4.0 SUMMARY OF HUMAN HEALTH RISK ASSESSMENT

This section provides a summary of the human health risk assessment conducted for this site. A risk assessment workplan was prepared in accordance with current Alaska DEC and EPA guidelines for human health risk assessment (Alaska DEC 2000a, 2000b, 2000c; USEPA 1989, 1991, 1997a, and 1998a). The risk assessment was prepared in accordance with the workplan, following Alaska DEC's approval of the workplan. The assessment follows available science where appropriate regulatory guidance is not available to accommodate site-specific conditions. Where information is incomplete, conservative assumptions are made so that risk to public health is not underestimated. The complete, detailed human health risk assessment is included as Appendix C, Part I.

The previous sections of the focused feasibility study have identified petroleum compounds in soil and groundwater above regulatory levels at the site from leaks associated with a currently abandoned fuel line that likely transported JP-5. While there were subsurface pipelines running through the area containing a variety of fuel types (see Figure 2-2), the analytical data indicate a predominantly diesel range petroleum release. The risk assessment evaluated whether potential health risks were present if people encountered these petroleum-impacted materials in their environment according to the risk assessment procedures specified by Alaska DEC (2000c). Alaska DEC provides guidance for four methods of determining cleanup levels (beginning with Method One) that increase in level of effort and site-specificity. Method Four uses risk assessment to determine site specific cleanup levels (Alaska DEC 2000c). Sufficient site information is available to determine Method Four cleanup and the results are summarized below; details are provided in Appendix C, Part I.

4.1 CHEMICAL OF POTENTIAL CONCERN SELECTION

The first step in a human health risk assessment is an evaluation of the data in order to select chemicals of potential concern (COPCs) for human health. Of the total available data, the following were selected as applicable to human health:

- Groundwater data from impacted monitoring wells.
- Soil data from samples collected to a depth of 15 feet. Alaska DEC excludes soil deeper than 15 feet from human health risk assessments because humans would generally not encounter material this deep. Alaska DEC defines surface soil as 0 to 2 feet bgs (Alaska DEC 2000a). One surface soil sample was collected (location 02-850). The soil in the area where this sample was collected has been

removed and backfilled (BEESC 2001a). Although additional surface soil samples were not collected, this does not represent a data gap because the source of contamination was to the subsurface and the single location with contaminated surface soil was removed and replaced with clean fill material. Thus, there are no on-site exposures to impacted surface soil at South of Runway 18-36 Area.

EPA's Region 9 PRGs dated October 2002, and Alaska total petroleum hydrocarbon (TPH) cleanup levels were used as screening values (USEPA 2002a; Alaska DEC 2003). Chemical concentrations in groundwater and soil were compared to one-tenth of the PRG or cleanup level for noncarcinogens and the full value for carcinogens. Screening values represent concentrations below which there is no health concern. If the maximum concentration of a chemical was less than the screening value, the chemical was eliminated from the risk assessment because it would not be a health concern. Chemicals with concentrations greater than the screening values were evaluated further in terms of their frequency of detection, magnitude of exceedance of screening levels, and toxicity. Several COPCs were selected for in-depth evaluation in the assessment based on their toxicity and the frequency and magnitude with which their concentrations exceeded the screening levels. Eight chemicals were selected as COPCs in groundwater:

- 2-Methylnaphthalene
- Acetone
- Benzene
- Ethylbenzene
- Naphthalene
- Xylenes
- DRO
- GRO

The following four chemicals were selected as COPCs in soil:

- 2-Methylnaphthalene
- Naphthalene
- DRO
- GRO

4.2 EXPOSURE ASSESSMENT

Once COPCs are selected, the second step in risk assessment is an evaluation of the exposure pathways by which people could encounter chemicals. The exposure assessment identifies the populations potentially exposed to chemicals at the site, the means by which exposure occurs,

and the amount of chemical received from each exposure medium (i.e., the dose). Only complete exposure pathways are quantitatively evaluated. Complete pathways consist of four elements: (1) a source and mechanism of chemical release, (2) a retention or transport medium (e.g., groundwater), (3) a point of potential human contact with the affected medium, and (4) a means of entry into the body at the contact point. Figure 4-1 presents the CSM, which depicts the complete pathways for this site.

The South of Runway 18-36 Area is zoned for commercial land use. Thus, no residential populations would be exposed to chemicals at the site. Because there is no impacted surface soil and chemicals in groundwater are moving away from the residential areas, off-site populations would not be exposed to chemicals migrating from the site to the residential areas. Child trespassers would not be exposed at West Canal Ditch, because the airport runway area is restricted to airport personnel; therefore, any exposures to surface water and sediment would likely be infrequent and of short duration. In addition, impacted sediment has mostly been removed from the South Sweeper Creek and covered in abandoned areas of the airport ditch system in the vicinity of the site. Further control of seeps has likely improved surface water quality, and recent sampling show levels below concentrations that would be a concern for human health. For these reasons, child recreational users playing in surface water of South Sweeper Creek at the site, while a potentially complete pathway, is likely insignificant.

People have been observed fishing and harvesting shellfish at the mouth of South Sweeper Creek where it drains into Sweeper Cove. Therefore, the fish ingestion pathway could represent a potentially complete pathway. However, part of the remedial action for Sweeper Cove is the issuance of a fish advisory which limits the amount of shellfish ingested from Sweeper Cove (U.S. Navy 2004). While the South of Runway 18-36 Area does not have any restrictions on shellfish consumption, shellfish are not expected to be present in the South of Runway 18-36 Area in great numbers. The fish advisory in place for Sweeper Cove is expected to be protective of potential shellfish contamination at the mouth of South Sweeper Creek. Therefore, the fish ingestion pathway was not evaluated for this site, because it is being addressed by the remedial actions in place for Sweeper Cove.

Current and future exposures to chemicals in soil and groundwater at the South of Runway 18-36 Area were therefore evaluated for potential construction workers who could be involved in tasks requiring subsurface intrusion. The following exposure pathways were selected for quantitative evaluation under current and future conditions:

- Construction workers potentially disturbing soil in the course of construction activity could be exposed through incidental ingestion, dermal contact, and inhalation of chemicals in soil (to a depth of 15 feet).

- Construction workers conducting intrusive subsurface work could be exposed to chemicals in shallow groundwater (less than 15 feet bgs) through dermal contact and inhalation of volatile chemicals.

Ingestion of groundwater is an incomplete pathway for all receptors. As discussed in Section 3.0, groundwater is not suitable as a drinking water source due to salt water intrusion.

4.3 TOXICITY ASSESSMENT

The third step in risk assessment is an evaluation of the toxicity of the COPCs by an assessment of the relationship between the dose of a chemical and the occurrence of toxic effects. Chemical toxicity criteria, which are based on this relationship, consider both cancer effects and effects other than cancer (noncancer effects). The toxicity criteria are required in order to quantify the potential health risks due to the COPCs. Benzene and ethylbenzene were evaluated for cancer effects, and the other chemicals (where toxicity information exists) were evaluated for noncancer effects.

4.4 RISK CHARACTERIZATION

The last step in human health risk assessment is a characterization of the health risks. The exposure factors, media concentrations, and toxicity criteria are combined to calculate health risks. Health risks are calculated differently for chemicals that cause cancer and for chemicals that cause noncancer effects. The calculation of cancer risk assumes that no level of the chemical is without some risk, whereas for chemicals with noncancer effects, a "threshold" dose exists. Risks (for cancer) and hazards (for noncancer effects) are calculated for the reasonable maximum exposure (RME) for each pathway, a calculation that overestimates risks for the majority of the population in order to ensure that public health is protected. Cancer risk estimates represent the potential for cancer effects by estimating the probability of developing cancer over a lifetime due to site exposures. Noncancer hazards assume there is a level of chemical intake that is not associated with an adverse health effect even in sensitive individuals.

Table 4-1 summarizes the cancer risks and noncancer hazards calculated for construction workers. Cancer risks for the construction worker scenario were 4×10^{-8}, and the non-TPH and TPH hazard indices were 0.09 and 0.9, respectively. These values do not exceed the Alaska DEC target health goals of no more than a 1×10^{-5} chance of developing cancer and a hazard quotient for noncarcinogenic chemicals that does not exceed 1. Therefore, neither groundwater nor soil were found to be a health risk for construction workers, and no actions are necessary to protect public health from chemicals in soil or groundwater at the South of Runway 18-36 Area.

Free-product recovery has been conducted at the South of Runway 18-36 Area intermittently from September 1997 through November 2004. An estimated 1,040 to 5,200 gallons of free product may still be present in the central portion of the site (Figure 3-2). While exposures to free product cannot be quantitatively evaluated in risk assessments, exposures to free product may represent an unacceptable health risk. The degree of risk would depend on a number of factors, including the specific type and location of the project and the actual amount of material disturbed. Therefore, in the event that free product is encountered, the appropriate measures should be taken to minimize contact and exposure. Free product removal will continue at the site, ultimately reducing the potential hazards from exposure to free product.

Because depth to groundwater is on average less than 15 feet bgs, construction workers could potentially come into contact with free product while performing subterranean activities. Free product is also migrating toward South Sweeper Creek. Therefore, recreational users of the creek could potentially come into contact with free product while engaged in outdoor activities, if the product intercept device fails. However, recreational exposures to surface water and sediment along the creek were considered an insignificant pathway based on infrequent exposures and exposures of only short duration. This assumption would still apply if sediment concentrations increased due to the potential presence of free product in surface water. Therefore, the presence of free product in surface water is not likely to present a health concern for recreational exposures in South Sweeper Creek. However, Alaska DEC surface water criteria state that no contamination which could cause a sheen on surface water is permitted. Therefore, while the presence of free product in South Sweeper Creek would not likely present a health concern for intermittent recreational exposures, Alaska DEC surface water criteria would be exceeded.

4.5 CLEANUP LEVELS DISCUSSION

If chemicals at a site exceed target health goals, then site-specific cleanup levels can be calculated to provide information to risk managers. Alaska DEC allows site-specific cleanup levels to be calculated, rather than using the State's default values for soil and groundwater (18 AAC 75.340 and 18 AAC 75.345, respectively). Because no chemicals exceeded target health goals or contributed to exceedances above target health goals, site-specific ACLs were not calculated for this site.

However, recent monitoring well results were compared to the proposed groundwater cleanup levels as discussed in Section 3.6.1. The proposed groundwater cleanup levels for the South of Runway 18-36 Area are the Alaska DEC cleanup criteria for groundwater not currently used as a drinking water source and not reasonably expected to be used as a drinking water source per Alaska Regulation (18 AAC 75.345[b][2]). Out of the 26 groundwater wells sampled at the site,

none had any concentrations of petroleum related chemicals exceeding this criteria in the latest round of groundwater sampling. In addition, only three wells (02-231, E-217, and LC6A) had DRO concentrations exceeding this criteria (15,000 µg/L) in any round of groundwater sampling. The extent of groundwater contamination exceeding the proposed groundwater cleanup levels is depicted on Figure 4-2.

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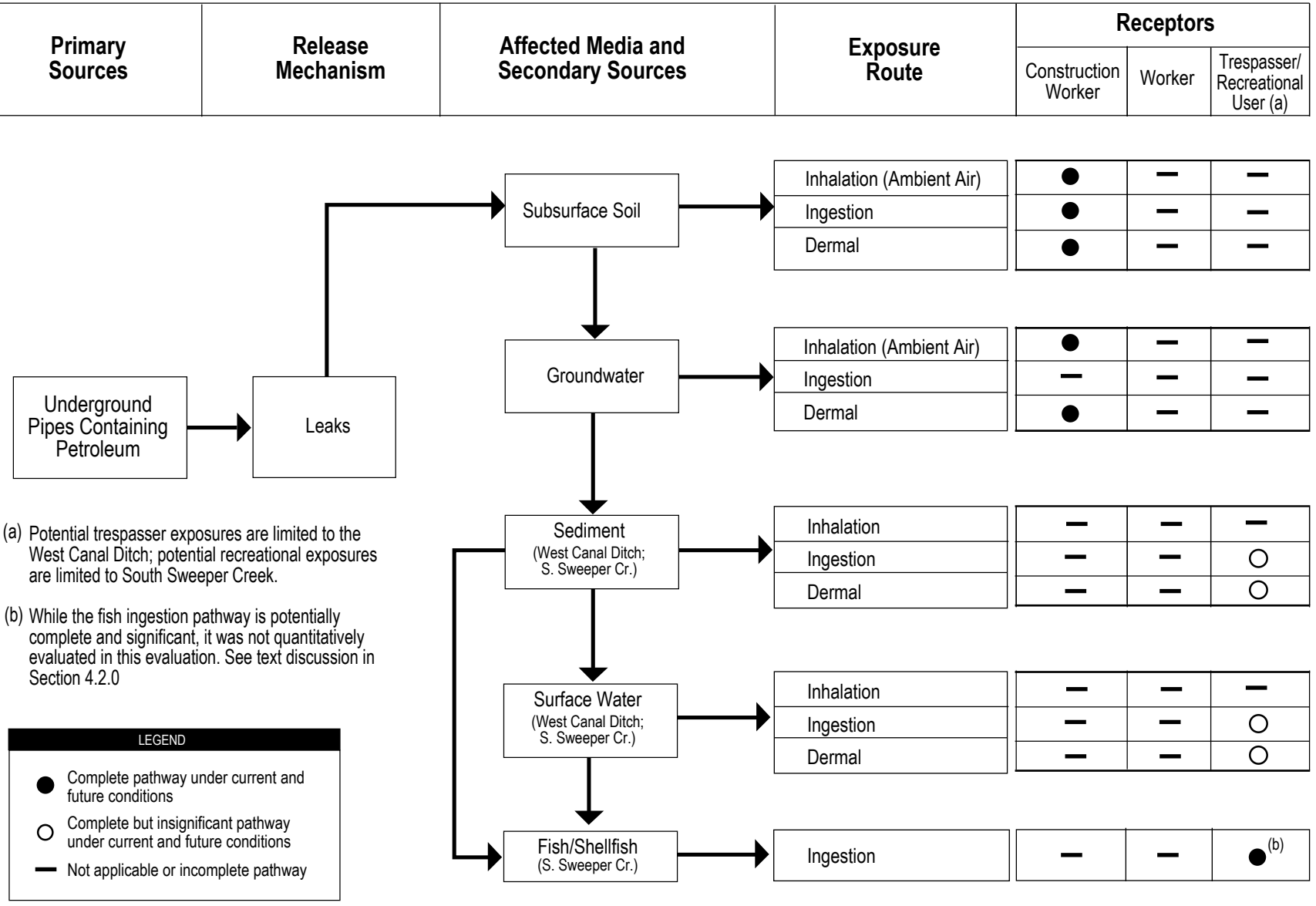
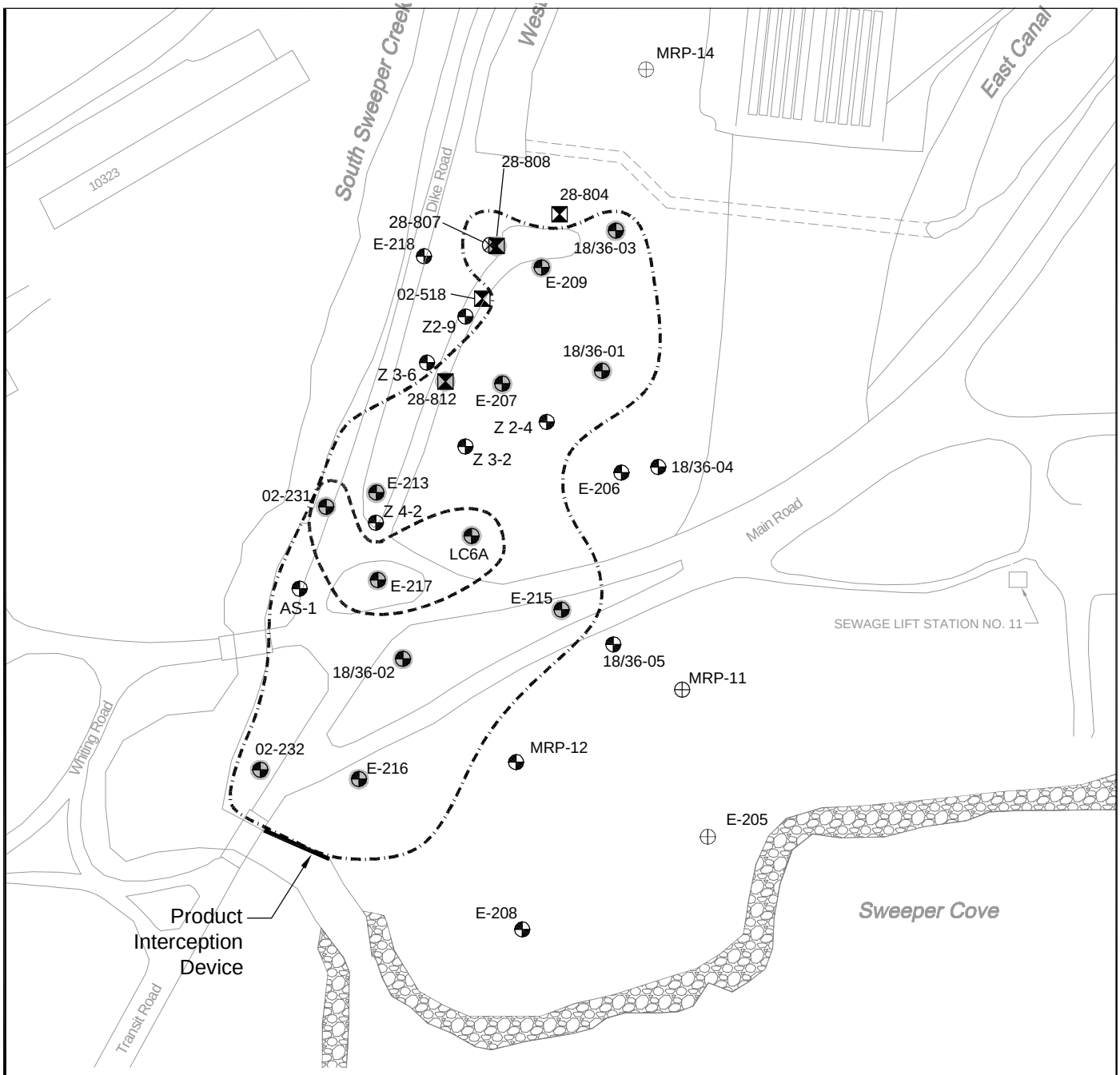


U.S.NAVY

Figure 4.1
Human Health Conceptual Site Model
South of Runway 18-36 Area

Delivery Order 0037
Adak Island, AK
FOCUSED FEASIBILITY STUDY



LEGEND

- Geoprobe Well
- Monitoring Well
- Abandoned/Lost Monitoring Well
- Recovery Well
- Approximate Extent of Riprap

Locations Where Petroleum-Related Chemicals in Groundwater Exceed the Most Stringent Alaska DEC Criteria or Where Free Product was Observed in Measurable Thicknesses.

Extent of Groundwater Where Petroleum-Related Chemicals Exceed the Proposed Groundwater Cleanup Levels.

Extent of Groundwater Where Petroleum-Related Chemicals Exceed the Most Stringent Alaska DEC Criteria or Where Free Product is Present.

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Figure 4-2
Extent of Groundwater Contamination Exceeding Alaska DEC Groundwater Criteria and the Proposed Cleanup Levels, South of Runway 18-36 Area

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Adak Island, AK
FOCUSED FEASIBILITY STUDY

Table 4-1
Summary of Total RME Risks and Hazards for the Construction Worker From Groundwater and Soil

Chemicals of Potential Concern	Total		Groundwater		Soil	
	HI	CR	HI	CR	HI	CR
2-Methylnaphthalene	0.02	NA	b	NA	0.02	NA
Acetone	b	NA	b	NA	a	a
Benzene	0.01	4E-08	0.01	4E-08	a	a
Ethylbenzene	0.0002	1E-09	0.0002	1E-09	a	a
Naphthalene	0.062	NA	0.02	NA	0.04	NA
Xylenes	0.003	NA	0.003	NA	a	a
Non-TPH Total Hazard/Risk	0.09	4E-08	0.03	4E-08	0.06	--
DRO aliphatics	0.2	NA	b	NA	0.2	NA
DRO aromatics	0.3	NA	b	NA	0.3	NA
GRO aliphatics	0.02	NA	0.004	NA	0.02	NA
GRO aromatics	0.3	NA	0.1	NA	0.2	NA
TPH Total Hazard/Risk	0.9	NA	0.2	NA	0.7	NA

[a] Chemical was not selected as a COPC in this media
[b] Toxicity criteria are not available to quantify exposures to this media.

Notes:
CR - cancer risk
HI - hazard index
NA - not applicable; these chemicals are not considered carcinogenic by this pathway.
NE - not evaluated
RME - reasonable maximum exposure
TPH - total petroleum hydrocarbon
-- - no value

5.0 SUMMARY OF ECOLOGICAL EVALUATION OF THE SOUTH OF RUNWAY 18-36 AREA

In accordance with Alaska DEC risk assessment guidance (Alaska DEC 2000a), the first stage of the ecological risk assessment for the South of Runway 18-36 Area was to determine whether a detailed, quantitative ecological risk assessment (required whenever the potential for an ecological threat from site contaminants exists) of the site was required. Alaska DEC terms this determination Ecological Scientific/Management Decision Point #1. In order to make that decision, Alaska DEC requires the assessment of two factors:

1. The potential presence of state or federal sensitive environments, critical habitats, or sensitive species at the South of Runway 18-36 Area; and

2. The potential presence of complete exposure pathways that result in the ecologically significant exposure of ecological receptors to site contaminants.

If, at Ecological Scientific/Management Decision Point #1, the determination can be made that: 1) no state or federal sensitive environments, critical habitats, or sensitive species are present; and 2) no exposure pathways exist that result in the ecologically significant exposure of ecological receptors to site contaminants; Alaska DEC guidance permits the ecological risk assessment process for a given site to be terminated.

5.1 PROBLEM FORMULATION

An ecological checklist (found in Appendix B of the Alaska DEC Risk Assessment Procedures Manual [2000] and included in this report as Attachment CII-1) was completed, describing the location and characteristics (e.g., environmental setting, land use, environmental fate-and-transport, ecological receptors) of specific environments within the boundaries of the South of Runway 18-36 Area. Through this exercise, it was determined that critical habitat for anadromous salmonids is present in South Sweeper Creek and nearshore marine areas of Sweeper Cove near the South of Runway 18-36 Area. Note that the airport ditch system is an engineered diversionary structure that does not provide high quality ecological habitat. Therefore, references to surface water and sediment in this section refer exclusively to South Sweeper Creek and nearshore marine areas of Sweeper Cove.

An ecological conceptual site model (CSM) was also prepared for the South of Runway 18-36 Area, describing the completeness and significance of exposure pathways by which ecological receptors may potentially be exposed to site contaminants. The CSM (included as Figure 5-1)

revealed that the following complete exposure pathways exist at the South of Runway 18-36 Area that result in the ecologically significant exposure of ecological receptors to site contaminants:

1. Aquatic receptors may be exposed to site contaminants in marine and estuarine waters and sediments of South Sweeper Creek.

2. Terrestrial receptors may be exposed to site contaminants in surface soil 0 to 6 feet below ground surface.

Based on this assessment, a potential ecological threat exists to ecological receptors from petroleum release products in South Sweeper Creek and nearshore marine areas of Sweeper Cove at the South of Runway 18-36 Area. Therefore, an ecological effects evaluation that quantitatively described the potential ecological risk associated with exposure to site contaminants was conducted.

5.2 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

Ecological risk at the South of Runway 18-36 Area was estimated for contaminants in surface soil, fresh and estuarine surface water of South Sweeper Creek, and freshwater and estuarine sediments of South Sweeper Creek. A screening level ecological risk assessment was conducted to determine whether any of the contaminants detected in these media onsite might present an unacceptable risk to ecological receptors. Hazard quotients were derived for the detected contaminants; chemicals with hazard quotients greater than or equal to 1.0 were retained as contaminants of potential ecological concern (COPECs).

The results of the screening level ecological risk assessment to identify COPECs are presented in Table 5-1 for soil, Table 5-2 for surface water, and Table 5-3 for sediment. No COPECs were identified in soil during this risk assessment.

Three surface water contaminants were identified as COPECs:

- Indeno(1,2,3-cd)pyrene
- DRO
- GRO

Four sediment contaminants were identified as COPECs:

- 2-Methylnaphthalene
- Phenanthrene
- DRO
- GRO

COPECs identified during the screening level risk assessment were forwarded to the baseline ecological risk assessment.

5.3 BASELINE ECOLOGICAL RISK ASSESSMENT

All of the COPECs identified during the screening level portion of this ecological risk assessment were also identified as contaminants of concern (COCs) during the risk characterization phase of the baseline ecological risk assessment. The results of the baseline ecological risk assessment are presented in Table 5-4 for surface water, and Table 5-5 for sediment.

Indeno(1,2,3-cd)pyrene concentrations in surface water exceed its risk-based screening concentration of 0.28 µg/L at one location (851) in South Sweeper Creek. GRO concentrations in surface water exceed its risk-based screening concentration of 114 µg/L at two locations (525 and 851) in South Sweeper Creek. These locations, shown on Figure 3-5, are situated in the lower portion of South Sweeper Creek between the 1999 sediment removal areas and Sweeper Cove.

DRO in surface water exceeds its solubility concentration (0.014 µg/L), used as the risk-based screening concentration, wherever it is detected in surface water of South Sweeper Creek. The presence of DRO at concentrations greater than this solubility concentration could produce a sheen on the surface waters of South Sweeper Creek. While not toxicologically quantifiable, such sheen can be associated with physical toxicity to aquatic biota (e.g., covering of respiratory surfaces) and wildlife (e.g., coating of fur or feathers, hypothermia). Alaska water quality standards (18 AAC 70.020[b]) for growth and propagation of fish, shellfish, other aquatic life, and wildlife require that surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.

Concentrations of 2-methylnaphthalene in sediment exceed its risk-based screening concentration of 0.0202 mg/kg at one location (851) in South Sweeper Creek. Phenanthrene concentrations in sediment exceed its risk-based screening concentration of 0.225 mg/kg at one

location (852) in South Sweeper Creek. GRO concentrations in sediment exceed its risk-based screening concentration of 12.2 mg/kg at one location (852) in South Sweeper Creek. DRO concentrations in sediment exceed its risk-based screening concentration of 90.6 mg/kg at four locations (702, 703, 851, and 852) in South Sweeper Creek. Similar to locations where chemicals in surface water exceeded risk-based screening concentrations, these locations, shown on Figure 3-5, are situated in the lower portion of South Sweeper Creek between the 1999 sediment removal areas and Sweeper Cove.

5.4 CONCLUSION

Based on these data, a potential ecological threat exists to aquatic life and benthic biota from COCs in freshwater and estuarine surface water and sediment in South Sweeper Creek in the vicinity of the South of Runway 18-36 Area. However, this potential threat is likely lessening over time because of the continuing source area free-product removal activities and former sediment removal activities that have occurred in South Sweeper Creek. Surface soils at the South of Runway 18-36 Area do not pose quantifiable risks to any ecological receptor.

Alaska State Regulations do not establish cleanup levels for sediment (Alaska DEC 2004). Therefore, the RBSCs derived for sediment were selected as the risk-based cleanup levels for chemicals identified as COCs in sediment: 0.02 mg/kg for 2-methylnaphthalene, 0.225 mg/kg for phenanthrene, 90.6 mg/kg for TPH-DRO, and 12.2 mg/kg for TPH-GRO.

For surface water, as discussed in Section 3.6.1, the water quality standards established by Alaska regulation 18 AAC 70 specifies that "Total Aqueous hydrocarbons (TAqH) in the water column nay not exceed 15 µg/L. Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 µg/L. 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" [18 AAC 70.020(b)(17)(A)(i), 18 AAC 70.020(b)(17)(B)(ii), 18 AAC 70.020(b)(17)(C)]. These water quality criteria are the cleanup levels for surface water of South Sweeper Creek in the vicinity of the South of Runway 18-36 Area.

Alaska State Regulations do not establish cleanup levels for individual chemicals, TPH-DRO and TPH-GRO in surface water. Therefore, the RBSCs derived for surface water were selected as the risk-based cleanup levels for the individual chemicals that were identified as COCs in surface water of South Sweeper Creek: 0.28 µg/L for indeno(1,2,3-cd)pyrene, 0.014 µg/L for TPH-DRO, and 114 µg/L for TPH-GRO. These are additional cleanup levels and do not replace the surface water quality criteria applicable to the site, as described in the previous paragraph. Note, the risk-based cleanup level for TPH-DRO of 0.014 µg/L is based on the maximum

solubility of the chemical. The presence of TPH-DRO at concentrations greater than this solubility could produce a sheen on the surface waters of South Sweeper Creek. Thus, the risk-based cleanup level for TPH-DRO meets the Alaska water quality standard 18 AAC 70.020(b)(17)(C).

Table 5-1
Results of the Screening Level Ecological Risk Assessment to Identify COPECs in Soil at the South of Runway 18-36 Area

Chemical	Maximum Detected Concentration (mg/kg)	RBSC (mg/kg)	Hazard Quotient	Poses Potential Ecological Risk?	Rationale
TPH - Diesel range organics	9,100	20,100	0.5	**NO**	Site chemical concentration lower than RBSC
TPH - Gasoline range organics	2.86	1840	0.002	**NO**	Site chemical concentration lower than RBSC

Notes:
COPEC - Contaminant of potential ecological concern
mg/kg - milligrams contaminant per kilogram of soil
RBSC - Risk-based screening concentration
TPH - Total petroleum hydrocarbons

Table 5-2
Results of the Screening Level Ecological Risk Assessment to Identify COPECs in Surface Water at the South of Runway 18-36 Area

Chemical	Maximum Detected Concentration (µg/L)	RBSC (µg/L)	Hazard Quotient	Poses Potential Ecological Risk?	Rationale
2-Methylnaphthalene	1.5	72	0.02	**NO**	Site chemical concentration lower than RBSC
Benzo(a)anthracene	0.84	2.2	0.4	**NO**	Site chemical concentration lower than RBSC
Benzo(a)pyrene	0.34	0.96	0.4	**NO**	Site chemical concentration lower than RBSC
Benzo(b)fluoranthene	0.5	0.68	0.7	**NO**	Site chemical concentration lower than RBSC
Benzo(g,h,i)perylene	0.33	0.44	0.8	**NO**	Site chemical concentration lower than RBSC
Benzo(k)fluoranthene	0.27	0.64	0.4	**NO**	Site chemical concentration lower than RBSC
Chrysene	1.5	2	0.8	**NO**	Site chemical concentration lower than RBSC
Ethylbenzene	1.5	6400	0.0002	**NO**	Site chemical concentration lower than RBSC
Fluorene	3.5	39.3	0.09	**NO**	Site chemical concentration lower than RBSC
Indeno(1,2,3-cd)pyrene	0.32	0.28	1.1	**YES**	Site chemical concentration exceeds RBSC
Toluene	1.1	3500	0.0003	**NO**	Site chemical concentration lower than RBSC
TPH - Diesel range organics	79000	0.014	NC	**UNKNOWN**	RBSC cannot be used to quantify risks when concentration of diesel-range organics is in excess of maximum water solubility
TPH - Gasoline range organics	650	114	5.7	**YES**	Site chemical concentration exceeds RBSC
Xylenes	5.7	332	0.02	**NO**	Site chemical concentration lower than RBSC

Notes:
COPEC - Contaminant of potential ecological concern
µg/L - micrograms contaminant per liter of water
NC - not calculated
RBSC - Risk-based screening concentration
TPH - Total petroleum hydrocarbons

Table 5-3
Results of the Screening Level Ecological Risk Assessment to Identify COPECs in Sediment at the South of Runway 18-36 Area

Chemical	Maximum Detected Concentration (mg/kg)	RBSC (mg/kg)	Hazard Quotient	Poses Potential Ecological Risk?	Rationale
2-Methylnaphthalene	0.13	0.0202	6.4	**YES**	Site chemical concentration exceeds RBSC
Ethylbenzene	0.03	14	0.002	**NO**	Site chemical concentration lower than RBSC
Fluoranthene	0.05	0.6	0.08	**NO**	Site chemical concentration greater than RBSC
Naphthalene	0.13	0.99	0.1	**NO**	Site chemical concentration greater than RBSC
Phenanthrene	1.4	0.225	6.2	**YES**	Site chemical concentration exceeds RBSC
Pyrene	0.03	0.35	0.09	**NO**	Site chemical concentration greater than RBSC
Toluene	0.07	4.6	0.01	**NO**	Site chemical concentration lower than RBSC
TPH - Diesel range organics	1200	90.6	13.2	**YES**	Site chemical concentration exceeds RBSC
TPH - Gasoline range organics	28	12.2	2.3	**YES**	Site chemical concentration exceeds RBSC
Xylenes	0.2	0.79	0.3	**NO**	Site chemical concentration lower than RBSC

Notes:
COPEC - Contaminant of potential ecological concern
mg/kg - milligrams contaminant per kilogram of sediment
RBSC - Risk-based screening concentration
TPH - Total petroleum hydrocarbons

Table 5-4
Results of the Baseline Ecological Risk Assessment to Identify COCs in Surface Water at the South of Runway 18-36 Area

Chemical	Exposure Point Concentration (µg/L)	RBSC (µg/L)	Hazard Quotient	Poses Potential Ecological Risk?	Rationale
Indeno(1,2,3-cd)pyrene	0.32	0.28	1.14	**YES**	Site chemical concentration exceeds RBSC
TPH - Diesel range organics	79,000	0.014	NC	**UNKNOWN**	RBSC not available to quantify risks when DRO concentration is in excess of maximum water solubility
TPH - Gasoline range organics	650	114	5.7	**YES**	Site chemical concentration exceeds RBSC

Notes:
COC - Contaminant of concern
DRO - diesel-range organics
µg/L - micrograms contaminant per liter of water
NC - not calculated
RBSC - Risk-based screening concentration
TPH - Total petroleum hydrocarbons

Table 5-5
Results of the Baseline Ecological Risk Assessment to Identify COCs in Sediment at the South of Runway 18-36 Area

Chemical	Exposure Point Concentration (mg/kg)	RBSC (mg/kg)	Hazard Quotient	Poses Potential Ecological Risk?	Rationale
2-Methylnaphthalene	0.13	0.0202	6.4	**YES**	Site chemical concentration exceeds RBSC
Phenanthrene	1.4	0.225	6.2	**YES**	Site chemical concentration exceeds RBSC
TPH - Diesel range organics	1200	90.6	13.2	**YES**	Site chemical concentration exceeds RBSC
TPH - Gasoline range organics	28	12.2	2.3	**YES**	Site chemical concentration exceeds RBSC

Notes:
COC - Contaminant of concern
mg/kg - milligrams contaminant per kilogram of sediment
RBSC - Risk-based screening concentration
TPH - Total petroleum hydrocarbons

6.0 POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Applicable or relevant and appropriate requirements (ARARs) are promulgated federal and state laws and regulations that are either applicable to the conditions at a cleanup site or are relevant and appropriate. Relevant and appropriate requirements address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the site. Three kinds of ARARs exist for cleanup of petroleum release sites on Adak Island: chemical-specific, location-specific, and action-specific. These ARAR types are discussed in the subsections that follow.

In addition to ARARs, many federal and state environmental and public health programs also have criteria, advisories, guidance, and proposed standards that are to be considered (TBC) in developing remedies. Although not legally binding, TBCs may provide information that is useful in the evaluation of proposed actions. Where appropriate, these materials, along with ARARs, were evaluated to establish protective cleanup levels.

As noted previously, free-product recovery is already taking place as an interim remedial measure at this site. This recovery is being conducted in accordance with 18 AAC 75.325, which requires recovery to the maximum extent practicable. The recovery is being performed in a manner that minimizes the spread of contamination into an uncontaminated area by using containment, recovery, and disposal techniques appropriate to site conditions; avoids additional discharge; and results in the disposal of the recovered free product in compliance with applicable local, state, and federal requirements.

Note that since groundwater as a drinking water source has been already addressed through institutional controls, groundwater-specific ARARs are not identified.

Chemical-Specific ARARs

Chemical-specific ARARs are generally risk-based concentration limits or discharge limits for specific chemicals. When a specific chemical is subject to more than one discharge or exposure limit, the more stringent of the requirements is used. Chemical-specific ARARs for the South of Runway 18-36 Area include the following:

- 18 AAC 75, Oil and Other Hazardous Substances Pollution Control regulations: This is the primary ARAR for soil and groundwater impacted by petroleum-related chemicals released to the environment within the State of Alaska.

- 18 AAC 70: Water quality standards are relevant and appropriate for fresh and marine surface waters within the State of Alaska.

- 33 United States Code (USC) 1314, Clean Water Act: Ambient water quality criteria are relevant and appropriate for surface water that could be impacted by plume migration.

Location-Specific ARARs

Location-specific ARARs are those requirements that relate to the geographic position or physical condition of the site. These requirements may limit the type of remedial activities that can be implemented or may impose additional constraints. The only potential location-specific ARAR identified for petroleum release sites on Adak Island is the following:

- Alaska Coastal Zone Management Program regulations (6 AAC 80.130): These regulations are relevant and appropriate for coastal areas including off-shore areas, estuaries, wetlands and tideflats, and barrier islands and lagoons that could be impacted by plume migration.

No cultural resources regulations appear to be applicable because the soils that would be disturbed during soil removal are fill materials that were placed during World War II.

Action-Specific ARARs

Action-specific ARARs generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities. These requirements are activated by the particular remedial activities. Potential action-specific ARARs for the alternatives are presented in Table 6-1.

Table 6-1
Potential Action-Specific ARARs for Petroleum Release Sites

Potential Action	Regulatory Citation	ARAR/TBC Determination	Comment
Air emissions	Alaska Air Quality Control (18 AAC 50.300 through 50.380)	Potentially applicable	The substantive construction and operational requirements are potentially applicable to use of technologies with the potential for air emissions including but not limited to air sparging, biosparging, SVE, and low-temperature thermal desorption. These sections include, by reference, other chapters and sections of 18 AAC 50 that specify numerical operational parameters for chemical emissions, feed rates, and so forth.
Cleanup operation	Alaska Oil and Hazardous Substances Pollution Control (18 AAC 75.360)	Potentially applicable	Requires the submittal of a schedule, sampling and analysis plan, waste management plan, a cleanup plan, list of chemical additives, site control plan, demonstration of compliance with air quality standards and requirements (18 AAC 50), plan for ensuring that contaminated soil does not come in contact with uncontaminated soil, and nondomestic wastewater system plan under 18 AAC 72.600. Lists specific requirements for ex-situ cleanup technologies including but not limited to bioremediation and *in-situ* cleanup techniques.
	Handbook for Conducting Cleanups of Contaminated Sites and Regulated Underground Storage Tanks under the Voluntary Cleanup Program	Potential TBC	Specifies design requirements for certain cleanup technologies including but not limited to stockpiling, thermal treatment, soil vacuum extraction, bioremediation, transportation, and disposal of remediated material.
Disposal of hazardous waste	Resource Conservation and Recovery Act (RCRA) regulations (40 CFR Parts 261, 262, 268) and Alaska Hazardous Waste (18 AAC 62)	Potentially applicable	Identifies requirements for identification and proper disposal of hazardous wastes that may be generated during site remediation. Refers to federal regulations including 40 CFR Parts 261, 262, 268, and 273.
Institutional controls	Alaska Oil and Hazardous Substances Pollution Control (18 AAC 75.375)	Potentially applicable	Alaska DEC and the landowner may determine that use of institutional controls is necessary to ensure compliance with an applicable cleanup level; protection of human health, safety, or welfare, or of the environment; or the integrity of site cleanup activities or improvements.

Table 6-1 (Continued)
Potential Action-Specific ARARs for Petroleum Release Sites

Potential Action	Regulatory Citation	ARAR/TBC Determination	Comment
Monitored natural attenuation	EPA OSWER Directive 9200.4.17P	Potential TBC	Guides the use of monitored natural attenuation (MNA) at a site, including performance monitoring and evaluation. States that use of MNA is appropriate in conjunction with other remediation measures (e.g., source control or groundwater extraction) or as a followup to active remediation measures that have already been implemented.
Offsite or portable treatment facilities	Alaska Oil and Hazardous Substances Pollution Control (18 AAC 75.365)	Potentially applicable	Requires that an owner/operator of an offsite or portable treatment facility will obtain approval from the Alaska DEC of an operations plan prior to accepting or treating contaminated soil. Requires confirmation sampling and analysis of treated soil in accordance with the post-treatment sampling and analysis plan, complete containment of contaminated soil before, during, and after treatment; and site monitoring to demonstrate that secondary contamination at the treatment facility did not occur. If secondary contamination did occur at the treatment facility, the owner/operator must perform a cleanup of the secondary contamination within two years of terminating operation.
	Soil Treatment Facility Guidance (Alaska DEC, November 2002)	Potential TBC	Specifies design criteria for containment of contaminated soil and water (associated with soil processing) before, during, and after treatment at an offsite or portable treatment facility.
Recycling of recovered oil	Alaska Oil and Hazardous Substances Pollution Control (18 AAC 75.325)	Potentially applicable	Requires that recovered free product be disposed of in compliance with applicable disposal regulations.
Sampling and analysis	Alaska Oil and Hazardous Substances Pollution Control (18 AAC 75.355)	Potentially applicable	Requires the performance of final confirmation sampling and analysis by a qualified, impartial third party. Specifies sampling and analysis requirements if the practical quantitation limit is higher then the cleanup level. Specifies laboratory analysis must be performed by a laboratory approved by Alaska DEC and the analytical methods to be used by the laboratory.

Table 6-1 (Continued)
Potential Action-Specific ARARs for Petroleum Release Sites

Potential Action	Regulatory Citation	ARAR/TBC Determination	Comment
Storage of contaminated soil	Alaska Oil and Hazardous Substances Pollution Control (18 AAC 75.370)	Potentially applicable	Prohibits blending of contaminated soil with uncontaminated soil; requires that petroleum-contaminated soil be stored on a liner that meets minimum specifications.
Treatment and disposal of wastewater	Alaska Wastewater Disposal (18 AAC 72.500 through 72.610)	Potentially applicable	Requires submittal of engineering plans for treatment and disposal of non-domestic wastewater.
Treatment and disposal of wastewater to surface water	Federal Clean Water Act – NPDES Program (40 CFR Part 131)	Potentially applicable	Substantive standards require that discharge cannot cause a violation of water quality standards.
	Alaska Water Quality Standards (18 AAC 70.20)	Potentially applicable	Sets limits for chemical concentrations in surface water.
Well installation	Alaska Oil and Hazardous Substances Pollution Control (18 AAC 75.345(j))	Potentially applicable	Requires installation, development, and decommissioning of groundwater monitoring wells in accordance with the *Recommended Practices for Monitoring Well Design, Installation, and Decommissioning* (Alaska DEC, April 1992) or another method that is protective of human health, safety, and welfare, and of the environment.
	Recommended Practices for Monitoring Well Design, Installation, and Decommissioning (Alaska DEC, April 1992)	Potential TBC	Specifies construction standards for recovery and monitoring well installation. A well start card is required and the well construction log must be submitted to Alaska DEC.

Notes:
AAC - Alaska Administrative Code
ARAR - applicable or relevant and appropriate requirement
CFR - Code of Federal Regulations
DEC - Department of Environmental Conservation
EPA - U.S. Environmental Protection Agency
MNA - Monitored natural attenuation
OSWER - Office of Solid Waste and Emergency Response
TBC - to be considered
SVE - soil vapor extraction

7.0 REMEDIAL ACTION OBJECTIVES

This section presents proposed remedial action objectives (RAOs) intended to protect human health and the environment from risks related to current and potential future exposure to petroleum hydrocarbons at the site. RAOs indicate where remedial actions may be needed and establish goals to be accomplished by the remedial actions. The RAOs are used to develop general response actions (GRAs), identify technologies and process options, and evaluate remedial alternatives. General response actions, remedial technologies and process options, and remedial alternatives considered for achieving the RAOs presented in this section are discussed in subsequent sections.

This section proposes RAOs that provide for the protection of human health and the environment assuming aviation or public facilities land reuses at the South of Runway 18-36 Area, as proposed by the Adak Reuse Corporation (ASCG 2000) and discussed in Section 2.1.2. These RAOs consider overall risk management objectives and establish the basis for remedial decision making. Specific RAOs developed for this site focus on addressing unacceptable human health and ecological risks posed by exposure to petroleum contaminants of concern (COCs).

7.1 HUMAN HEALTH REMEDIAL ACTION OBJECTIVES

Based on the human health risk assessment conducted for this site and the regulatory requirements, the following RAOs were developed for the protection of human health at the South of Runway 18-36 Area:

- Reduce petroleum hydrocarbons in groundwater to concentrations less than or equal to the Alaska DEC groundwater cleanup levels established for groundwater not currently used for, or not reasonably expected to be used for drinking water

- Minimize exposure to free-phase product

A site-specific human health risk assessment was performed for the site, and the results of this analysis are summarized in Section 4. The potential risks to construction workers resulting from exposure to subsurface soil and groundwater were found to be acceptable. However, exposure to free product may represent an unacceptable health risk. Therefore, in the event that free product is encountered by construction workers performing subterranean activities, the appropriate measures should be taken to minimize contact and exposure. Remedial actions for free product will be evaluated to reduce the potential risk to future construction workers.

The ROD for OU A (U.S. Navy et al. 2000) established the criteria for cessation of free-product recovery based on achievement of the technically practical endpoints. These criteria, based on the operational performance of recovery systems that are not dependent on water table depression (automated skimmers), are as follows:

> *When the monthly volume of recovered product averaged over the most recent 6 months (6-month moving average) is less than 5 gallons of product recovered per month, the technically practicable endpoint for recovery has been reached. If this endpoint criterion has been met for a period of 12 months of product recovery, the system is considered to meet the technically practicable endpoint and recovery can be discontinued (URSG 1999b).*

As previously described, the risks to construction workers resulting from exposure to groundwater were found to be acceptable. However, COC concentrations in groundwater beneath the South of Runway 18-36 Area exceed the Alaska DEC groundwater cleanup levels specified in 18 AAC 75. For the South of Runway 18-36 Area, groundwater cleanup levels consistent with 18 AAC 75.345 (b) (2) apply (i.e., concentrations in groundwater are to be reduced to less than or equal to cleanup levels established for groundwater not currently used for, or not reasonably expected to be used for drinking water). Although the Navy has not submitted a request for an alternative cleanup level in accordance with a groundwater use determination under 18 AAC 350, the Navy believes that the groundwater beneath the South of Runway 18-36 area meets all applicable criteria for alternative cleanup levels. Although the quantity of groundwater in the downtown area may be sufficient for potential limited domestic use, the groundwater is not a reasonably expected potential future source of drinking water based on the quality of the groundwater (18 AAC 75.350 (2) (B)) in the South of Runway 18-36 Area. The groundwater in the South of Runway 18-36 Area is impacted by salt water intrusion (URS 1995c, URSG 2001a).

At a minimum, the Alaska DEC groundwater cleanup levels will be achieved using passive treatment technologies (i.e., monitored natural attenuation [MNA]), as specified in the OU A ROD. MNA with institutional controls was the remedy selected (OU A ROD) for groundwater at the 10 downtown petroleum sites where petroleum-related chemicals exceed Alaska DEC groundwater cleanup levels, but where free product has not been observed. The OU A ROD also specified that the downtown groundwater body would be addressed as one hydrogeologic unit regarding development of remedial alternatives and comparison of the resulting alternatives. As a result, a reanalysis of groundwater treatment technologies for the South of Runway 18-36 Area is not needed based on the exceedance of the Alaska DEC groundwater cleanup levels at the site. However, further analysis of groundwater treatment technologies is included in this document,

because of the exceedances of ecological risk-based screening concentrations (RBSCs) and Alaska DEC water quality standards in surface water and sediment (see Section 7.2).

7.2 ECOLOGICAL REMEDIAL ACTION OBJECTIVES

Based on the ecological risk assessment conducted for this site and the regulatory requirements, the following RAOs were developed for the protection of ecological receptors at the South of Runway 18-36 Area:

- Prevent the migration of petroleum hydrocarbons to sediments that would result in adverse health effects to ecological receptors

- Prevent the migration of petroleum hydrocarbons to surface water that would result in adverse health effects to ecological receptors and/or an exceedance of the Alaska surface water quality standards.

- Prevent ecological exposure to petroleum hydrocarbons in surface water and sediment that would result in adverse health effects to ecological receptors and/or an exceedance of the Alaska surface water quality standards.

A site-specific ecological risk assessment was performed for the site, and the results of this analysis are summarized in Section 5. Ecological risks were found to exceed target health goals because of petroleum contamination in surface water and sediment. Surface soils do not pose unacceptable risks to any ecological receptors.

Because Alaska State regulations do not establish cleanup levels for sediment, risk-based cleanup levels were established for sediment at the South of Runway 18-36 Area based on the results of the risk assessment. These risk-based cleanup levels were set at the RBSCs for the chemicals that potentially pose an unacceptable ecological risk:

- 2-Methylnaphthalene 0.0202 mg/kg
- Phenanthrene 0.225 mg/kg
- GRO 12.2 mg/kg
- DRO 90.6 mg/kg

Because sediment impacts are the result of migration of contaminants from the source area to sediment via groundwater, remedial technologies applicable to the source area (free-phase product and aquifer media) and groundwater will be evaluated. Remedial actions for sediment

exceeding these risk-based cleanup levels will also be evaluated to reduce the site risks to below target health goals in the sediment, because sediment can remain contaminated for a period of time after the source of contamination has been remediated.

Because Alaska State regulations do not establish cleanup levels for individual chemicals in surface water, risk-based cleanup levels were established for surface water at the South of Runway 18-36 Area based on the results of the risk assessment. These action-based ACLs were set at the RBSCs for the chemicals that potentially pose an unacceptable ecological risk:

- Indeno(1,2,3-cd)pyrene 0.28 µg/L
- GRO 114 µg/L
- DRO 0.014 µg/L

Because surface water impacts are the result of migration of contaminants from the source area to surface water via groundwater, remedial technologies applicable to the source area (free-phase product and aquifer media) and groundwater will be evaluated. Remedial actions specifically for surface water exceeding these risk-based cleanup levels will not be evaluated. Remediating the surface water in the creek would not be effective, because the source of the surface water contamination is the groundwater and/or free-phase product. As soon as the source of contamination is addressed, the surface water concentrations of contaminants will quickly decrease.

In addition, surface water and sediment in South Sweeper Creek do not meet the Alaska DEC surface water quality standards, established by Alaska regulation 18 AAC 70. These surface water quality standards are:

- Total aqueous hydrocarbons (TAqH) may not exceed 15 µg/L
- Total aromatic hydrocarbons (TAH) may not exceed 10 µg/L
- Petroleum hydrocarbons in shoreline or bottom sediments may not cause deleterious effects to aquatic life
- Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration

As specified in 18 AAC 75.345(f), groundwater that is closely connected hydrologically to nearby surface water may not cause a violation of these water quality standards for surface water or sediment. Remedial actions will be evaluated for aquifer media, free product, and

groundwater such that these surface water quality standards will be met in the surface water and sediment.

7.3 EXTENT OF CONTAMINATION FOR MEDIA OF CONCERN

The media of concern for which RAOs were established in Sections 7.1 and 7.2 include groundwater, free-phase product, surface water, and sediment. The extent of contamination for these media is summarized below and shown on Figure 7-1.

The approximate extent of free-product remaining on the site is presented in Section 3. Figures 7-1 and 7-2 show the estimated extent of residual free product for three different timeframes. In addition, Figure 7-2 shows the locations where free product thicknesses exceeded 0.5 feet from January 2001 through December 2004. During 2004, measurable thicknesses of free product were detected in an area totaling approximately 164,000 square feet.

The extent of groundwater that exceeds Alaska DEC criteria established for groundwater not currently used for, or not reasonably expected to be used for drinking water is delimited in Section 4. The area that potentially exceeds the Alaska DEC criteria for groundwater not used for drinking water is shown on Figure 7-1 and Figure 7-3. This area totals approximately 27,000 square feet. In addition, Figure 7-3, shows the locations where detected concentrations exceed the Alaska DEC criteria for groundwater not used for drinking water.

The RBSCs described in Appendix C and summarized in Section 5 and the Alaska DEC surface water quality standards were used to delimit the area that exceeds acceptable risk for ecological exposure to petroleum hydrocarbons in surface water and/or exceeds the surface water quality standards. RBSCs and surface water quality standards have been defined for the following COCs in surface water:

- Indeno(1,2,3-cd)pyrene 0.28 µg/L
- GRO 114 µg/L
- DRO 0.014 µg/L
- TAqH 15 µg/L
- TAH 10 µg/L

Concentrations of these chemicals in surface water are shown on Figure 7-4. Locations where concentrations exceed the RBSCs and surface water quality standards are also shown on this Figure. In addition, the concentrations of these chemicals in groundwater collected from wells located adjacent to the surface water bodies at the site are shown on Figure 7-5. This figure also

shows the well locations adjacent to surface water bodies where concentrations exceeded the RBSCs or surface water quality standards.

The RBSCs described in Appendix C and summarized in Section 5 were used to delimit the area that exceeds acceptable risk for ecological exposure to petroleum hydrocarbons in sediment. RBSCs have been defined for the following COCs in sediment:

- 2-Methylnaphthalene 0.0202 mg/kg
- Phenanthrene 0.225 mg/kg
- GRO 12.2 mg/kg
- DRO 90.6 mg/kg

Concentrations of these chemicals in sediment are shown on Figure 7-6. Locations where concentrations exceed the RBSCs are also shown on Figure 7-6.

The area shown on Figure 7-1 was identified as containing surface water and sediment with COC concentrations exceeding the RBSCs and/or surface water quality standards. This area encompasses a total of approximately 87,000 square feet. The depth of sediments contaminated with petroleum-related hydrocarbons is not known, because only surface sediments were collected at the site. Assuming that the top two feet of sediment is contaminated with petroleum-related compounds at concentrations greater than RBSCs, approximately 6,400 cy of contaminated sediment exist at the site.

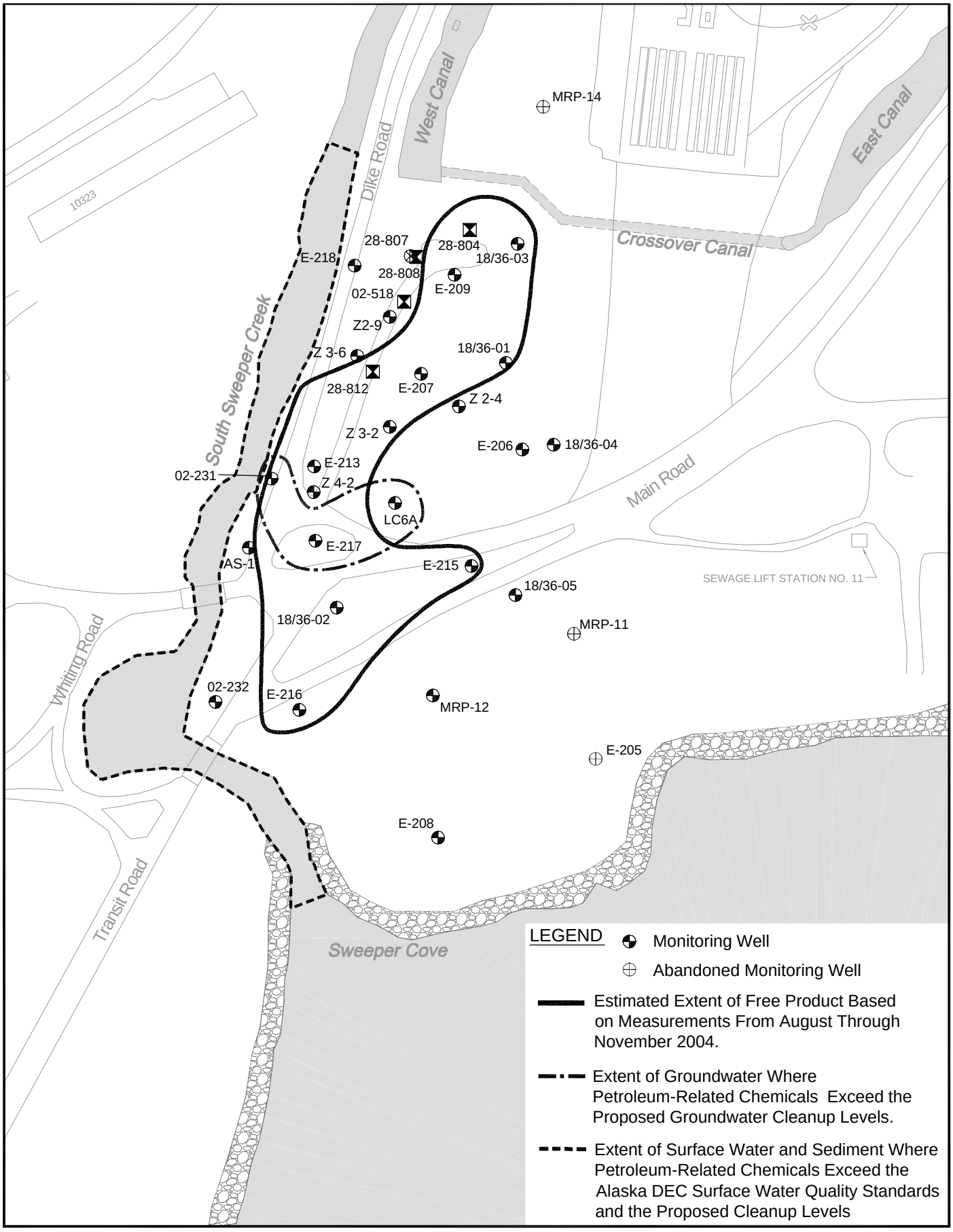

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Figure 7-1
Extent of Contamination
South of Runway 18-36 Area

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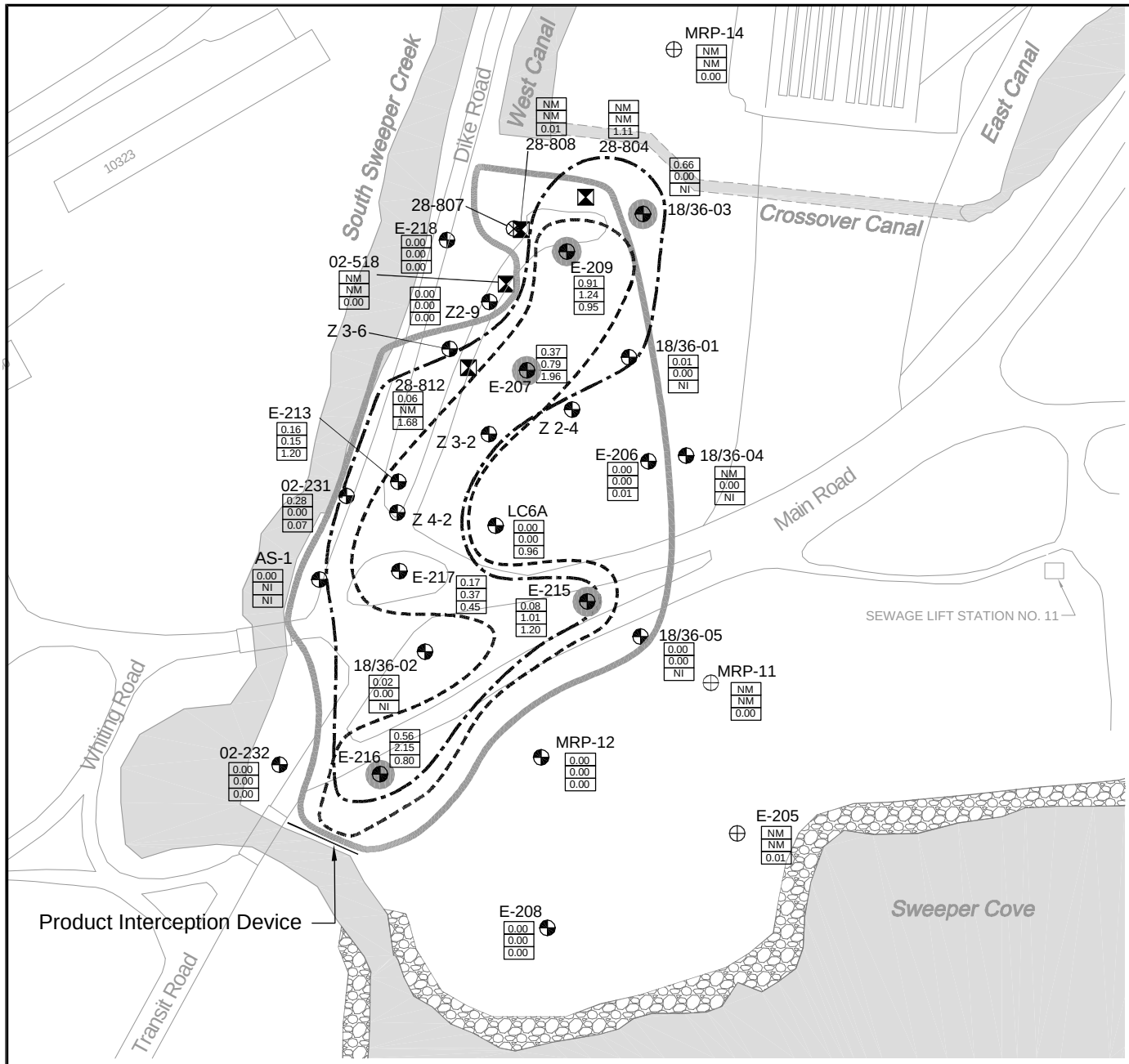

LEGEND

- Geoprobe Well
- Monitoring Well
- Abandoned/Lost Monitoring Well
- Recovery Well
- MLLW Mean Lower Low Water
- NM Not Measured
- NI Not Installed
- Approximate Extent of Riprap
- Estimated Extent of Free Product Based on Measurements From August Through November 2004.
- Estimated Extent of Free Product Based on Measurements From January 2001 Through October 2003.
- Estimated Extent of Free Product Based on Measurements From November 1992 Through October 2000.
- 0.02 August - December 2004
- 2.33 January 2001 - October 2003
- 1.65 November 1992 - October 2000
- Locations Where Free-Product Thickness Exceeded 0.5 Feet January 2001 Through December 2004

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Figure 7-2
Estimated Extent of Residual Free-Product South of Runway 18-36 Area

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Adak Island, AK
FOCUSED FEASIBILITY STUDY

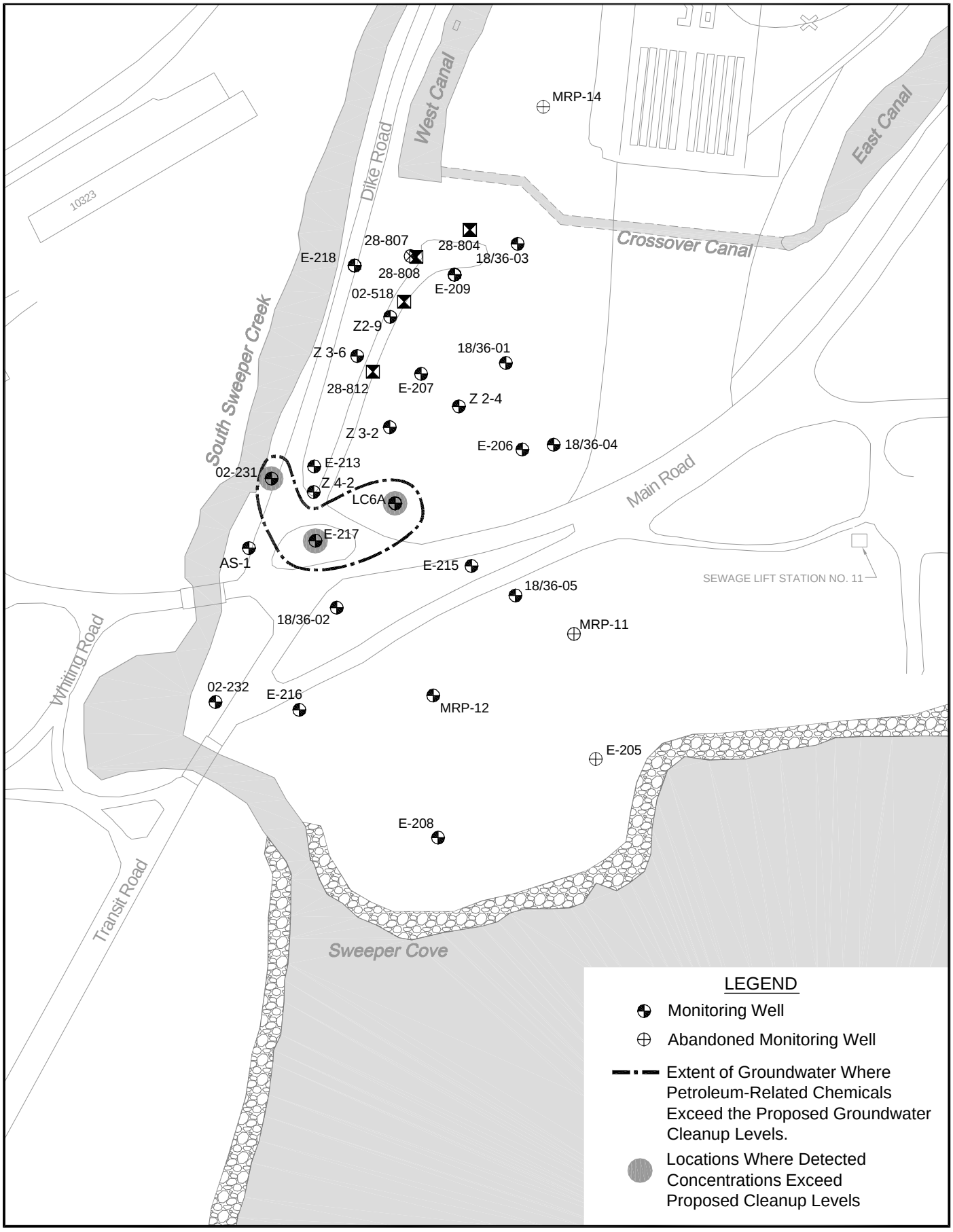

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Figure 7-3
Locations Where Petroleum-Related Chemicals in Groundwater Exceeded Proposed Groundwater Cleanup Levels
South of Runway 18-36 Area

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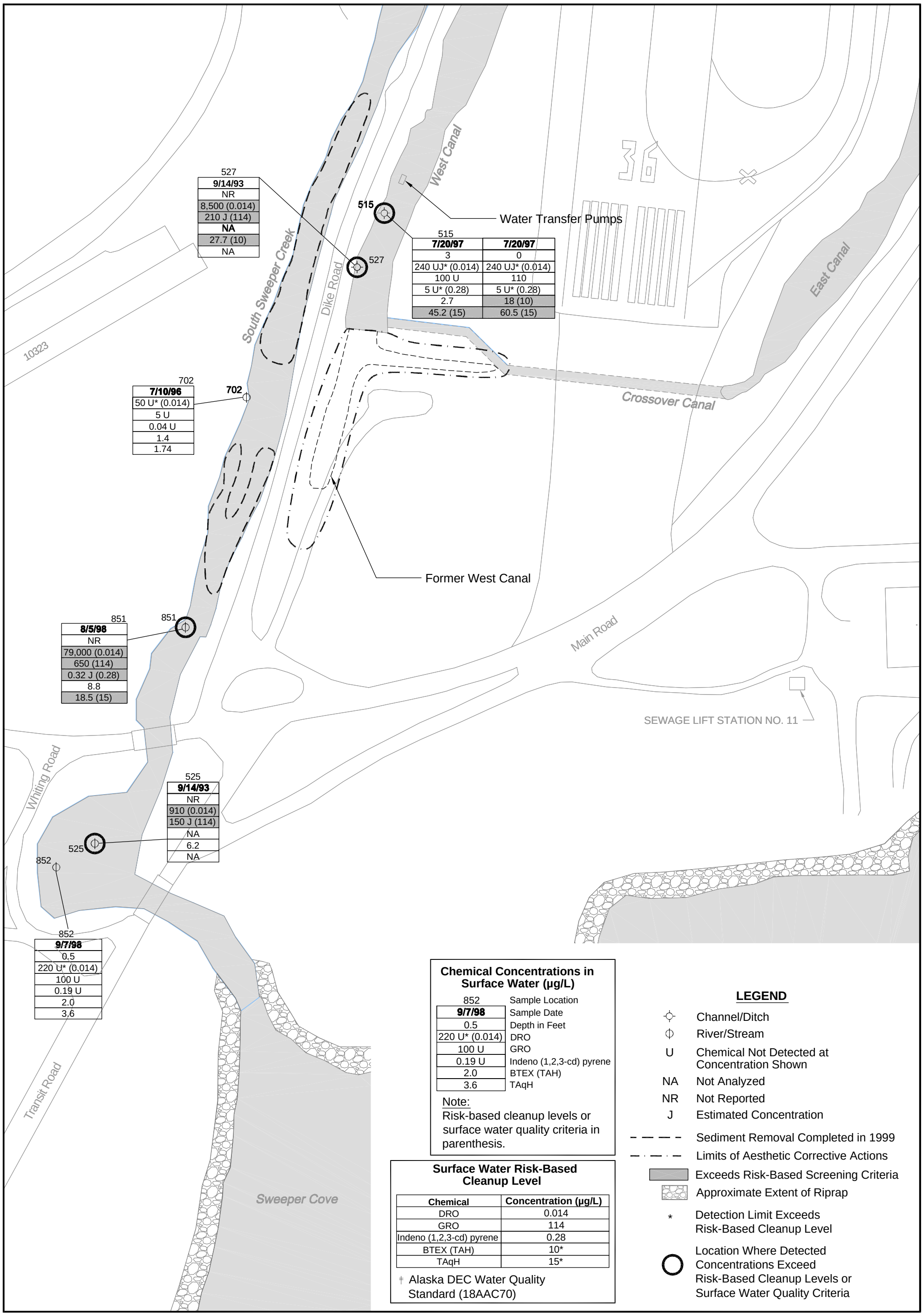
Adak Island, AK
FOCUSED FEASIBILITY STUDY



Chemical Concentrations in Surface Water (µg/L)

852	Sample Location
9/7/98	Sample Date
0.5	Depth in Feet
220 U* (0.014)	DRO
100 U	GRO
0.19 U	Indeno (1,2,3-cd) pyrene
2.0	BTEX (TAH)
3.6	TAqH

Note:
Risk-based cleanup levels or surface water quality criteria in parenthesis.

Surface Water Risk-Based Cleanup Level

Chemical	Concentration (µg/L)
DRO	0.014
GRO	114
Indeno (1,2,3-cd) pyrene	0.28
BTEX (TAH)	10*
TAqH	15*

† Alaska DEC Water Quality Standard (18AAC70)

LEGEND

- Channel/Ditch
- River/Stream
- U — Chemical Not Detected at Concentration Shown
- NA — Not Analyzed
- NR — Not Reported
- J — Estimated Concentration
- Sediment Removal Completed in 1999
- Limits of Aesthetic Corrective Actions
- Exceeds Risk-Based Screening Criteria
- Approximate Extent of Riprap
- * — Detection Limit Exceeds Risk-Based Cleanup Level
- Location Where Detected Concentrations Exceed Risk-Based Cleanup Levels or Surface Water Quality Criteria

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SCALE IN FEET

Figure 7-4
Locations Where Petroleum-Related Chemicals in Surface Water Exceeded Risk-Based Cleanup Levels or Surface Water Quality Criteria South of Runway 18-36 Area

Delivery Order 0037
Adak Island, AK
FOCUSED FEASIBILITY STUDY

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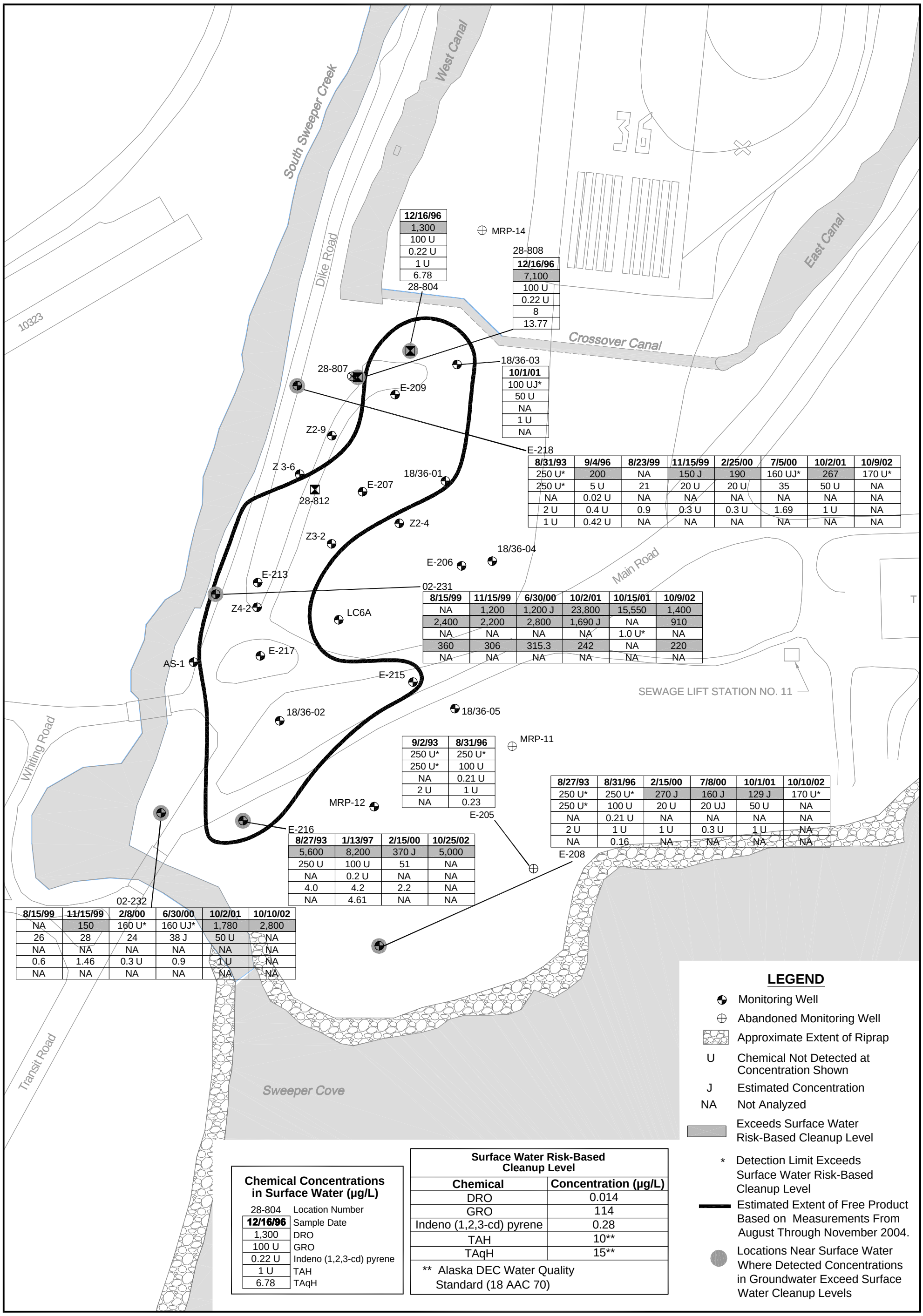

12/16/96
1,300
100 U
0.22 U
1 U
6.78

12/16/96
7,100
100 U
0.22 U
8
13.77

10/1/01
100 UJ*
50 U
NA
1 U
NA

8/31/93	9/4/96	8/23/99	11/15/99	2/25/00	7/5/00	10/2/01	10/9/02
250 U*	200	NA	150 J	190	160 UJ*	267	170 U*
250 U*	5 U	21	20 U	20 U	35	50 U	NA
NA	0.02 U	NA	NA	NA	NA	NA	NA
2 U	0.4 U	0.9	0.3 U	0.3 U	1.69	1 U	NA
1 U	0.42 U	NA	NA	NA	NA	NA	NA

8/15/99	11/15/99	6/30/00	10/2/01	10/15/01	10/9/02
NA	1,200	1,200 J	23,800	15,550	1,400
2,400	2,200	2,800	1,690 J	NA	910
NA	NA	NA	NA	1.0 U*	NA
360	306	315.3	242	NA	220
NA	NA	NA	NA	NA	NA

9/2/93	8/31/96
250 U*	250 U*
250 U*	100 U
NA	0.21 U
2 U	1 U
NA	0.23

8/27/93	8/31/96	2/15/00	7/8/00	10/1/01	10/10/02
250 U*	250 U*	270 J	160 J	129 J	170 U*
250 U*	100 U	20 U	20 UJ	50 U	NA
NA	0.21 U	NA	NA	NA	NA
2 U	1 U	1 U	0.3 U	1 U	NA
NA	0.16	NA	NA	NA	NA

8/27/93	1/13/97	2/15/00	10/25/02
5,600	8,200	370 J	5,000
250 U	100 U	51	NA
NA	0.2 U	NA	NA
4.0	4.2	2.2	NA
NA	4.61	NA	NA

8/15/99	11/15/99	2/8/00	6/30/00	10/2/01	10/10/02
NA	150	160 U*	160 UJ*	1,780	2,800
26	28	24	38 J	50 U	NA
NA	NA	NA	NA	NA	NA
0.6	1.46	0.3 U	0.9	1 U	NA
NA	NA	NA	NA	NA	NA

Chemical Concentrations in Surface Water (µg/L)

28-804	Location Number
12/16/96	Sample Date
1,300	DRO
100 U	GRO
0.22 U	Indeno (1,2,3-cd) pyrene
1 U	TAH
6.78	TAqH

Surface Water Risk-Based Cleanup Level

Chemical	Concentration (µg/L)
DRO	0.014
GRO	114
Indeno (1,2,3-cd) pyrene	0.28
TAH	10**
TAqH	15**

** Alaska DEC Water Quality Standard (18 AAC 70)

LEGEND

- Monitoring Well
- Abandoned Monitoring Well
- Approximate Extent of Riprap
- U — Chemical Not Detected at Concentration Shown
- J — Estimated Concentration
- NA — Not Analyzed
- Exceeds Surface Water Risk-Based Cleanup Level
- * — Detection Limit Exceeds Surface Water Risk-Based Cleanup Level
- Estimated Extent of Free Product Based on Measurements From August Through November 2004.
- Locations Near Surface Water Where Detected Concentrations in Groundwater Exceed Surface Water Cleanup Levels

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Figure 7-5
Well Locations Near Surface Water Where Petroleum-Related Chemicals in Groundwater Exceeded Surface Water Risk-Based Cleanup Levels
South of Runway 18-36 Area

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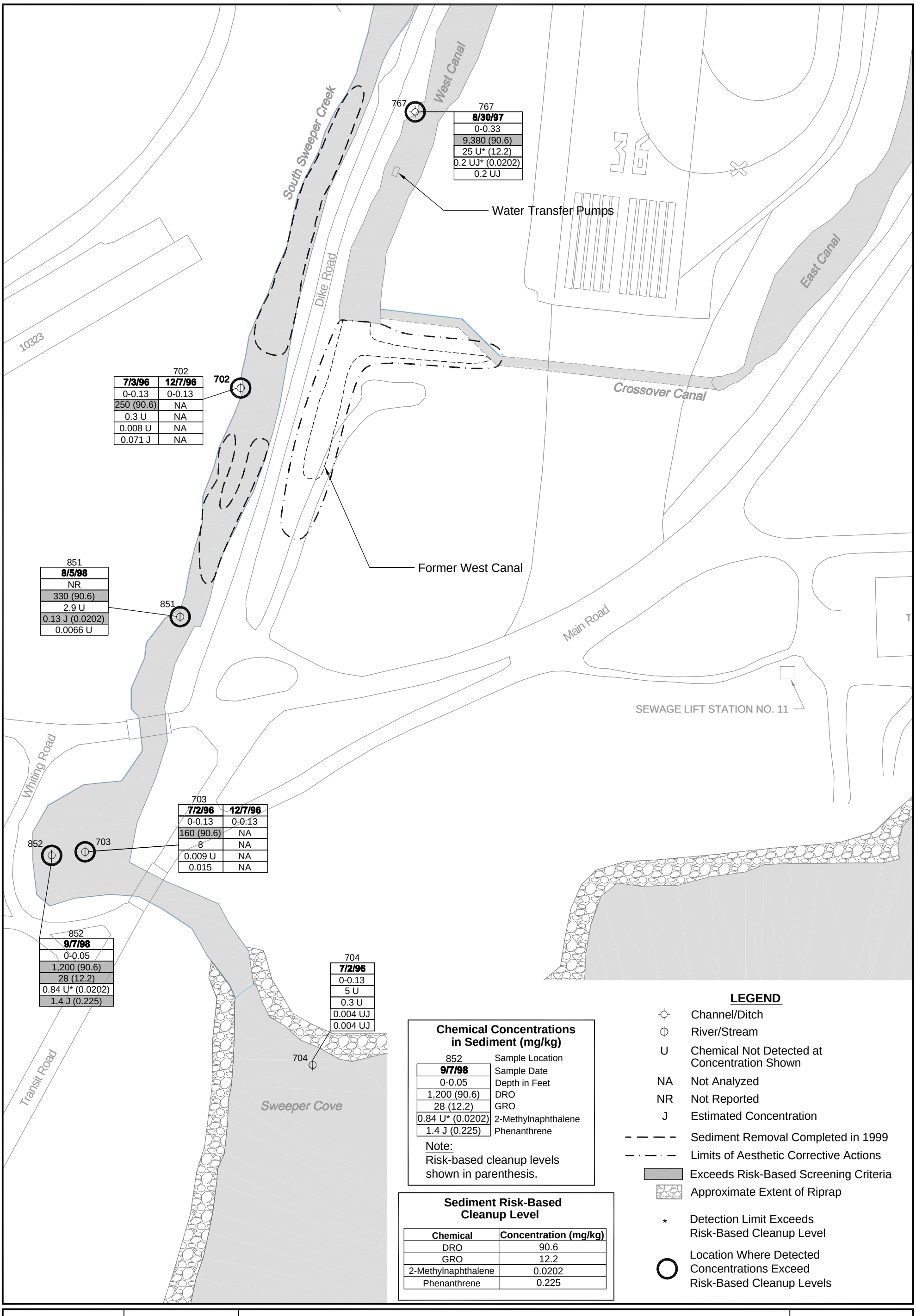

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Figure 7-6
Locations where Petroleum-Related Chemicals in Sediment Exceeded Risk-Based Cleanup Levels
South of Runway 18-36 Area

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8.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGY TYPES AND PROCESS OPTIONS

This section provides the identification and screening of technology types and process options for all the downtown petroleum sites on Adak Island where site-specific risk assessments indicate a risk to human health or the environment above target health goals, and the screening of technology types and process options specific to the South of Runway 18-36 Area. Remedial technology types and process options were identified and screened first for the downtown sites as a group, because FFSs will be prepared for four downtown Adak petroleum sites (NMCB Expanded Area, South of Runway 18-36 Area, Solid Waste Management Unit [SWMU 17], and SWMU 62) that have similar characteristics. This approach was taken to streamline the process by reducing the number of process options and technologies potentially applicable to downtown petroleum sites prior to screening the process options and technologies for each individual downtown site. Then, the technology types and process options determined to be applicable to the downtown petroleum sites (i.e., the "short list") were evaluated using site-specific information to identify those applicable to the South of Runway 18-36 Area. The results of the screening for the downtown sites are presented in Section 8.1 and Appendix D, and the results of the site-specific evaluation for the South of Runway 18-36 Area are presented in Section 8.2. A flowchart that presents the overall screening process is provided in Figure 8-1.

8.1 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGY TYPES AND PROCESS OPTIONS APPLICABLE TO DOWNTOWN PETROLEUM SITES

The identification and screening of remedial technology types and process options for the downtown petroleum sites is provided in Appendix D. The identification and screening of remedial technology types and process options for the downtown sites were performed using the following process:

- First, the potentially impacted media were identified (Section D.1 of Appendix D).
- Second, the general response actions were identified and screened (Section D.2 of Appendix D).
- Third, the technology types potentially applicable to petroleum sites on Adak Island were identified and screened to eliminate those technology types that could not be technically implemented at the downtown petroleum sites due to

downtown-specific conditions such as the depth to impervious formations (Section D.3 of Appendix D).

- Finally, the process options underwent an evaluation screening step to identify process options best able to meet remedial action objectives and screening criteria for incorporation into the remedial alternatives (Section D.4 of Appendix D).

The purpose of this identification and screening process is to identify a short list of technology types and process options that are applicable to all the downtown petroleum sites based on the following factors common to these sites: the remoteness of Adak Island, the weather conditions on Adak, and the geologic conditions (soil type) of the downtown sites. Factors considered due to the remoteness of Adak Island include the difficulty of operating and maintaining equipment given that the island is 1,300 miles from supplies, workers with the requisite technical expertise may not be available on the island, and the unreliable power supply. The weather conditions on the island influencing process option selection include frequent intense storms that restrict human activity. Because this screening is for a focused feasibility study, there is no requirement to evaluate technologies applicable to chemicals other than the contaminants of concern. Therefore, technology types and process options applicable only to petroleum hydrocarbons were considered.

The process options best able to meet the remedial action objectives and the screening criteria for each medium were selected for consideration at the downtown petroleum sites. Based on the screening performed in Appendix D, the short list of technology types and process options retained for further evaluation is presented in Table 8-1.

8.2 SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS FOR THE SOUTH OF RUNWAY 18-36 AREA

This section presents the potential remedial technology types and process options capable of meeting the RAOs discussed in Section 7 for the South of Runway 18-36 Area. In this section, short-listed technology types and process options identified for the downtown petroleum sites in Tables D-8, D-9, D-10, D-11, and D-12 of Appendix D and Table 8-1 are evaluated using site-specific information for the South of Runway 18-36 Area to identify process options that will be developed into alternatives to meet site-specific RAOs identified in Section 7. This evaluation was conducted with respect to protectiveness, ability to meet cleanup levels, and implementability, which are the three criteria identified in Alaska DEC guidance (Alaska DEC 1999b). The results are provided in Tables 8-2, 8-3, 8-4, and 8-5 for aquifer media (saturated soil), free-phase product, groundwater (surface water and sediment protection), and sediment,

respectively. The retained process options, which are listed in Table 8-6, were selected for potential inclusion in the remedial alternatives as described in Section 9.

Process options associated with the four aquifer media GRAs—no action, institutional controls, in situ treatment of aquifer media, and excavation and treatment of aquifer media (with dewatering)—were retained for the aquifer media at the South of Runway 18-36 Area (Table 8-2). No action and all of the process options considered for institutional controls were retained for inclusion in the remedial action alternatives. One of the six process options considered for in situ treatment of aquifer media at the South of Runway 18-36 Area was retained for inclusion in the remedial action alternatives: MNA. The physical treatment process option—air sparging—and two biological treatment process options—biosparging and in situ submerged oxygen curtain by Inventures Technologies Incorporated (iSOC^{TM}) bioremediation enhancement—were eliminated because they would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons and reducing migration of petroleum hydrocarbons to surface water. The thermal treatment process option—steam stripping—was eliminated because of the complexity of the steam generation system and because it has the potential to adversely affect the ambient surface water temperature in South Sweeper Creek and Sweeper Cove. The chemical treatment process option—chemical reduction/oxidation—was not selected as an aggressive treatment option because the presence of free-phase product is not compatible with this technology and the subsurface is not homogeneous. Finally, the single process option considered for excavation and treatment of aquifer media (with dewatering) at the South of Runway 18-36 Area—thermal desorption—was retained for inclusion in the remedial action alternatives.

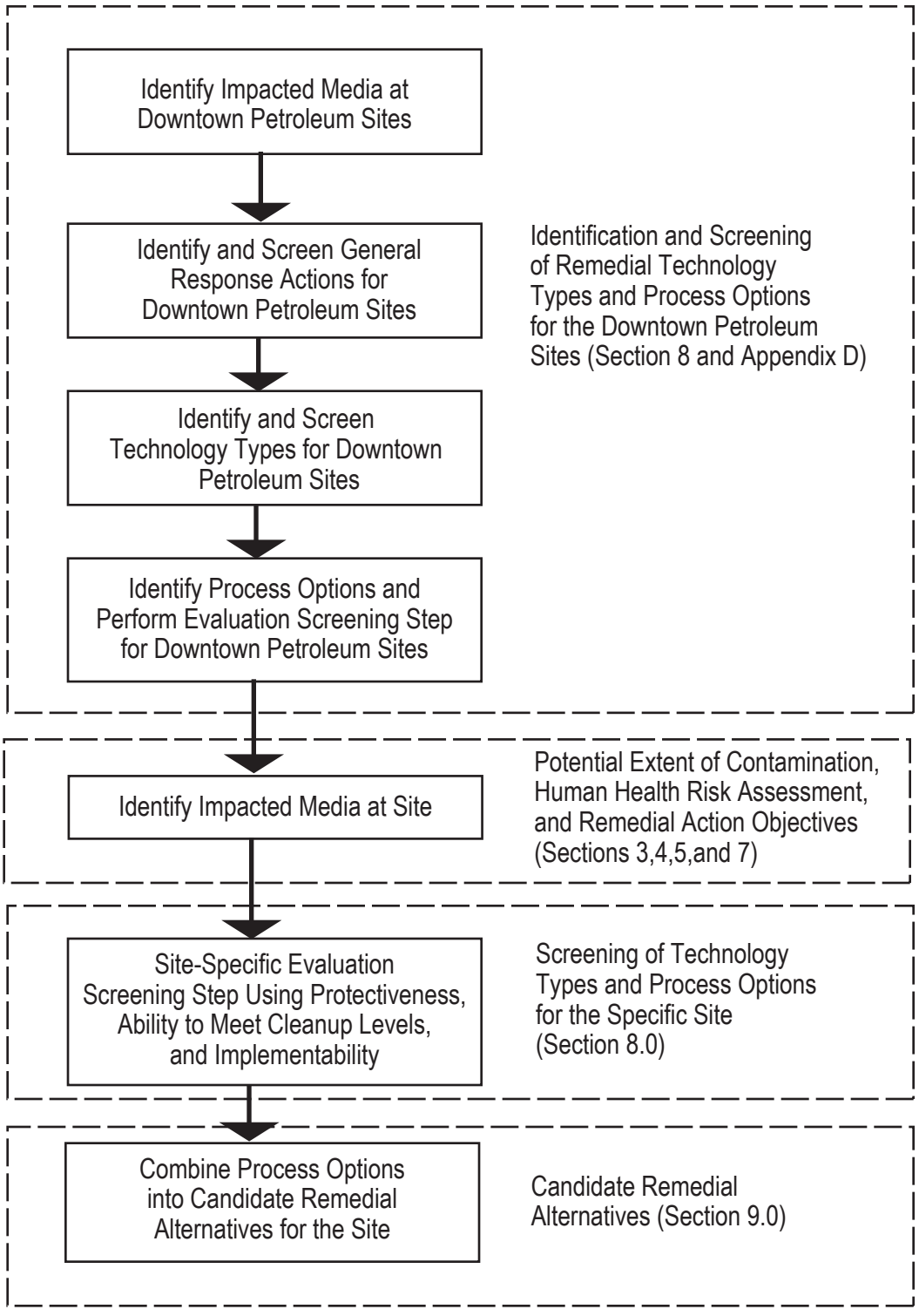
Process options associated with the three free-phase product GRAs—no action, institutional controls, and free-phase product recovery—were retained for the free-phase product at the South of Runway 18-36 Area (Table 8-3). No action and all of the process options considered for institutional controls were retained for inclusion in the remedial action alternatives. The only process option considered for active recovery of free-phase product—dual-phase extraction (DPE)—was not retained for inclusion in the alternatives, due to the presence of permeable soils, the close distance to surface water bodies (East Canal, South Sweeper Creek, and Sweeper Cove), and the tidal cycles. Treating the large quantity of water pumped due to these site conditions would be difficult. All of the process options for passive recovery of free-phase product—automated passive skimmers, passive skimmers, and sorbent booms/sorbent socks—were retained for inclusion in the remedial action alternatives. The free-phase product recovery GRA was included even though free-phase product recovery activities are already occurring at the South of Runway 18-36 Area. Currently, passive free-phase product recovery, incorporating automated passive skimmers and passive skimmers, is being used at the site (see Section 3.3 for a detailed description of the free-phase product recovery activities that have occurred through

November 2004). Additional actions (i.e., expanding the use of these process options) are being considered at the site to accelerate recovery activities and thereby reduce the time that will be required to meet the technically practicable endpoint for free-phase product recovery and to protect surface water and sediment.

Process options associated with the four groundwater (for surface water and sediment protection) GRAs—no action, institutional controls, containment, and in situ treatment of groundwater—were retained for the groundwater (for surface water and sediment protection) at the South of Runway 18-36 Area (Table 8-4). No action and all of the process options considered for institutional controls were retained for inclusion in the remedial action alternatives. All of the process options considered for containment of groundwater contamination were retained for inclusion in the remedial action alternatives. These process options are air sparging, biosparging, and iSOC™ bioremediation enhancement. One of the six process options for in situ treatment of groundwater—MNA—was retained for inclusion in the remedial action alternatives. Air sparging, biosparging, and iSOC™ bioremediation enhancement were eliminated as in situ treatment of groundwater process options because they would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons in the subsurface and reducing migration to surface water, free-product removal would need to be completed prior to use, and these technologies would not be an efficient method of meeting surface water RAOs and ACLs because very little of the contamination is in the dissolved phase. The thermal process option—steam stripping—was eliminated because of the complexity of the steam generation system and because it has the potential to adversely affect the temperature in South Sweeper Creek and Sweeper Cove. The chemical treatment process option—chemical reduction/oxidation—was not selected as an aggressive treatment option because the presence of free-phase product is not compatible with this technology and the subsurface is not homogeneous. The ex situ treatment of groundwater process option—liquid-phase carbon adsorption—was eliminated because it would not be an efficient technology for remediating a site with free product, which continues to dissolve petroleum hydrocarbons into the groundwater.

Process options associated with the five of the six sediment GRAs—no action, institutional controls, in situ treatment, sediment removal/disposal (with dewatering), and sediment removal/treatment/disposal (with dewatering)—were retained for the sediment at the South of Runway 18-36 Area (Table 8-5). All of the process options under containment/capping were eliminated because sediment excavation would be required to maintain the flow characteristics of South Sweeper Creek. Therefore, containment/capping would provide no additional benefit and additional costs over just performing sediment excavation. No action and all of the process options considered for institutional controls and in situ treatment were retained for inclusion in the remedial action alternatives. Only one of the process options for sediment removal/disposal—conventional excavation with coffer dams—was retained for inclusion in the

remedial action alternatives. The three dredging process options—hydraulic dredging, mechanical dredging, and combination dredging—were eliminated because South Sweeper Creek is too small to accommodate hydraulic or mechanical dredging equipment. Two of the process options for sediment removal/treatment/disposal—conventional excavation with coffer dams and thermal desorption—were retained for inclusion in the remedial alternatives. The three dredging process options were eliminated as described for sediment removal/disposal.



U.S.NAVY	**Figure 8-1** **Screening Process Flowchart**	Delivery Order 0037 Adak Island, AK FOCUSED FEASIBILITY STUDY

Table 8-1
Process Options Retained for Downtown Sites on Adak Island

Unsaturated Soil	Aquifer Media	Free-Phase Product	Groundwater (Surface Water and Sediment Protection)	Sediment
• No action • Equitable servitude restrictions • Access restrictions • Site inspections • Environmental monitoring • Soil vapor extraction • Natural attenuation • Bioventing • In situ steam stripping • Excavation and thermal desorption	• No action • Equitable servitude restrictions • Access restrictions • Site inspections • Environmental monitoring • Air sparging • MNA • Biosparging • In situ treatment using iSOC™ bioremediation enhancement • In situ steam stripping • In situ chemical reduction/oxidation • Excavation and thermal desorption (with dewatering)	• No action • Equitable servitude restrictions • Access restrictions • Site inspections • Environmental monitoring • Dual-phase extraction • Automated passive skimmers • Passive skimmers • Sorbent booms/ sorbent socks	• No action • Equitable servitude restrictions • Access restrictions • Site inspections • Environmental monitoring • Containment using air sparging • Containment using biosparging • Containment using iSOC™ bioremediation enhancement • Air sparging • MNA • Biosparging • In situ treatment using iSOC™ bioremediation enhancement • In situ steam stripping • In situ chemical reduction/oxidation • Ex situ treatment using liquid-phase carbon adsorption	• No action • Wake and propeller use restrictions • Access restrictions/fishing advisory • Site inspections • Environmental monitoring • Natural recovery • Sand/rock cap • Manufactured cap • Hydraulic dredging and disposal • Mechanical dredging and disposal • Combination dredging and disposal • Conventional excavation with coffer dams and disposal • Hydraulic dredging and thermal desorption • Mechanical dredging and thermal desorption • Combination dredging and thermal desorption • Conventional excavation with coffer dams and thermal desorption

Table 8-1 (continued)
Process Options Retained for Downtown Sites on Adak Island

Notes:
iSOC™ - in situ Submerged Oxygen Curtain by Inventures Technologies
MNA - monitored natural attenuation

Table 8-2
Identification and Screening of Process Options Potentially Applicable to Aquifer Media at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
No Action						
No Action	No action	Least	Least	Greatest	Retained for comparison to the action alternatives.	Yes
Institutional Controls						
Access Restrictions	Equitable servitude restrictions	Moderate	Least	Greatest	Effective at limiting human exposure to petroleum hydrocarbons and would therefore meet some RAOs. No unacceptable risks in soil. However, would not help meet ACLs in surface water or sediment. Relatively easy to implement since no construction activities are associated with this alternative.	Yes
	Access restrictions	Moderate	Least	Greatest	Effective at limiting human exposure to petroleum hydrocarbons during construction and would therefore meet some RAOs. No unacceptable risks in soil. However, would not help meet ACLs in surface water or sediment. Relatively easy to implement since very limited construction activities are associated with this alternative.	Yes
Monitoring	Site inspections	Moderate	Least	Greatest	Effective at limiting human exposure to petroleum hydrocarbons during construction and would therefore meet some RAOs. No unacceptable risks in soil. However, would not help meet ACLs in surface water or sediment. Relatively easy to implement since no construction activities are associated with this alternative.	Yes
	Environmental monitoring	Moderate	Least	Greatest	Effective at limiting human exposure to petroleum hydrocarbons by identifying problems early and would therefore meet some RAOs. No unacceptable risks in soil. However, would not help meet ACLs in surface water or sediment. Relatively easy to implement since no construction activities are associated with this alternative.	Yes

Table 8-2 (Continued)
Identification and Screening of Process Options Potentially Applicable to Aquifer Media at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
In Situ Treatment of Aquifer Media						
Physical	Air sparging	Marginal	Marginal	Moderate	No unacceptable risks in soil. However, could be implemented to reduce concentrations in soil and thus reduce migration to surface water. Would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons and reducing migration. Would not be capable of meeting RAOs for free-phase product present in the aquifer media by itself. Free-phase product would need to be removed prior to use of this technology. In addition, only effective at reducing volatile petroleum concentrations in aquifer media. This active treatment technology is moderately implementable because it is a relatively simple system. Air sparging would have to be used in conjunction with biosparging and soil vapor extraction.	No
Biological	MNA	Marginal	Least	Greatest	No unacceptable risks in soil. However, could be implemented to reduce concentrations in soil and thus reduce migration to surface water. However, not as effective as other in situ biological treatment options because oxygen is not supplied to the subsurface. In addition, this option would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons and reducing migration. Would not be capable of meeting RAOs for free-phase product present in the aquifer media by itself. However, this option is retained because it is very easy to implement since no construction activities are associated with this alternative.	Yes

Table 8-2 (Continued)
Identification and Screening of Process Options Potentially Applicable to Aquifer Media at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
In Situ Treatment of Aquifer Media (continued)						
Biological (continued)	Biosparging	Marginal	Moderate	Moderate	No unacceptable risks in soil. However, could be implemented to reduce concentrations in soil and thus reduce migration to surface water. Would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons and reducing migration. Would not be capable of meeting RAOs for free-phase product present in the aquifer media by itself. Free-phase product would need to be removed prior to use of this technology. This active treatment technology is moderately implementable because it is a relatively simple system.	No
	iSOC™ bioremediation enhancement	Marginal	Moderate	Greatest	No unacceptable risks in soil. However, could be implemented to reduce concentrations in soil and thus reduce migration to surface water. Would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons and reducing migration. Would not be capable of meeting RAOs for free-phase product present in the aquifer media by itself. Free-phase product would need to be removed prior to use of this technology. This active treatment technology is relatively easy to implement because it requires no power or infrastructure.	No

Table 8-2 (Continued)
Identification and Screening of Process Options Potentially Applicable to Aquifer Media at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
In Situ Treatment of Aquifer Media (continued)						
Thermal	Steam stripping	Marginal	Greatest	Least	No unacceptable risks in soil. However, could be implemented to reduce concentrations in soil and thus reduce migration to surface water and sediment. This process option is highly effective. Would be capable of meeting RAOs for free-phase product present in the aquifer media by itself. This process option has marginal protectiveness because it would heat large volumes of soil and groundwater, which could adversely affect the temperature in South Sweeper Creek and Sweeper Cove. Overall, this technology is least implementable because of the complexity of the steam generation system and because the soil contamination is located at depths less than 10 feet.	No
Chemical	Chemical reduction/ oxidation	Marginal	Marginal	Least	No unacceptable risks in soil. However, could be implemented to reduce concentrations in soil and thus reduce migration to surface water. Would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons and reducing migration. Would not be capable of meeting RAOs for free-phase product present in the aquifer media by itself. The soils at the South of Runway 18-36 Area are heterogeneous (fill material near surface contains a combination of rock, sand, and gravel), therefore this technology has marginal effectiveness for site conditions. In addition, this option is the least implementable because of the complexity of the system, and free-phase product would need to be removed prior to use of this technology.	No

Table 8-2 (Continued)
Identification and Screening of Process Options Potentially Applicable to Aquifer Media at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
Excavation and Treatment of Aquifer Media (with dewatering)						
Thermal	Thermal desorption	Greatest	Greatest	Moderate	No unacceptable risks in soil. However, could be implemented to reduce concentrations in soil and thus reduce migration to surface water and sediment. This process option is highly effective. Would be capable of meeting RAOs for free-phase product present in the aquifer media by itself.	Yes

Notes:
ACL - alternative cleanup level
ft – foot
iSOC™ - in situ Submerged Oxygen Curtain by Inventures Technologies
RAO - remedial action objective

Table 8-3
Identification and Screening of Process Options Potentially Applicable to Free-Phase Product at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
No Action						
No Action	No action	Least	Least	Greatest	Retained for comparison to the action alternatives.	Yes
Institutional Controls						
Access Restrictions	Equitable servitude restrictions	Marginal	Least	Greatest	Effective at limiting human exposure to free-phase product. Very easy to implement since no construction activities are associated with this alternative.	Yes
	Access restrictions	Marginal	Least	Greatest	Effective at limiting human exposure to free-phase product. Very easy to implement since very limited construction activities are associated with this alternative.	Yes
Monitoring	Site inspections	Marginal	Least	Greatest	Effective at limiting human exposure to free-phase product. Very easy to implement since no construction activities are associated with this alternative.	Yes
	Environmental monitoring	Marginal	Least	Greatest	Effective at limiting human exposure to free-phase product. Very easy to implement since no construction activities are associated with this alternative.	Yes
Free-Phase Product Recovery						
Active	Dual phase extraction (DPE)	Marginal	Marginal	Marginal	This process is not proven and reliable given the site conditions—the presence of permeable soils, the close distance to surface water bodies (East Canal, Sweeper Creek, and Sweeper Cove), and the tidal cycles. The ability of this technology to meet RAOs is not proven for site conditions. Treating the large quantity of water pumped due to these site conditions would be difficult. Specialized equipment and expertise required.	No

Table 8-3 (Continued)
Identification and Screening of Process Options Potentially Applicable to Free-Phase Product at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
Free-Phase Product Recovery (continued)						
Passive	Automated passive skimmers	Moderate	Moderate	Moderate	Is expected to meet RAOs for free-phase product. Technology is slightly more difficult to construct, operate, and maintain when compared to passive skimmers.	Yes
	Passive skimmers	Moderate	Moderate	Greatest	Is expected to meet RAOs for free-phase product. Technology is easy to construct, operate, and maintain.	Yes
	Sorbent booms/sorbent socks	Moderate	Moderate	Greatest	Sorbent booms are expected to meet RAOs for free-phase product in surface water, except at locations immediately adjacent to seeps. Could be used to prevent spread of sheen on surface water bodies, as an interim measure until other technologies are in place. Sorbet socks expected to meet RAOs for free-phase product in wells. Technology is easy to install and maintain.	Yes

Notes:
RAO - remedial action objective

Table 8-4
Identification and Screening of Process Options Potentially Applicable to Groundwater (Surface Water and Sediment Protection) at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
No Action						
No Action	No action	Least	Least	Greatest	Retained for comparison to the action alternatives.	Yes
Institutional Controls						
Access Restrictions	Equitable servitude restrictions	Marginal	Least	Greatest	Effective at limiting human exposure to petroleum hydrocarbons and would therefore meet some RAOs. However, would not help meet ACLs in surface water or sediment. Relatively easy to implement since no construction activities are associated with this alternative.	Yes
	Access restrictions	Marginal	Least	Greatest	Effective at limiting human exposure to petroleum hydrocarbons during construction activities and would therefore meet some RAOs. However, would not help meet ACLs in surface water or sediment. Relatively easy to implement since very limited construction activities are associated with this alternative.	Yes
Monitoring	Site inspections	Marginal	Least	Greatest	Effective at limiting human exposure to petroleum hydrocarbons during construction activities and would therefore meet some RAOs. However, would not help meet ACLs in surface water or sediment. Relatively easy to implement since no construction activities are associated with this alternative.	Yes
	Environmental monitoring	Marginal	Least	Greatest	Effective at limiting human exposure to petroleum hydrocarbons by identifying potential problems early and would therefore meet some RAOs. However, would not help meet ACLs in surface water or sediment. Relatively easy to implement since no construction activities are associated with this alternative.	Yes

Table 8-4 (Continued)
Identification and Screening of Process Options Potentially Applicable to Groundwater (Surface Water and Sediment Protection) at the South of Runway Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
Containment						
Physical Treatment Barrier	Air sparging	Marginal	Marginal	Moderate	Would be implemented to reduce migration to surface water. Generally effective at reducing volatile petroleum concentrations in groundwater. Not effective at reducing concentration of DRO in groundwater. Therefore, probably not capable of meeting RAOs and ACLs for DRO in surface water if not used in conjunction with biosparging and soil vapor extraction.	Yes
Biological Treatment Barrier	Biosparging	Moderate	Moderate	Moderate	Would be implemented to reduce migration to surface water. Generally effective at reducing petroleum concentrations in groundwater. Would be capable of meeting RAOs and ACLs in surface water. This active treatment technology is moderately implementable because it is a relatively simple system.	Yes
	iSOC™ bioremediation enhancement	Moderate	Moderate	Moderate	Would be implemented to reduce migration to surface water. Generally effective at reducing petroleum concentrations in groundwater. Would be capable of meeting RAOs and ACLs in surface water. This active treatment technology is relatively easy to implement because it requires no power or infrastructure.	Yes

Table 8-4 (Continued)
Identification and Screening of Process Options Potentially Applicable to Groundwater (Surface Water and Sediment Protection) at the South of Runway Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
In Situ Treatment of Groundwater						
Physical	Air sparging	Marginal	Marginal	Moderate	Would be implemented to reduce concentrations in groundwater and thus reduce migration to surface water. Generally effective at reducing volatile petroleum concentrations in groundwater. Would be capable of meeting surface water RAOs and ACLs for the volatile components of gasoline. May not be capable of meeting RAOs and ACLs for the semivolatile components of the petroleum hydrocarbons present at the site. However, would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons in the subsurface and reducing migration (see Table 8-1). In addition, air sparging could not be implemented until free-product removal is completed. Air sparging would not be an efficient way of meeting surface water RAOs and ACLs because very little of the contamination is present in the dissolved phase. This active treatment technology is moderately implementable because it is a relatively simple system. Air sparging would have to be used in conjunction with biosparging and soil vapor extraction.	No

Table 8-4 (Continued)
Identification and Screening of Process Options Potentially Applicable to Groundwater (Surface Water and Sediment Protection) at the South of Runway Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
In Situ Treatment of Groundwater (continued)						
Biological	MNA	Marginal	Least	Greatest	Would be implemented to reduce concentrations in groundwater and thus reduce migration to surface water. Not as effective as other in situ biological treatment options because oxygen is not supplied to the subsurface. In addition, this option would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons and reducing migration (see Table 8-1). May require a long cleanup time to achieve RAOs and ACLs in surface water. MNA would not be an efficient way of meeting surface water RAOs and ACLs because very little of the contamination is present in the dissolved phase. However, this option is retained because it is very easy to implement since no construction activities are associated with this alternative.	Yes
	Biosparging	Marginal	Moderate	Moderate	Would be implemented to reduce concentrations in groundwater and thus reduce migration to surface water. Generally effective at reducing petroleum concentrations in groundwater. Would be capable of meeting RAOs and ACLs in surface water. However, would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons in the subsurface and reducing migration (see Table 8-1). In addition, biosparging could not be implemented until free-product removal is completed. Biosparging would not be an efficient way of meeting surface water RAOs and ACLs because very little of the contamination is present in the dissolved phase. This active treatment technology is moderately implementable because it is a relatively simple system.	No

Table 8-4 (Continued)
Identification and Screening of Process Options Potentially Applicable to Groundwater (Surface Water and Sediment Protection) at the South of Runway Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
In Situ Treatment of Groundwater (continued)						
Biological (continued)	iSOC™ bioremediation enhancement	Marginal	Moderate	Greatest	Would be implemented to reduce concentrations in groundwater and thus reduce migration to surface water. Generally effective at reducing petroleum concentrations in groundwater. Would be capable of meeting RAOs and ACLs in surface water. However, would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons in the subsurface and reducing migration (see Table 8-1). In addition, iSOC™ could not be implemented until free-product removal is completed. iSOC™ would not be an efficient way of meeting surface water and RAOs and ACLs because very little of the contamination is present in the dissolved phase. This active treatment technology is relatively easy to implement because it requires no power or infrastructure.	No
Thermal	Steam stripping	Marginal	Greatest	Least	Would be implemented to reduce concentrations in the subsurface and thus reduce migration to surface water and sediment. This process option is highly effective. Would be capable of meeting the RAOs and ACLs in surface water and sediment. This process option has marginal protectiveness because it would heat large volumes of soil and groundwater, which could adversely affect the temperature in South Sweeper Creek and Sweeper Cove. Overall, this technology is least implementable because of the complexity of the steam generation system and because soil contamination is located at depths less than 10 feet	No

Table 8-4 (Continued)
Identification and Screening of Process Options Potentially Applicable to Groundwater (Surface Water and Sediment Protection) at the South of Runway Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
In Situ Treatment of Groundwater (continued)						
Chemical	Chemical reduction/ oxidation	Marginal	Marginal	Least	Would be implemented to reduce concentrations in groundwater and thus reduce migration to surface water. However, would not be as effective as excavation in reducing concentrations of petroleum hydrocarbons and reducing migration (see Table 8-1). Free-phase product would need to be removed prior to use of this technology. In addition, the soils at the South of Runway 18-36 Area are heterogeneous (materials near surface contains a combination of sand and gravel). Therefore, this technology has marginal effectiveness for site conditions. In addition, this option is the least implementable because of the complexity of the system.	No
Ex Situ Treatment of Groundwater						
Physical	Liquid-phase carbon adsorption	Moderate	Moderate	Marginal	This process option is highly effective for treating groundwater, however it requires pumping of groundwater, which is operation and maintenance-intensive, making it unsuitable for a remote site such as Adak. Would not be an efficient way of meeting surface water RAOs and ACLs because very little of the contamination is present in the dissolved phase. Spent carbon generated may need to be barged for disposal on the mainland at a TSD facility.	No

Notes:
ACL - alternative cleanup level
ft - foot
iSOC™ - in situ Submerged Oxygen Curtain by Inventures Technologies
RAO - remedial action objective
TSD - treatment, storage, and disposal

Table 8-5
Identification and Screening of Process Options Potentially Applicable to Sediment at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
No Action						
No Action	No action	Least	Least	Greatest	Retained for comparison to the action alternatives.	Yes
Institutional Controls						
Access Restrictions	Wake and propeller use restrictions	Marginal	Least	Greatest	Would not meet RAOs or ACLs. Relatively easy to implement since no construction activities are associated with this alternative.	Yes
	Access restrictions and fishing advisory	Marginal	Least	Greatest	Effective at limiting human receptor access to contaminated sediments and would therefore meet some RAOs. Relatively easy to implement since very limited construction activities are associated with this alternative.	Yes
Monitoring	Site inspections	Marginal	Least	Greatest	Effective at limiting human exposure to contaminated media and would therefore meet some RAOs. Relatively easy to implement since no construction activities are associated with this alternative.	Yes
	Environmental monitoring	Marginal	Least	Greatest	Effective at limiting human exposure to contaminated sediments by identifying potential problems early and would therefore meet some RAOs. Relatively easy to implement since no construction activities are associated with this alternative.	Yes
In Situ Treatment						
Biological	Natural Recovery	Marginal	Least	Greatest	Would be capable of meeting RAOs and ACLs, but would take a long time. Would be effective in combination with other treatment technologies that would reduce risk at the site.	Yes

Table 8-5 (Continued)
Identification and Screening of Process Options Potentially Applicable to Sediment at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
Containment/Capping						
Subaqueous Capping	Sand/rock cap	Greatest	Moderate	Moderate	Would be capable of meeting RAOs and ACLs for sediment, given the source is removed or significantly reduced. Would not be appropriate for the South of Runway 18-36 Area without excavation because flow characteristics of South Sweeper Creek would be altered without excavation. Since excavation is required, there is no benefit beyond just excavating sediments, and there are added costs associated with this process option. Therefore, this process option was not retained.	No
	Manufactured cap	Moderate	Moderate	Moderate	Would be capable of meeting ACLs for sediment. Would not meet all RAOs unless it is completed in conjunction with a sand/rock cap. By itself, a manufactured cap will isolate sediments, but is not considered appropriate habitat for marine invertebrates. In addition, would not be appropriate for the South of Runway 18-36 Area without excavation because flow characteristics of South Sweeper Creek would be altered without excavation. Since excavation is required, there is no benefit beyond excavating sediments, and there are added costs associated with this process option. Therefore, this process option was not retained.	No
Sediment Removal/Disposal (with dewatering)						
Dredging	Hydraulic dredging (hopper or pipeline)	Greatest	Greatest	Marginal	Would be capable of meeting RAOs and ACLs for sediment. Because dredging would be required primarily within South Sweeper Creek, which would be too small to accommodate hydraulic dredging, this process option would not be applicable. Also requires upland dewatering and disposal sites.	No

Table 8-5 (Continued)
Identification and Screening of Process Options Potentially Applicable to Sediment at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
Sediment Removal/Disposal (with dewatering) (continued)						
Dredging (continued)	Mechanical dredging (clamshell or environmental bucket)	Greatest	Greatest	Marginal	Would be capable of meeting RAOs and ACLs for sediment. Because dredging would be required primarily within South Sweeper Creek, which would be too small to accommodate mechanical dredging, this process option would not be applicable. Also requires upland dewatering and disposal sites.	No
	Combination dredging (hydraulic/ mechanical)	Greatest	Greatest	Marginal	Would be capable of meeting RAOs and ACLs for sediment. Because dredging would be required primarily within South Sweeper Creek, which would be too small to accommodate hydraulic or mechanical dredging, this process option would not be applicable. Also requires upland dewatering and disposal sites.	No
Excavation	Conventional excavation with coffer dams	Greatest	Greatest	Greatest	Would be capable of meeting RAOs and ACLs for sediment. Would be necessary to have upland disposal site, or material would have to be barged to an appropriate landfill.	Yes
Sediment Removal/Treatment/Disposal (with dewatering)						
Dredging	Hydraulic dredging (hopper or pipeline)	Greatest	Greatest	Marginal	Would be capable of meeting RAOs and ACLs for sediment. Because dredging would be required primarily within South Sweeper Creek, which would be too small to accommodate hydraulic dredging, this process option would not be applicable. Also requires upland dewatering site.	No
	Mechanical dredging (clamshell or environmental bucket)	Greatest	Greatest	Marginal	Would be capable of meeting RAOs and ACLs for sediment. Because dredging would be required primarily within South Sweeper Creek, which would be too small to accommodate mechanical dredging, this process option would not be applicable. Also requires upland dewatering site.	No

Table 8-5 (Continued)
Identification and Screening of Process Options Potentially Applicable to Sediment at the South of Runway 18-36 Area

Technology Type	Process Option	Screening			Screening Comments	Selected for South of Runway 18-36 Area?
		Protectiveness	Ability to Meet Cleanup Levels	Implementability		
Sediment Removal/Treatment/Disposal (with dewatering) (continued)						
Dredging (continued)	Combination dredging (hydraulic/ mechanical)	Greatest	Greatest	Marginal	Would be capable of meeting RAOs and ACLs for sediment. Because dredging would be required primarily within South Sweeper Creek, which would be too small to accommodate hydraulic or mechanical dredging, this process option would not be applicable. Also requires upland dewatering site.	No
Excavation	Conventional excavation with coffer dams	Greatest	Greatest	Greatest	Would be capable of meeting RAOs and ACLs for sediment.	Yes
Thermal	Thermal desorption	Greatest	Greatest	Marginal	Would be capable of meeting RAOs and ACLs in treated excavated sediment. This process option is proven and reliable. Necessary equipment and workers may be available depending on use for other sites on Adak.	Yes

Notes:
ACL - alternative cleanup level
RAO - remedial action objective

Table 8-6
Process Options Retained for Incorporation Into Remedial Alternatives for South of Runway 18-36 Area

Aquifer Media	Free-Phase Product	Groundwater (Surface Water and Sediment Protection)	Sediment
• No action • Equitable servitude restrictions • Access restrictions • Site inspections • Environmental monitoring • MNA • Excavation and thermal desorption (with dewatering)	• No action • Equitable servitude restrictions • Access restrictions • Site inspections • Environmental monitoring • Automated passive skimmers • Passive skimmers • Sorbent booms/sorbent socks	• No action • Equitable servitude restrictions • Access restrictions • Site inspections • Environmental monitoring • Containment using air sparging • Containment using biosparging • Containment using iSOC™ bioremediation enhancement • MNA	• No action • Wake and propeller use restrictions • Access restrictions and fishing advisory • Site inspections • Environmental monitoring • Natural recovery • Conventional excavation equipment with coffer dams and disposal • Conventional excavation equipment with coffer dams and thermal desorption

Notes:
iSOC™ - in situ Submerged Oxygen Curtain by Inventures Technologies