September 24 through October 23, 2007

611 Air Support Group, 10471 20th Street, Suite 338, Elmendorf Air Force Base, Alaska 99506-2270

INTRODUCTION

This Proposed Plan describes environmental cleanup options and recommendations for Groundwater Zone 1 - OT027 (Zone 1) at King Salmon Airport (KSA) in King Salmon, Alaska. Figure 1 shows the King Salmon Airport facilities. Zone 1 is one of five groundwater zones and several sites and areas of concern at KSA. Only the actions planned for Zone 1 are addressed in this Proposed Plan.

Zone 1 consists of the area west of Eskimo Creek around the base dining facility and tank farm (see Figure 2). Zone 1 initially included four separate sites:

- Eskimo Creek (SS011)
- Petroleum, Oil, and Lubricants (POL) Tanks (ST015)
- MOGAS Station (SS019)
- Dry Well (DP023)

These sites were addressed by either administrative action or an Interim Record of Decision (IROD) (USAF, 2000; USAF 1995; USAF 2006). All remaining contamination present in Zone 1, regardless of the original source and affected media, is addressed in this Final Proposed Plan for Zone 1. Environmental media (soil and groundwater) at Zone 1 are contaminated with dissolved trichloroethene (TCE) and petroleum.

This Proposed Plan presents a discussion of investigative and cleanup work conducted in Zone 1 at KSA and identifies recommendations for the Final Remedial Action at the site. This Proposed Plan is an update of an earlier plan published in 1999, entitled *Proposed Plan for Interim Remedial Action, Groundwater Zone OT027, King Salmon*. Since completion of the 1999 plan and implementation of interim remedial actions, the understanding of site conditions has changed sufficiently to warrant selection of different remedial alternatives to address the dissolved TCE and petroleum contamination at the site.

HOW CAN YOU PARTICIPATE?

Final decisions will not be made until after the community has the opportunity to review and comment on this Proposed Plan. You are encouraged to comment on this Proposed Plan. The public comment period begins September 24, 2007, and ends on October 23, 2007. You are invited to write or use email. A comment form is provided on page 19 of this Proposed Plan. Please send your comments to the following address:

Community Relations Coordinator
Mr. Tommie Baker
10471 20th St., Suite 340

Elmendorf AFB, Alaska 99506-2200
800-222-4137
email: tommie.baker@elmendorf.af.mil

The Air Force will host a public meeting in King Salmon on October 16, 2007, to discuss this Proposed Plan and take your comments. The meeting will be held in the King Salmon Base Lounge at 7 pm.

This plan is also available on this website: www.adminrec.com

This Proposed Plan is issued by the Department of the Air Force (AF) as the lead agency. The AF is managing remediation of soil and groundwater contamination at Zone 1 in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as required by the Defense Environmental Restoration Program.

As the lead agency, the AF has selected a preferred alternative as the final remedy for Zone 1. Both the AF and the Alaska Department of Environmental Conservation (ADEC) encourage the public to participate in making a decision about the preferred alternative. A 30-day comment period is provided, and all

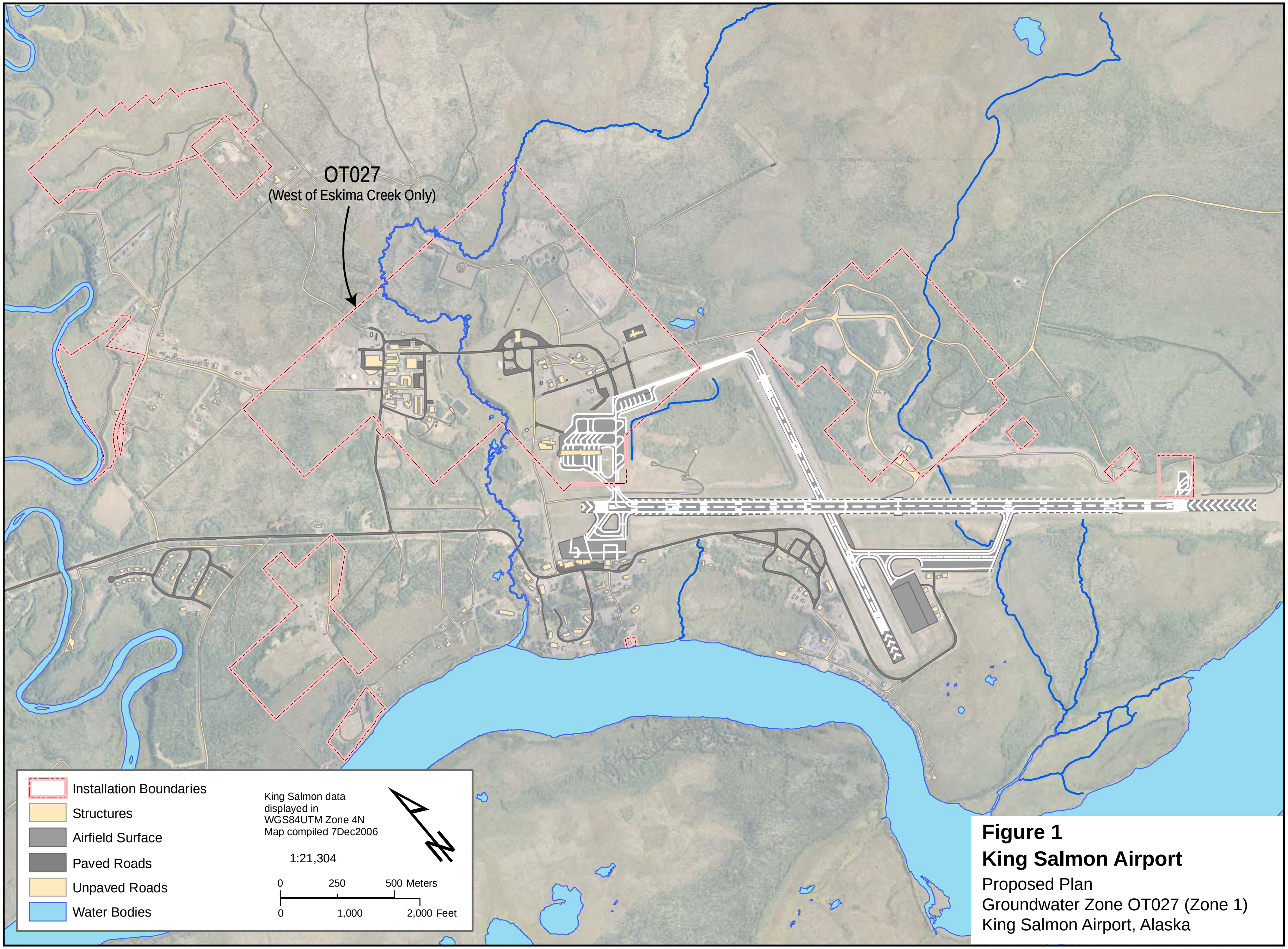


Figure 1
King Salmon Airport
Proposed Plan
Groundwater Zone OT027 (Zone 1)
King Salmon Airport, Alaska

334265.01.04.91_ES042007012SEA . KSPP_Fig1 king salmon airport.ai . 9/25/07

334265.01.04.91_ES042007012SEA . KSPP_Fig2 Zone 1 Site Map.ai . 9/25/07

Figure 2
Zone 1 Site map
Proposed Plan
Groundwater Zone OT027 (Zone 1)
King Salmon Airport, Alaska

comments should be sent to the AF. A mailing and e-mail address is provided above, and a self-addressed comment form is included at the end of this Proposed Plan.

Following review and consideration of public comments received on the plan, the AF will document the final selected remedy for the site in a Final ROD document.

Summary of Proposed Actions

Remedial alternatives for Zone 1 were developed and evaluated based on information obtained from the Remedial Investigation (1989-1993), a comprehensive and a focused feasibility study (1997 and 1999), an Interim ROD (IROD) (2000), and the first five-year CERCLA review (2006). Based on the results of these investigations and evaluations, the AF selected monitored natural attenuation (MNA) of TCE and petroleum in groundwater, continued passive petroleum product removal from groundwater, No Further Action for residual smear-zone soil contamination, and land use controls (LUCs) as the preferred alternative for Zone 1. The major components of the selected response action are presented below:

- Periodic sampling of groundwater, sediment, and surface water
- Periodic measurement and removal of liquid-phase petroleum product in monitoring wells
- No Further Action for residual smear-zone contamination
- Restrictions on the current and future use of the land and groundwater in Zone 1

The selected performance standards for this response action are provided in Alaska Water Quality Standards (18 Alaska Administrative Code [AAC] 70) and Alaska Oil and Other Hazardous Pollution Control Regulations (18 AAC 75).

Purpose and Scope of Proposed Plan

The purpose of this Proposed Plan is to facilitate public involvement in the remedy selection process. This plan presents the lead agency's preliminary recommendation concerning how best to address contamination at the site, presents the alternatives that were evaluated, and explains the reasons why the lead agency recommends the preferred alternative.

The lead agency solicits public comment on the Proposed Plan because the lead and support agencies may select a remedy other than the preferred alternative based on public comment. The final decision regarding the selected remedy will be documented in the Final ROD after the lead agency has considered all comments from both the support agency and the public.

SITE BACKGROUND

This section provides background information about conditions that led to the development of the preferred alternative for Zone 1.

The following investigations and reports contributed to the understanding of conditions in Zone 1 environmental media.

- *Remedial Investigation/Feasibility Study for King Salmon Airport* (CH2M HILL, August 1989).
- *Final King Salmon Airport, King Salmon, Alaska: Remedial Investigation/Feasibility Study at Fourteen Sites. Stage 3, Part 1: Remedial Investigation* (EMCON, 1995a).
- *Final Feasibility Study Report (Revised), King Salmon Airport, King Salmon, Alaska* (EMCON, 1997).
- *CG-027 (Groundwater Zone 1) Final Feasibility Study Report, Installation Restoration Program, King Salmon Air Station, King Salmon, Alaska* (OASIS, 1999).
- *Risk Assessment Report, Groundwater Zone 1 (Buildings 647 and 649), King Salmon Airport, Alaska* (OASIS, 1998).
- *Final Groundwater Monitoring Report, Zone 1* (Paug-Vik, 1999); *Final Monitoring Report, Eskimo Creek Impact Study, King Salmon Air Station, Alaska* (Paug-Vik, 2001); *Draft Report, 2003 Long-term Monitoring, Groundwater Zone 1, King Salmon* (Paug-Vik, 2004).
- *Technical Memorandum, Evaluation of TCE in Groundwater, King Salmon Airport, Groundwater Zone 1* (CH2M HILL, 2006).

Contamination at Zone 1 consists of commingled dissolved TCE and petroleum hydrocarbons in groundwater, and free-phase petroleum and residual TCE in subsurface smear-zone soil. A synopsis of their history is provided below to describe the suspected source areas for Zone 1 contamination.

- **Eskimo Creek (SS011)**. This site is located west of Eskimo Creek. POL seeps (Seeps 1 and 2) were first reported in the mid-1970s along the west bank of Eskimo Creek, east of Building 603. In 1981, two French drains were installed along the west bank of the creek to intercept free-phase product prior to its entry into Eskimo Creek. Subsequently, the AF, ADEC, and the U.S. Environmental Protection Agency (EPA) remedial project managers independently determined that this water treatment system is no longer needed to protect human health and the environment, nor is it effective in promoting petroleum hydrocarbon cleanup at this site. The system was shut down in July 2005.

- **POL Tank Area (ST015, often referred to as SS015)**. The POL tank storage area site north of Storage Road and Silver Street contained four aboveground storage tanks. Tank contents included JP-4, diesel fuel, and possibly gasoline. Three of the tanks were taken out of service and the remaining tank was reconditioned in accordance with the American Standards for Testing and Materials. Releases of petroleum hydrocarbons from the POL Tank Area (ST015), primarily diesel oils for the base power and heat plant, occurred from the 1940s through the 1970s, resulting in subsurface soil contamination and free-phase product discharge to Eskimo Creek (see SS011, above).
- **MOGAS Station (SS019)**. The MOGAS Station site was a motor vehicle refueling facility located northeast of Silver Street. It contained three underground storage tanks, one 500-gallon aboveground storage tank, and a small office building. The tanks were removed in 1994.
- **Dry Well Site (DP023)**. A former dry well located east of the POL storage tanks was used for disposal of petroleum and other liquid waste products from the late 1950s until the mid-1970s. In 1994, The AF 611th Civil Engineer Squadron characterized soil and groundwater next to the dry well and excavated contaminated soil above the smear zone.

Figure 3 shows the locations of monitoring locations in the Zone 1 area.

SITE CHARACTERISTICS

King Salmon is situated on the Alaska Peninsula adjacent to Bristol Bay and Katmai National Park and Preserve, approximately 280 miles southwest of Anchorage.

Land Use

The current land use of KSA is military or light industrial. As the lead agency, the AF has the authority to determine the future anticipated land use of Zone 1. The AF has determined that the most likely land use of this area over the foreseeable future will remain industrial.

The current land use of adjacent land surrounding Zone 1 includes an undeveloped natural vegetation buffer on the north, south, and east sides; the KSA approach and lighting on the south; and wetland areas and Eskimo Creek on the west. No residential land use (e.g., single or multifamily homes) is present directly within Zone 1, although the east side is adjacent to a residential area that is upgradient from any contamination.

Topography and Geology

KSA is located on the poorly drained lowlands northwest of the Aleutian Range. The topography consists of a hummocky plain interrupted by drainages, with minimal topographical relief. KSA ground elevations range from 30 to 68 feet above mean sea level.

Most of the Alaska Peninsula was buried under ice during the last ice age, between 25,000 and 18,000 years ago. The surficial geology around KSA reflects deposition of materials as the glaciers receded, leaving moraine and drift features that have been extensively reworked by erosion. KSA is underlain by more than 180 feet of unconsolidated gravels, sands, silts, and clays. The exact depth to bedrock in the King Salmon area is unknown. Wells as deep as 180 feet do not encounter bedrock, and bedrock is not exposed in the bluffs along the Naknek River near King Salmon.

Hydrogeology

Based on field observations and soil boring data, at least three aquifer units are known to exist in the King Salmon area. The aquifers consist of unconsolidated, well-sorted to poorly sorted silty and gravely sands separated by aquitard units consisting of silty sands, silts, and clays.

The shallowest aquifer, the A-Aquifer, is unconfined and exposed in many areas within KSA. The total depth to the A-Aquifer ranges from near surface at the Eskimo Creek wetlands to 45 feet below ground surface (bgs) along the northern margin of KSA. Groundwater movement in the A-Aquifer generally is toward local topographic lows and surface drainages such as wetlands, rivers, creeks, and ditches. There are no water supply wells completed in the A-Aquifer at Zone 1. The primary groundwater flow direction in the A-Aquifer in Zone 1 is southeasterly. The flow direction is more easterly near Eskimo Creek and more southwesterly on the western portion of the site, closer to King Salmon Creek.

Underlying the A-Aquitard, the top of the B-Aquifer has been encountered at depths ranging from 50 to 80 feet bgs. The known thickness of the B-aquifer ranges from 15 to 40 feet. There are no residential drinking water supply wells screened in the B-Aquifer in Zone 1. The B-Aquitard underlies the B-Aquifer. The thickness of this aquitard may vary from 10 to 120 feet. The C-Aquifer underlies the B-Aquitard at a depth of approximately 200 feet bgs. Several KSA water supply wells have been completed in the C-Aquifer, but none are located in Zone 1. The thickness and direction of groundwater flow in the C-Aquifer are unknown.

Surface Water Hydrology

The central part of KSA is drained by Eskimo Creek; the northern edge by King Salmon Creek. The creeks empty into the Naknek River.

Ecology

The King Salmon area supports a diverse and productive range of fish, birds, mammals, and plants.

No threatened or endangered species have been observed within Zone 1. While peregrine falcons and a variety of marine mammals live near the area, these species are not likely to use KSA property for feeding, nesting, or propagating.

Nature and Extent of Contamination

This section describes the distribution of contaminants in Zone 1 environmental media.

TCE

TCE contamination consists of a relatively thin plume extending from MW-28 to Eskimo Creek (Figure 4). The TCE plume is about 750 feet long and 60 to 80 feet wide. Concentrations of TCE within the plume are between 500 and 1,100 ug/L based on groundwater samples collected between 1998 and 2005. The average TCE concentration in the plume is about 1,000 ug/L.

The highest concentrations of TCE occur between the northwest corner of Building 649 and Eskimo Creek (Figure 3). Building 649 was used as a bowling alley, where TCE was reportedly used to clean the equipment. The dissolved TCE plume formed when groundwater moving through the area came into contact with residual TCE nonaqueous-phase liquid beneath and behind Building 649.

TCE typically biodegrades anaerobically in groundwater through reductive dechlorination, yielding several chlorinated daughter products, including cis-1,2-dichloroethene, trans- 1,2-dichloroethene, and vinyl chloride. Of these, only cis-1,2-dichloroethene has been detected in the Zone 1 plume. The more toxic daughter product, vinyl chloride, has not been detected in any of the wells. TCE and its breakdown products (cis-1,2-dichloroethene; trans-1,2-dichloroethene; 1,2-dichloroethene; and vinyl chloride) have been detected at varying concentrations in groundwater throughout Zone 1.TCE and breakdown product contamination in Zone 1 groundwater are limited to the A-Aquifer. Samples have been collected annually for VOC testing from Zone 1 monitoring wells. Selected analytical data for the period 1988 to 2006 are presented in Table 1. Dissolved TCE concentrations demonstrated a decreasing trend in several wells, with average concentrations of approximately 1 milligram per liter (mg/L) from 1998 through 2006.

TCE soil contamination at Zone 1 is negligible and localized in the relatively thin smear zone approximately 30 ft bgs. Soil tests have shown very low VOC content that is believed be the result of the natural biodegradation due to the presence of organic carbon from the petroleum hydrocarbons.

TCE in surface water and sediments of Eskimo Creek have been sampled at multiple locations over the last several years. Between 1995 and 2003, 23 surface water samples and 15 sediment samples were collected and analyzed. During that time, TCE was detected in three samples (two surface water samples and one sediment sample), with most concentrations below potentially applicable screening criteria. In the most recent 2004 sampling effort, TCE was not detected in any surface water or sediment sample.

Petroleum

The main source of petroleum contamination in Zone 1 appears to have been from releases of diesel fuel from the POL Tank Area (SS015). Tests of the released petroleum show it is primarily diesel fuel and it is localized in a thin (e.g., 0.5- to 1.5-foot) smear zone in subsurface soil at a depth of approximately 30 feet bgs across the main base area of Zone 1. Surface and shallow-subsurface soils in Zone 1 are not contaminated. Prior to the use of product recovery systems, liquid-phase petroleum was observed in groundwater seeps along the bluff face and in wetland areas parallel to Eskimo Creek.

Source: USAF (2006).

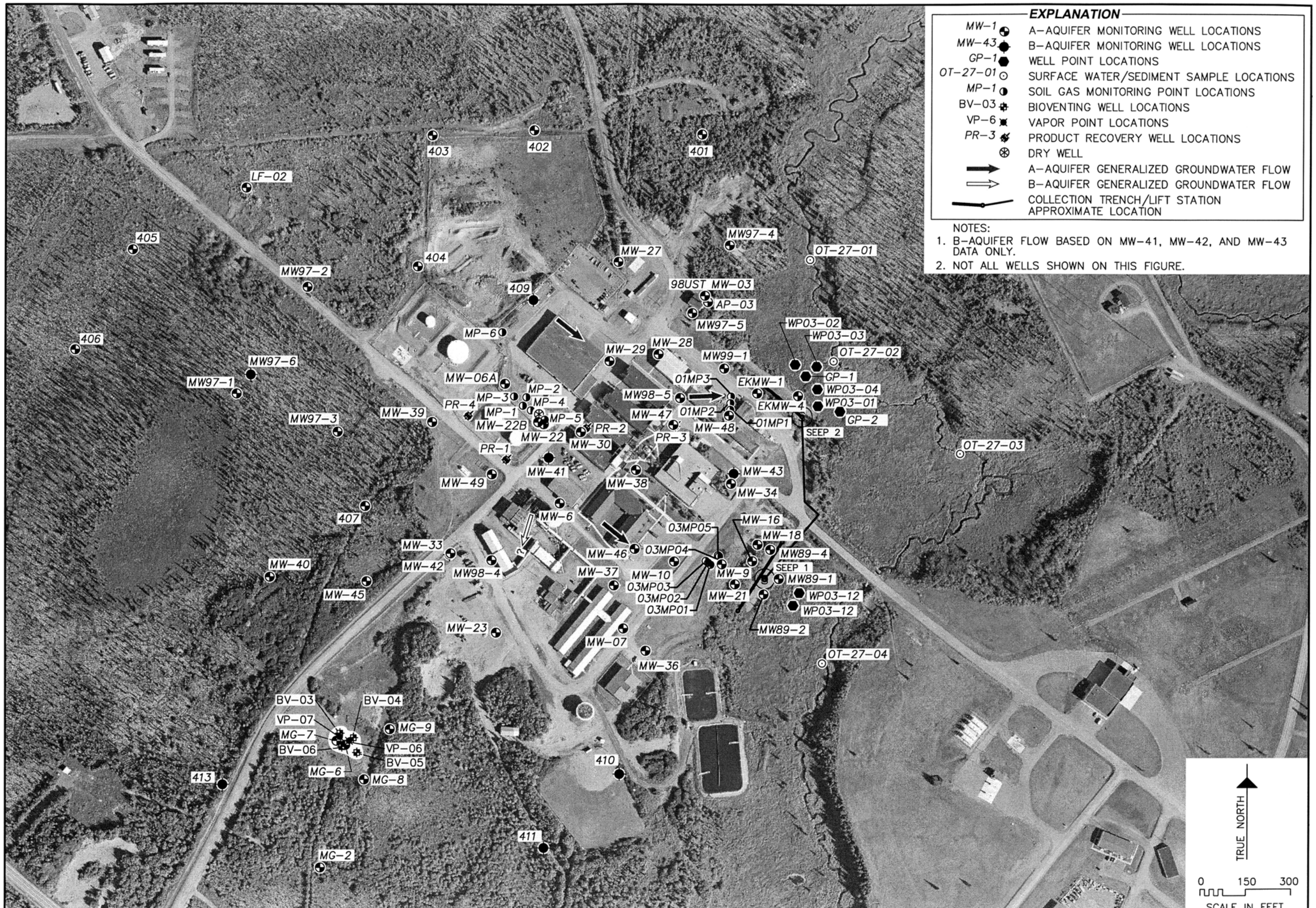
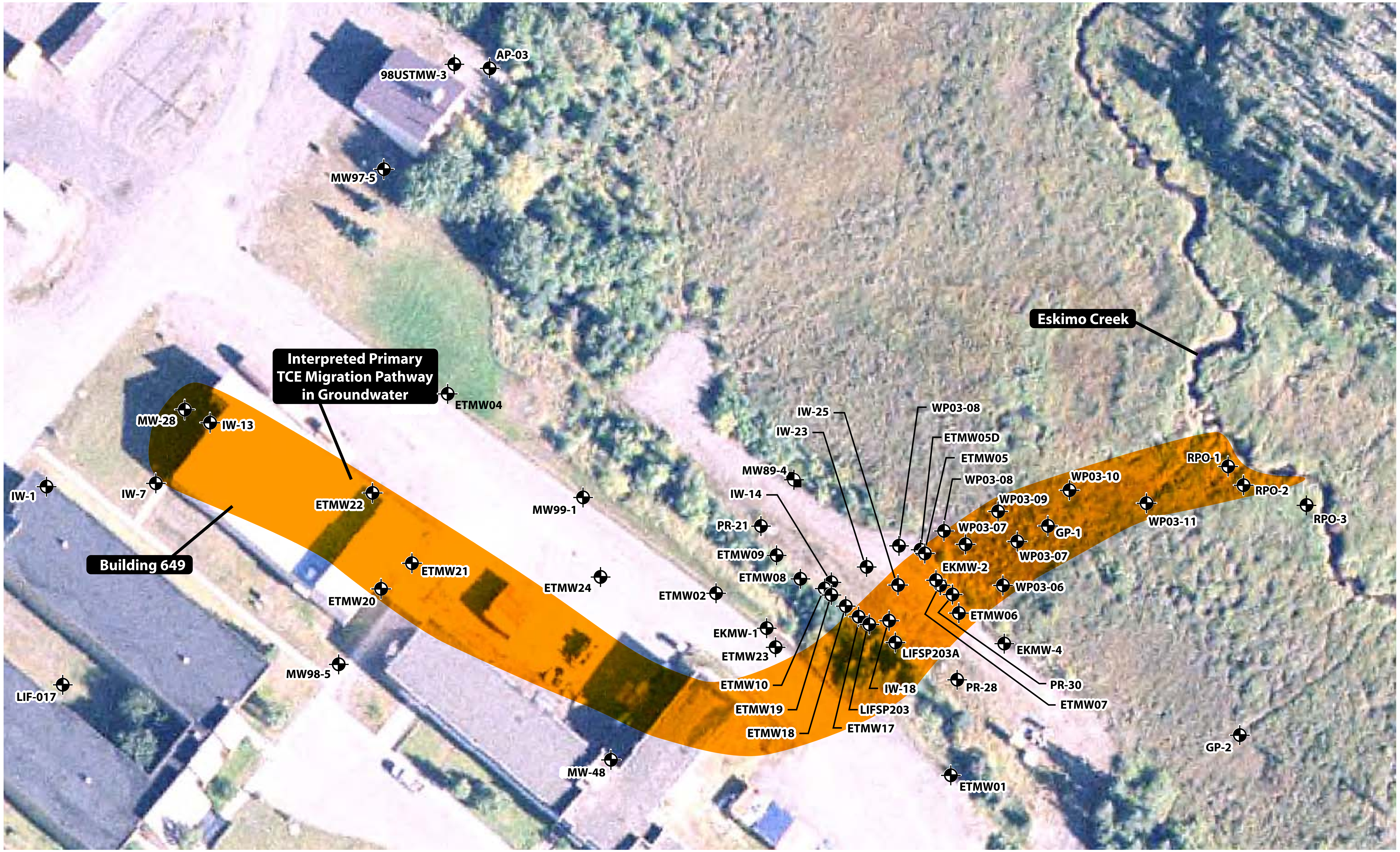


Figure 3
Monitoring Locations and Interim Actions in Zone 1
Proposed Plan
Groundwater Zone OT027 (Zone 1)
King Salmon Airport, Alaska



Source: CH2M HILL (2006).

LEGEND

MW-13 ⌖ **Existing Monitoring Points**

Projnumber JMSnumber KS1_Aerial.ai 12/12/06 cts

North

0 60 120

Approximate scale in feet

Figure 4
MW-28 Plume Detail
Proposed Plan
Groundwater Zone OT027 (Zone 1)
King Salmon Airport, Alaska

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Table 1: Historical TCE Concentrations in Selected A-Aquifer and B-Aquifer Monitoring Wells – Groundwater Zone 1

Sample Location	1993	1994	1995	1997[1]	1998[2]	1999	2002	2003	2004	2005	2006
A-Aquifer Wells											
EKMW-4	0.0014	0.0032J		**0.16**	0.0337	ND	ND	0.005			
MW-9	0.0075			0.0024			0.0019	0.001	0.00138		0.00056
MW-28	**5.9**	**7.4 JB**		**1.65**	**0.861**	**0.32 J**	**0.0592**	**0.672**	**1.79**	**1.10**	**0.317**
MW-33	0.0085	**0.062 J**		0.0102	0.0078		0.00659	0.0044	0.0053		
MW-47		**0.015**	**0.098**				**0.0992**	**0.0965**	**0.0827**		**0.0663**
MW89-1		0.0096J		0.0145	0.014		0.0104J	0.0081			0.0041
GP-1(A)				**0.64**	**1.34**		**0.616**	**0.564**	**0.774**	**0.250**	
B-Aquifer Wells											
MW-41	0.0082			0.028	0.041		0.031	**0.059**	**0.051**	**0.055**	0.042
MW-43	0.002	ND		0.0037	ND		ND	0.0006	ND		

Source: 611th CES (January 2006), Table 3-5
Notes: All concentrations are in mg/L
Flags: J – estimated; F – below quantitation limit; ND – Non Detect
Bold values indicate exceedances of groundwater RAO of 0.05 mg/L.
Blank cells indicate that the monitoring well was not sampled for TCE.
[1] Maximum concentration detected during the 1997 field season
[2] Maximum concentration detected during the 1998 field season

Since its discovery, the occurrence of measurable liquid-phase petroleum in monitoring wells has decreased due to long-term use of product recovery systems, entrainment in pores in the smear zone, and recent applications of bioventing. The remaining liquid-phase petroleum is highly weathered, localized in a thin interval, and unlikely to be mobile. The natural processes of oil movement combined with water table fluctuations (which smear the oil) have exhausted its additional mobility. In addition, site-specific hydrocarbon composition and equilibrium aqueous solubility analyses conducted in 2005 have demonstrated that the residual hydrocarbons in the subsurface are highly weathered and devoid of a soluble/toxic fraction. Thus, future transport of liquid-phase petroleum to the wetland areas or Eskimo Creek is expected to be negligible and will not result in increased or unacceptable impacts on these areas.

Dissolved petroleum constituents in groundwater appear to be naturally attenuated before reaching Eskimo Creek. During the 2004 long-term monitoring program, surface water and sediment sample pairs were collected from four locations in Eskimo Creek and analyzed for diesel-range and gasoline-range organics, volatile organic compounds (VOCs), and polynuclear aromatic hydrocarbons. No contaminants were detected above the Remedial Action Goals (RAOs) in any of these sample pairs.

SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

Remedial alternatives presented in this Proposed Plan were developed and evaluated based on the remedial investigation, feasibility study, IROD, and the first five-year review.

The overall cleanup strategy and recommended remedy for KSA involves maximizing environmental protectiveness by applying source management, migration, and exposure controls, and minimizing costs while moving Zone 1 toward closure. The selected alternative for Zone 1 fits into the overall site management plan by controlling potential exposure and by using natural processes to cost-effectively treat contaminated soil and groundwater. The current cleanup plan for KSA is anticipated to progress until groundwater attains protective concentrations as determined by the performance standards.

SUMMARY OF SITE RISKS

This section summarizes the human health and ecological risk assessments that have been performed at KSA Zone 1. Under current site conditions and land use, there is no exposure to or unacceptable risk from contaminated media to humans and ecological receptors.

Human Health Risk Assessment

Carcinogenic[1] risks and noncarcinogenic[2] impacts for each COC were evaluated for all populations and media of interest, including both current and future land use settings. No unacceptable carcinogenic (i.e., greater than 10^{-4} excess lifetime cancer risk or noncarcinogenic (i.e., hazard index greater than 1) risks were identified for the COCs and exposure pathways evaluated in the HHRA.

A baseline risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. Potential risks for both current and future site occupants are also discussed.

Although other chemicals were detected at the site, the risk assessments identified TCE, diesel-range organics, and petroleum hydrocarbons as contaminants of concern (COCs) in Zone 1. These were the most important chemicals (i.e., those chemicals presenting 99 percent of the total risk) detected at the site. The risk assessments evaluated the presence of these COCs in soil, surface water, sediment, and groundwater, as well as the potential human exposure to these COCs based on current and future land use.

Land use at KSA is currently industrial and will remain so in the future. However, to be conservative, the 1995 Human Health Risk Assessment (HHRA) (EMCON, 1995b) assumed an industrial and residential land use scenario based upon the presence of nearby military housing for current exposures and upon assumed future residential development to complete the exposure assessment. Potential human receptors included adult workers and child and adult residents; exposure routes included ingestion and dermal contact with soil, ingestion of contaminated groundwater, inhalation of vapors from soil and groundwater, and inhalation of dust, as well as ingestion of plant, fish, and animal tissue.

Based on existing site conditions and land use controls, there is no current or future unacceptable risk from contaminated media to human health.

Ecological Risk Assessment

In 1995, a Tier I Ecological Risk Assessment (ERA) identified potential risks associated with chemicals present at KSA Zone 1 (EMCON, 1995c). The Tier I ERA concluded that ecological risks potentially existing at Eskimo Creek area were due to diesel- and water-borne petroleum contaminants to small-bodied birds that forage along affected areas of the creek and to fish and aquatic organisms within the creek. In 1996, a fish tissue sampling and analysis was completed to refine the Tier I model and provide a Tier II assessment of the potential for ecological risks posed by contamination possibly entering Eskimo Creek (EA, 1997).

The Tier II ERA addressed the food chain exposure pathway of fish to fish-eating wildlife. Modeled evidence from the Tier I ERA suggested that target species exposure to COCs was possible, but the Tier II ERA demonstrated that any exposure is below levels that result in accumulation in fish tissue. Subsequent sampling data corroborated that surface water has not been affected by petroleum contaminants in Zone 1. Surface water and sediment sample results indicate that COC concentrations do not exceed NOAA SQuiRT values and are, therefore, below action levels. Finally, the TCE action level presented in the 2000 IROD was re-evaluated (CH2M HILL, 2006) and shown to be almost threefold higher than what was in the IROD. The 2006 evaluation used more current ecological toxicity data such as the most recent revision to EPA's EcoTox database and ecological screening values for TCE in surface water, sediment, and soil.

Based on existing site conditions, there is no current or future unacceptable risk from contaminated media to environmental receptors.

Basis for Taking Action

Based on the potential but unlikely risk from TCE exposure to human health in groundwater and to aquatic and terrestrial receptors at Eskimo Creek, it is

1 An excess lifetime cancer risk of 1 x 10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This risk-based benchmark is established as acceptable by CERCLA and 18 AAC 75.

2 The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. RfD represents a daily individual intake that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of site-related daily intake to the RfD is called a hazard quotient. A hazard quotient <1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. This risk-based benchmark is established as acceptable by CERCLA and 18 AAC 75.

the AF's current judgment that the preferred alternative identified in this Proposed Plan is necessary to protect the environment from actual or threatened releases of hazardous substances into the environment.

The current risk management approach for petroleum contamination implemented by the AF, which includes maintaining land and groundwater use controls, continued passive petroleum product removal from groundwater, and monitoring for petroleum products in the groundwater, addresses this concern. No basis for taking action is believed to be necessary for residual contamination found in the subsurface smear-zone soil due to existing land use controls and its inaccessibility.

REMEDIAL ACTION OBJECTIVES

RAOs provide a general description of what the cleanup will accomplish. These goals typically serve as the design basis for the remedial alternatives, which will be presented in the next section.

The RAOs for KSA Zone 1 are as follows:

- Protect human health by maintaining or reducing the current risk levels resulting from potential COC exposures.
- Protect environmental receptors by maintaining or reducing the current risk levels resulting from TCE exposures.
- Protect human health by preventing exposure to contaminated smear zone soil.
- Protect and maintain the integrity of natural features such as wetlands and topography.

The RAOs presented in the 1999 feasibility study (OASIS, 1999) were based on industrial land use and a 25-year restoration time frame. The RAOs for the final remedy anticipate that land use will remain the same. However, based on updated conceptual model information, the 25-year time frame for restoration is not feasible. The RAOs for the final remedy assume a 100-year restoration time frame. Regardless of the precise time, the RAOs will be maintained for the duration of the restoration period.

SUMMARY OF REMEDIAL ALTERNATIVES

A total of three alternatives were developed to address remediation at Zone 1. These alternatives are applicable to TCE in groundwater, which may discharge to surface water and sediment in Eskimo Creek. The Alternatives also rely on existing Land use controls that are currently addressing petroleum contamination in soil and groundwater. This section provides a summary overview of the components of the three remedial alternatives.

Alternative 1: No Action

Evaluation of the No Action alternative is required by CERCLA as a baseline to reflect current conditions without remediation. This alternative is used for comparison with each of the other alternatives. Although natural processes may reduce contaminant concentrations to acceptable levels over time, these processes would not be monitored. This alternative does not include any treatment, containment components, modeling, or treatability studies.

Alternative 2: Monitored Natural Attenuation and Institutional Controls

This alternative involves monitoring groundwater and surface water to evaluate and confirm that natural attenuation processes are occurring and to assure that contaminant concentrations do not result in exposure until cleanup levels are reached.

Knowledge about MNA has advanced over the last two decades and is formally recognized by EPA as a viable and cost-effective technology to achieve remedial action goals. Institutional controls (also referred to as LUCs) rely on continued restriction on land use, including the use of groundwater. The major components of Alternative 2 include the following:

- Groundwater monitoring to better understand hydrogeologic conditions and to evaluate the stability and/or depletion of the contamination
- Surface water monitoring to better understand groundwater and surface water interaction and to evaluate possible discharge of contaminants to Eskimo Creek
- Groundwater, surface water, and sediment sampling conducted initially on an annual basis, with a rationale for reduced sampling frequency based on observed rates of change in contaminant concentrations in groundwater and/or surface water
- Continued monitoring until unrestricted use of groundwater is feasible
- Control of current and future land use in Zone 1 by the AF

Alternative 3: In Situ Air Sparging, MNA, and Institutional Controls

Air sparging to address TCE contamination in groundwater involves injecting air into the contaminated groundwater, creating an underground stripper that removes TCE through volatilization. Soil vapor extraction (SVE) wells would be used in conjunction with the air sparging wells to control the flow of volatilized TCE.

Because air sparging is an in situ technology, no groundwater extraction, treatment, or disposal is expected, but the feasibility study anticipated that some offsite waste handling and disposal would be necessary. As with Alternative 2, LUCs that restrict groundwater use would also be a component of Alternative 3.

The major components of Alternative 3 include the following:

- Treatment system pilot test and design
- Installation of a treatment system that includes air sparging, monitoring, SVE wells, trenching, and weatherized equipment buildings
- Installation of winterized piping, gauges, valves, and metering devices
- Treatment system operation and monitoring
- Continued monitoring until TCE cleanup levels for groundwater are achieved
- Continued restriction of groundwater in the A- and B- Aquifers
- Continued LUCs in Zone 1 by the AF

Table 2 summarizes the common and distinguishing features of each alternative. Table 3 summarizes the outcomes of each alternative.

Table 2: Common Elements and Distinguishing Features of Alternatives

	Alternative 1 No Action	Alternative 2 MNA and Institutional Controls	Alternative 3 In Situ Air Sparging, MNA, and Institutional Controls
Key applicable or relevant and appropriate requirements (ARARs) associated with alternative	Alaska Water Quality Standards (18 AAC 70); Alaska Oil and Other Hazardous Substance Pollution Control (18 AAC 75)	Alaska Water Quality Standards (18 AAC 70); Alaska Oil and Other Hazardous Substance Pollution Control (18 AAC 75)	Alaska Water Quality Standards (18 AAC 70); Alaska Oil and Other Hazardous Substance Pollution Control (18 AAC 75)
Long-term reliability of remedy	None	Rated "average" in the feasibility study. Provides protection through monitoring, and mobility, toxicity, and volume of contamination will be reduced by natural processes. Institutional controls prevent exposure to contaminated groundwater.	Rated "better" in the feasibility study. Reliability depends on the removal efficiency of sparging and the distance between point of sparging and point of potential exposure.
Quantity of untreated waste and treatment residuals to be disposed of offsite or managed onsite in a containment system, and the degree of hazard remaining in such material	None	None	If activated carbon is required, waste treatment residuals will require offsite disposal. Degree of hazard will depend on concentration of contaminants and handling procedures.
Estimated time to reach remediation goals	Unknown since monitoring will not be conducted	100 years	10 to 25 years (based on the feasibility study and on the restoration time frame agreed to with ADEC)
Estimated capital cost[a]	0	\$12,500 to \$27,000	\$515,000 to \$1,100,000
Estimated annual operation and maintenance costs	0	\$31,000 to \$66,000	\$66,000 to \$141,000
Estimated total present worth	0	\$258,000 to \$554,000	\$692,000 to \$1,483,000
Discount rate	No applicable	7%	7%
Number of years over which cost is projected	25 years	25 years	10 years (5 years active treatment; 5 years monitoring)
Use of presumptive remedies and/or innovative technologies	None	None	None

[a] Costs originally developed in OASIS (1999) and updated to 2007 costs with an escalation factor of 1.25.

Table 3: Expected Outcome of Each Alternative

	Alternative 1 No Action	Alternative 2 MNA and Institutional Controls	Alternative 3 In Situ Air Sparging, MNA, and Institutional Controls
Available uses of land upon achieving cleanup levels	No change. The AF has determined that the most likely future land use of Zone 1 and surrounding land is expected to remain the same over the foreseeable future.	No change. The AF has determined that the most likely future land use of Zone 1 and surrounding land is expected to remain the same over the foreseeable future.	No change. The AF has determined that the most likely future land use of Zone 1 and surrounding land is expected to remain the same over the foreseeable future.
Time frame to achieve available land use	No change. Subsurface soil contamination is not within expected range of human activities.	No change. Subsurface soil contamination is not within expected range of human activities.	No change. Subsurface soil contamination is not within expected range of human activities.
Available uses of groundwater	Groundwater use in the A- and/or B-Aquifers is restricted until groundwater RAOs are achieved.	Groundwater use in the A- and/or B-Aquifers is restricted until groundwater RAOs are achieved.	Groundwater use in the A- and/or B-Aquifers is restricted until groundwater RAOs are achieved.
Time frame to achieve available groundwater use	Unknown since monitoring will not be conducted.	100 years estimated based on TCE natural degradation.	10 to 25 years estimated based on treated TCE degradation.
Other impacts or benefits associated with alternative	None	No remediation wastes. Reduced cross-media contamination potential. Not intrusive. Lower cost.	May generate treatment residuals that will require offsite dispoisal. Slight risk of cross-contamination . Intrusive. Higher cost.

EVALUATION OF ALTERNATIVES

In accordance with the National Contingency Plan (NCP), the alternatives for KSA Zone 1 were evaluated using the nine criteria described in Section 121(b) of CERCLA and the NCP §300.430(f)(5)(i). These criteria are classified as threshold criteria, balancing criteria, and modifying criteria.

Threshold criteria are standards that an alternative must meet to be eligible for selection as a remedial action. There is little flexibility in meeting the threshold criteria—the alternative must meet them or it is unacceptable. The following are classified as threshold criteria:

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements (ARARs)

Balancing criteria weigh the tradeoffs between alternatives. These criteria represent the standards upon which the detailed evaluation and comparative analysis of alternatives are based. In general, a high rating on one criterion can offset a low rating on another balancing criterion. Five of the nine criteria are considered balancing criteria:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Modifying criteria are as follows:

- Community acceptance
- State/support agency acceptance

In the feasibility study, each of the alternatives considered for Zone 1 was evaluated against eight of the NCP's nine evaluation criteria. The threshold and balancing criteria were scored for every alternative. Criteria scores were 0, 3, or 5, with 5 being the most effective and 0 the least effective.

Using the same scoring system developed for the feasibility study, this section summarizes how well the three alternatives presented in this Proposed Plan satisfy each evaluation criterion. It indicates how an alternative compares to the others under consideration. Individual criteria scores for a single alternative have been added to develop an overall rating score for that alternative (the overall score is attained by totaling each criterion score). The AF is responsible for weighing all information and selecting the best alternative considering such factors as risk, budget, and modifying criteria. The overall score for each alternative provides the AF with a semi-quantitative means to compare among them. Criteria, overall scores, and comparative analyses among alternatives are presented in Table 4. All of the alternatives except the No Action alternative are protective of human health and the environment by controlling risks at the site through restricting exposure to contaminated groundwater and subsurface soil. In the comparative analyses, Alternatives 2 and 3 were judged to provide equivalent protection, compliance with ARARs, long-term effectiveness, implementability, and reduction in toxicity, mobility, and volume through treatment. Alternative 3 would yield these results in a faster period, but since there are no current risks and future exposure can be controlled through LUCs, the comparison ranked these criteria equally. For the short-term effectiveness criterion, Alternative 3 received the highest score because it was assumed that the time to implement the remedy would be the shortest. Alternative 2 received the highest score for cost effectiveness because it avoided construction and associated costs for operating and maintaining an active engineered system.

PREFERRED ALTERNATIVE

For Zone 1, Alternative 2, MNA and Institutional Controls is the preferred alternative for the groundwater remediation. No Further Remedial Action is proposed for the soil. The AF believes that Alternative 2 meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The remedy is expected to satisfy the following statutory requirements of CERCLA § 121(b):

(1) be protective of human health and the environment;

(2) comply with ARARs;

(3) be cost-effective;

(4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and

(5) satisfy the preference for treatment as a principle element, or explain why the preference for treatment will not be met.

Based upon compliance with threshold criteria, the cost-to-effectiveness quotient, the total cost, regulatory agency review, and the total CERCLA balancing criteria score derived in this detailed analysis of alternatives, Alternative 2 as described, provides the best balance of tradeoffs and will achieve RAOs established for Zone 1.

Table 4: Comparative Analysis Summary

Criterion	Alternative 1 No Action	Alternative 2 MNA and Institutional Controls	Alternative 3 In Situ Air Sparging, MNA, and Institutional Controls
Protective of Human Health and the Environment	○	●	●
Compliance with ARARs	○	●	●
Long-Term Effectiveness and Permanence	○	●	●
Reduction in Toxicity, Mobility, or Volume Through Treatment	○	●	●
Short-Term Effectiveness	○	◒	●
Implementability	●	●	◒
Cost	●	◔	○

Note: Modifying criteria not included.

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GLOSSARY OF TERMS

ADEC – Alaska Department of Environmental Conservation, the lead regulatory agency for the King Salmon Airport site

AF – U.S. Air Force

ARARs – Applicable or relevant and appropriate requirements, laws, and regulations that establish cleanup levels for sites with contamination

bgs – below ground surface

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act of 1980, also known as Superfund

COC – Contaminant or chemical of concern, means a contaminant or a chemical that poses public health and/or environmental risks

EPA – U.S. Environmental Protection Agency

ERA – Ecological Risk Assessment, the process of defining and quantifying risks from contaminant to non-human biota and determining the acceptability of those risks

Feasibility Study – An evaluation of site conditions and potentially applicable remedial actions. As stated by the NCP, the primary objective of a feasibility study is to "ensure that appropriate remedial alternatives are developed and evaluated such that relevant information concerning the remedial action alternatives can be presented to a decision-maker and an appropriate remedy selected."

Free Product – Mobile phase petroleum product floating on the water table. The petroleum product is lighter than water and relatively insoluble in water; therefore, it is maintained as a separate phase on the water table. In Zone 1, the free product is a diesel-range product.

HHRA – Human Health Risk Assessment, a systematic evaluation of available data on significant existing or potential risks from contamination to human health

IRP – Installation Restoration Program

KSA – King Salmon Airport

MNA – The term monitored natural attenuation refers to the remedial approach that allows natural processes to reduce concentrations of contaminants to acceptable levels. MNA involves physical, chemical, and biological processes that act to reduce the mass, toxicity, and mobility of subsurface contamination. Physical, chemical, and biological processes involved in MNA include biodegradation, chemical stabilization, dispersion, sorption, and volatilization.

NCP – National Contingency Plan, the regulations that provide the structure and procedures for responding to discharges of oil and hazardous substances, as directed by CERCLA

POL – Petroleum, oil, and lubricants

RAO – Remedial Action Objective

Remedial Action – Action taken to eliminate, reduce, or control the hazards posed by contamination at a site

ROD – Record of Decision, documentation of the selected remedy for a site and the rationale for its selection

Smear Zone – In the presence of free product, the soil interval extending from the high groundwater table to the low groundwater table levels. This interval is called the "smear zone" because the free product tends to become smeared across this interval by the rising and falling water table.

SVE – An in-situ soil treatment technology that removes vapors from air spaces in contaminated soil by setting up a pressure gradient or vacuum. SVE is often used in conjunction with air sparging (the injection of air into the ground).

TCE – Trichloroethene, a widely used chlorinated solvent

Water Table – The groundwater surface in an unconfined aquifer (such as the A-Aquifer at KSA)

COMMENT CARD

Proposed Plan for
Final Remedial Action
King Salmon Airport Groundwater Zone 1 – OT027
King Salmon, Alaska

Your comments and suggestions about the remedial alternatives in this Proposed Plan are important to the U.S. Air Force. Comments that the public provides will be valuable in helping the agencies select a final alternative for Groundwater Zone 1 – OT027.

You may use the space provided below to submit your comments. When you are finished, please fold and mail. A return address has been provided on the back of this page for your convenience. Comments must be postmarked by October 23, 2007. If you have any questions, please contact Tommie Baker, Community Relations Coordinator at (800) 222-4137.

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