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ENGINEERING EVALUATION/COST ANALYSIS (EE/CA)
DRAFT REPORT

SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA

Prepared by:
URS Group, Inc.

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MARCH 2007

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
ADF&G	Alaska Department of Fish & Game
Ah	aryl hydrocarbon hydrolase
ARARs	applicable or relevant and appropriate requirements
ASCC	Alaska State Climate Center
ASTs	above-ground storage tanks
AVS	acid volatile sulfide
AWQC	ambient water quality criteria
BCF	bioconcentration factor
BLM	U. S. Bureau of Land Management
BTEX	benzene, toluene, ethylbenzene, and xylenes
CBR	critical body residue
CFR	Code of Federal Regulations
cfs	cubic feet per second
COEC	chemicals of potential ecological concern
COHC	chemicals of potential human concern
COPC	chemical of potential concern
CTRG	Canadian tissue residue guidelines
DRO	diesel range organics
DQOs	data quality objectives
Forest Service	U.S. Forest Service, Alaska Region
Eco-SSL	ecological soil screening levels
ECW	environmental contaminants in wildlife
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
ERBSC	ecological risk based screening criteria
ERL	effects range low
ERM	effects range medium
°F	degrees Fahrenheit
H2S	hydrogen sulfide
HQ	hazard quotient
L/kg	liters per kilogram
MLLW	Mean Lower Low Water datum
µg/g	microgram per gram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram

ACRONYMS AND ABBREVIATIONS (continued)

mg/L	milligrams per liter
ND	not detected
NE	not established
NEIC	Netherlands Ecotox Intervention Criteria
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
%	percent
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PEL	probable effects level
PGEs	platinum group elements
PRGs	preliminary remediation goals
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RAO	remedial action objective
RBSL	risk-based screening level
RfD	reference dose
RPPT	reductive precipitation
RRO	residual range organics
SAP	Sampling and Analysis Plan
SEM	simultaneously extractable metal
SQGs	sediment quality guidelines
SQuiRT	screening quick reference tables
SRE	streamlined risk evaluation
TaqH	total aqueous hydrocarbons
TBC	To-Be-Considered
TCDD	tetrachlorodibenzo-p-dioxin
TCLP	toxicity characteristic leaching procedure
TEL	threshold effects level
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
TSC	tissue screening criteria
UET	upper effects threshold
URS	URS Corporation
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency

ACRONYMS AND ABBREVIATIONS (continued)

WQC	Water Quality Criteria
WRCC	Western Regional Climate Center
yd^3	cubic yards

EXECUTIVE SUMMARY

This document presents an Engineering Evaluation/Cost Analysis (EE/CA) for removal actions at Salt Chuck Mine, located on Prince of Wales Island in the Tongass National Forest of southeast Alaska. This work was conducted by URS Corporation for the U.S. Forest Service, Alaska Region.

The results of site investigations conducted at Salt Chuck Mine between 1995 and 2006 and the Streamlined Risk Evaluation (SRE) indicate that chemical concentrations in the following site media pose a threat to human health or the environment: soils at Building C4 and the AST/drum cache area, unsaturated tailings at the millsite, and piles D14 and D15, tailings in the unnamed stream, intertidal tailings piles (Zones A through C and a portion of Zone D tailings), intertidal saltwater emanating from the main tailings area, and food chain impacts from shellfish tissue. The SRE involved the identification of chemicals of concern (COCs) based on comparison of maximum site concentrations to human and ecological risk-based levels and background. The primary COC in most media is copper, primarily due to ecological impacts and potential impacts on the beneficial use of shellfish harvesting. Other COCs include DRO, PCBs, benzo(a)pyrene, and various inorganics (e.g., arsenic, lead, mercury, selenium, and zinc). Although concentrations of some metals above risk-based criteria were noted in adit water, no significant exposure pathways were identified and downgradient surface water was not found to be impacted. Therefore, no further action is recommended with regard to site freshwater. In general, source removal of the intertidal tailings is recommended to address impacts observed in intertidal water and shellfish tissue.

Based on the results of the site characterization and SRE, removal action objectives (RAOs) were developed for impacted site media, exposure pathways, and COCs. Spatial analysis of impacted media exceeding these RAOs resulted in the following volume estimates targeted for removal action: approximately 7,000 cubic yards (cy) in the onshore areas of the site (soils and unsaturated tailings), and approximately 60,000 cy in the offshore areas (intertidal tailings zone and spit).

Technologies potentially applicable to the management of threats to human and ecological receptors at the site from the COCs, were identified and evaluated as part of the EE/CA. Technologies that passed the screening process were assembled into candidate removal action alternatives that represent a range of measures to address site concerns. Four candidate removal actions were evaluated against the criteria of implementability, effectiveness, and cost:

Alternative 1: No Action
Alternative 2: Institutional Controls
Alternative 3: Consolidation in Onsite Repository with Cap
Alternative 4: Excavation and Transport to Offsite Disposal Area

These were analyzed on an individual basis with respect to the above criteria, as well as with respect to each other in a comparative analysis, to develop a recommended action. Based on this analysis, Alternative 3 was shown to effectively address impacts to human and ecological receptors, to be in compliance with ARARs, and to be cost effective. Alternative 3 would involve constructing an onsite lined repository, removing impacted media, placing materials into the repository, and capping the repository. Annual O&M would

include repository inspection and maintenance, and monitoring of remaining levels of COCs to confirm the effectiveness of source removal in reducing exposure to receptors. Capital costs for Alternative 3 are estimated to be $4,600,000, and annual O&M costs $53,000.

1.0 INTRODUCTION

Presented in this report are the results of an Engineering Evaluation/Cost Analysis (EE/CA) completed by URS Corporation (URS) for the The U.S. Forest Service, Alaska Region (Forest Service) for the Salt Chuck Mine site located on Prince of Wales Island in the Tongass National Forest, Alaska (Figure 1-1). The EE/CA was completed in accordance with General Services Administration (GSA) Contract No. GS-10F-0105K; Task Orders A2S12S0085 dated March 5, 2002, and 2002AG-0109-D-06-0009 dated June 28, 2006; U.S. Environmental Protection Agency (USEPA) guidance document entitled *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA, 1993a); and URS' *Final Work Plan EE/CA for Salt Chuck Mine Tongass National Forest, Alaska* dated July 18, 2002, and *Final Work Plan Addendum for Salt Chuck Mine Tongass National Forest, Alaska* dated September 2006.

1.1 BACKGROUND

The Forest Service has completed preliminary removal assessments for numerous abandoned and inactive mine sites located in the Tongass National Forest. Inventories conducted in 1995 and 1997 at the Salt Chuck Mine identified physical and chemical hazards that pose a potential threat to the public and the environment (U.S. Bureau of Land Management [USBLM], 1998; Montgomery Watson, 1999). As a result of the BLM (1998) preliminary removal assessments, it was determined that non-time critical removal actions were appropriate for the Salt Chuck Mine site. URS initiated an EE/CA at the site in 2002. Preliminary risk interpretation of the 2002 data (URS, 2003) indicated the need for additional investigation, which was conducted in 2006. This report presents the results of both the 2002 and 2006 field investigations.

1.2 PURPOSE AND OBJECTIVES

The purpose of this EE/CA was to:

- Verify results of past contamination studies.
- Fill data gaps necessary to satisfy environmental review requirements and document the need for removal actions to address contamination onsite.
- Evaluate the potential for offsite migration of the contamination through groundwater and surface water pathways.
- Conduct a streamlined human health and ecological risk assessment to determine potential threats posed by onsite contamination.
- Provide a framework for evaluating and selecting potential response actions and technologies.
- Evaluate future land use alternatives to ensure that they are compatible with, and will not reverse, the effects of potential removal actions.

The objective of this EE/CA is to identify removal action objectives (RAOs), identify removal action alternatives, screen the alternatives, and recommend an alternative(s) that will satisfy the RAOs based on

the evaluation criteria of effectiveness, implementability, and cost. Conclusions from this report will be used to guide decision making and preparation of work plans for potential future removal actions.

2.0 SITE CHARACTERIZATION

Characterization of environmental conditions at the site is based on information collected during field investigations conducted in 1995, 1997, 2002, and 2006. These investigations were conducted by the BLM and URS on behalf of the Forest Service. This section includes a description of the site, a discussion of the site history and physical setting, and a summary of site investigations completed to date, including the results of soil, surface water, tailings, and sediment sampling as compared to values developed in a streamlined risk evaluation.

2.1 SITE DESCRIPTION AND BACKGROUND

Salt Chuck Mine is located at the northern extremity of Kasaan Bay, on Prince of Wales Island, approximately 4.5 miles south-southwest of Thorne Bay, Alaska. The mine is located within Section 16 and 17, Township 72 South, Range 84 East, Copper River Meridian, Alaska. The mine takes its name from the shallow, restricted Salt Chuck Bay, which borders the mine site to the south, and forms the northernmost arm of Kasaan Bay (Figures 1-1 and 2-1). The nearest year-around population is located at Thorne Bay, which is accessible from the site by road and trail. The closest community by water is the Native village of Kasaan, located 10 miles southeast of the site on the east side of Kasaan Bay.

The site is located in a mineral-rich area with much historic mining activity nearby (Maas et al., 1995). The Rush & Brown Mine is located on the west slope of Lake Ellen (Figure 1-1). Venus Mine is located about 1-1/2 miles southwest of the site, in an area that drains southward into Karta Bay. Haida Mine is located northeast of Browns Bay about 2-1/2 miles southeast of the site.

2.1.1 Site History

Salt Chuck Mine was originally known as the Goodro Mine, when the first claims were staked in 1905 (USBLM, 1998). Copper, gold, silver and platinum group elements (PGEs), most notably palladium, were the primary ores produced from Salt Chuck Mine. By 1907, approximately 35 feet of adit had been driven, a short shaft had been sunk, and several surface cuts were opened. A mill with a rated capacity of 30 tons/day was constructed on site in 1915. The mill capacity was increased to a 300 tons/day in 1923. Total production figures for the mine indicate that over 326,000 tons of ore were mined at the site with production halting in 1941 (USBLM, 1998).

Claims at the mine site were relocated again in 1979 and 1996, and several companies investigated the Salt Chuck area in the 1980s and 1990s. Santoy Resources, Inc. currently holds active mining claims at the site (1,590 acres, 100% ownership), extending from about 200 feet north of the mill to the northwest beyond Lake Ellen. Santoy conducted an exploration program in this area in 2000 (Santoy Resources Ltd., 2007; Szumigala et al., 2000). Nevada Star Resource Corporation currently holds about 620 acres of

unpatented Federal mining claims northeast of the mill around Power Lake, and extending southeast of the mill and tailings areas along the coast east of the unnamed island (Nevada Star, 2007).

The remnants of at least 25 structures are at present at the mine site (Figure 2-2). The buildings are located near the beach, along the tramway leading from adit W1 to the mill, upstream along the unnamed stream that flows past the portal of W1, and near the glory hole. The buildings include cabin sites formerly used to house and feed workers, a superintendent's house, a general office, a blacksmith or machine shop, a large mill, and platforms used to load and transfer rock. Two large aboveground storage tanks (ASTs) that formerly held diesel fuel to supply four separate banks of Fairbanks Morse diesel engines are also present adjacent to the millsite (Figure 2-3).

Mine workings at the site (Figure 2-2) are located at elevations between 100 and 300 feet above mean sea level (msl) and consist of a large glory hole connected to a main haulage adit (W1), two shafts (W4 and W5), and a tunnel (W3) (USBLM, 1998). The upland portions of the site encompass nearly 45 acres. Thirteen waste rock dumps are distributed along a 0.5-mile corridor from the northeast side of the glory hole, south to the mill site located at the head of Salt Chuck Bay. The waste rock dumps range in size from over 100 cubic yards (yd^3) to over 4,000 yd^3 (USBLM, 1998). A large amount of the rock was also used to create a tramway bed leading from the main adit to the millsite.

An extensive tailings deposit comprising roughly 100,000 yd^3 of material is located primarily in the intertidal zone south and southeast of the mill (Figure 2-4). The intertidal tailings are divided into four zones, referred to as Zones A through D, on the basis of natural boundaries and elevations. Zones A through C were identified during the USBLM (1998) investigations, and Zone D was added in 2002 as a result of additional field observations collected during the URS (2002, 2003) investigation. Smaller areas of tailings lie above the intertidal zone along the tailings spit, around the mill, adjacent to the unnamed creek (Piles D14 and D15), and in the bottom of the unnamed creek (Figure 2-2). Together, the tailings deposits cover an area of approximately 23 acres. The distribution and thickness of the deposit are further discussed in Section 2.2.

Federal actions taken to reduce public hazards at historic mines must adhere to provisions of the National Historic Preservation Act of 1966. Salt Chuck Mine was included in a pilot study conducted by the Forest Service to assess the significance and National Register eligibility of historic mining sites (Bruder, 2002).

The four criteria for National Register significance concern are: A) association with significant events; B) association with significant people; C) representativeness of culture or technology; and D) potential for yielding important information about the human past. The results of the study indicated that the Salt Chuck Mine was the most important copper producer in the Ketchikan Mining District, the state's single lode palladium mine, and of national importance as a palladium producer in the 1920s. The study concluded that the mine property is a district entity that should be regarded as a historic district, that major components reflecting the mine's most important years of production have been preserved to date, and that the property retains good integrity of setting, feeling, materials, and workmanship. It was concluded that the mine should be considered eligible for National Register listing under criteria A, B,

and D, with the strongest case for eligibility set forth under criterion A. The State Historic Preservation Officer agreed with the determination of eligibility. These results are incorporated into the consideration of ARARs and for evaluation of removal action alternatives in the EE/CA (Sections 3.0 through 5.0).

2.1.2 Climate

The nearest climatological data station to Salt Chuck Mine providing data recorded by the National Oceanic and Atmospheric Administration (NOAA) is located at Annette Island, south of Ketchikan and approximately 50 miles southeast of the site (USBLM, 1998). Annual precipitation at Annette Island is approximately 110 inches, with the rainy season in fall and early winter (Alaska State Climate Center [ASCC], 1992 as cited in BLM, 1998; Western Regional Climate Center [WRCC], 1999a). Average annual temperature is 46 degrees Fahrenheit (°F). July and August are the warmest months, with average high temperatures in the mid-60s (°F), and January is typically the coldest month, with average low temperatures in the low-30s (°F).

Local climate summaries are also available for Beaver Falls and Ketchikan, which are closer to Salt Chuck than Annette Island is. Although temperature data for Beaver Falls and Ketchikan are consistent with that of Annette Island, higher annual precipitation amounts of approximately 150 inches have been recorded at these two stations (WRCC, 1999b, 1999c).

2.1.3 Regional and Local Geology

The Salt Chuck area is underlain by Paleozoic ultramafic igneous rocks that intrude a sequence of older sedimentary and volcanic rocks. The Salt Chuck Mine ore body is hosted in a magnetite clinopyroxenite/gabbro sequence similar to other Alaskan-type ultramafic-mafic intrusions in southeast Alaska (Himmelberg and Loney, 1995), the nearest of which is the Union Bay complex on the eastern shores of Clarence Strait. Mineralization at the mine consists of chalcopyrite, bornite, digenite, chalcocite, and covellite with magnetite, pyrrhotite and pyrite also present (USBLM, 1998).

2.1.4 Soils

Soils surrounding the main workings at Salt Chuck Mine have been predominantly classified as McGilvery soils with minor components of Kogish Peat and Maybeso Mucky Peat to the north (USBLM, 1998). These soils occur within broken mountain slope topography that contains rock outcrops, deep organic-rich soils, and peat. The soils are generally moderately to well-drained, and are characterized to a 15-inch depth as being comprised of a 1- to 4-inch layer of peat and forest litter, overlying a mixed layer of peat and sandy to gravelly loam with boulders. The soils support a variety of plant species, including Western hemlock, blueberry, red cedar, devil's club, and salmonberry.

Soils adjacent to the intertidal zones are classified as Karta–Tolstoi very gravelly loam (USBLM, 1998). The profile of these soils includes a thin layer of forest litter and organic debris overlying silt loam up to 6 inches thick. The silt loam is underlain by a layer of gravelly to gravelly sandy loam up to 4 feet thick. These soils are moderately well drained and support a vegetative series dominated by Western hemlock, and blueberry.

2.1.5 Surface Hydrology

Surface water runoff at the Salt Chuck site enters the glory hole at the 300-foot elevation and drains into the haulage level of the main adit. The water mixes with groundwater, and a significant quantity of water is dammed up behind a rock and debris plug near the adit portal. A steady trickle discharges from the portal with an estimated flow rate of <0.1 cubic feet per second (cfs). Rainwater collection in the glory hole and groundwater percolation through bedrock fractures are the principal factors that create discharge from the main adit portal.

A small, unnamed stream, originating northeast of the site from Power Lake (Figure 2-2), bisects the mine property and converges with water discharging from the main portal adit. During high flow events, the unnamed creek overflows its channel near the adit portal, and flows both west down the established drainage and south along the rail line. The rail line overflow leaves the track after approximately 100 feet and flows westerly, rejoining the unnamed creek. The stream continues to the south, flowing into the head of Salt Chuck Bay west of the millsite, and continuing along the west side of the tailings pile at low tide (Figure 2-4). The flow rate in this stream ranges from less than 1 to 10 cfs, and varies directly with rainfall conditions.

Lake Ellen Creek, originating from Lake Ellen 0.5 miles west of the site, flows around the western portion of the mine site into Kasaan Bay (Figure 2-1). At low tide, Lake Ellen Creek merges with the unnamed stream southwest of the tailings pile before entering Salt Chuck Bay (Figure 2-4). Estimated flow in Lake Ellen Creek is approximately 15 to 20 cfs (USBLM, 1998).

An intertidal zone encompassing approximately 80 acres is located south of the mill site, and extends around an unnamed island in the middle of Salt Chuck Bay (Figure 2-4) The intertidal zone is covered by fucus, gravel, and beach grasses. At high tide, saltwater from Salt Chuck Bay inundates the lower portions of Lake Ellen Creek, the unnamed stream, and the main tailings pile. The streams, tailings, and outlying sediment are exposed at low tide. Maximum tidal ranges in the Kasaan Bay area are typically on the order of 18 to 23 feet (NOAA, 2002). Local intertidal zone elevations are depicted on Figures 2-4 and 2-5 (data from USBLM [1998]). At highest high tides, saltwater is expected to be on the order of 3 to 9 feet above the seafloor near the mouth of Lake Ellen Creek. Wetland areas are present along the entire length of the small unnamed stream that bisects the mine site.

2.1.6 Ecological Setting

The Kasaan Peninsula area is located on east-central Prince of Wales Island, bounded by Clarence Strait to the north and Kasaan Bay to the south. The peninsula is a long mountainous ridge with numerous abandoned mines, prospects, and mineral occurrences located on the western half of the steep, heavily timbered peninsula.

The mine workings at Salt Chuck are located in an uplands environment characterized by gently rolling hills, bedrock, and dense vegetation (USBLM, 1998). Site vegetation includes spruce, cedar, hemlock,

and alder trees, intermixed with abundant berry bushes and devil's club. Wetland areas are present along the entire length of the small unnamed stream that bisects the mine site.

The mill structure is located in a narrow band of lowlands adjacent to Kasaan Bay, dominated by alders and bushes. The intertidal beach areas are classified as estuarine intertidal, emergent, and persistent in a tidal regime that is irregularly flooded. The intertidal area is classified as regularly flooded, with sand and gravel flats and aquatic beds-algae. Lake Ellen Creek is classified as riverine, tidal, with an unconsolidated bottom and permanent tidal wetland (USBLM, 1998).

Species of fish, birds, and mammals common to Southeast Alaska and which may be present in the site area are listed in Tables 2-1 through 2-4. Lake Ellen Creek is an anadromous fish stream supporting pink, chum, and coho salmon, steelhead, and dolly varden (USBLM, 1998). Sculpins and frogs were observed near the mouth of the small stream that bisects the site, and evidence of deer, bear, and river otter have been observed throughout the area. The southern part of the intertidal tailings deposit supports a significant population of marine worms, and is almost devoid of shellfish. The intertidal area south of the mouth of Lake Ellen Creek contains a diverse assemblage of marine invertebrates and seaweeds. No designated habitat for Threatened and Endangered Species has been identified at the site or surrounding areas, and no sensitive environmental areas have been designated by the Alaska Coastal Management Program near the site (USBLM, 1998).

2.1.7 Land Use

The Salt Chuck Mine site is accessible by road, boat, float plane, or helicopter. Logging roads extend past the north end of the mine site, and are used by hunters and casual recreational vehicle traffic. Areas north and east of the site are designated as timber harvest units, and were actively logged in 1997 with no apparent direct effects to the mine site (USBLM, 1998).

Salt Chuck Bay is designated as an area of intensive public recreation use by the Alaska Department of Natural Resources (ADNR, 1998) *Prince of Wales Island Area Plan*. Salt Chuck Bay is an excellent protected waterway for canoes, kayaks, and other small boats, and passage to Lake Ellen is possible for small craft on high tides. The glory hole at the Salt Chuck Mine is regularly used by rock climbers for rappelling. A Forest Service campground is located about 1.2 miles northwest of the site at Lake No.3. In addition, public cabins are located on Forest Service land on the southeast shore of Salt Chuck Bay about one mile from the site, and on the north shore of Browns Bay about 1-1/2 miles south of the site (ADNR, 1998). Although there are no dock facilities at the mine site, a trailhead at the upper end of Salt Chuck Bay is accessible during high tide by small craft. However, BLM (1998) reports that this mode of access is used less frequently than the road system and trail extending from the glory hole to the mill. There is a marked trailhead located along the Forest Service road about 0.5 miles north of the glory hole. The nearest public access boat ramp to the site is located in Kasaan, about 10 miles southeast of the site.

According to the ADNR (1998) plan, the Salt Chuck Mine falls within Land Management Subunit 11b (Karta Bay), which is designated as having high fish and wildlife habitat and harvest values. Crucial

habitat has been identified in this area for seasonal black bear populations, waterfowl, herring spawning, and salmon rearing and schooling. Lake Ellen Creek supports runs of several types of anadromous fish.

There is an abundance of shellfish located in the intertidal area adjacent to the site (Table 2-1). ADNR (1998) indicates that aquatic farming previously occurred at Salt Chuck Bay, and that future use of the area should not preclude aquatic farming. Although no subsistence use has been documented (USBLM, 1998), the Salt Chuck Bay area is designated for potential intensive community use for harvest of clams, crab, oysters, waterfowl, and black bear by residents of Kasaan, Hollis, and Craig (ADNR, 1998). The closest of these communities, Kasaan, is located about 10 miles southeast of Salt Chuck Mine along the eastern shore of Kasaan Bay.

2.2 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

The primary source of contamination at the site is the extensive tailings deposit. As described in Section 2.1.1, tailings located primarily in the intertidal zone south and southeast of the mill cover an area of approximately 23 acres and comprise roughly 100,000 yd^3 of material (Figure 2-4). The intertidal tailings are divided into four zones, referred to as Zones A through D, on the basis of natural boundaries and elevations. Lake Ellen Creek borders the deposit to the south at low tide. Smaller areas of tailings lie above the intertidal zone along the tailings spit, around the mill, adjacent to the unnamed creek (Piles D14 and D15), and in the bottom of the unnamed creek (Figure 2-2). The estimated thickness of the tailings deposits have been contoured as shown in Figure 2-5 on the basis of aerial photograph evidence and field data (Forest Service, 1991a, 1991b; USBLM, 1998; URS, 2002, 2003). Tailings deposits are believed to range in thickness from about 10 feet southwest of the mill, to less than 1 foot near the south edge of the pile. The maximum thickness of Zone D tailings is at least 4 feet.

As described in the following sections, the tailings contain elevated concentrations of a number of metals such as copper, selenium, vanadium. The nature and extent of contamination from the tailings deposit and its possible migration into intertidal sediment and shellfish tissue are further discussed in Sections 2.4.33, 2.4.4, and 2.4.6. Potential removal alternatives for these constituents are addressed in this EE/CA.

Thirteen large waste rock piles were identified at the site by BLM (1998). However, based on visual observations and surface water field measurements, there was no indication that acid mine drainage or metals leaching were being generated from these piles.

Other sources of contamination at the site include:

- Diesel formerly stored in ASTs and drum caches east of the mill (Figure 2-3);
- Metals in soils around Building C4, which may have been used as an assay shop (Figure 2-3);
- Diesel engines, fuel tanks, and sludge on the floor within the mill: the sludge had accumulated beneath the tanks adjacent to four banks of diesel engines, and appeared to have migrated into tailings beneath and adjacent to the mill, and into the intertidal zone (USBLM, 1998; URS, 2003);

- Polychlorinated biphenyls (PCBs) in tailings around the mill and in the intertidal zone, possibly from former electrical equipment at the mill site;
- Lead in batteries from an electric locomotive north of the mill (Figure 2-2); and
- Metals in surface water draining from the mine workings and tailings (Figure 2-2).

As described in the following sections, soils east of the millsite contain elevated concentrations of diesel range organics (DRO) and several metals such as copper and lead; and elevated levels of polynuclear aromatic hydrocarbons (PAHs) and PCBs were found in onshore tailings and extending into the intertidal zone. Potential removal alternatives for these constituents are addressed in this EE/CA. The nature and extent of contamination from the ASTs, drum caches, Building C4, and locomotive are further discussed in Section 2.4.1. The extent of contamination from diesel, sludge, and PCBs from the mill site, and its possible migration into intertidal tailings and downgradient sediment is further discussed in Sections 2.4.2, 2.4.3.3, and 2.4.4. The distribution of metals in surface water at the site is further discussed in Section 2.4.5.

Other abandoned equipment was encountered around the site during the previous investigations, such as a boiler at tailings pile D15 and miscellaneous debris associated with structures east of Building C4, west of the unnamed stream, and around the mine workings and tramway (Figure 2-2). As described in Section 2.1.1, the buildings include workers' housing, a general office, and a blacksmith or machine shop. No evidence of hydrocarbon staining or other contaminant sources were observed in these areas, and no sampling was conducted.

2.3 PREVIOUS INVESTIGATIONS

Existing site data and historical information were compiled by the BLM in a report entitled *"Removal Preliminary Assessment, Final Report"* completed for the Salt Chuck Mine (USBLM, 1998). The BLM conducted an inventory-level evaluation of physical and chemical hazards in 1995. During the 1995 evaluation, unfiltered water samples were taken to determine if metals were leaching into downstream waters. Samples were also collected from the mine tailings and analyzed to evaluate the presence of heavy metals. These samples were described as "character" samples, indicating the analyses were not necessarily performed by standard protocols generally required for site assessments. The data collected provided guidance to determine if follow-up environmental sampling was warranted.

The Salt Chuck Mine was listed on the Federal Agency Hazardous Waste Compliance Docket, published in the Federal Register on June 27, 1997.

In July 1997, additional water, tailings, sediment, soil, and mollusk tissue samples were collected from the Salt Chuck Mine and from background locations by the BLM. Sample analyses were generally performed to provide usable data for site assessment purposes. The objective of the 1997 Preliminary Assessment/Site Inspection was to determine if hazardous substance releases warranted removal actions under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Thirteen large waste rock piles were identified at the site during the previous investigations by BLM (1998). However, based on visual observations and surface water field measurements conducted by BLM (1998), there was no indication that acid mine drainage or metals leaching was being generated from these piles, and no further sampling, pH testing, or acid-base accounting was conducted.

In July 2002, URS conducted a sampling program at Salt Chuck Mine for the Forest Service as part of this EE/CA. The objective of the investigation was to further characterize the nature and extent of contaminants, conduct a risk-based evaluation of site data, and assess removal action alternatives to prevent or mitigate releases at the site (URS, 2002). The following media were collected and analyzed during this investigation: soil in upland areas of the site; sludge found at the mill; tailings from the mill area, the unnamed stream, and the intertidal zone; saltwater sediment beyond the tailings; surface water in both freshwater and intertidal areas; and bivalve tissue from the intertidal tailings and Salt Chuck Bay sediment. Background samples of soil, sediment, freshwater, and bivalve tissue were also collected in 2002. The results of this investigation were provided to the Forest Service in 2003 in summary table form only (URS, 2003), pending additional funding for followup field sampling.

In September 2006, URS returned to the site to conduct additional field work to further characterize the nature and extent of the chemical threats to human health and the environment that were identified as a result of the previous investigations. Since much of the work of characterizing site hazards was already complete, the 2006 investigation focused on areas where additional data was required to eliminate data gaps. The specific objectives of the 2006 field investigation included the following:

- Definition of the extent of RCRA metals soil contamination adjacent to Building C4.
- Waste characterization of soil and tailings at Building C4 and the mill area.
- Further characterization of intertidal tailing Zones A through D.
- Re-estimation of the volume of tailings in Zone D and adjacent areas.
- Further characterization of sediment, surface water, and shellfish tissue at intertidal tailings Zones A through D, the intertidal areas west and east of the Unnamed Island, intertidal portions of southern Salt Chuck Bay and Brown's Bay, and the background site at Gosti Island.
- Evaluation of ground conditions of onshore area west side of Salt Chuck Bay for suitability for containment area construction.
- Documentation of the physical characteristics of the site to aid in evaluation of possible future access by heavy equipment, and to identify potential borrow sources.

2.4 ANALYTICAL DATA

The following subsections summarize available data from the 1995, 1997, 2002, and 2006 investigations that are pertinent to preparing the EE/CA for the Salt Chuck Mine. Sample locations are shown on Figures 2-1 through 2-7, and analytical results are summarized in Tables 2-5 through 2-18. Raw laboratory analytical data for the 2002 and 2006 investigations are provided in Appendices A and B, respectively.

QA/QC procedures implemented during the 1995 and 1997 sampling and analytical activities were not available; therefore, assessment of data quality for these investigations was limited to a qualitative understanding of sample methods used, and comparative results of duplicate sample analyses. Data collected during the 2002 and 2006 investigations were validated in accordance with USEPA standards. Data validation flags appear on the summary data Tables 2-5 through 2-18 where appropriate, and complete data validation procedures and memoranda for the 2002 and 2006 investigations are provided in Appendices C and D, respectively.

Data Tables 2-5 through 2-18 are divided by media type as well as by inorganics and organics analytes. Soils data are provided in Tables 2-5 through 2-7. Tailings data are split into three groups: unsaturated tailings (i.e., tailings above the intertidal zone) are included in Tables 2-8 and 2-9, along with sludge data from the mill; data from saturated stream bottoms are listed in Table 2-10; and data for tailings within the intertidal zone are listed in Tables 2-11 and 2-12. Soil and tailings analyzed specifically by the Toxicity Characteristic Leaching Procedure (TCLP) or Synthetic Precipitation Leaching Procedure (SPLP) are presented separately in Table 2-6. Sediment data are provided in Tables 2-13 and 2-14. Tables 2-15 and 2-16 presents surface water data for the site, and Tables 2-17 and 2-18 present the results of bivalve tissue analyses.

During the previous BLM (1998) investigations, soil and sediment character samples were analyzed for a complete suite of heavy metals targeted by a mining assay laboratory. As described in the 2002 Work Plan (URS, 2002), the data included a number of metals that are not listed in Tables 2-5 through 2-17 because they are not considered relevant to the EE/CA investigation. For most of these metals (e.g., bismuth, gold, palladium), no human health or ecological risk-based values exist. In the case of gallium, lanthanum, tungsten, and uranium, all site data were non-detect. Other inorganics such as sodium and potassium are considered essential nutrients, and are not typically part of environmental risk analyses. Risk-based values do exist for some of the metals (e.g., cobalt, molybdenum, titanium), but there are no chemical-specific regulatory ARARs governing these metals, and the site data are below the risk-based values, and/or below regional background levels (Gough, et al., 1988; Maas, et al., 1995; URS, 2001). Thus, these types of metals were not considered further in the EE/CA investigation. The intent of the EE/CA was to focus on priority-pollutant and other metals (listed in Tables 2-5 through 2-17) that have known toxicological effects to human health and the environment.

A summary of information related to site soils, tailings, surface water, sediment, and tissue sampling and analyses, including general trends and qualitative comparisons to background data, are presented in the following subsections. The site data are further compared to background and to risk-based screening values developed for this project in the Streamlined Risk Evaluation (SRE) in Section 2.5.

2.4.1 Soils

Three surface soil samples (including two composite samples) were collected during the 1997 field investigation in the upland area east and north of the mill site to test for possible contaminants related to the AST area, fuel drum caches, and batteries from the electric locomotive (Figures 2-2 and 2-3). In 2002, an additional 10 surface soil samples were collected in the AST and drum cache areas, two samples

next to Building C4 (former assay shop), and one additional sample near the locomotive. Five background soil samples were also collected in 2002 (Figure 2-1). In 2006, three additional soil samples were collected in the vicinity of Building C4 to further define the extent of previously detected metals contamination and to determine if the contaminated soil is a hazardous waste for alternatives analysis and possible disposal purposes. The analytical results are summarized below, and the significance of these results compared to risk-based values is discussed in Section 2.5.

- **ASTs and Drum Caches.** The results of analyses for petroleum hydrocarbons in this area indicate the presence of DRO in most samples in the range of 174 to 17,400 milligrams per kilogram (mg/kg), and residual range organics (RRO) in the range of 195 to 7,400 mg/kg (Table 2-7). The lateral distribution of DRO in soils is depicted on Figure 2-8. DRO and RRO analyses were also conducted using a silica gel cleanup approach at four of the sample locations in an effort to identify contributions from naturally occurring organics. These analyses indicated DRO up to 4,580 mg/kg (compared to 5,500 mg/kg without silica gel cleanup), and RRO up to 1,240 mg/kg (compared to 1,640 mg/kg without silica gel cleanup). DRO and RRO were detected in background soil samples up to 685 and 907 mg/kg, respectively. Two PAHs, benzo(a)anthracene and benzo(a)pyrene, were detected at low levels in one of two samples from the AST area (Table 2-7, Figure 2-8).
- **Electric Locomotive.** The results of two samples collected at this location indicated the presence of several metals in soil slightly above background (Table 2-5).
- **Building C4.** Soil samples collected next to this building exhibited the presence of elevated levels of copper, lead, mercury and other metals well above background (Table 2-5). The distribution of copper and lead in this area is shown on Figure 2-8. TCLP analysis at one of the sample locations (SCSS-25, Figure 2-3) indicates that RCRA levels defining a toxicity characteristic solid waste are not exceeded; that is, the soil would not be considered a hazardous waste for disposal purposes (Table 2-6).

2.4.2 Sludge

During the 1995 investigation, a sample of a thick gooey sludge was collected from the floor of the northwest corner of the mill (Sample SO01, Figure 2-2). The sludge had accumulated beneath fuel tanks adjacent to four banks of diesel engines, and appeared to have migrated into the intertidal zone (USBLM, 1998). Analysis of the sludge sample indicated a concentration of 163,000 mg/kg DRO (Table 2-9). Additional sampling was conducted during the 2002 investigation along the west side and southwest corner of the mill building where the sludge and possible diesel contamination appeared to have migrated into tailings. The results of these analyses are discussed in Section 2.4.3.1.

2.4.3 Tailings

A total of 38 tailings samples were collected from the mine site during the 1995 and 1997 investigations. In 2002 an additional 10 samples, and in 2006 an additional 9 tailings samples were collected. These are discussed in the following subsections by location and media type. Unsaturated tailings located above the

intertidal zone are discussed in Section 2.4.3.1 and listed in Tables 2-8 and 2-9. Tailings encountered in the bottom of the unnamed stream are discussed in Section 2.4.3.2 and listed in Table 2-10. Tailings in the intertidal zone are discussed in Section 2.4.3.3 and listed in Tables 2-11 and 2-12. The locations of tailings samples are depicted on Figures 2-2 and 2-4.

2.4.3.1 Unsaturated Tailings

Three character samples of tailings above the intertidal zone were collected in 1995 near the mouth of the unnamed creek, the mill area, and the tailings spit. Four additional samples of these materials were collected in 2002. The analytical results are summarized below, and the significance of these results compared to risk-based values is discussed in Section 2.5.

- **Adjacent to Mill.** Most of the material surrounding the mill is a mixture of waste rock and tailings (Figure 2-2). Samples collected in this area (Table 2-8) exhibit elevated concentrations of several metals well above background levels in soil (Table 2-5), the most pronounced of which are copper and selenium. In addition, several PAHs and PCBs were detected in samples from this area (Table 2-9). The distribution of the PAH benzo(a)pyrene is shown on Figures 2-8 and 2-9, and the distribution of PCBs is shown on Figure 2-11.
- **Piles D14 and D15.** These tailings piles are located on both sides of the unnamed creek (Figure 2-2). The samples collected in each of these piles contain concentrations of several metals above background, most notably copper (Table 2-8).
- **Tailings Spit.** Tailings that extend south of the mill and into the intertidal zone cover an area of approximately 40 by 200 feet that appears exposed at high tide (Forest Service, 1991b). The top of this pile at Sample 3-4 is described as dry windblown silt with a stunted spruce tree and driftwood present, indicating the storm high tide mark (USBLM, 1998). Character Sample 3-4 contained a level of copper (3,160 mg/kg) well above soil background (Tables 2-5 and 2-8).

2.4.3.2 Stream Tailings

Tailings are located in the unnamed stream between tailings piles D14 and D15. A composite character sample of the stream tailings, was collected in 1995, and an additional sample was collected in 2002 (Table 2-10, Figure 2-2). Metals analyses on these samples indicate elevated levels of copper and mercury above soil background. Due to the limited amount of stream tailings at the site, background samples of freshwater sediment were not deemed warranted. The significance of the stream tailings results compared to risk-based values for freshwater sediment is discussed in Section 2.5.

2.4.3.3 Intertidal Tailings

Tailings in the intertidal zone are comprised of two main piles, zones A and B located west of the rock jetty and northeast of the piers respectively; and two flatter zones (C and D) that spread out to the south and southeast which are visible only at low tide (Figures 2-4 and 2-5). The unsaturated tailings spit (Section 2.4.3.1), which forms an island at high tide, lies within Zone A. At low tide, Zones A and B are bisected by a seep and reentrant flowing southeasterly along the piers to a confluence with Lake Ellen

Creek. The south end of the intertidal tailings zone is bounded by Lake Ellen Creek at low tide and the unnamed island to the southeast. The tailings piles have relatively distinct elevation gradients marked by changes in surface expression on aerial photos. The texture and color of the tailings material is reported to be largely homogeneous throughout the intertidal deposition zone (Forest Service, 2002).

A total of 35 samples from the intertidal tailings were analyzed during the 1995 and 1997 investigations, and an additional five samples were collected and analyzed in both 2002 and 2006 (Tables 2-11 and 2-12). Most of the 1995-1997 samples were given sample designations in the field beginning with "SC", which were also used by the laboratories in reporting data. For the purposes of the 1998 report, however, BLM reassigned each sample location a map number (beginning with "3-" or "3a-"), starting at the northwest end of the tailings pile, and continuing southward in roughly west-to-east rows. Low map numbers are close to the mill, and high numbers are generally further from the mill. Since the map numbers do not correlate directly with the original SC numbers, all sample designations have been included in Table 2-11. For the purposes of clarity on Figure 2-4, however, only one sample identifier is used, in the following order of preference: map numbers first, then SC numbers only where no map numbers have been assigned.

Analytical results from the intertidal tailings samples are summarized below, and the significance of these results compared to risk-based values is discussed in Section 2.5.

- **Metals Data.** The results of character sample analyses conducted in 1995 and 1997, and the EPA method analyses conducted in 2002 and 2006 (Table 2-11), indicate the presence of several metals in the intertidal tailings deposits above background intertidal sediment data (Table 2-13). In particular, copper and vanadium are well above background throughout the tailings. The distribution of copper in intertidal tailings is shown on Figure 2-10. Copper reaches a maximum concentration of 3,880 mg/kg in Zone A, and generally decreases with distance from the mill and at lower elevations in the intertidal zone.

  The distribution of co-located tailings and tissue data for selected metals is shown on Figure 2-12. Discussion of these results is provided in Section 2.4.6.

  Five intertidal tailings samples were analyzed for TCLP metals. These results, presented in Table 2-6 alongside Federal regulatory levels for defining hazardous waste, indicate that while several metals were detected in leachate from the samples (barium, copper, and zinc), none were present above regulatory levels for a toxicity characteristic of solid waste. Two additional samples collected in 2006 were analyzed by EPA Method 1312, Synthetic Precipitation Leaching Procedure (SPLP), using site intertidal water in the laboratory extraction in an effort to mimic less acidic natural conditions. The SPLP results indicate detections of copper and vanadium in leachate under these conditions. The level of copper in the SPLP leachate from Zone A (SCIT-11, 0.725 mg/L) is similar to dissolved copper concentrations in tailings seep samples discussed in Section 2.4.5 (up to 0.596 mg/L, Table 2-15). The copper concentration in the Zone D SPLP sample (SCIT-13, 0.009 mg/L) is significantly less than that in Zone A.

A sample of Zone D intertidal tailings was collected and analyzed for acid volatile sulfide/simultaneously extractable metals (AVS/SEM) in 2006, for use in the interpretation of bioavailability for the divalent metals cadmium, copper, nickel, lead, and zinc. These results are included on Table 2-11 and discussed in the SRE in Section 2.5.

- **Bioassay Tests.** Toxicity tests on intertidal tailings samples from Zones C and D (SCIT-12 and SCIT-13, Figure 2-4) were conducted in 2006 to further evaluate risk in the SRE, and to provide input for a weight-of-evidence approach to determining cleanup levels. The samples were analyzed by EPA Method 1006.0 for conducting a 7-day chronic sediment test using an estuarine silverside *Menidia beryllina* fish species. This fish was utilized for the critical life stage bioassay because larval stage Menidia can tolerate a large range of salinities, and because a standard bioassay with a chronic endpoint (larval growth) was available. An elutriate test was performed because the test species are more sensitive to the dissolved cupric ion (Cu^{+2}) than sediment-bound copper, and because the test simulates percolation of copper from tailings into surface waters where fish would be exposed. The results showed a survival rate of 100 percent for the maximum (undiluted) elutriate solution at SCIT-12, and 95 percent for the undiluted elutriate at SCIT-13. With a standard deviation of 5.8 percent, the 5 percent mortality rate associated with SCIT-13 was considered insignificant (Pacific EcoRisk, 2006). Samples SCIT-12 and SCIT-13 had corresponding total copper concentrations of 1,340 and 153 mg/kg, respectively (Figure 2-10).
- **Organics Data.** One sample of intertidal tailings just south of the barge was analyzed for DRO, and four samples from the Zone A through D tailings were analyzed for PAHs and PCBs, in an effort to identify the extent of hydrocarbon contamination extending from the west side of the mill, south into the intertidal area (Sections 2.4.2 and 2.4.3.1). Sample SO02 was found to contain a relatively low level of DRO (86 mg/kg) (Table 2-12). The PAH and PCB analyses yielded detections of a number of PAHs in all samples, and PCBs in two of four samples (Figure 2-11). The significance of these data compared to risk-based levels is discussed in Section 2.5.

2.4.4 Sediment

A total of 15 samples of intertidal sediment from Salt Chuck Bay, and 3 samples of background sediment, were analyzed during the 1995 and 1997 investigations to evaluate the possible migration of metals from the tailings pile (Table 2-13). The 1995 and 1997 sediment samples were given sample designations in the field beginning with "SC", which were also used by the laboratories in reporting data. In the BLM (1998) report, however, each sample location was reassigned a map number (beginning with "3-", "3a-", or "4-"). Lower map numbers were generally located towards the head of Kasaan Bay near the tailings, and higher map numbers towards the south end of the bay; numbers beginning with "4-" are background samples. Since the map numbers do not correlate directly with the original SC numbers, all sample designations have been included in Table 2-13. For the purposes of simplicity on Figures 2-4 and 2-7, however, only the map numbers are used to identify sediment sample locations.

During the 2002 investigation, a total of 14 site sediment samples and one background sediment sample were collected. Eight of the 2002 site samples were analyzed for total metals, and six were analyzed for

mercury only as part of a contingency sampling approach. In addition, two samples were analyzed for PAHs and PCBs to further identify the extent of possible organics contamination from the mill area. During the 2006 investigation, an additional nine sediment samples were collected and analyzed for selected metals based on preliminary risk screening and data gaps analyses. Two samples were analyzed for PCBs at locations west of the unnamed island to further evaluate the presence, extent, and risk posed by PCBs that could potentially be traced to a site source. Analytical results from the sediment samples for all investigations are summarized below, and the significance of these results compared to risk-based values is discussed in Section 2.5.

- **Metals Data.** Several metals were encountered in the sediment samples above background levels (Table 2-13), in particular, arsenic, copper, and vanadium. The distribution of copper in sediment samples near the site is depicted on Figure 2-10. Copper concentrations generally decrease with distance from the tailings zones. Mercury was found to be elevated in localized spots west of the unnamed island (e.g., Samples 3a-5 and SCSD-2, Table 2-13).

  The distribution of co-located sediment and tissue data for selected metals is shown on Figure 2-12. Discussion of these results is provided in Section 2.4.6.

  During the 2006 investigation, an attempt was made to collect sediment samples for AVS/SEM analyses to support the SRE. These analyses were not conducted, however, because the anaerobic conditions required for a valid interpretation were not encountered in the intertidal sediment areas.

- **Organics Data.** Analyses of PAHs and PCBs at two sediment sample locations in 2002 indicated the presence of several individual PAHs and PCBs, as well as total PCBs, above RBSLs/benchmarks (Table 2-8, Figure 2-10). PCBs were not detected above the laboratory detection limits in the two sediment samples collected in 2006.

- **Bioassay Tests.** Toxicity tests were conducted on one sediment sample from the area west of the unnamed island (SCSD-28, Figure 2-4) and on one background sample. The samples were analyzed by EPA Method 1006.0 as described in Section 2.4.3.3. The results showed a survival rate of 100 percent in both samples for the maximum (undiluted) elutriate tested. Sample SCSD-28 had a corresponding total copper concentration of 205 mg/kg (Figure 2-10).

2.4.5 Surface Water

Sample Locations. Surface water samples were collected at a total of 12 site locations and five background locations during past investigations. Sample locations included the following:

Freshwater Samples

- Background samples of the unnamed stream that bisects the mine site, collected upstream of the mine workings, structures, and debris present along the north side of the drainage (Figure 2-2).

- The unnamed stream just upstream the adit water confluence (field measurements only) (Figure 2-2).
- Background samples from a lake and lake outlet feeding Lake Ellen Creek west of the site (Figure 2-1).
- Groundwater and runoff water draining from the main haulage adit W1 (Figure 2-2).
- The unnamed stream at locations just downstream of the adit water confluence (Figure 2-2).
- Near the mouth of the unnamed stream, just upstream of tailings piles D14 and D15 (Figures 2-2 and 2-4).

Intertidal Water Samples

- The tailings seep at the head of the reentrant bisecting tailings Zones A and B at low tide (Figure 2-4).
- Lake Ellen Creek at four locations (Figure 2-4): two upstream of its confluence with the unnamed stream at locations that get flooded at high tide; and two downstream from its confluence with the unnamed creek at low tide; one of which is also downstream of its confluence with the tailings seep.
- Three locations around the unnamed island at low tide (Figures 2-4 and 2-6): at the southeast edge of Zone D; the west side of the island; and the constriction point on the northeast side of the island. These samples were collected to further identify the extent of contamination, and to establish baseline data for possible monitoring following a removal action.
- Two locations outside of Salt Chuck Bay: Lindeman Cove just beyond the south end of Salt Chuck Bay (Figure 2-6); and Mills Bay about 3 miles south of Salt Chuck Bay (Figure 1-1). These locations were sampled to evaluate the downgradient reach of site-related impacts, to identify whether offsite sources such as other mines in the area may be contributing to elevated metals concentrations in the region, and to establish baseline data for potential future site monitoring.
- The previously established background area used for sediment and tissue sampling at Gosti Island (Figure 2-7), to examine the correlation of metals concentrations between all three intertidal media at a location unaffected by the site, and to evaluate whether metals are naturally present in background saltwater for the purpose of tissue data interpretation.

Sampling methods for the low flow tailings seep and other intertidal locations followed methods described in the 2002 work plan (URS, 2002). These involved manually digging a depression in the sediments to allow for sample collection by submerging a sample bottle into the pool.

Three of the previous intertidal water sample locations were resampled in 2006 to further evaluate possible variations in metals concentrations between different years and sampling seasons. In addition, split samples at three locations (tailings seep, Gosti Island, and Mills Bay) were analyzed by different

sample preparation methods to evaluate the effects of suspected saltwater matrix interference in the 2002 data set (URS, 2006). Selected metals were analyzed by both the standard ICP/MS preparation used in 2002, and by a Reductive Precipitation (RPPT) preparation that can separate certain metals from a salt-reach matrix. All other 2006 analyses utilized the RPPT preparation only (Table 2-15). One intertidal sample (tailings seep) was also analyzed for PAHs and PCBs to identify possible migration from potential sources in the mill area.

Sample Results. Analytical results for surface water are provided in Tables 2-15 and 2-16 for inorganics and organics data, respectively. The results and general trends are summarized below, and the significance of these data compared to risk-based values is discussed in Section 2.5. The distribution of two metals (arsenic and copper) in surface water is shown on Figure 2-14.

- **Freshwater Metals Data.** Selenium was the only metal detected in background freshwater samples. It was present at dissolved concentrations up to 10.4 µg/L in the background lake and lake outlet samples.

  Water coming from the main adit exhibited detections of both dissolved copper and selenium. The selenium value was only slightly higher than background, however, indicating a possible regional contribution to site selenium from this mineralized area. Copper and selenium were not detected in the next sample downstream of the adit-unnamed stream confluence.

- **Intertidal Metals Data.** Trace to low levels of dissolved arsenic, copper, mercury, nickel and selenium were detected in background intertidal water samples at the Gosti Island site and in Mills Bay (Table 2-15).

  These metals were also detected in most samples collected in the intertidal areas of Salt Chuck Bay and just south of the mouth of the bay. The highest concentrations were encountered in the tailings seep, and generally decrease with distance from the tailings. The presence of metals in Lake Ellen Creek samples upstream of the confluence with the unnamed stream is likely due to flood tides carrying tailings residues up into the mouth of the creek.

  The results of the RPPT analyses indicate that arsenic in particular is substantially reduced by the RPPT preparation, indicating that prior data sets from the intertidal zone analyzed without this preparation method may represent false positives. Nickel and selenium may also be reduced by the RPPT method, but the results are less definitive. The copper data do not appear to be affected by saltwater interference.

  Independent of saltwater interference issues, variations in results between different sampling years do not exhibit consistent trends. For example, dissolved arsenic and nickel in the tailings seep were lower in 2006 than in 2002, but copper was higher. Intertidal samples from 1997 were generally lower in metals concentrations than 2002 or 2006. These variations are more likely due to differences in seasonal precipitation, tide level, sample location, or laboratory methodologies, than to real trends or changes in leaching from the tailings over time.

- **Organics Data.** The results of analyses for PAHs and PCBs conducted on the tailings seep (Table 2-16) indicate no detectable concentrations of these compounds. The non-detect results confirm the absence of obvious organics contamination in seep water coming from potential sources in the mill area.

2.4.6 Tissue

A total of 27 samples of bivalves from Salt Chuck Bay, and 7 samples of bivalves in background sediment, were analyzed during the 1997 and 2002 investigations to evaluate the possible impact of site metals on intertidal species. Six additional samples were collected in 2006 to complete the evaluation of human health and ecological risk, as well as decisions regarding RAOs in the EE/CA. Tissue sample locations are shown on Figures 2-4, 2-6, and 2-8.

Tissue samples were collected from four different species in the 1997 through 2006 investigations for a variety of reasons (URS, 2006). Samples were collected in the tailings deposits and in northern Salt Chuck Bay sediment to identify the nature and extent of metals and PCBs related to site sources, and to evaluate the relationship between concentrations in tailings/sediment and different bivalve species. Samples from middle and southern Salt Chuck Bay were collected to address concerns about high arsenic levels and different uptake rates in certain clam species, and to confirm the lack of elevated mercury in bivalves where mercury in sediment appeared to be locally high. Inorganic arsenic was also analyzed alongside total arsenic in several tissue samples to assess the relative concentration of inorganic vs. organic arsenic present and their implications for human health risk, as inorganic arsenic is the form most toxic to humans. Butter clam samples collected at the closest known harvest area to the site, Fourth-of-July Island (Figure 2-6), were split and prepared in the field using two methodologies to simulate the range of local collection and food preparation habits, in that one of the two samples was allowed to depurate (purge) in local water for 24 hours prior to packaging. Other tissue samples were packaged immediately following collection.

The results of site bivalve tissue analyses, provide in both dry and wet weight concentrations, are listed in Tables 2-17 and 2-18 alongside background data organized by species. Median concentrations for metals studied by O'Connor (1998) as part of NOAA's nationwide Mussel Watch Program are listed alongside the background data for reference. Site data and general trends are summarized below, and the significance of these results compared to risk-based values is discussed in Section 2.5. The lateral distribution of several metals of concern in tissue are depicted on Figures 2-12 and 2-13. Figure 2-12 also shows tailings and sediment data that are co-located with the tissue samples.

- **Bivalves in Background Sediment.** Most metals were detected at trace to low levels in background tissue (Table 2-17). The background data indicate that some species concentrate certain metals in their tissue at higher levels than others. For example, copper is highest in butter clams, and mercury is highest in blue mussels. For some metals such as arsenic, selenium, and vanadium, more limited data sets preclude comparisons between species. PCBs were not detected in background tissue (Table 2-18).

- **Bivalves in Tailings Deposits.** Analytical data from the tailings zones bivalves indicate the presence of several metals above site-specific background and NOAA reference bivalves, including arsenic, copper, selenium, and vanadium. Both copper and vanadium occur at higher concentrations in softshell clam tissue than in blue mussel tissue. Arsenic is present at higher concentrations in littleneck clams than other species sampled in the tailings. Bivalves were not observed in the northern part of Zones A through C, and begin to appear within about 200 feet of Lake Ellen Creek. This distribution corresponds to both decreasing elevations in the intertidal zone and decreasing copper concentrations. The northernmost tissue samples were found living in tailings containing copper concentrations in the range of 500 to 1,500 mg/kg (Figures 2-10 and 2-12). An attempt was made in 2006 to collect butter clams from the tailings zones, as this is the more commonly harvested species in the area. Butter clams were not found in the tailings, however.
- **Bivalves in Sediment, Northern Salt Chuck Bay.** Tissue data from sediment south of the tailings deposits indicate the presence of the same metals as in the tailings bivalves, which exceed background in several samples each, although generally at lower concentrations than in the tailings tissue samples. Copper and vanadium show a general decrease in tissue in this area as compared to the tailings, while arsenic and selenium exhibit similar ranges in the two areas. Arsenic appears to be more readily absorbed in butter and littleneck clams than in mussels and softshells in northern Salt Chuck Bay. Other metals in co-located tissue data from this area do not exhibit as clear a difference between species as arsenic. Mercury was present in tissue above background levels in localized spots within northern Salt Chuck Bay (e.g., SCTIBM-27); however, these locations do not correlate well with elevated levels in sediment samples (e.g., SCSD-2, Figure 2-12).
- **Bivalves in Sediment, Southern Salt Chuck Bay Area.** Tissue data from sediment south of the unnamed island in Salt Chuck Bay, and in Lindeman Cove and Brown's Bay just outside the mouth of Salt Chuck Bay, indicate the presence of arsenic above background and NOAA reference bivalves in three of seven sample locations. Like the northern Salt Chuck Bay samples, arsenic is highest in littleneck and butter clams. Maximum copper, selenium, and vanadium concentrations in this area are only slightly above background and NOAA reference bivalves, and mercury is not present at concentrations above these levels. Tissue samples collected at Fourth-of-July Island were generally similar to background levels. There was no significant difference in concentrations between the purged and unpurged samples from Fourth-of-July Island (Table 2-17).
- **Organics Data.** PCBs were analyzed in selected tissue samples from the tailings and Salt Chuck Bay sediment. PCBs were not detected in any of these samples (Table 2-18, Figure 2-11).

2.5 STREAMLINED RISK EVALUATION (SRE)

An SRE was completed for the EE/CA to develop appropriate risk-based remedial goals for chemicals of potential concern (COPCs) in affected media, and to ensure that human health and beneficial uses of the

environment at the Salt Chuck Mine are protected in a cost-effective manner. According to USEPA (1993b) *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA,* a streamlined process can be used where the risk assessment is conducted as part of the remedial investigation. Thus, a streamlined risk approach was performed that focuses on the comparison of contaminant concentrations to chemical-specific ARARs or risk-based concentrations in the absence of ARARs. This approach is used in the SRE to identify COPCs, to assess how and to what extent people and the environment might be exposed, to project potential risk under a no action scenario, to identify what exposures need to be addressed by the removal action, and to define appropriate cleanup levels. Thus, the SRE is used as the basis for defining RAOs in Section 3.0.

The approach described below incorporates standard steps for risk assessment, and is based on both ADEC and EPA regulations and methodologies (e.g., ADEC, 2001, 2006b, 2007a; USEPA, 1989, 1992, 1993b, 1997, 1998). The SRE methodology for the Salt Chuck EE/CA was previously reviewed and approved by ADEC (2002a) following completion of the 2002 Work Plan, and updated in the 2006 Work Plan Addendum. During development of this report, risk guidances and regulations used in the work plans were reviewed for currency, and the SRE approach and screening criteria updated where necessary.

Data evaluation procedures for the EE/CA were essentially the same for both the human and ecological SREs, and are discussed in Section 2.5.1. Because SRE methodologies vary for human and ecological receptors, they are discussed separately: the human health SRE in Section 2.5.2 and the ecological SRE in Section 2.5.3. In this SRE, site data are compared to risk-based screening criteria for COPC selection. For the purposes of this assessment, COPCs refer to chemicals of both human and ecological concern collectively; while COHCs are defined as chemicals of potential concern for human health protection, and COECs are defined as chemicals of potential concern for protection of ecological receptors.

2.5.1 Data Evaluation

The following data evaluation procedures apply to both the human and ecological SRE. Site characterization and data collection activities, including information developed by both BLM and URS, are detailed in Sections 2.1 through 2.4 of this report. Data are summarized in Tables 2-5 through 2-18.

2.5.1.1 Data Validation

Validation of site data was conducted to identify those data that are usable for risk assessment purposes. EPA guidance states that, in order to meet data quality objectives for risk assessment, analytical data shall meet Level III quality criteria, which is defined as the level that can accurately identify and quantify chemicals present in site media, and can be relied upon to make assessments which may affect human or ecological health (USEPA, 1993c). Data that fail to meet Level III criteria are classified as Level I or Level II. Data of Level I quality can provide indications of chemicals when present, but cannot quantify concentrations. Character sample data collected at the Salt Chuck site in the 1990s were generally considered Level II, in that, like an onsite mobile laboratory, they approximate quantity for the purpose of roughly identifying extent, but do not have QA/QC reports that can be used to validate information such

as system performance, detection limits, etc., and as such, cannot be relied upon to make assessments that may affect human health or the environment.

Analytical data collected during the 2002 and 2006 investigations at the Salt Chuck Mine are provided in Appendices A and B, respectively. The validation process performed on these data are summarized in URS memoranda provided in Appendices C and D and discussed in the following section.

2.5.1.2 Data Reduction

Prior to risk evaluation, data were evaluated in the validation process and reduced using the following strategies:

- Non-detected results were reported with "U" flags in the raw laboratory data, and listed as "ND" in the summary data tables (Tables 2-5 through 2-18) with detection limits provided in parentheses. For non-detected data, proxy concentrations of one-half the detection limit were utilized for screening in the SRE to identify compounds that should be retained for qualitative evaluation.
- Data were reviewed by the laboratory and data validator to determine if "J" qualifiers should be assigned for estimated values. These flags were added to tabulated summary data for several reasons: where a result fell below the Practical Quantitation Limit (PQL) but higher than the Method Detection Limit (MDL); where matrix spike or surrogate recoveries were outside of laboratory QC criteria; where duplicate relative percent differences (RPDs) were outside of control limits; where holding times were exceeded; and where matrix interference was present, e.g., by salts in intertidal water. Footnotes describing the use of "J" flags for individual data points are provided in Tables 2-5 through 2-18. The estimated concentrations were used in the SRE and re-assessed for data quality if necessary following risk screening.
- Analytical results rejected in the data validation process were noted with "R" flags in the summary tables, and excluded from use in the risk evaluation.
- Blanks were evaluated in the validation process to determine if "B" qualifiers should be assigned for chemicals also detected in method blanks. Inorganic compounds not considered common laboratory contaminants were flagged as non-detects if the measured concentration was less than ten times the maximum detected concentration in a method blank or equipment blank, or less than five times the detected concentration in a continuing calibration blank.
- The average of analytical results from duplicate field samples was used in the SRE. These data are footnoted as such in the summary data tables. If one result was detected and the other non-detected, the average was calculated using half the detection limit for the non-detect sample.
- Chemicals were evaluated in the SRE if detected in at least one sample from each media type.
- The maximum concentration of each detected compound was used for risk screening.
- Background data were used in the SRE to eliminate COPCs (e.g., metals) that may initially indicate a risk, but are present at the site at concentrations below natural conditions. During the

1995 through 2006 investigations, background data were collected for a variety of media. Background locations are discussed in Section 2.4; depicted on Figures 1-1, 2-1, 2-2, and 2-7; and included on summary data Tables 2-5, 2-7, 2-13, 2-15, 2-17, and 2-18. Background values used in the SRE were calculated in accordance with ADEC (2003c) guidance:

  - For media with four to eight background data points, the interquartile range (IQR) of the sample set was used to estimate the 95% confidence limit (CL) on the median (ADEC Method 2).
  - For media with three or fewer background data points, the maximum value was used (ADEC Method 3).

- The original USBLM (1998) soil/sediment character sample data sets, which had been analyzed by a mining assay laboratory, were reduced during development of the URS (2002) Work Plan by several heavy metals that were not considered relevant to the EE/CA investigation. The rationale for this process is described in Section 2.4.
- Character sample results were used for approximating extent of contamination, but were excluded from risk calculations. For comparison purposes, frequency of detections were calculated for non-character samples alone, as well as for character and non-character samples added together.
- Intertidal surface water data were analyzed using both RPPT and non-RPPT preparation to identify the effects of saltwater interference with certain metals analyses. Both of these data sets were used in a side-by-side analysis in the SRE.
- Clam tissue data are listed in both dry weight and wet weight concentrations in summary Table 2-17. Wet weight concentrations were used in human health SRE, as they were considered the more likely form to be ingested. Clams are more likely to be eaten by humans in chowders and stews than dried and smoked.
- Clam tissue data were grouped by species in the SRE. Both species-specific and total tissue data were evaluated in the SRE.

2.5.2 Human Health SRE

Consistent with ADEC (2005a) risk assessment procedures, the human health SRE involved the development of a conceptual site model which identifies human receptors and complete exposure pathways, selection of COHCs through comparison to risk-based screening levels (RBSLs), and qualitative discussion of potential human health risks. Along with the results of the ecological SRE, the results of the human health SRE are used as the basis for defining RAOs for removal action in Section 3.0.

2.5.2.1 Receptors and Pathways of Concern

Human receptors of concern for the Salt Chuck Mine site are expected to include recreational users (e.g. hunters, rock climbers, etc.), future mining workers, and recreational users of surface water resources

(e.g., kayakers, small boats, shellfish harvestors, and fishers). Pathways of concern for risk to human health are presented in a conceptual site model in Figure 2-15, which is described in the following paragraphs.

For mine areas with impacted surface soils and sediment, potentially complete pathways for recreational users exist, and include incidental ingestion of surface soil or sediment (at low tide), dermal contact, and inhalation of particulates. With the possible exception of mercury, the types of chemicals at the site are not volatile, such that inhalation of vapors is considered an insignificant exposure pathway. RBSLs based on ingestion and inhalation of soils are presented in Section 2.5.2.2.1. In addition, recreational users could ingest fish and shellfish collected from the area. In general, the upland area of Salt Chuck Mine represents only a small portion of the potential foraging area of game species such as bear, and deer, such that chemical uptake from the site and accumulation into tissues at harmful concentrations is unlikely to be significant.

Groundwater ingestion is not considered to be a pathway of concern for humans, because there are no drinking water wells within a 15-mile target distance hydrologically downgradient of the Salt Chuck Mine site (USBLM, 1998). Given the proximity of the lower portion of the site to marine and estuarine water, it is likely that groundwater in this area is not potable and would not be used for drinking water in the future. Groundwater in the upland area is potentially potable, but is unlikely to be developed for drinking water in the future, due to the presence of more readily available surface water sources, and low yields in bedrock aquifers. The migration-to-groundwater pathway for soils is, however, retained in the SRE due to ADEC requirements under 18 AAC 75 that soil cleanup levels be protective of this pathway even if groundwater is not a drinking water source, and to be protective of migration to potential surface water seeps. RBSLs based on soil migration to groundwater are presented in Section 2.5.2.2.1.

Surface water at the site could potentially be used as drinking water by recreational and mining users where it is not brackish. Surface water is also an important indirect pathway through fish ingestion. RBSLs for surface water based on water and fish ingestion are provided in Section 2.5.2.2.2.

According to the *Prince of Wales Island Area Plan* (ADNR, 1998), land management intent for Salt Chuck Bay is that activities in the area should not preclude its use for aquatic farming, or for the protection of critical habitat for herring spawning and salmon rearing and schooling. Thus, fish and shellfish ingestion are important pathways to consider in the SRE. Hazards to shellfish populations that could impact an aquatic farming land use were addressed in the ecological SRE through sediment screening levels. However, it is important to note that many site features besides chemical concentrations can influence the presence, abundance or absence of shellfish populations (e.g., salinity, grain size, dissolved oxygen, degree of saturation, etc.). There may be inadequate substrate present on the tailings to support shellfish populations. Also, tailings deposition may have elevated the intertidal zone to a point where tidal flooding does not cover the substrate long enough to support shellfish colonization (Forest Service, 2002). Human health RBSLs for shellfish ingestion, based on both subsistence and recreational take of resources where available, are provided in Section 2.5.2.2.3.

2.5.2.2 Selection of Risk-Based Screening Levels (RBSLs)

The following sections describe the development of human health RBSLs. These values were used in the SRE to interpret the significance of site data, and to assist in risk management decisions where a risk or hazard was identified.

2.5.2.2.1 RBSLs for Soils, Tailings, and Sediment

Ingestion and Inhalation Pathways. With the exception of DRO and lead, the approach for pathways involving soils, tailings, and sediment was to use ADEC (2006b) Method Two soil cleanup levels (18 AAC 75.340) for sites with greater than 40 inches per year mean annual precipitation. These levels are provided in Table 2-19 for the compounds sampled during the EE/CA investigations. These values were used to select COHCs based on potential incidental ingestion of uplands soils and unsaturated tailings, as well as recreational exposures of saturated tailings during low stream flow or low tide. For some constituents (e.g., thallium, individual PCBs), no ADEC cleanup levels have been established under Method Two. In these cases, EPA Region 6 human health screening levels for industrial soil - outdoor worker (USEPA, 2006b) were selected for use in the SRE (values in parentheses in Table 2-19). Region 6 screening levels (outdoor worker) were also considered in the qualitative evaluation of COHCs that exceed initial screening in the SRE (Sections 2.5.2.3.1 and 2.5.2.3.2).

Migration-to-Groundwater Pathway. With the exception of DRO, the approach for this pathway was to use soil cleanup levels following ADEC Method Two regulations and guidance (18 AAC 75.340). These levels are provided in Table 2-19 for the metals and organic compounds sampled during the EE/CA investigations. For constituents with no ADEC cleanup levels, EPA Region 6 human health screening levels for migration to groundwater using a dilution factor of 20 to account for high precipitation (USEPA, 2002, 2006) were selected for use in the SRE (values in parentheses in Table 2-19).

Approach for Lead. Two separate exposure scenarios were considered for lead: one involving uplands activities by future mining claimants, hunters, or climbers; and a second involving intertidal/offshore recreationists and shellfish collectors. Under the uplands scenario, lead concentrations in soil, unsaturated tailings, and stream tailings were compared to the ADEC (2006b) Method Two cleanup level for residents. For the intertidal scenario, potential cumulative impacts from both dietary ingestion of shellfish tissue and incidental ingestion of exposed tailings/sediment at low tide were considered, an approach which takes into account the fact that toxic effects of lead are correlated with blood lead levels rather than exposure levels of daily intake. The latter approach is further described in Section 2.5.2.2.3.

Approach for DRO and RRO. Site DRO and RRO data were initially screened using ADEC (2006b) Method Two soil cleanup levels. For data that exceeded these values, a site-specific alternative cleanup level was calculated under ADEC Method Three (18 AAC 75.340e). Site-specific soil TOC data were used to modify the migration-to-groundwater cleanup level based on ADEC (2004a) equations and parameters. A 95% confidence level (CL) of TOC data from site background areas was calculated (0.1334 g/g), and used in place of the default fraction organic carbon (f_{oc}) value in the ADEC migration-

to-groundwater equation. The results of the Method Three calculation are provided in Appendix E, and indicate a soil cleanup level of 12,500 mg/kg, based on the maximum allowable DRO in soil.

Cumulative Risk. Under 18 AAC 75.340(k), for cleanups conducted under ADEC Method Two or Three, a calculation of cumulative risk must be conducted using 1/10th the Method Two ingestion and inhalation values. For the purposes of the SRE, this was conducted only for areas and media proposed for no further action following screening. Systematic screening at 1/10th Method Two values was not conducted on a site-wide basis for reasons documented in the uncertainty section (Section 2.5.2.3.9). However, for areas of the site having no identified COHCs higher than RBSLs, cumulative risk was evaluated following risk screening in the SRE using ADEC's (2007b) online Method Three Calculator for sites with greater than 40 inches per year mean annual precipitation and commercial/industrial settings. Because recreational users would be exposed only infrequently and for much shorter exposure durations than typical commercial settings, these values were considered protective of recreational users. Site-specific TOC data (described above for DRO) were used in the calculations. Given that groundwater is not a pathway of concern in this area, groundwater concentrations were assumed to be zero in the cumulative risk calculations. The cumulative risk calculations take into account individual metals and organic compounds, and do not include petroleum hydrocarbon mixtures. This approach was used to confirm the lack of need for further action for soils in the electric locomotive area and for the stream tailings based on human health (Section 2.5.2.3.3), and will also be used at the site to evaluate remaining risk following completion of the interim removal action recommended by this EE/CA (Section 5.5).

2.5.2.2.2 RBSLs for Surface Water

Water Ingestion Pathway. Maximum Contaminant Levels (MCLs) provided under ADEC Drinking Water regulations (18 AAC 80.300) were selected as RBSLs for those areas of the site where surface water could potentially be used as drinking water, such as in non-brackish upstream portions of the unnamed creek. These levels are listed in Table 2-20 for chemicals that were sampled at the mine site.

For those constituents with no MCL provided in 18 AAC 80, criteria from Alaska Water Quality Standards (18 AAC 70) for freshwater drinking water supply use are listed in Table 2-20. In the absence of drinking water MCLs, these regulations designate the use of human health criteria for noncarcinogens for consumption of water and aquatic organisms (ADEC, 2003b, 2006a).

Fish Ingestion Pathway. Due to the potential for recreational fishing in the site vicinity, Alaska and EPA water quality criteria for fish ingestion were also selected for screening of site surface water data. These include (1) criteria for noncarcinogens contained in ADEC (2003b) for consumption of aquatic organisms; and (2) EPA chronic ambient water quality criteria (AWQC) for ingestion of fish (USEPA, 2004). In the absence of AWQCs for fish ingestion, AWQCs for fish ingestion and water combined (USEPA, 2004) were selected. Table 2-20 presents the fish ingestion RBSLs used in the risk evaluation for this pathway.

2.5.2.2.3 Human Health Approach for Invertebrate Tissue Ingestion

Shellfish Ingestion RBSLs. With the exception of lead, the approach for assessing site tissue data for human health risk was to use shellfish ingestion RBSLs. These are compiled in Table 2-21 in the following order of preference:

- USEPA (2000) Screening Values for fish/shellfish ingestion – Both subsistence and recreational levels of fish ingestion are provided by EPA for certain metals, total PAHs, and total PCBs. Although these values were derived using fish consumption ingestion rates, their use for shellfish ingestion is conservative and recommended in USEPA (2000).
- USEPA (2006a) Region 3 risk-based concentrations (RBCs) for fish ingestion - These RBSLs are concentrations estimated to be protective of human health and correspond to a one-in-a-million (10^{-6}) excess cancer risk or a unit hazard for noncancer effects under a non-site-specific conservative set of exposure assumptions.

Exposure assumptions used in developing the above RBSLs were reviewed in light of local conditions to evaluate whether they are protective of community subsistence harvest practices in the Salt Chuck vicinity. USEPA (2000) Screening Values are based on ingestion rates of 142.4 grams/day for subsistence fishers, and 17.5 grams/day for recreational or sport fishers. USEPA (2006) Region 3 RBCs are based on an ingestion rate of 54 grams/day. Harvest data available from the Alaska Department of Fish and Game (ADF&G, 2000, 2001) were reviewed for five communities close to the site, including Craig, Hollis, Kasaan, Klawock, and Thorne Bay. Kasaan exhibited the highest mean annual per capita subsistence harvest of clams and mussels of 11.4 pounds/year (14.2 grams/day). Because this harvest rate is below the ingestion rates used to develop the RBSLs, because site access is often limited such that harvesting is expected to be infrequent and by few individuals, and because the local ingestion rate is closest to the least conservative ingestion rate (i.e., for recreational fishers), all of RBSLs listed in Table 2-21 were considered protective of local conditions.

Approach for Ingestion of Lead in Invertebrate Tissue. The toxic effects of lead are correlated with blood lead levels rather than exposure levels of daily intake. Consequently, toxicity values (e.g., RfDs) which would allow the evaluation of lead in the same manner as other inorganic chemicals are not available. Therefore, potential health impacts from lead-impacted tissue were estimated based on an alternative methodology published by California Department of Toxic Substances Control (CDTSC, 1992) and EPA (2005a).

Exposure to lead in the intertidal environment was evaluated by accounting for contributions from tailings, sediment, food, air, and water. Existing site-specific data for intertidal tailings and sediment (non-character sample data only) and invertebrate tissue were used, as well as standard default inputs for air and drinking water. It was assumed that a receptor eats 0.035 kg/day as an adult, or 0.006 kg/day as a child, of fish and/or shellfish that was exposed to site-related lead. For exposure to lead in site sediment/tailings, a concentration of 3.8 mg/kg was assumed based on the maximum detected lead concentration in the intertidal zone (Tables 2-11 and 2-13, non-character samples only). The lead model

from CDTSC was modified to also include lead uptake by ingestion of shellfish. The maximum detected lead concentration in site shellfish (wet weight concentration) is 0.101 µg/g or 101µg/kg (Table 2-17). The resulting blood lead concentration was compared to a blood lead concentration criteria of 10 µg/dl for children established by CDTSC and EPA (Section 2.5.2.3.8).

2.5.2.3 Human Health Risk Characterization

Typically, not all chemicals present at a site pose health risks or contribute significantly to overall site risks. EPA guidelines (USEPA, 1989) recommend focusing on a group of "chemicals of potential concern" based on inherent toxicity, site concentration, and behavior of the chemicals in the environment. To identify these COPCs, risk-based screening values are compared to site concentrations of chemicals. If site concentrations of a chemical exceed their respective screening concentrations, then further evaluation of their concentrations is conducted and the chemicals may be retained as COPCs for further evaluation in the risk assessment. For inorganics expected to occur naturally in the environment without influence from humans, background comparisons were also performed. It should be noted that an exceedance of the screening value by a maximum concentration does not necessarily represent either an individual or an additive health concern within the context of a particular site. To provide an initial understanding of the relative magnitude of the exceedence of the risk based criterion, risk factor scores were developed by calculating the ratio of the maximum concentration to the ADEC risk-based criterion. In general, a risk factor score of one or less indicated that the concentrations of this chemical posed a low risk and did not warrant further consideration. Risk factor scores of greater than one indicated further evaluation was needed. To assess cumulative risk, risk factor scores above 0.1 are also discussed as appropriate where the ADEC criteria were based on ingestion. Risks to human receptors are discussed by media in the following sections.

2.5.2.3.1 Soil

For the purpose of initial COHC screening, the most conservative ADEC criterion was selected. In most cases, this criterion was based on protection of groundwater. However as noted in Section 2.5.2.1, nearshore groundwater at the site is probably not potable due to saltwater influence. While groundwater in the upland area is potentially potable, it is unlikely to be developed for drinking water in the future due to the presence of more readily available surface water sources, and to low yields in bedrock aquifers. Thus, for those COHCs selected on the basis of migration to groundwater, the ADEC ingestion criteria are considered a more appropriate measure of environmental significance in this human health risk evaluation.

Site soils in the following distinct areas were investigated: the fuel drum caches, upper AST area, the electric locomotive, and the area around Building C4 (Figures 2-8 and 2-9). Based on the maximum concentration in any area, six metals were initially identified as COHCs for soils: antimony, arsenic, copper, lead, mercury, and selenium (Table 2-23). The full data set for site soils are presented in Tables 2-5 and 2-7, respectively. The human health risk-based criteria for soils used in this SRE are presented in Table 2-19. Each of the COHCs with risk factor scores above one are further considered below.

Petroleum Hydrocarbons and PAHs. Several types of total petroleum hydrocarbons (TPH) measurements (e.g, RRO, DRO and TRPH) were collected in selected areas of the site (e.g, the AST and drum cache area), and a number of sample locations exceeded the ADEC Method Two cleanup levels for DRO (Table 2-23). However, because the effects of TPH mixtures on humans are difficult to relate to weathered products, and because there is a high degree of uncertainty quantifying risk to this type of contaminant, human health risks for TPH are typically evaluated through the most toxic individual constituents. For the type of petroleum found at the site (DRO and RRO), PAHs are considered the most toxic individual constituents. None of the PAH concentrations in soils exceeded the ADEC risk-based criteria. Thus, the ADEC Method Three soil cleanup level (12,500 mg/kg) was presumed to provide an appropriate level of protection for human receptors exposed to petroleum-related contamination, and TPH results are not considered further in this risk evaluation. The extent of site soils exceeding the Method Three cleanup level is depicted on Figure 2-8.

Antimony. Antimony was identified as a COHC because the maximum soil concentration at the site is greater than the Method Two cleanup level for migration to groundwater. Based on the conceptual site model, the primary human receptors of concern for soil exposure are recreational users visiting the site and future mine workers; thus, the ADEC ingestion value was considered a better measure of site risk. The maximum detected concentration of antimony of 15.4 mg/kg is below the ADEC Method Two ingestion RBSL of 33 mg/kg for antimony (Table 2-23). Thus, antimony was not considered to pose an unacceptable health risk to the human receptors of concern at the site.

Arsenic. Arsenic was identified as a COHC because the maximum soil concentration at the site is greater than the Method Two cleanup level for the migration-to-groundwater pathway. As noted above for antimony, the ADEC ingestion value was considered a better measure of site risk for the human receptors of concern at Salt Chuck Mine. The maximum detected concentration of arsenic of 4.95 mg/kg is slightly above the ADEC Method Two ingestion RBSL of 4.5 mg/kg and above the background concentration of 4.0 mg/kg. However, this slight exceedence of background is likely within the range of natural data variability. In addition, the maximum arsenic concentration is less than the USEPA (2006b) Region 6 risk-based screening value of 18 mg/kg for outdoor workers. Because soil exposure to casual visitors at the site is likely to be much less than the exposure levels assumed for outdoor workers and in the Method Two calculations, arsenic was not considered to pose an unacceptable health risk to the human receptors of concern at the site.

Copper. Copper was identified as a COHC because the maximum soil concentration at the site is greater than the Method Two cleanup level based on ingestion. The maximum copper concentration in site soils of 7,320 mg/kg is approximately two times the ADEC Method Two value of 3,320. However, this concentration is much less than the USEPA (2006b) Region 6 risk-based screening value of 42,000 mg/kg for outdoor workers. For this reason and because soil exposure to casual visitors at the site is likely to be much less than the exposure levels assumed for outdoor workers and in the Method Two calculations, future mine workers and recreational users are unlikely to be exposed to unacceptable levels of copper through incidental soil ingestion. As such, no further action is recommended to address the copper concentrations in soil for the protection of human health.

Lead. Lead was identified as a COHC because the maximum soil concentration at the site of 6,170 mg/kg is greater than the ADEC residential pathway-specific value of 400 mg/kg. Although soil exposure to casual visitors and adult future miners at the site is likely to be much less than the exposure levels presumed in the development of this residential number, the high lead concentrations are co-located with high concentrations of copper, and further evaluation of lead risks does not appear warranted for remedial decision-making. As such, interim removal action is recommended to address the lead concentrations in soil based on this conservative screening criteria. The extent of lead in site soils that exceed 400 mg/kg is depicted on Figure 2-8.

Mercury. Mercury was identified as a COHC because the maximum soil concentration at the site is greater than the Method Two cleanup level for migration to groundwater. As noted above, groundwater is unlikely to be used at the site, and ADEC has not identified a Method Two cleanup level for ingestion. Although mercury is considered volatile, and the maximum site soil concentration exceeds the ADEC inhalation value, this criterion was considered overly conservative because the harsh climate in the area is likely to minimize outdoor vapor exposure. The USEPA (2006b) Region 6 value for direct contact with industrial soil – outdoor worker was considered a better measure of site risk for human receptors of concern at Salt Chuck Mine. The maximum detected mercury concentration of 311 mg/kg is essentially equal to the Region 6 ingestion risk-based criterion of 310 mg/kg; thus, no further action is recommended to address the mercury concentrations in soil. Regardless, the highest mercury concentration near Building C4 (Table 2-5) is co-located with elevated lead levels recommended for removal action described above (Figure 2-8).

Selenium. Selenium was identified as a COHC because the maximum soil concentration at the site is greater than the Method Two cleanup level for migration to groundwater. As noted above, groundwater is unlikely to be used at the site; thus, the ADEC ingestion value was considered a better measure of site risk for human receptors of concern at Salt Chuck Mine. The maximum detected selenium concentration of 8.36 mg/kg is well below the ADEC Method Two ingestion value of 420 mg/kg. Thus, selenium was not considered to pose an unacceptable health risk to the human receptors of concern at the site.

Cumulative Risk. While COHCs were identified for several soil constituents, concentrations near the electric locomotive were all below screening levels or background (Tables 2-5 and 2-23). Thus, cumulative risk was evaluated for soils in this area only, using ADEC's (2007b) online Method Three calculator. Detected chemicals at this location that exceed $1/10^{th}$ ADEC Method Two values (for ingestion and inhalation) include arsenic, chromium, and vanadium. The results, provided in Appendix F, indicate an overall cumulative hazard index of 0.016 and cancer risk of 1×10^{-6}. Because these values do not exceed ADEC (2006b) cumulative risk targets of 1.0 (HI) or 1×10^{-5} (cancer risk), further action to address these chemicals for human health risk was not considered warranted.

Other Bioaccumulative Chemicals. Bioaccumulative compounds are defined by ADEC as having a bioconcentration factor (BCF) equal to or greater than 1,000 for organic compounds or identified by EPA (2000) as bioaccumulative inorganic compounds. According to ADEC (2005a) guidance, if the ingestion of wild foods is a complete pathway at the site, bioaccumulative compounds should be retained as

COHCs. The Salt Chuck area is open to hunting. However, hunting of wild game such as deer or bear within the actual site area is unlikely because of limited access. Hunters could possibly cruise the shores of Salt Chuck Bay looking for deer and bear. Berry and herb gathering is not known to occur in the site area. However, because there are no terrestrial food items harvested at the site, because the upland area of Salt Chuck Mine represents only a small portion of the potential foraging area for game species in the area such that chemical uptake from the site is unlikely to be significant, and because shellfish tissue data are available to assess potential risks from soil runoff to aquatic organisms, only those bioaccumulative chemicals above ADEC risk-based screening criteria (e.g., arsenic, copper, mercury, lead and selenium) were retained. Remaining bioaccumulative compounds present in soil at concentrations below risk-based criteria are discussed in the uncertainty section (Section 2.5.2.3.9).

2.5.2.3.2 Unsaturated Tailings

Unsaturated tailings are located in three distinct areas at the site: the area adjacent to mill where most of the material surrounding the mill is a mixture of waste rock and tailings, Piles D14 and D15 where tailings piles are located on both sides of the unnamed creek, and the tailings spit area located south of the mill and into the intertidal zone covering an area of approximately 40 by 200 feet. These tailings were considered separately from soil since it was considered likely the mill area would be frequented by future workers and because of concerns that the mill area might be considered a cultural resource. The top of this pile is described as dry windblown silt with a stunted spruce tree and driftwood present, indicating the storm high tide mark (USBLM, 1998). In addition, during the 1995 investigation, a sample of a thick gooey sludge was collected from the floor of the northwest corner of the mill near the tailings piles (Sample SO01, Figure 2-4). Due to the proximity of this sample to the tailings piles, this sample is included in this section.

As with the site soils, the analytical program for unsaturated tailings and a single sludge sample contained measurements for TPH. However, because the ecological effects of total petroleum hydrocarbons are not well studied and there is a high degree of uncertainty quantifying ecological risk to this type of contaminant, risks for TPH are typically evaluated through the most toxic individual constituents (e.g, PAHs). Although no PAH data was collected in the sludge sample, benzo(a)pyrene was detected in nearby unsaturated tailings and the risks are discussed below. The TPH levels in the unsaturated tailings (Table 2-9) are below the ADEC Method Three soil cleanup level (12,500 mg/kg), such that removal based on petroleum-related contamination in tailings associated with TPH would not be required, except for the sludge area (Sample SO01) where 163,000 mg/kg of DRO was measured.

The COHCs initially identified for the unsaturated tailings include benzo(a)pyrene, antimony, arsenic, copper, selenium, and silver (Table 2-24). In addition, one-half the maximum detection limit for mercury was elevated above the Method Two cleanup level for the migration to groundwater pathway. However, because one-half the detection limit did not exceed the ADEC Method Two inhalation criteria, mercury was not retained as a COHC for unsaturated tailings. The full data set for unsaturated tailings are presented for inorganics and organics in Tables 2-8 and 2-9, respectively. Each of the COHCs are further considered below.

Benzo(a)pyrene. Benzo(a)pyrene was identified as a COHC because the maximum unsaturated tailings concentration of 2.69 mg/kg at the site is greater than the Method Two cleanup level for ingestion. In addition, although not initially selected as COHCs, other PAHs (benzo(a)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene) have risk factor scores greater than 0.1 suggesting unacceptable cumulative risk may be present. The benzo(a)pyrene concentration is also above the EPA Region 6 outdoor worker RBSL of 0.78 mg/kg (USEPA, 2006b). Given that future mine workers could reasonably be exposed to unacceptable risk levels via incidental unsaturated tailings ingestion, further action is recommended to address the benzo(a)pyrene concentrations in unsaturated tailings in the mill area. The distribution of benzo(a)pyrene in unsaturated tailings is depicted on Figure 2-9.

Antimony. Antimony was identified as a COHC because the maximum unsaturated tailings concentration at the site is greater than the Method Two cleanup level for migration to groundwater. Based on the conceptual site model, the primary human receptors of concern for soil exposure are recreational users visiting the site and future mine workers, thus, the ADEC ingestion values were considered a better measure of site risks. The maximum detected concentration of antimony of 5.1 mg/kg is below the ADEC Method Two ingestion RBSL of 33 mg/kg. Thus, antimony in unsaturated tailings is not considered to pose an unacceptable health risk to human receptors of concern at the site.

Arsenic. Arsenic was identified as a COHC because the maximum unsaturated tailings concentration at the site is greater than the Method Two cleanup level for migration to groundwater. As noted above for antimony, the ADEC ingestion values were considered a better measure of site risks for human receptors of concern at Salt Chuck Mine. The maximum detected concentration of arsenic of 10.2 mg/kg is above the ADEC Method Two ingestion RBSL of 4.5 mg/kg and above the background concentration of 4.0 mg/kg. However, the maximum arsenic concentration is less than the USEPA (2006b) Region 6 risk-based screening value of 18 mg/kg for outdoor workers. Because soil exposure to casual visitors at the site is likely to be much less than exposure levels assumed for outdoor workers and in the Method Two calculations, further action is not recommended to address the arsenic concentrations in unsaturated tailings for protection of human health.

Copper. Copper was identified as a COHC because the maximum unsaturated tailings concentration at the site is greater than the Method Two cleanup level for the ingestion pathway. The maximum copper concentration in unsaturated tailings of 53,400 mg/kg exceeds the ADEC Method Two value of 3,320 mg/kg. This concentration is higher also than the EPA (2006b) Region 6 risk-based screening value of 42,000 mg/kg for outdoor workers. While soil exposure to casual visitors is likely to be much less than the exposure levels assumed for outdoor workers and in the Method Two calculations, and recreational users are not likely to be exposed to unacceptable levels of incidental unsaturated tailings ingestion, further action is recommended to address the copper concentrations above the EPA Region 6 risk-based screening value of 42,000 mg/kg in unsaturated tailings in the mill area for protection of human health. The distribution of copper in unsaturated tailings is depicted on Figure 2-9.

Selenium. Selenium was identified as a COHC because the maximum unsaturated tailings concentration at the site is greater than the Method Two cleanup level for migration to groundwater. As noted above,

groundwater is unlikely to be used at the site; thus, the ADEC ingestion value was considered a better measure of site risk for human receptors of concern at Salt Chuck Mine. The maximum detected selenium concentration of 65.4 mg/kg is well below the ADEC Method Two ingestion value of 420 mg/kg. Thus, selenium in unsaturated tailings was not considered to pose an unacceptable health risk to the human receptors of concern at the site.

Silver. Silver was identified as a COHC because the maximum unsaturated tailings concentration at the site is greater than the Method Two cleanup level for migration to groundwater. As noted above, groundwater is unlikely to be used at the site; thus, the ADEC ingestion value was considered a better measure of site risk for human receptors of concern at Salt Chuck Mine. The maximum detected (non-character sample) silver concentration of 34.1 mg/kg is well below the ADEC Method Two ingestion value of 420 mg/kg. Thus, silver in unsaturated tailings was not considered to pose an unacceptable health risk to the human receptors of concern at the site.

Other Bioaccumulative Chemicals. For the reasons described above in the bioaccumulative chemical discussion of site soils (Section 2.5.2.3.2), only those bioaccumulative chemicals in unsaturated tailings above ADEC risk-based screening criteria (e.g., benzo(a)pyrene, arsenic, copper, and selenium) were retained. Remaining bioaccumulative compounds present in unsaturated tailings at concentrations below risk-based criteria are discussed in the uncertainty section (Section 2.5.2.3.9).

2.5.2.3.3 Stream Tailings

Tailings are located in the unnamed stream between tailings piles D14 and D15. A composite character sample of the stream tailings was collected in 1995, and an additional sample collected in 2002. Based on the maximum concentration of the two samples, no stream tailing COHCs were identified (Table 2-25). While one-half the maximum detection limit for mercury is elevated above the Method Two cleanup level for migration to groundwater, because one-half the detection limit does not exceed the ADEC Method Two inhalation criterion, mercury was not retained as a COHC for unsaturated tailings. The full data set for the stream tailings are presented in Table 2-10.

Cumulative Risk. Cumulative risk calculations were not conducted for the stream tailings because this media is recommended for further action based on ecological risk (Section 2.5.3.4.4). Calculation of cumulative risk to human health is deferred until after confirmatory sampling is conducted following the removal action.

2.5.2.3.4 Intertidal Tailings

The intertidal tailings have been delineated into four Zones (Zones A, B, C, and D) (Figure 2-4). Although human exposure to intertidal tailings is considered to be unlikely, for the purposes of this SRE, maximum concentrations in any tailings zone exposed at low tide were compared to the ADEC Method Two risk-based values in Table 2-26. Arsenic and PCBs were initially identified as COHCs and are further evaluated below. The full dataset for intertidal tailings are presented for inorganics and organics in Tables 2-11 and 2-12, respectively. Because shellfish tissue ingestion could be influenced by

chemicals in intertidal tailings, the risks from lead exposure are addressed separately via the lead model in Section 2.5.2.3.8.

Arsenic. Comparison of the ADEC Method Two risk-based criteria for ingestion is conservative since recreational use of this site is hampered by accessibility. While arsenic has been found to accumulate in shellfish tissue in littleneck and butter clams above local background concentrations (discussed in Section 2.5.2.3.7), the arsenic concentrations in tailings are generally within the natural variability of background sediment concentration. Thus, further action to address arsenic in intertidal tailings is not considered necessary for protection of human health.

PCBs. The distribution of PCBs in intertidal tailings is depicted on Figure 2-11. PCBs at only location SCSD-9/10 (Zone D) were above the ADEC Method Two ingestion criteria. A risk factor score of 2.2 was calculated. However, given the limited distribution of PCBs and the lack of detectable PCBs in shellfish tissue (Table 2-18), further action to address PCBs is not considered necessary for protection of human health.

Other Bioaccumulative Compounds. These chemicals are addressed through the evaluation of shellfish tissue data in Section 2.5.2.3.7. Cumulative risk calculations were not conducted for the intertidal tailings because this media is recommended for further action based on ecological risk (Section 2.5.3.4.5). Calculation of cumulative risk to human health is deferred until after confirmatory sampling is conducted following the removal action.

2.5.2.3.5 Intertidal Sediment

Direct contact exposure to intertidal sediment by recreational users at low tide is hampered by accessibility, and is highly unlikely given that protective gear is needed due to the cold water. Nonetheless, for the purposes of screening, direct contact exposure pathways were considered complete. Exposure through the food chain from chemicals in sediment is addressed through the shellfish tissue evaluation (Section 2.5.2.3.7). Based on the maximum concentration in any area, the initially identified COHCs in intertidal sediment are arsenic, mercury, and Total PCBs (Table 2-27). The full data set for intertidal sediment are presented for inorganics and organics in Tables 2-13 and 2-14, respectively. Each of the COHCs are further considered below.

Arsenic. A risk factor score of 1.7 was derived based on the maximum detected concentration and the ADEC Method Two ingestion value. Given the low score and the low potential for sediment exposure, further action to address arsenic in sediment was not considered warranted for the protection of human health. Risks from arsenic ingestion via shellfish are addressed in Section 2.5.2.3.7.

Mercury. Mercury was identified as a COHC because the maximum soil concentration of 5.53 mg/kg at the site was greater than the Method Two cleanup level for migration to groundwater. Although mercury is considered volatile, the ADEC inhalation criterion was considered overly conservative because the harsh climate in the area is likely to minimize outdoor vapor exposure. The USEPA (2006b) Region 6 value for direct contact with industrial soil – outdoor worker was considered a better measure of site risk

for the recreational users in the mine vicinity. The maximum detected mercury concentration of 5.53 mg/kg is well below the Region 6 ingestion risk-based criterion of 310 mg/kg. In addition, mercury was not identified as a shellfish COHC (Section 2.5.2.3.7). Thus, further action to address mercury in sediment was not considered warranted for the protection of human health.

PCBs. A risk factor score of 1.5 was derived based on the maximum detected concentration. PCB concentrations exceeded the RBSL at only one of sediment sample locations (Figure 2-11). Given the low score, the absence of detectable PCBs in shellfish tissue (Table 2-18), and the low potential for sediment exposure, further action to address PCBs in sediment for protection of human health was not considered warranted.

Other Bioaccumulative Chemicals. These chemicals are addressed through the shellfish tissue data evaluation in Section 2.5.2.3.7. Although no significant risks were identified for the sediment media, cumulative risk calculations were not considered warranted due to the low potential for direct human contact with sediment.

2.5.2.3.6 Surface Water

Freshwater. The full data set for freshwater and intertidal surface waters are presented in Table 2-15 for inorganics, and the distribution of selected metals is shown on Figure 2-14. Risk screening results for freshwater and saltwater are provided in Tables 2-28 and 2-29, respectively. Based on the maximum dissolved concentration in any freshwater sample, no freshwater COHCs were identified (Table 2-28). While one-half the maximum detection limits for arsenic and mercury exceed risk-based criteria for fish ingestion, further consideration of these metals in freshwater does not appear warranted for several reasons. The freshwater fish of concern at the site are anadromous and are unlikely to be exposed solely to the maximum detected concentration as the animals move along this stream. In addition, fishing would be limited by the seasonal presence of the animals and the maximum concentration of total arsenic was present in an adit where fish would not occur.

It should be noted that total metals concentrations in freshwater were higher than dissolved concentrations for arsenic, chromium, copper and nickel (Table 2-28). For arsenic, however, one-half the maximum detection limit was higher than the detected concentration, and the detected concentration was collected in an adit where drinking water consumption is unlikely. The maximum total copper concentration was essentially twice the dissolved concentration, but with a risk factor score well below one; this concentration was also found in the adit. Total nickel and chromium concentrations were highest in the stream where drinking water collection would be more likely to occur. However, relatively low risk factor scores of 1.2 and 1.7 for these metals, respectively, indicate that these concentrations are unlikely to pose a significant health risk. As such, further consideration of the metals concentrations in freshwater does not appear warranted

Intertidal/Saltwater. Because the measured concentrations of selected inorganics can be biased high by salts in intertidal water, a reductive precipitation (RPPT) step was performed to minimize matrix interference. The RPPT concentrations are considered a better measure of the true concentration of

arsenic, copper, mercury, nickel, selenium, and vanadium. Both arsenic and mercury were selected as intertidal surface water COHCs based on fish ingestion criteria (Table 2-29). Dissolved arsenic concentrations (RPPT data) were above screening fish ingestion criteria at locations SCSW-5/6, SCSW-1, SCSW-2 in the tailings Zones A through C, and exhibit a risk factor score of 30 and background ratio of 3.9. Removal action for these tailings is recommended based on ecological concerns (Section 2.5.3.4.5), and short term monitoring of water quality is recommended to ensure it is improved after removal. Arsenic was identified as a COHC for shellfish tissue (Section 2.5.2.3.7), but was generally found to present a low risk to humans based on the percentage of inorganic arsenic measured in the tissue. Although mercury is identified as a saltwater COHC based on a conservative fish ingestion RBSL, mercury was not identified as a shellfish tissue COHC and further action to address the exceedence of this conservative benchmark does not appear warranted.

Other Bioaccumulative Chemicals. These chemicals are addressed through the evaluation of shellfish tissue data in the following section.

2.5.2.3.7 Shellfish Tissue.

Tissue concentrations in invertebrates were measured to reduce the uncertainty in estimating risks from the consumption of local shellfish since estimating uptake rates from water column and sediment data often results in overestimates of risk. Site tissue concentrations were compared to EPA tissue criteria. Based on the maximum concentration on a wet weight basis in any clam or mussel tissue sample, arsenic (total and inorganic) and vanadium were identified as COHCs in tissue (Table 2-30), and are further evaluated below. Exposure to lead in shellfish is addressed in Section 2.5.2.3.8. The full data set for tissue is presented in Tables 2-17 and 2-18 for organic and inorganic chemicals, respectively. The distribution of selected metals data at co-located tissue and sediment/tailings sample sites in northern Salt Chuck Bay are depicted on Figure 2-12. Additional tissue data for selected metals in southern Salt Chuck Bay are shown on Figure 2-13.

Arsenic. Seafood consumption is a major source of arsenic exposure in the human diet (USEPA, 2000b). However, advisories based on arsenic are relatively rare. The excess lifetime cancer risk of arsenic is dependent on the amount of inorganic arsenic and is subject to interpretation, given that marine fish and shellfish naturally contain high levels of arsenic. Arsenic in the edible portions of fish and shellfish is predominantly found as the chemical arsenobetaine, a stable, nontoxic, metabolically inert, organic chemical containing a pentavalent arsenic atom (USEPA, 2000b). Therefore, the degree of arsenic risk depends on the amount of inorganic arsenic in the ingested tissue. Thus, inorganic arsenic measurements as well as total concentrations in shellfish tissue were collected.

At Salt Chuck Mine, arsenic has been found to accumulate in shellfish tissue in littleneck and butter clams above local background arsenic tissue concentrations. Based on total arsenic data, blue mussels and softshell clams do not appear to accumulate arsenic above background. Arsenic concentrations in butter clams and littlenecks is considered in the following paragraphs.

Arsenic in Butter Clams. As discussed above, the inorganic arsenic concentration is considered a better measure of risk to humans. The maximum detected wet weight concentration of total arsenic in butter clams of 4.65 mg/kg was found at location SCTIBC-17 which was collected in Lindeman Cove. No inorganic arsenic measurements were made at that location. However, inorganic measurements of arsenic in butter clams in nearby sample SCTIBC-32a show a relative proportion of the total versus inorganic arsenic in butter clams to be only 0.7% of the total arsenic value. The inorganic arsenic concentration is below the recreational user tissue criterion at that location. Assuming the same relative percentage of inorganic relative to total arsenic is present in butter clams collected at Lindeman Cove in Sample SCTIBC-17, the inorganic fraction of arsenic would be 0.031 ug/g resulting in a risk factor score of 1.2 relative to the recreational RBSL. Wet weight concentrations of inorganic arsenic in butter clams at SCTIBC-36 also exceeded the recreational RBSL with a risk factor scores of 1.7. No butter clams were found within the tailings piles. These low risk scores suggest a low potential for adverse effects. As noted in Section 2.5.2.3.6, arsenic concentrations in intertidal surface waters collected in tailings Zones A through C area exceed fish ingestion water criteria. Because further action to address the tailings from Zones A through C has been recommended based on ecological concerns, surface water concentrations of arsenic will likely be reduced when the tailings are reduced, which will further reduce uptake of arsenic into shellfish tissue in the area.

Arsenic in Littleneck Clams. No inorganic arsenic data was collected in littleneck clam tissue. The maximium detected total arsenic concentration of 4.47 mg/kg was found at location SCTILN-3 northeast of the unnamed island, where the arsenic concentration in sediment is below background (Figure 2-12). This location is downgradient of the tailings piles, and further action to address ecological risk in tailings Zones A through C (Section 2.5.3.4.5) will likely reduce surface water concentrations of arsenic in the vicinity, thus reducing arsenic uptake in littleneck shellfish tissue.

Vanadium. EPA (2006b) has not established Screening Values for fish/shellfish ingestion under recreational or subsistence ingestion rates. Therefore, the EPA (2006a) Region 3 value for fish/shellfish ingestion was considered. Of the four species sampled, only softshell clams have vanadium concentrations in their tissues above the Region 3 tissue RBSL. A risk factor score of 6.9 was noted in softshell clams. Three locations were identified where softshell clams have vanadium tissue concentrations above the RBSL: one in Zone C Tailings, one in sediment south of Zone C tailings (SCTISS-4), (SCTISS-11) and one in Zone D tailings (SCTISS-9/10) (Figure 2-12). The SCTISS-4 tissue concentration of 1.49 is only slightly above the RSBL of 1.4, and was not considered to warrant further action. The associated tailings concentrations in SCIT-4/SD-20 in Zone C Tailings and SCSD9/10 in Zone D tailings were 281 and 291 mg/kg, respectively. These concentrations were below the RBSL for direct contact pathways, such that vanadium was not selected as a tailings COHC. No background tissue data for vanadium in softshell clams was collected; however, vanadium concentrations in softshell clams distant from the tailings (e.g., northeast of the unnamed island) were lower than those collected near the tailings piles, suggesting that accumulation is occurring at the tailings piles. However, because the risk factor scores for vanadium were comparatively low for all other species, and because of access limitations, it is unlikely the vanadium in softshell clam tissue represents a significant threat to human health.

2.5.2.3.8 Lead

The potential for health effects from lead exposure is evaluated differently from most chemicals in that the criterion is based on a level of concern in blood predicted using lead concentrations in a variety of exposure scenarios and media (e.g., produce, drinking water, soil, etc.). Some of the characteristic effects of lead, particularly changes in the levels of certain blood enzymes, appear to occur at blood lead levels so low as to be essentially without a threshold. The Centers for Disease Control and Prevention (CDC) has indicated that, while there is no evidence of a threshold below which adverse effects are not experienced in children, the level of concern of blood lead levels above 10 μg/dL is an appropriate criteria (CDC, 2004).

The Cal-Lead model (DTSC Lead Spreadsheet, Version 7, 2000) or LeadSpread 7 was used to calculate potential blood lead levels in recreational users and future miners present on Salt Chuck mine. The most significant risk from lead exposure is for children, and while it is unlikely children would be present on the site, even the EPA adult lead methodology extends the same concept to develop cleanup goals preventive of fetal risk. Since it is possible to have a pregnant miner or recreational user on the site, the more protective endpoint for children was considered.

For exposure to lead in site sediment/tailings, a concentration of 3.8 mg/kg was assumed based on the maximum detected lead concentration in the intertidal zone (Tables 2-11 and 2-13, non-character samples only). Concentrations of lead in soil and unsaturated tailings were addressed based on ADEC risk-based soil concentrations (Section 2.5.2.3.1). The CDTSC lead model was modified to also include lead uptake by ingestion of shellfish. The maximum detected lead concentration in site shellfish (wet weight concentration) is 0.101 μg/g or 101μg/kg (Table 2-17). The results of this model are presented in Table 2-31.

The resulting 99th percentile (as well as the 95th percentile) blood lead concentrations of 7.4 ug/dl for children was lower than the blood lead concentration criteria of 10 μg/dl for children established by CDTSC and EPA. Since the site lead concentrations are not a health threat to children, who are more sensitive to lead exposure than adults, it can be assumed that no adverse impacts would be predicted for adults. Thus, lead in shellfish and intertidal tailings/sediment were not considered to pose an unacceptable human health risk.

2.5.2.3.9 Summary and Conclusion of the SRE

Further action is recommended to address the DRO concentrations above ADEC Method 3 cleanup criteria in soil and unsaturated tailings, and the concentrations of lead in soil and the benzo(a)pyrene in unsaturated tailings above risk-based criteria. Remedial action objectives (RAOs) concerning these media and compounds are presented in Section 3.0. Although some exceedences of risk-based screening criteria were noted in water, intertidal tailings, and shellfish tissue, in general, the human health risks from these media were generally considered low. Copper and other inorganics in the intertidal tailings (e.g.,

vanadium) may be affecting shellfish abundance. The risks to the beneficial use of shellfish harvesting is further addressed in the ecological SRE (Section 2.5.3).

2.5.2.3.10 Uncertainty in the Human Health SRE

Varying degrees of uncertainties (generally conservatively biased) are present in risk assessments. An understanding of those limitations is critical to support risk management decision-making processes. Areas of uncertainty are discussed below:

- Recent trends in the environmental sampling of PCBs have resulted in a variety of analytical data for this chemical. Traditionally, PCBs have been reported as five Aroclors (1016, 1242, 1248, 1254 and 1260). The chemical manufacturer (Monsanto) had defined the Aroclors based on the total amount of chlorine present, as well as the congener composition. However, various biotic and abiotic processes can shift the congener composition, and analytical methods have been refined so that both homolog and up to 2009 individual congeners can be detected using EPA Method 1668. These analyses are costly and interpretation of congener data relative to established toxicity data which are based on Aroclor measurements, contributes to the uncertainty in risk evaluations for PCBs. For instance, the EPA fish tissue concentrations used to derive consumption limits that are protective of non-cancer health effects are based on the EPA reference dose (RfD) for Aroclor 1254 (0.00002 mg/kg/day). Given the high cost of analytical work, coupled with the uncertainties of extrapolating measured congener concentrations to toxicity data based on Aroclor analyses, PCB data were not collected using the analytical method for congeners in this study; rather total PCB risks are estimated based on Aroclor data. No PCBs were detected in shellfish tissue (Table 2-18). Reference bivalve tissue data for PCBs (from O'Connor, 1998) are based on Aroclor data, and the detection limits for site tissue samples were lower than the reference levels.
- ADEC Method Two soil cleanup levels were not systematically adjusted by a factor of 1/10 to account for cumulative risk to tailings, and sediment exposure during the screening process. Rather, cumulative risk calculations were performed for selected areas/media where no further action was recommended. Risk factor scores greater than 0.1 would represent those chemicals that would have been retained if a systematic $1/10^{th}$ screening procedure were followed. No PAHs in soils have a risk factor score of 0.1 or higher, indicating cumulative risk are not of concern from this class of chemicals. PAHs in unsaturated tailings that had a risk factor score of greater than 0.1 or higher are co-located with elevated benzo(a)pyrene concentrations and targeted for further action. In general, the inorganic risk criteria were based on conservative ADEC migration to groundwater RBSL, an unlikely exposure pathway at the site. Thus, the lack of systematic $1/10^{th}$ adjustment to the risk criteria during screening is unlikely to represent a significant underestimation of risk from soil, tailings, and sediment exposure.
- In general, only data that have undergone Level III data validation are typically selected as usable for risk assessment purposes. For this reason, because the historical character sample data for inorganics did not undergo standard data validation procedures nor did they follow standard

laboratory methods, the character sample data is considered uncertain and risk factor scores were generally calculated for the inorganic chemicals using the maximum non-character sample concentrations.

- Because there are no terrestrial food items harvested at the site, because the upland area of Salt Chuck Mine represents only a small portion of the potential foraging area of game species in the area such that chemical uptake from the site is unlikely to be significant, and because shellfish tissue data are available to assess potential risks from soil runoff to aquatic organisms, only those bioaccumulative chemicals in soil above ADEC risk-based screening criteria (e.g., arsenic, copper, mercury, lead and selenium) were retained. Bioaccumulative chemicals detected in soil that were not evaluated included selected PAHs, cadmium, nickel, silver and zinc. While shellfish tissue data were not collected for PAHs, these tend to sorb strongly to soils and, with the possible exception of transfer via runoff, are unlikely to be a source.
- Paralytic shellfish poisoning (PSP) is a serious illness caused by eating shellfish that have consumed large amounts of a poison-producing microscopic organism known as *Alexandrium catenella*. This risk evaluation does not address the risks from PSP. Butter clams, in particular are prone to accumulate *Alexandrium catenella*. In butter clams, much of the PSP toxin tends to become concentrated in the black tip of the siphon and is held there for varying lengths of time. This retention and also the consumption of cysts may cause butter clams to be poisonous throughout the year in certain areas (Nishitani et al., 1999). It is not known if the butter clams at the Salt Chuck Mine site contain this microorganism at harmful levels. While some organisms may accumulate copper to protect themselves from *Alexandrium catenella*, copper tissue data were collected at this site and if this phenomenon is occurring, the risks are unlikely to be underestimated.

2.5.3 Ecological SRE

The ecological SRE incorporates approaches described in ADEC (2005a, 2007a) guidance documents, as well as screening level problem formulation and ecological effects evaluation guidance described by EPA (1997, 1998). This SRE includes identification of habitat and ecological receptors in the area, complete exposure pathways, benchmarks used as measures of effect, chemical stressors or chemicals of potential ecological concern (COECs), and potential ecological hazards from chemical exposure.

2.5.3.1 Habitat and Ecological Receptors

Information regarding potential ecological receptors at the mine site are provided in Section 2.1.6 and Tables 2-1 through 2-4, and summarized in the following paragraphs. Pathways of concern for risk to ecological receptors are presented in a conceptual site model in Figure 2-16. Photographs attached with this report provide a general depiction of site habitats.

Transient and resident wildlife inhabit the area surrounding the mine site in both terrestrial and aquatic environs. In addition to wildlife, anadromous fish streams and intertidal habitats with several species of shellfish have been documented adjacent to the site. Evidence of deer, bear, and frogs have also been

observed at the mine site. No critical habitat for Threatened and Endangered Species has been identified in the site vicinity. However, according to the *Prince of Wales Island Area Plan* (ADNR, 1998), Salt Chuck Bay has high fish and wildlife and harvest values, and crucial habitat has been identified for seasonal black bear populations, waterfowl, herring spawning, and salmon rearing and schooling.

An exposure pathway is defined as the route a constituent takes from a source to a receptor. Exposure pathways are considered complete if the following four elements exist: a chemical source; a mechanism of release, retention, or transport of a given chemical in a given medium; a point of contact with the affected medium; and an exposure route at the point of contact (e.g., ingestion, dermal absorption, or inhalation). If any of these elements is missing, the pathway is considered incomplete and does not present a means of exposure. The ecological conceptual site model identifies key components of exposure pathways at the site.

Terrestrial Receptors. Potential exposure pathways for terrestrial plants, soil invertebrates, and microogranisms include uptake of chemicals through soil or upland tailings. For terrestrial wildlife, potentially complete and significant exposure pathways include ingestion of chemicals in surface water, incidental ingestion of soil or upland tailings, and ingestion of surface water from freshwater creeks and ingestion of prey. Inhalation of vapor is not expected to be significant, given the types of contaminants present on the site (i.e., the lack of volatile chemicals). Likewise, inhalation of particulates is not expected to be a significant exposure pathway for wildlife, given the mobility of most species and the presence of vegetation and often saturated conditions. Typically, dermal contact for wildlife is not considered a significant exposure route, given the presence of fur and feathers that minimize exposure.

Aquatic Organisms and Upper Trophic Level Receptors. Potential exposure pathways for aquatic plants, aquatic organisms in water, and benthic species in sediment include direct contact and uptake of chemicals through ingestion or dermal contact from water or tailings. For wildlife feeding on aquatic prey (e.g., shorebirds, otters, etc.), potentially complete and significant exposure pathways include ingestion of chemicals in surface water, incidental ingestion of soil, sediment, or intertidal tailings, and ingestion of prey. Inhalation of vapor is not expected to be significant, given the types of contaminants present on the site (i.e., the lack of volatile chemicals). Likewise, inhalation of particulates also is not expected to be a significant exposure pathway for aquatic wildlife given the saturated conditions along the creeks. Typically, dermal contact for wildlife is not considered a significant exposure route, given the presence of fur and feathers that minimize exposure.

2.5.3.2 Assessment Endpoints and Measures of Ecological Effects

Assessment endpoints are explicit expressions of environmental values to be protected (USEPA, 1998). Typically, assessment endpoints cannot be directly quantified in the field, so one or more measures of ecological effect are evaluated for each assessment endpoint. A measure of ecological effect is defined as a measurable ecological characteristic that is related to the valued characteristics selected as assessment endpoints (Suter et al., 2000). Ecological effect measures in this ecological SRE are concentrations of

COECs related to the environmental values which are to be protected. The assessment endpoints and measures of ecological effect are presented in the following table.

Assessment Endpoint	Measure of Effect	Connection Between Assessment Endpoint and Measure of Effect
Survival, reproduction, and growth of terrestrial wildlife (e.g., game species such as deer and bear) and their food resources (e.g., plants and soil invertebrates).	Comparison of measured site concentrations in soil and unsaturated tailings to soil benchmarks protective of wildlife and components of the terrestrial ecosystem.	Benchmarks are representative of acceptable exposure concentrations for upper trophic level wildlife, terrestrial plants, soil microorganisms, and/or soil invertebrates.
Survival, reproduction, and growth of aquatic organisms (e.g., fish and shellfish) in nearby surface waters and their food resources (e.g. benthic invertebrates).	Comparison of measured site concentrations in surface water or shellfish tissue to aquatic or tissue criteria and comparison of site concentrations in sediment and intertidal tailings to sediment benchmarks.	ADEC or EPA water criteria are derived from either aquatic toxicity bioassays or predicted water concentration assuming bioconcen-tration factors equivalent to acceptable exposure concentrations for upper trophic level species; tissue criteria associated with acceptable chemical exposure in other media (e.g., water). Sediment benchmarks are conservative values representative of species living in sediment media.
Survival, reproduction, and growth of aquatic avian and mammalian species and their food resources.	Comparison of measured site concentrations in shellfish tissue to tissue screening criteria for wildlife.	Concentrations in the tissues of wildlife where the combined concentration in surface water and that bioaccumulated in prey species have no observable effect on wildlife receptors.

2.5.3.3 Media-Specific Benchmarks for COEC Selection

The following sections provide conservative benchmarks for the primary pathways and media of concern for ecological receptors. The benchmarks were previously reviewed and approved by ADEC (2002a) following completion of the 2002 Work Plan, and updated in the 2006 Work Plan Addendum. During development of this report, various risk guidance documents and regulations used in the work plans were reviewed for current applicability, and the SRE approach and screening criteria were updated where necessary.

2.5.3.3.1 Ecological Benchmarks for Surface Soils

The approach for the ecological SRE for soils focused primarily on direct contact pathways. ADEC (2007a) provides conservative screening level benchmarks for soil that were used as an initial screening tool for site soil data. These benchmarks are listed in Table 2-19 for those compounds analyzed in the EE/CA.

Where site data exceed the ADEC screening values, they were compared to other applicable benchmarks, such as Preliminary Remedial Goals (PRGs) for various species of wildlife developed by Oak Ridge National Laboratory (ORNL) (1997a); plant phytotoxicity and invertebrate benchmark soil screening values, also developed by ORNL (1997b, 1997c), Netherlands Ecotoxicity Intervention Criteria (NEIC) (Netherlands Department of Soil Protection, 2000); and in some cases, the EPA Ecological Soil Screening

Levels (Eco-SSLs). These benchmarks, compiled in a separate column of Table 2-19 in the following order of preference, are further described below:

- **PRGs for Wildlife.** Wildlife PRGs are upper concentration limits for specific media that are anticipated to protect the environment (ORNL, 1997a). PRGs generally correspond to small effects on individual organisms that are expected to cause minimal effects at the population and community levels. The PRG for the most sensitive indicator species was selected as the soil benchmark.
- **Plant Phytotoxicity and Invertebrate Benchmarks.** Plant phytotoxicity and invertebrate benchmark values (ORNL, 1997b; ORNL, 1997c) were selected as screening criteria in the absence of wildlife PRGs. Earthworm and microorganism benchmarks were preferentially selected, since microorganisms and invertebrates are a crucial component of nutrient cycling and ecosystem function. Plant phytotoxicity criteria were secondarily selected; these have been developed based on agricultural crops, which are likely to be more sensitive than native plants. In some cases, the reported phytotoxicity criterion may be less than background levels (e.g., arsenic, iron, mercury, nickel, and zinc). Natural background levels will be considered as part of the process of evaluating site data and selecting COECs. In addition, the confidence of most of the plant phytotoxicity benchmarks is reported to be low for most chemicals. Application of these values to other species of plants further increases the uncertainty. These benchmark values represent conservative screening criteria and are largely available only for metals.
- **NEIC.** These values (Netherlands Department of Soil Protection, 2000) are chemical levels in soils, that are based on preserving the vulnerable ecological function of soils (e.g., decomposition, primary production), and on defining impacts that can influence structure and species composition in an ecosystem. NEIC values are available for some organic chemicals.
- **Eco-SSLs.** Eco-SSLs are EPA-derived values protective of ecological receptors that commonly come into contact with soil, or ingest biota that live in or on soil. Eco-SSLs are not designed to be used as cleanup levels, and thus, are considered as supplemental criteria in this SRE. Eco-SSLs are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds, and mammals. These values are presumed to provide adequate protection of terrestrial ecosystems, and have generally been updated on a regular basis. These criteria were considered in the risk characterization discussion for soil for selected constituents as appropriate. Eco-SSLs below ADEC criteria were not considered. The interim final eco-SSL for antimony (USEPA, 2005c), copper (USEPA, 2006c), and lead (USEPA, 2005d) are listed in parentheses in Table 2-19.

2.5.3.3.2 Ecological Benchmarks for Water

Surface Water. Table 2-20 presents ecological surface water benchmarks for both freshwater and saltwater used in the ecological SRE. Freshwater habitats at the mine site include Lake Ellen Creek, the unnamed stream, and mine adit drainage water. Saltwater or brackish water habitats at the site include the

intertidal portion of Salt Chuck Bay, and the lower portions of Lake Ellen Creek and the unnamed stream at high tide (Section 2.1.5). To protect these habitats, measured surface water concentrations were initially compared to ADEC (2007a) screening values for freshwater and marine water. Where site data exceed these values, they were also compared to ADEC (2006a) Water Quality Standards for aquatic life (18 AAC 70), which designate the use of aquatic life criteria contained in ADEC's (2003b) *Alaska Water Quality Criteria Manual for Toxic and Deleterious Organic and Inorganic Substances*. These criteria are mostly derived from EPA Ambient Water Quality Criteria (AWQC) (e.g., USEPA, 2004). For those freshwater criteria which are hardness dependent (e.g., cadmium, copper), an average of the ambient (filtered) site hardness values listed in Table 2-15 (90 mg/L) was used in the ADEC (2003b, 2005b) equations to derive the site-specific criteria listed in Table 2-20. A copy of the ADEC (2005b) online worksheet used to calculate the hardness-dependent criteria is provided in Appendix G.

In the absence of established Alaska or EPA criteria for individual PAHs, proposed AWQC from EPA (1986) and NOAA (1999) Screening Quick Reference Tables (SQuiRT) were used. In addition, secondary chronic values listed in ORNL (1996, 1997a) were selected in the absence of any other individual PAH criteria. PAH results were also summed and compared to the ADEC (2006a) value for Total Aqueous Hydrocarbons (TAqH) for aquaculture and aquatic life.

Groundwater. It is possible that groundwater could provide a migration pathway for contaminants from the ASTs to intertidal ecological receptors. ADEC (2000) distinguishes between groundwater in a zone of saturation, and groundwater beneath the surface of the soil that is not in a zone of saturation. The latter type of groundwater is anticipated at the site due to the presence of shallow bedrock; temporary groundwater is expected to occur sporadically at the soil/groundwater contact. Groundwater cleanup levels are not established for this type of groundwater; rather, ADEC requires that migration via this type of groundwater be eliminated using appropriate soil cleanup levels and techniques, and that any receiving surface water body and sediment meet water quality standards under 18 AAC 70 (described above). No groundwater data were collected in this investigation. However, measured concentrations in surface water were compared to WQC (Table 2-20).

2.5.3.3.3 Ecological Benchmarks for Sediment

Freshwater Sediment. Potential impacts to freshwater ecological receptors were considered for stream bottom tailings data. ADEC (2007a) provides conservative screening level benchmarks for freshwater sediment that were used as an initial screening tool for stream tailings data. These benchmarks are listed in Table 2-22 for those compounds analyzed in the EE/CA.

Where site data exceed the ADEC screening values, they were compared to other applicable sediment benchmarks chosen for use in the ecological SRE in the following order of preference:

- **Threshold Effects Levels (TELs) and Probable Effects Levels (PELs).** TELs identify concentrations below which harmful effects on marine sediment-dwelling organisms are not expected; whereas PELs are concentrations above which harmful effects are considered probable. These criteria are recommended by ADEC (2004b) to be utilized as Sediment Quality Guidelines

(SQGs) in first tier screening for contaminated freshwater sediment evaluation. They have been compiled by NOAA (1999) in their SquiRT tables and by the Florida Department of Environmental Protection (MacDonald, 1994).

- **Effects Range Low (ERL)/Effects Range Medium (ERM) Values.** In the absence of freshwater TELs/PELs, marine sediment ERLs/ERMs (Long et. al., 1995; NOAA, 1999) were utilized. These criteria are described below under "Interdtidal Sediment."
- **Upper Effects Thresholds (UET).** These criteria are suggested for freshwater sediment by NOAA (1999) based on various rationale (footnoted in Table 2-22), and were used in the absence of TELs/PELs or ERLs/ERMs.
- Other marine sediment criteria listed in ADEC (2004b) and NOAA (1999) were used if none of the above values are available (see Table 2-22).

Intertidal Sediment. Potential impacts to intertidal ecological receptors were considered for sediment and tailings samples collected within the intertidal zone. ADEC (2007a) provides conservative screening level benchmarks for saltwater sediment that were used as an initial screening tool for intertidal tailings and sediment data. These benchmarks are listed in Table 2-22 for those compounds analyzed in the EE/CA.

Where site data exceed the ADEC screening values, they were compared to other applicable sediment benchmarks in the following order of preference:

- **NOAA ERLs/ERMs.** An ERL is defined by Long et al. (1995) as the concentration of a chemical in marine sediment below which adverse effects were rarely observed among sensitive species. An ERM is defined as the concentration of a chemical in sediment above which effects are frequently or always observed among most species. The range between the ERL and ERM is assumed to represent the range in which effects are occasionally observed (MacDonald, 1994). ERMs, rather than ERLs, are used to predict toxicity of samples due to the lower, Type I error (i.e., false positives) associated with them (Ingersoll et al., 1996). However, ERLs can be used to efficiently identify concentrations below which toxicity is rarely observed. The state of Alaska does not have a definitive framework for screening assessment and remediation of contaminated sediment. In the initial 2002 Salt Chuck Work Plan (URS, 2002), NOAA ERLs/ERMs were preferentially selected and approved by ADEC (2002a) to be used for screening of site sediment and intertidal tailings data. ERLs/ERMs are the preferred sediment assessment method by NOAA and some lower 48 states, and are intended for informal use in ranking COECs and areas that warrant further study of adverse effects (Cormack, 2001). ERLs have been adopted as conservative screening values for most metals and PAHs in ADEC's (2007a) *Ecoscoping Guidance*. For these reasons and others cited below, ERLs/ERMs were selected preferentially over TELs/PELs for use in the Salt Chuck ecological SRE.
- **Marine Sediment TELs/PELs.** The development of the TEL/PEL method built upon the ERL/ERM method, in that it incorporated a "no effects" data set that the ERL/ERM did not, and

used a different statistical approach due to uncertainty in data set distributions (Cormack, 2001). PELs are considered too conservative by some (e.g., Smith et al., 1996) due to relatively low internal reliability in adequately identifying concentrations above which effects are expected to occur frequently. TELs/PELs are the preferred marine sediment assessment method by Canada and some lower 48 states (Cormack, 2001) and were selected in the absence of ERL/ERMs (ADEC, 2004b; NOAA, 1999). These criteria are intended to assist sediment quality assessment applications, such as identifying priority areas for non-point source management actions, designing wetland restoration projects, and monitoring trends in environmental contamination.

- **USEPA Sediment Cleanup Objectives.** Sediment cleanup objectives for Commencement Bay, Washington (USEPA, 1993a) represent the lowest apparent effect thresholds for amphipod mortality, oyster larvae abnormality bioassay, or benthic infauna bioassay. In the absence of ERL/ERM or TEL/PEL values, benchmarks for several PAHs (benzo[b]fluoranthene, benzo[k]fluoranthene, indeno[1,2,3-cd]pyrene, and benzo[g,h,i]perylene) were selected on this basis.
- Other marine sediment benchmarks listed in NOAA (1999) SQuiRT tables, or sediment PRGs listed by ORNL (1997a), were used in the absence of any of the above criteria.

In addition to benchmark comparisons, acid volatile sulfides (AVS)/ simultaneously extracted divalent metals (SEM) data collected from intertidal tailings and sediment samples were used to evaluate bioavailability of five divalent metals (cadmium, copper, nickel, lead, and zinc). Divalent metals are bound to sulfur compounds in anaerobic sediment, effectively reducing their bioavailability. The ratio of the sum of SEM to AVS can be used as a screening criterion for these metals (e.g., Allen et al., 1993; Ankley et al. 1996a, 1996b; USEPA, 1991). AVS are a reactive pool of iron and magnesium sulfides present in anaerobic sediment that are readily broken apart, releasing hydrogen sulfide (H_2S). H_2S reacts with the divalent metal ions, forming insoluble and non-biologically available metal sulfides. If the ratio of SEM to AVS does not exceed 1.0, then there is sufficient AVS to bind the SEM, the metals are not bioavailable, and no toxicity would be expected. When insufficient H_2S is available, the excess metals are available to organisms and may be expressed in measurable toxicity.

2.5.3.3.4 Ecological Approach for Tissue

Hazards to shellfish populations are primarily addressed in the ecological SRE through intertidal sediment screening levels (Section 2.5.3.3.3), although a few chemicals do have established tissue screening criteria. With the exception of these few, there are no existing tissue benchmarks in the literature to measure risk to higher food chain receptors, such as birds eating shellfish. However, most upper trophic level species found in the Salt Chuck Mine area are likely to have a wide foraging range; that is, it is very unlikely they would use the site intertidal zone as their sole food source. For this reason, and because modeled tissue concentrations tend to be overly conservative and be highly uncertain, no attempt was made to develop tissue criteria for those chemicals without established tissue screening levels.

Hazards to upper trophic levels from exposure to several bioaccumulative compounds were addressed in the ecological SRE through the use of wildlife tissue screening concentrations. For mercury, a Canadian Tissue Residue Guideline (CTRG) of 0.033 µg/g or mg/kg wet weight was developed based on methylmercury analysis and available toxicity data for various wildlife species, mainly birds and mammals (Canadian Council of Ministers of the Environment [CCME], 2001; 2006). No methylmercury measurements were made in site data. Therefore, both this criteria and a criteria based on total mercury were considered. A 3 mg/kg total mercury whole body value (wet weight) is presented in Beyer et al. (1996). The total mercury tissue value was derived from a 1976 study (McKim et al. 1976, as cited in Beyer et al., 1996) where brook trout were exposed methylmercuric chloride in water for 273 days.

Tissue concentrations for selenium of 1 µg/g wet weight, and for copper in dry weight units were also selected as screening benchmarks in the SRE (Table 2-21). The selenium benchmark is an aquatic life value developed by CCME (1991b, 2006) as in interim guideline for both freshwater and marine environments, and is based on mean body weight. The tissue residue benchmark for copper was derived based on Environmental Contaminants in Wildlife (ECW) concentrations published by Beyer et al. (1996). Because these chemicals may have a greater effect on, or accumulate to a greater degree, in specific tissues, recommended values are generally specific to tissue type. The whole body tissue value for copper was selected. Salazar and Salazar (2003) evaluated 43 studies of copper toxicity and tissue residues using marine bivalves to derive a mean effects concentration (EC-tissue) of 80.3 µg/g dry weight (dw) and a mean no-effects concentration (NOEC-tissue) of 23.9 µg/g dw. Site tissue concentrations lower than the tissue threshold values are not expected to cause significant adverse effects. For those inorganics without ecologically-based tissue screening criteria, measured concentrations in tissues were compared to background concentrations.

For PCBs, a Tier 1 tissue screening criteria (TSC) of 0.436 µg/g wet weight for invertebrates (U.S. Navy Environmental Health Center, 2005) was conservatively selected. The PCB TSC was calculated using the chronic freshwater quality criteria set to 0.014 µg/L, and a bioaccumulation factor (31,200 L/kg) applicable to aquatic species with an average lipid content of 3%. This TSC was preferentially selected because the saltwater-based TSC for aquatic invertebrates was a larger value.

2.5.3.4 Risk Characterization

Risk characterization is the final phase of the ecological SRE. As noted in EPA (2000a) *Ecological Soil Screening Level Guidance Draft*, there is no standardized format for presentation of the risk characterization section. The following risk characterization section summarizes the risk drivers and affected areas in support of the risk management decision-makers. The uncertainties associated with the risk assessment are also presented in this section.

For the purposes of this EE/CA, the risk characterization integrates not only the assessment of ecological risk typically provided for ecological risk assessments, but also contains information to support reasonable risk-management decisions. For example, a selected risk-based criteria could result in a cost-effective remediation alternative that might remove 90% of the contamination, but to address the remaining 10% to achieve the most stringent criteria might result in marginal environmental

improvement. In addition, remedial actions required to further reduce or eliminate contamination to this level can cause substantive ecological losses. Thus, while the conservative screening criteria are present as recommended in ADEC (2005a, 2007a), additional risk criteria and the implications for soil or sediment/tailings cleanup are also considered during the risk characterization phase. Alternative risk criteria are only presented in the ecological screening tables if the ADEC value was exceeded. For similar reasons, because the historical character sample data for inorganics, did not undergo standard data validation procedures, hazard quotients (HQs) were generally calculated using the maximum non-character sample concentrations. HQs were calculated as follows:

HQ = chemical concentration (mg/kg or mg/L) / ecological benchmark (mg/kg or mg/L)

COECs were selected if an HQ above one was calculated. As indicated in USEPA (1999), Superfund remedial actions generally should not be designed to protect organisms on an individual basis (the exception being designated protected-status resources, such as listed or candidate threatened and endangered species or treaty-protected species that could be exposed to site releases), but to protect local populations and communities of biota. Thus, HQs will be interpreted with caution. For the purposes of this assessment, factors that may influence risk interpretation could include an evaluation of habitat quality and likely population impacts. Risk estimates are interpreted using various lines of evidence that address uncertainty and variability and take into account the site-specific conditions. Mitigating factors, such as high reproductive potential and recruitment from other areas, may compensate for losses to a portion of the population. These factors should be considered when evaluating the significance of COECs. HQs less than unity (1) indicate that the predicted exposures are generally acceptable, and no further action is warranted. HQs greater than 1.0 will be evaluated using professional judgment. For sediment benchmarks, because the range between the ERL and ERM is assumed to represent the range in which effects are occasionally observed (MacDonald, 1994), HQs were calculated based on the ERM. Further, a relatively low correlation between the incidence of effects and the ERL for total PCBs has been noted, indicating the conservative nature of the ERLs.

During the risk interpretation phase, the results of the risk estimate are presented in a scientific context that can be used to support the decision-making process for management of the environmental issues at the site. Spatial mapping was also performed to assist in risk management decisions and guide the remedial decisions (Figures 2-8 through 2-14).

2.5.3.4.1 Soil

The mine workings at Salt Chuck are located in an uplands environment characterized by gently rolling hills, bedrock, and dense vegetation (USBLM, 1998). Because no designated habitat for Threatened and Endangered Species has been identified at the site or surrounding areas, and no sensitive environmental areas have been designated by the Alaska Coastal Management Program near the site (USBLM, 1998), the primary ecological endpoint of concern for upland soils is protection of game species such as deer, bear, and river otter that have been observed throughout the area.

Several types of total petroleum hydrocarbons (TPH) measurements (e.g, RRO, DRO, and TRPH) were collected in selected areas of the site (e.g, the AST and drum cache area, Table 2-7). However, because the ecological effects of TPH are not well studied and there is a high degree of uncertainty quantifying ecological risk to this type of contaminant, the ecological risks for TPH are typically evaluated through the most toxic individual constituents (e.g, PAHs). PAHs were not identified as COECs in site soils (Table 2-32). Nonetheless, the ADEC Method Three soil cleanup level (12,500 mg/kg) is presumed to provide an appropriate level of protection for ecological receptors for petroleum-related contamination, and TPH results are not considered further in this risk evaluation.

Site soils in two distinct areas were investigated for potential metals contamination: the electric locomotive and the area around Building C4 (Table 2-5, Figures 2-2, and 2-3). Based on the maximum concentration in both areas, six metals were initially identified as COECs for soil: antimony, copper, lead, mercury, selenium, and zinc (Table 2-32). Each of the COECs are further considered below.

Antimony. An HQ of 3.1 was calculated for antimony using the maximum detected concentration of 15.4 mg/kg and a highly uncertain benchmark based on the protection of plants of 5 mg/kg (Table 2-32). As noted in Table 2-5, only one soil sample contained a concentration above the conservative plant benchmark. No eco-SSL for plants was derived by EPA (2005c) and the mammalian-based eco-SSL is below the ADEC value. The maximum detected concentration of antimony in soil is less than the invertebrate eco-SSL benchmark of 78 mg/kg. Given the low HQ and limited distribution of antimony greater than the uncertain risk-based criteria based on plants, and the lack of exceedence of the invertebrate eco-SSL, the risks to ecological receptors from antimony exposure are considered low.

Copper. An HQ of 20 was calculated for copper based on the wildlife soil PRG of 370 mg/kg and a maximum detected copper concentration of 7,320 mg/kg at Building C4 (Tables 2-5 and 2-32). The maximum detected copper concentration at the electric locomotive area is 147 mg/kg; this concentration does not exceed the wildlife PRG of 370 mg/kg. As such, copper in the electric locomotive area was not considered to pose a significant environmental threat. The distribution of copper around Building C4 is shown on Figure 2-8. The maximum concentration exceeds all eco-SSL values for bird and mammal species (USEPA, 2006c) as well as the eco-SSL for plants of 70 mg/kg and invertebrates of 80 mg/kg. Bird eco-SSLs for copper range from a low of 28 mg/kg for an insectivorous bird such as a woodcock and 76 mg/kg for an herbivorous bird such as a dove, to a high of 1,600 mg/kg for a predatory bird such as a hawk. Mammalian eco-SSLs for copper are generally higher with a low of 51 mg/kg for a mammalian insectivore (shrew), 1,100 mg/kg for an herbivore (vole) and a high of 1,600 mg/kg for a mammalian carnivore (weasel). As noted previously, the eco-SSLs are not intended to be cleanup criteria and are provided herein for discussion purposes. The concentrations of copper in soil at locations SCSS-1, SCSS-2, and SCSS-27 all exceed the wildlife PRG of 370 mg/kg. In addition, because copper is highly toxic in the aquatic environment, the significance of copper in soil as a potential source of release to marine waters was also evaluated. Location SCSS-27 contained copper at 5,770 mg/kg and is near the high tide line. Thus, the potential exists for copper at this location to mobilize and impact nearby surface waters. As such, copper at locations SCSS-1, SCSS-2, and SCSS-27 at Building C4 are considered to pose a potential environmental health threat.

Lead. An HQ of 150 was calculated for lead based on the maximum detected concentration of 6,170 mg/kg at Building C4 and the wildlife soil PRG of 40.5 mg/kg (Table 2-32). The maximum detected lead concentration at the electric locomotive area was 21 mg/kg. Although a review of the alternative screening criteria indicate that minor effects could occur in selected species, the area of impact appears localized and this concentration does not exceed the wildlife soil PRG of 40.5 mg/kg. Bird eco-SSLs for lead range from a low of 11 mg/kg for an insectivorous bird such as a woodcock (which is below the background value of 13.5 mg/kg), to 46 mg/kg for an herbivorous bird such as a dove, to a high of 510 mg/kg for a predatory bird such as a hawk (USEPA, 2005d). Mammalian eco-SSLs for lead range from a low of 56 mg/kg for a mammalian insectivore (shrew), to 460 mg/kg for a mammalian carnivore (weasel), and a high of 1,200 mg/kg for an herbivore (vole). As such, the wildlife PRG is considered a representative value expected to protect species at the population level that is also above background. The concentrations of lead in soil at locations SCSS-1, SCSS-2, and SCSS-27 all exceed the wildlife PRG of 40.5 mg/kg and are the same locations where elevated copper concentrations were noted. The distribution of lead around Building C4 is shown on Figure 2-8.

Mercury. An HQ of 1,000 was calculated for mercury based on the maximum detected concentration of 311 mg/kg and the ADEC soil criterion of 0.3 mg/kg. Development of a site-specific background mercury concentration in soil was problematic due to elevated detection limits in four of five samples. However, the wildlife PRG of 0.00051 mg/kg was below the one measured background concentration of 0.0922 mg/kg (Table 2-32). Likewise, while mercury was not detected in the electric locomotive area, elevated detection limits were noted. However, because elevated mercury concentrations were generally co-located with high concentrations of lead and copper, and lead and copper concentrations were not considered to pose a significant environmental health threat at the electric locomotive area, it can be presumed that the mercury does not require further action or assessment at this location.

In general, the mercury concentrations at Building C4 are co-located with the high concentrations of copper and lead. While the mercury concentration at location SCSS-26 is less than the microorganism screening criterion of 30 mg/kg (ORNL, 1997c) and a phytotoxicity value of 0.3 mg/kg (ORNL, 1997b), the concentration slightly exceeds the earthworm criterion of 0.1 mg/kg. EPA eco-SSLs are not currently available for mercury. Because the wildlife PRG is based on methylmercury and the environmental samples measure total mercury, and because the concentration at SCSS-26 is approximately equivalent to background, the mercury at location SCSS-26 was not considered to pose a significant environmental health threat. However, the concentration of mercury at location SCSS-2 was elevated well above risk-based benchmark for microorganisms of 30 mg/kg and given the propensity for mercury to bioaccumulate, this high concentration of mercury was considered to pose a potential environmental health threat.

Selenium. An HQ of 40 was calculated for selenium based on the maximum detected concentration of 8.36 mg/kg in the Building C4 area and the wildlife soil PRG of 0.21 mg/kg (Table 2-32). The selenium concentration at the electric locomotive area was not detected, but the detection limit is above the PRG value. However, because elevated selenium concentrations were generally co-located with high concentrations of lead and copper, and lead and copper concentrations were not considered to pose a

significant environmental health threat in the electric locomotive area, it can be presumed that the selenium at the electric locomotive area does not require further action or assessment. Like mercury, the development of a site-specific background concentration of selenium in soil was problematic due to elevated detection limits in all five samples. EPA eco-SSLs are not currently available for selenium. The wildlife soil PRG is based on the white-footed mouse. Alternative wildlife PRGs of 0.93 mg/kg for the red fox and 1.66 mg/kg for the white-tailed deer have been developed. Because there are no threatened or endangered species at the site, and because rodents and deer tend to have a high reproductive potential, the wildlife PRG for the red fox of 0.93 mg/kg, which is essentially equivalent to the plant phytotoxicity benchmark of 1 mg/kg (ORNL, 1997b), was deemed a more appropriate value for risk interpretation. The concentrations of selenium at locations SCSS-2 and SCSS-27, and one-half the detection limit at SCSS-1, are higher than this risk-based benchmark.

Zinc. An HQ of 34 was calculated for zinc based on the maximum detected concentration of 290 mg/kg in the Building C4 area and the wildlife soil PRG of 8.5 mg/kg. The wildlife soil PRG is below the background concentration of 30.9 mg/kg and is based on the woodcock, a species assumed to consume earthworms as their sole diet. Thus, this wildlife PRG was considered overly conservative, as is the plant phytotoxicity benchmark of 50 mg/kg. Alternative wildlife PRGs for mammalian species range from 1,600 mg/kg to 35,000 mg/kg for the white-footed mouse (ORNL, 1997a). The screening criteria for zinc for microorganisms and earthworms were 100 and 200 mg/kg, respectively (ORNL, 1997c). Given the uncertainties with the zinc wildlife PRG and the plant benchmark, the benchmark for microorganisms of 100 mg/kg was deemed a more suitable basis for risk management decisions. Using this criterion, the concentrations of zinc in the electric locomotive area, and at locations SCSS-26 and at SCSS-27 in Building C4 were lower than this criterion. The concentrations of zinc in soil at locations SCSS-1 and SCSS-2 exceed this criterion and may pose a potential environmental threat. These locations overlap the same locations where elevated lead and copper concentrations were noted (Figure 2-8).

Other Bioaccumulative Chemicals. Bioaccumulative compounds are defined by ADEC as having a bioconcentration factor (BCF) equal to or greater than 1,000 for organic compounds, a log Kow greater than 3.5, or those identified by USEPA (2000a) as bioaccumulative inorganic compounds. Bioaccumulative chemicals detected in soil that were not identified as COECs during screening include selected PAHs, arsenic, cadmium, nickel, and silver. However, bioaccumulation of PAHs by vertebrate species has not been reported in the literature (Hartung, 1995). Evaluation of ecological risks from bioaccumulation into prey tissue for the remaining inorganic chemicals in surface soil was not considered necessary because high concentrations of metals tended to be co-located in the same samples, and surface soils are already targeted for removal based on elevated concentrations of other chemicals.

2.5.3.4.2 Unsaturated Tailings

Unsaturated tailings are located in three distinct areas: the area adjacent to mill where most of the material surrounding the mill is a mixture of waste rock and tailings, Piles D14 and D15 where tailings piles are located on both sides of the unnamed creek, and the tailings spit area located south of the mill and into the intertidal zone covering an area of approximately 40 by 200 feet. The top of this pile is

described as dry windblown silt with a stunted spruce tree and driftwood present, indicating the storm high tide mark (USBLM, 1998). In addition, during the 1995 investigation, a sample of a thick gooey sludge was collected from the floor of the northwest corner of the mill near the tailings (Sample SO01, Figure 2-4). Due to the proximity of this sample to unsaturated tailings, it is included in this section. The full data sets for unsaturated tailings and sludge are presented for inorganics and organics in Tables 2-8 and 2-9, respectively.

As with site soils, the analytical program for unsaturated tailings and the sludge sample included measurements for TPH (e.g., DRO, RRO). However, because the ecological effects of TPH are not well studied and there is a high degree of uncertainty quantifying ecological risk to this type of contaminant, the ecological risks for TPH are typically evaluated through the most toxic individual constituents (e.g, PAHs). No PAH data was collected for the sludge sample. Three PAHs (benzo[a]anthracene, benzo[a]pyrene and indeno[1,2,3-cd]pyrene) from unsaturated tailings samples had HQs above 1, with the highest HQ of 27 for benzo(a)pyrene (Table 2-33). DRO levels in the unsaturated tailings (Table 2-9) are below the ADEC Method Three soil cleanup level (12,500 mg/kg), such that removal based on DRO in tailings would not be required, except for the sludge where 163,000 mg/kg of DRO was measured. Because the benzo(a)anthracene and indeno(1,2,3-cd)pyrene concentrations were only elevated above ecological benchmarks in one sample and the high concentrations were co-located with benzo(a)pyrene, the risk interpretation discussion focuses on benzo(a)pyrene. With the exception of the NEIC which is designed to address the sum of PAHs, no alternative screening criteria for benzo(a)pyrene were identified for ecological receptors. Total PAH values for the two samples (SCUT-3 and SCUT-6) that had concentrations in excess of the ADEC ERBSC of 0.1 mg/kg for benzo(a)pyrene were below the NEIC criterion and were not targeted for further action based on ecological risk.

In addition to PAHs, COECs initially identified for the unsaturated tailings include antimony, arsenic, copper, lead, selenium zinc, and total PCBs (Table 2-33). The HQs for arsenic, antimony, and total PCBs were at 1.0 and are considered to pose a low risk based on the selected soil ecological benchmark. One-half the detection limits for mercury and thallium were elevated above ecological benchmarks, but were not selected as COECs for the following reasons. For mercury, while elevated detection limits were associated with non-character samples, mercury concentrations in character samples were below the ADEC ERBSC. For thallium, the elevated detection limits were associated with character samples only, and non-character sample detection limits were below screening levels. PCBs and mercury are bioaccumulative and are further discussed with respect to tissue in Section 2.5.3.4.8. Each of the COECs are further considered below.

Copper. An HQ of 140 was calculated for copper based on the maximum detected concentration of 53,400 mg/kg in a sample collected from the mill area and a wildlife soil PRG of 370 mg/kg. Copper concentrations in Piles D14 and D15 ranged from 1,085 to 1,450 mg/kg, also exceeding this criterion. In addition, an elevated copper concentration of 3,960 mg/kg was noted in a character sample from the tailings spit; this sample did not use standardized laboratory methods indicating uncertainty associated with the measured concentration. Thus, copper levels in all three areas were deemed to pose a potentially significant environmental threat to wildlife.

Lead. An HQ of 3.5 was calculated for lead based on the maximum detected concentration of 143 mg/kg in a sample collected from the mill area and a wildlife soil PRG of 40.5 mg/kg. All samples in the mill area exceeded this criterion. The maximum concentration of lead in Piles D14 and D15 and the tailings spit 2.0 mg/kg, which falls below this criterion.

Selenium. An HQ of 300 was calculated for selenium based on the maximum detected concentration of 65.4 mg/kg in a sample collected from the mill area and a wildlife soil PRG of 0.21 mg/kg. Selenium was not detected in Pile D14, and was not analyzed at Pile D15 or the tailings spit. The wildlife soil PRG is based on the white-footed mouse. Alternative wildlife PRGs of 0.93 mg/kg for the red fox and 1.66 mg/kg for the white-tailed deer have been developed. Because there are no threatened or endangered species at the site, and because rodents and deer tend to have a high reproductive potential, the wildlife PRG for the red fox of 0.93 mg/kg was deemed a more appropriate value for risk interpretation. The selenium concentrations at samples SCUT-3, SCUT-4/5, and SCUT-6 were above this criterion in the mill area.

Zinc. An HQ of 31 was calculated for zinc based on the maximum detected concentration of 266 mg/kg in a sample collected from the mill area and a wildlife soil PRG of 8.5 mg/kg. However, the wildlife soil PRG is below the background concentration of 30.9 mg/kg, and is based on the woodcock, a species assumed to consume earthworms as their sole diet. As discussed above for soil, the benchmark of 100 mg/kg for microorganisms was deemed a more suitable basis for risk management decisions. Zinc concentrations at locations SCUT–4/5, SO03, and SCUT-6 in the mill area exceed this benchmark. The maximum concentrations of zinc in Piles D14 and D15 of 64 mg/kg, and in the tailings spit of 62 mg/kg, fall below this criterion.

Other Bioaccumulative Chemicals. Bioaccumulative compounds are defined by ADEC as having a BCF equal to or greater than 1,000 for organic compounds, a log Kow greater than 3.5, or those identified by EPA (2000a) as bioaccumulative inorganic compounds. Bioaccumulative chemicals detected in unsaturated tailings that were not identified as COECs include selected PAHs, arsenic, cadmium, nickel, and silver. However, bioaccumulation of PAHs by vertebrate species has not been reported in the literature (Hartung, 1995). Evaluation of ecological risks from bioaccumulation into prey tissue for the remaining inorganic chemicals in unsaturated tailings was not considered necessary because high concentrations of these tended to be co-located in areas already targeted for removal based on elevated concentrations of other constituents.

2.5.3.4.3 Stream Tailings

Tailings are located in the unnamed stream between tailings piles D14 and D15 (Figure 2-2). A composite character sample of the stream tailings was collected in 1995, and an additional sample collected in 2002. The full data set for the stream tailings are presented in Table 2-10. Based on the maximum concentration of the two samples, copper and vanadium were initially identified as stream tailing COECs (Table 2-34). One-half the detection limits for mercury and selenium were elevated above their ecological benchmarks. For selenium, one half the detection limit was only marginally above

the benchmark (HQ of 1.1); thus it was not considered a COEC. Although an elevated detection limit was present in one sample for mercury, the detected concentration in the other sample did not exceed the upperbound ecological benchmark, and mercury was not retained as a COEC. Each of the COECs are further considered below.

Copper. An HQ of 3.6 was calculated for copper based on the maximum detected concentration of 709 mg/kg when compared to the freshwater PEL of 197 mg/kg. Copper concentrations in both samples were above the PEL. In addition, the copper concentrations in the stream tailings also exceed the acceptable concentration of 500 mg/kg derived using an EC-tissue level approach for the intertidal tailings (discussed in Section 2.5.3.4.8), suggesting the copper in stream tailings may result in environmental effects to invertebrates.

Vanadium. An HQ of 3.9 was calculated for vanadium based on the maximum detected concentration of 225 mg/kg when compared to the apparent effects value of 57 mg/kg. Concentrations of vanadium in the tailings piles were relatively uniform and were lower than the maximum detected vanadium concentration in soil background (Table 2-34) suggesting vanadium levels in stream tailings may be comparable to regional background levels.

Other Bioaccumulative Chemicals. Bioaccumulative chemicals detected in stream tailings that were not evaluated as COECs included arsenic, cadmium, mercury, nickel, selenium and silver. Because the stream tailings are targeted for removal based on copper concentrations, further evaluation of the ecological risks from bioaccumulation into prey tissue for the bioaccumulative inorganic chemicals was not considered warranted.

2.5.3.4.4 Intertidal Tailings.

The intertidal tailings have been delineated into four zones (Zones A, B, C, and D) (Figure 2-4). The full data set for intertidal tailings are presented for inorganics and organics in Tables 2-11 and 2-12, respectively. Based on the maximum concentration in any zone, three metals (copper, selenium and vanadium) and total PCBs were initially identified as COECs for intertidal tailings using the sediment ecological benchmarks listed in Table 2-22 (Table 2-35). The distribution of copper concentrations in intertidal tailings is presented in Figure 2-10. Each of the COECs are further considered below.

Copper. An HQ of 9.6 was calculated for copper based on the maximum detected concentration in any non-character sample in any area of 2,580 mg/kg when compared to the ERM of 270 mg/kg. This maximum concentration was located in Zone A. In Zone B, an HQ of 7.8 was calculated using the maximum non-character sample of 2,110 mg/kg (this was also the maximum concentration of all sample types). In Zones C and D, HQs of 5.1 and 5.9 were calculated based on maximum non-character sample concentrations of 1,370 and 1,590 mg/kg, respectively. An alternative risk-based value of 500 mg/kg in intertidal tailings/sediment has been derived based on a critical body residue (discussed in Section 2.5.3.4.8). Intertidal tailings with concentrations above this criterion are depicted by the cross-hatch pattern on Figure 2-10. All of Zones A through C, and portions of the Zone D tailings, exceed this criterion.

Selenium. An HQ of 1.6 was calculated for selenium on the maximum detected concentration of any non-character sample in any area of 1.55 mg/kg when compared to the NOAA AET of 1 mg/kg. The benchmark used in this risk evaluation for selenium is considered uncertain. EPA has not established a sediment benchmark for selenium, nor has NOAA identified an ERL or ERM for this inorganic. The detected selenium concentrations in Zone A tailings were all below this benchmark. Limited selenium data was collected in Zone B, but it was not detected in the single non-character sample. Two locations in Zone C had concentrations slightly above the selenium benchmark in Zone C tailings; these concentrations are co-located with copper concentrations in excess of the risk-based copper concentration of 500 mg/kg described above. Likewise, the sole selenium concentration found in excess of the selenium benchmark in Zone D tailings is co-located with a copper concentration in excess of the 500 mg/kg value. As such, given the uncertainties of the selenium benchmark and the low environmental significance of concentrations slightly in excess of the benchmark, further action to specifically address selenium in intertidal tailings, or to develop an RAO for ecological receptors, does not appear warranted.

Vanadium. An HQ of 7.7 was calculated for vanadium based on the maximum detected concentration of any non-character sample in any area of 438 mg/kg when compared to the NOAA AET of 57 mg/kg. This benchmark is considered uncertain, and is below the background level of vanadium in sediment (59.3 mg/kg). EPA has not established a sediment benchmark for vanadium, nor has NOAA identified an ERL or ERM for this inorganic. In general, concentrations of vanadium in the tailings were co-located with copper concentrations found in excess of the risk-based copper concentration of 500 mg/kg. Vanadium concentrations in Zone D tailings at locations not targeted for removal based on copper concentrations range from 79 (HQ of 1.3) to 170 mg/kg (HQ of 3.0). These levels are below soil background concentrations (Table 2-5), but not background sediment concentrations (Table 2-35), in the area. Given the uncertainties with the ecological benchmark and the potential for background soil runoff to influence vanadium concentrations in the area even after a removal action, the environmental significance of this finding is unknown, and further action to specifically address vanadium, or to develop an RAO for intertidal ecological receptors, does not appear warranted.

Total PCBs. An HQ of 12 was calculated for PCBs based on the maximum detected concentration of 2.2 mg/kg when compared to the NOAA ERM of 0.18 mg/kg. Despite the presence of PCB concentrations in excess of the PCB ecological benchmark for sediment, no detectable concentrations of PCBs were found in shellfish tissue (Section 2.5.3.4.8), suggesting risks to wildlife feeding higher on the food chain are not significant. Nonetheless, the exceedence of the ERM suggests the PCBs in intertidal tailings may result in environmental effects to invertebrates. The elevated PCB detections in the intertidal tailings (Figure 2-11) are co-located with areas of elevated copper in Zones B and D (Figure 2-10).

Other Bioaccumulative Chemicals. Bioaccumulative chemicals detected in intertidal tailings that were not evaluated as COECs included arsenic, cadmium, lead, mercury, nickel, and silver. The bioaccumulation potential of these chemicals in intertidal tailings were evaluated as part of the shellfish tissue risk evaluation in Section 2.5.3.4.8.

Bioassays. Because copper is highly toxic to aquatic species, and because of the high societal value of fisheries in the area, 7-day chronic fish bioassay tests were run on the elutriate of two intertidal tailings samples: SCIT-13 and SCIT-12 (Figure 2-4). Because surface waters near Salt Chuck Mine are intertidal, *Menidia* were selected as the test species as they can tolerate a large range of salinities. Both survival and a chronic test endpoint (growth) at a critical life stage (11-day old fish) were selected as the bioassay test endpoints. None of the 100% elutriate tests affected the survival of growth of the inland silverside, *Menidia beryllina.* Details on the biossay studies are presented in the bioassay laboratory report which is attached in Appendix B.

AVS/SEM. Acid-volatile sulfides (AVS) are defined as solid-phase sulfides that are soluble in 0.5 M acid. This chemical class represents a reactive mixture of iron and magnesium sulfides present in sediments and soils that are readily releasing hydrogen sulfide. Because H_2S reacts with certain divalent metal ions (Cd^{+2}, Cu^{+2}, Ni^{+2}, Pb^{+2}, and Zn^{+2}), termed simultaneously extractable metals (SEM), forming insoluble and non-biologically available metal sulfides; when sufficient AVS is available, the bioavailability of these metals is reduced. This process is additive for SEM; therefore, the following calculation was performed:

$$SEM = \Sigma[Metal^{+2}] = [Cd^{+2}] + [Cu^{+2}] + [Ni^{+2}] + [Pb^{+2}] + [Zn^{+2}]$$

where the concentrations are expressed on a molar basis. If the ratio of SEM to AVS does not exceed 1.0, then there is sufficient AVS to bind the SEM, and the metals can be considered not bioavailable, reducing or eliminating the potential for toxicity. No toxicity has been observed when sufficient AVS is available in both freshwater and marine systems using numerous benthic organisms including amphipods, mussels, grass shrimp, hard shell clams, worms, snails, and oligochaetes (*e.g.*, DiToro et al., 1990, 1992; Carlson et al,. 1991; Ankley et al., 1991, 1996a, 1996b; Allen et al., 1993; Casas and Crecelius, 1994; Pesch et al., 1995). Molar conversions were performed by the laboratory.

In general, AVS conditions are found in anaerobic sediments. Visual observations in the field at the Salt Chuck site did not suggest the tailings and sediment were oxygen-deprived with the exception of one targeted sampling location. A single intertidal tailings sample from Zone D was collected for AVS/SEM testing (SCIT-13). The results of this test are presented in Table 2-11. One half the detection limit was used for the non-detected metals. The SEM/AVS ratio was 1.07 suggesting that insufficient AVS is present to bind up the metals. Thus, divalent metals are likely bioavailable in the sediments/intertidal tailings.

2.5.3.4.5 Intertidal Sediment

In general, ecological impacts to sediment can be measured by the magnitude of sediment contamination, the degree of toxicity, and the composition of the infaunal community. Variability in the infaunal community may be the result of a wide variety of factors. Just as certain plants thrive in certain types of soils, different benthic species flourish in different sediment environments. Non-chemical factors, such as sediment particulate size, freshwater influence/salinity, etc., will influence the types of species present.

The full data set for intertidal sediment are presented for inorganics and organics in Tables 2-13 and 2-14, respectively. Sample locations are detailed on Figures 2-4, 2-6, and 2-7. The distribution of selected metals data at co-located tissue sample sites is depicted on Figure 2-13. Based on the maximum concentration in any area, five constituents were initially identified as COECs in intertidal sediment: copper, mercury, selenium, vanadium, and total PCBs (Table 2-36). Each of the COECs are further considered below.

Copper. An HQ of 1.2 was calculated for copper based on the maximum detected concentration of any non-character sample in any area of 324 mg/kg when compared to the ERM of 270 mg/kg. Only one non-character sample was found above the ERM; this slight exceedence was located distant from the tailings and is below the site-specific risk-based criterion for copper in sediment of 500 mg/kg (Section 2.5.3.4.8). As such, copper in sediment was not considered to pose an unacceptable risk to ecological receptors.

Mercury. An HQ of 7.8 was calculated for mercury based on the maximum detected concentration of any non-character sample in any area of 5.53 mg/kg compared to the ERM of 0.71 mg/kg. Mercury was not detected in co-located shellfish tissue data for littleneck clams and blue mussels above the wildlife benchmark of 0.033 micrograms of methylmercury per gram (wet weight) tissue criteria or above the total mercury tissue screening criteria for aquatic life (3 mg/g) (Figures 2-12 and 2-13), suggesting the mercury in sediment is not bioavailable at harmful levels. Although elevated detection limits above screening criteria were noted in some samples, the lack of elevated mercury concentrations in shellfish tissue suggests mercury in sediment does not pose unacceptable risk to ecological receptors.

Selenium. An HQ of 1.3 was calculated for selenium based on the maximum detected concentration of any non-character sample in any area of 1.3 mg/kg when compared to the NOAA AET of 1 mg/kg. As noted in Section 2.5.3.4.5, the benchmark for selenium is considered uncertain. EPA has not established a sediment benchmark for selenium, nor has NOAA identified ERL or ERMs for this inorganic. As such, given the uncertainties of the selenium benchmark and the low environmental significance of concentrations only slightly in excess of the benchmark, further action to specifically address selenium in sediment, or to develop an RAO for ecological receptors, does not appear warranted.

Vanadium. An HQ of 3.7 was calculated for vanadium based on the maximum detected concentration of any non-character sample in any area of 210 mg/kg when compared to the NOAA AET of 57 mg/kg. As noted in Section 2.5.3.4.5, the benchmark for vanadium is considered uncertain, and is below vanadium in background sediment (59.3 mg/kg). EPA has not established a sediment benchmark for vanadium, nor has NOAA identified ERL or ERMs for this inorganic. Approximately half of the vanadium sediment data for the site is from character samples. The highest concentrations were found in character samples collected from the shoreline adjacent to the east edge of tailings Zones B and C (430 to 467 mg/kg). These data are considered uncertain, and are near or below soil background concentrations in site sediment in the area (maximum of 460 mg/kg, Table 2-5). Given the uncertainties with the ecological benchmark and the potential for soil runoff to influence vanadium concentrations, the environmental

significance of the vanadium is unknown, and further action to specifically address vanadium in sediment or to develop an RAO for ecological receptors does not appear warranted.

Total PCBs. An HQ of 8.3 was calculated for total PCBs based on the maximum detected concentration of 1.5 mg/kg when compared to the NOAA ERM of 0.18 mg/kg. Despite the presence of PCB concentrations in excess of the PCB ecological benchmark for sediment, no detectable concentrations of PCBs were found in shellfish tissue (Section 2.5.3.4.8), suggesting risks to wildlife feeding higher on the food chain are not significant. The maximum total PCB concentration was collected in 2002 (sample SCSD-2, Figures 2-4 and 2-11); both littlenecks and blue mussels were present at this sample location, suggesting impacts to invertebrates, if present, were minor. Additional sediment samples collected north and south of this sample in 2006 did not contain detectable concentrations, suggesting that PCB concentrations may be limited to an isolated area and are not likely to pose a significant environmental risk.

Other Bioaccumulative Chemicals. Bioaccumulative chemicals detected in intertidal sediment that were not evaluated as COECs included arsenic, cadmium, lead, nickel, and silver. The bioaccumulation potential of these chemicals in sediment were evaluated as part of the shellfish tissue risk evaluation in Section 2.5.3.3.8.

Bioassays. Because copper is highly toxic to aquatic species, and because of the high societal value of fisheries in the area, 7-day chronic fish bioassay tests were run on the elutriate of a representative site sediment sample (SCSD-28), as well as on a background sample from Gosti Island (SCSD-22). None of the 100% elutriate tests affected the survival growth of the inland silverside, *Menidia beryllina* (Table 2-13). Details on the biossay studies are presented in the bioassay laboratory report which is included in Appendix B.

2.5.3.4.6 Surface Water

Because ecological benchmarks are based on the dissolved phase of metals (i.e., the bioavailable fraction), HQs were calculated on dissolved phase site concentrations. Based on the maximum concentration in any freshwater sample, two metals were initially identified as surface water COECs: copper and selenium (Table 2-37). Based on the maximum concentration in any intertidal water sample, copper was identified as a saltwater COEC (Table 2-38). The distribution of dissolved copper in water samples is shown on Figure 2-14. The full data set for freshwater and intertidal surface waters is presented in Table 2-15 for inorganics. Table 2-16 lists the analytical data for organics in intertidal water. For some chemicals, one-half the detection limit exceeded ecological benchmarks; this issue is discussed in the uncertainty section. No detectable concentrations of any organic chemicals (DRO, PAHs, or total PCBs) were found in intertidal water.

Freshwater. For freshwater, an HQ of 5.6 was calculated for copper (Table 2-37). However, this water sample was collected from an adit where exposure to ecological organisms is unlikely. Copper concentrations were not detected in a sample collected downgradient from the adit but within the stream (SCSW-3). In addition, the detectable concentrations of copper in the unnamed stream near tailings piles

D14 and D15 were below the ecological benchmarks. Therefore, copper was not considered to pose a significant environmental health threat in the unnamed freshwater stream. An HQ of 2.9 based on the ecological benchmark was calculated for selenium. However, when background was considered, an HQ of 1.4 was calculated. As with copper, the maximum concentration of selenium was found in the adit. Both the sample collected downgradient from the adit but within the unnamed stream (SCSW-3), and the surface water samples collected from the unnamed stream near tailings piles D14 and D15, did not contain detectable concentrations of selenium. As such, selenium was not considered to pose a significant environmental health threat in the stream. One half the maximum detection limit for cadmium exceeded risk-based criteria. However, the detection limits for some cadmium data did meet the risk-based criteria.

Intertidal/Saltwater. Because the measured concentrations of selected inorganics can be biased high by salts in intertidal water, a reductive precipitation (RPPT) step was performed on 2006 data to minimize matrix interference. The RPPT concentrations are considered a better measure of the true concentration of arsenic, copper, mercury, nickel, selenium, and vanadium. For arsenic, nickel, and selenium, the RPPT measurements were found to be below benchmarks and these chemicals were not retained as COECs (Table 2-38). The ADEC criteria and EPA chronic AWQC for copper are comparable values. An HQ of 190 was calculated for copper based on the maximum detected RPPT concentration at location SCSW-7 which was collected from the low tide seep in the mill tailings area in 2006. Both the RPPT and standard method analyses yielded similar copper concentrations. Water collected from the same location in 2002 (SCSW-5/6) also contained copper concentrations above ADEC water criteria (Figure 2-14).

No detectable concentrations of any organic chemicals (DRO, PAHs, or total PCBs) were found in intertidal water (Table 2-16). However, one-half the detection limit for PCBs exceeded the ecological benchmark. Nonetheless, because PCBs were not found in detectable concentrations in any tissue samples, this data quality issue was not deemed significant, and it can be inferred that PCBs in intertidal water do not pose a significant environmental health threat to aquatic organisms or their predators.

2.5.3.4.7 Shellfish Tissue

Tissue residue concentrations in invertebrates may reduce the uncertainty in estimating exposure to ecological receptors via the water column and sediment. These measurements also provide information on exposure via the food web. For the purposes of this ecological SRE, hazards to upper trophic levels from exposure to two bioaccumulative compounds, total PCBs and mercury, were addressed through the use of wildlife tissue screening concentrations. Screening concentrations were also available for selenium and copper. The development and rationale for selection of these benchmarks is presented in Section 2.5.3.3.4, and the result of the screening analysis are provided in Table 2-39. For those inorganics without ecologically-based tissue screening criteria, measured concentrations in tissues were compared to background concentrations (Table 2-40). The full data set for inorganics and organics (PCBs) for shellfish tissue are presented in Tables 2-17 and 2-18, respectively. Tissue data is presented on both a wet weight and dry weight basis. No detectable concentrations of any organic chemicals (PCBs) were found (Table 2-18).

Mercury. The CTRG to protect wildlife consumers of freshwater, marine, and estuarine biota is 0.033 micrograms of methylmercury per gram (wet weight) in prey tissue. The total methyl concentration in blue mussel tissue at one location exceeded this criterion (HQ of 2.3). However, it should be noted that the corresponding mercury concentration in sediment was a nondetect value, suggesting that developing an RAO for mercury in sediment would not address this finding total mercury whole body value. None of the mercury concentrations in shellfish tissue were above the 3 mg/kg total mercury whole body value for protection of fish (Table 2-39).

Selenium. The CTRG for selenium of 1 μg/g wet weight developed by CCME (2001b, 2006) was compared to the concentrations of selenium in shellfish in Table 2-40. No exceedences of the selenium CRTG were noted.

PCBs. The shellfish tissue total PCB data were compared to the screening fish tissue criteria for the wildlife consumption of PCBs of 0.436 μg/g (Navy Environment Health Center, 2005). No detectable concentrations of PCBs were found, and the detection limits were below the wildlife consumption risk-based criteria (Table 2-40).

Copper. No tissue criteria are established for the protection wildlife ingesting copper. However, tissue residues may be a more appropriate indicator of adverse effects in aquatic biota than external water concentrations because tissue residues represent a more toxicologically relevant dose. Bivalves, in particular, can regulate uptake of certain metals into their tissues. For example, indigenous zebra mussels were found to have developed physiological adaptation to a copper-contaminated environment (Mersch et al., 1995). Likewise, in spite of the magnitude of copper mine tailings near Caleta Palito in northern Chile, the effects of copper on intertidal assemblages has remain restricted to a small geographic area (Correa et al., 2006). Because the rate of accumulation is an important determinant of the effects of copper on bivalves, concentration-based benchmarks in abiotic media (e.g,. surface water and sediment) may be overly conservative and may not be the best measure for copper impacts in bivalves. Variables such as sediment properties (e.g., partitioning or K_d relationships), physiology of the organism (species-specific uptake rates from waters, and assimilation efficiencies from solids), and feeding behavior of the organism can all influence uptake and exposure (Simpson and King, 2005). As such, the critical body residues for copper in bivalves developed by Salazar and Salazar (2003) were considered. The critical body residue (CBR) is the concentration of chemical bioaccumulated in an aquatic organism that corresponds to a toxicity endpoint (e.g., mortality). Salazar and Salazar (2003) evaluated 43 studies of copper toxicity and tissue residues using marine bivalves, to derive a mean effects concentration (EC-tissue) of 80.3 μg/g dry weight and a mean no-effects concentration (NOEC-tissue) of 23.9 μg/g dry weight. Because there are no known threatened or endangered bivalve species, the mean effects concentration was selected for risk interpretation.

Regulation of inorganics in tissue is extremely complex and may be species dependent. Of the three species where tissue data was collected for copper, softshell clams appear to have the highest accumulation rates of copper. The copper concentrations in softshell clam tissue were only found to exceed the EC-tissue concentration in clams collected from the tailings piles (SCTISS-9/10 and SCTISS-

11, Figure 2-12). Blue mussels exposed to the same sediment/tailings did not contain copper concentrations in their tissues higher than the EC-tissue concentration, and the copper concentration in blue mussel tissue at SCTIBM-23/24 was equivalent to the NOEC-tissue level. As such, to support a risk-based cleanup, concentrations in tailings were back-calculated using the EC-tissue level for the most sensitive species (softshell clams) using an average uptake rate based on co-located copper concentrations in tissue and tailings on a dry weight basis using the following equation:

Uptake = Concentration in Tissue/Concentration in Tailings

Based on the calculated uptake rate, an acceptable copper concentration in tailings corresponding to the EC-tissue concentration can be estimated using the following equation:

Acceptable Concentration in Tailings = EC-Tissue/Uptake Rate

The uptake rate in Zone C Tailings at location SCTISS-11 for softshell clams was 12.7%, while the uptake rate in Zone D Tailings at location SCTISS-9/10 was 19.9%. The higher rate of uptake at the lower copper concentration in Zone D tailings suggests that uptake is concentration-dependent, and that uptake of copper into tissue slows at higher concentrations. To account for this phenomenon, an average uptake was calculated to derive a site-specific risk-based criterion for copper in tailings of 492 mg/kg which was rounded to 500 mg/kg.

Other Inorganics. Because there are no risk-based tissue screening criteria for most inorganics, a comparison of measured dry weight chemical concentrations in site tissue to site-specific background and NOAA reference data was made in Table 2-40. Shellfish tissue concentrations of cadmium, nickel, and silver at the site were lower than the combined background tissue data for all species.

No definitive conclusions can be drawn regarding the environmental effects of chemicals that are present at concentrations higher than site-specific background and NOAA reference concentrations. The maximum antimony and thallium tissue concentrations, which were encountered in softshell clams, are above background values. However, no antimony or thallium data were collected specifically from background softshell clams. The concentrations of antimony in butter clams on the site (0.014 μg/g dry weight) are comparable to background levels in butter clams (0.012 μg/g dry weight). Likewise, the concentrations of thallium in site butter clams (0.012 μg/g dry weight) are generally similar to background (0.008 μg/g dry weight). Beryllium was only detected in site butter clams, and the maximum concentration of 0.016 μg/g dry weight only slightly exceeds the background butter clam value of 0.009 μg/g dry weight. The maximum concentration of zinc in site tissue (157 μg/g dry weight) is associated with softshell clams, and is generally similar to zinc concentrations in softshell clams collected from background locations (139 μg/g dry weight). The slight exceedences of antimony, beryllium, thallium, and zinc in site softshell tissues relative to background concentrations were considered within range of natural data variability.

Arsenic concentrations in shellfish tissue from the site are above site-specific background for butter clams and littlenecks. However, arsenic was not identified as a COEC in intertidal tailings or sediment. Thus,

the environmental significance of this finding is unknown, and further action to address arsenic or develop a target cleanup goal for ecological receptors does not appear warranted.

Chromium tissue concentrations are highest in butter clams from the site, and are consistently higher than background levels (Table 2-40). However, chromium was not identified as a COEC in intertidal tailings or sediment. Thus, the environmental significance of this finding is unknown, and further action to address chromium or develop a target cleanup goal for ecological receptors does not appear warranted.

Lead tissue concentrations are slightly higher than background when all data are considered, and are higher than background on a species-by-species basis with the exception of littleneck clams (Table 2-40). However, the concentrations are all below NOAA reference levels, and lead was not identified as a COEC in intertidal tailings or sediment. Thus, the environmental significance of this finding is unknown and further action to address lead or to develop a target cleanup goal for ecological receptors does not appear warranted.

Vanadium tissue concentrations are highest in softshell clams collected from the tailings piles (Table 2-17), but no comparable background vanadium concentrations were available for softshell clams (Table 2-40). Concentrations of vanadium in blue mussels and littlenecks collected from the tailings piles are consistently higher than background vanadium tissue concentrations in comparable species. Vanadium was identified as a COEC in intertidal tailings and sediment. However, the ecological benchmark for vanadium in sediment is highly uncertain. Given the uncertainties with the ecological benchmark and the potential for background soil runoff to influence vanadium concentrations in the area even after a removal action, the environmental significance of this finding is unknown, and further action to specifically address vanadium or develop a target cleanup goal for ecological receptors does not appear warranted.

2.5.3.5 Uncertainty

Varying degrees of uncertainties (generally conservatively biased) are present in ecological risk assessment. An understanding of those limitations is critical to support the risk management decision-making process. Areas of uncertainty addressed below include issues associated with: (1) site characterization and data quality (e.g., chemicals for which detection limits exceed benchmarks and adequacy of the data set); (2) exposure assessment (e.g., seasonal presence of migratory species, and species mobility) (3) toxicity benchmarks, and (4) risk characterization (e.g., interpreting effects at the population level). Areas of uncertainty potentially affecting the ecological SRE include:

- No soil data were collected under the mill. The site has undergone a cultural resource evaluation and has been determined eligible for National Register listing under three of the four requisite criteria (Section 2.1.1). As such, disturbance of the mill site is not recommended. However, exclusion of this area from investigation has the potential to underestimate risk.
- Detection limits for mercury were elevated above ecological screening criteria in soil samples in the electric locomotive area, and in four of five background soil samples. This data quality issue contributed to the uncertainty of the evaluation of mercury. However, because elevated mercury concentrations were generally co-located with high concentrations of lead and copper, the

elevated detection limits were not considered to hinder risk management decision-making, though the potential to underestimate risk exists.

- While intertidal waters draining from the tailings zones were sampled during the site investigations, samples truly representative of porewater were not collected using more sophisticated techniques (e.g., porewater peepers) due to the lack of any one widely accepted repeatable method. Although metal bioavailability in sediment may be influenced by geochemical equilibration of metals between porewater and reactive sulfides, in an experiment with four types of invertebrates, metal concentrations in animal tissue correlated with those in sediments, but not with those in porewater (Lee et al., 2000). The lack of site porewater data has an unknown impact on the risk estimates. However, because the critical body residue values were used to define impacts from copper exposure, the lack of porewater data was also not deemed significant for the risk assessment.

- In general, only data that have undergone Level III data validation are typically selected as usable for risk assessment purposes. For this reason, because the historical character sample data for inorganics did not undergo standard data validation procedures, nor did they follow standard laboratory methods, the character sample data is considered uncertain. Because remedial actions can often result in impacts to habitats, and decision-making relies on the findings of the risk assessments, HQs were generally calculated for the inorganic chemicals using the maximum non-character sample concentrations. Because the character samples are often associated with the highest concentrations onsite, this practice has the potential to underestimate risk. Likewise, although the detection limits for character samples in soil or tailings did not meet ecological benchmarks for selected metals (e.g., mercury, selenium, and thallium in Table 2-33), given the uncertainties with the character data, this data quality issue was not deemed significant for risk management decisions-making.

- A number of detection limits for freshwater surface water samples were elevated above the ADEC freshwater ERBSC criteria (e.g., cadmium, copper, mercury, selenium, silver, and thallium in Table 2-37). However, for copper and selenium, the maximum detected concentrations were used in the benchmark comparisons, minimizing this uncertainty. One half the maximum detection limit for cadmium exceeded risk-based criteria and resulted in an HQ of 4.3. However, the detection limit for cadmium in some samples were low enough to meet the risk-based criteria. For the remaining chemicals, the detection limits were low enough to meet other applicable risk-based criteria.

- To determine if depuration affected the clam tissue data, butter clams were hung in a mesh bag suspended in a 2-gallon bucket filled with seawater collected from Fourth-of-July Island (SCTIBC-32b) for 24 hours. No significant differences were found between the depurated and nondepurated chemical data, and the nondepurated data were used in the ecological SRE. This is more representative of wildlife consumption exposure and is not expected to underestimate risk.

- Recent trends in the environmental sampling of PCBs have resulted in a variety of analytical data for this chemical. Traditionally, PCBs have been reported as five Aroclors (1016, 1242, 1248,

1254, and 1260). The chemical manufacturer (Monsanto) had defined the Aroclors based on the total amount of chlorine present, as well as the congener composition. However, various biotic and abiotic processes can shift the congener composition, and analytical methods have been refined so that both homolog and up to 209 individual congeners can be detected using EPA Method 1668. These analyses are costly and interpretation of congener data relative to established toxicity data, which are based on Aroclor measurements, contributes to the uncertainty in risk evaluations for PCBs. For instance, the ORNL estimated wildlife PRGs for PCBs in soils based on test species exposed to individual congeners (ORNL, 1997a). The most reasonable comparison to evaluate PCB risks based on the this toxicity data would be to compare site data for PCBs collected under the same analytical methodology (i.e., Aroclor measurements). Given the high cost of analytical tests for congener data, coupled with the uncertainties of extrapolating measured congener concentrations to toxicity data based on Aroclor analyses, PCB data were not collected using the analytical method for congeners in this study; rather, total PCB risks are estimated based on Aroclor data. No PCBs were detected in shellfish tissue (Table 2-18). NOAA reference tissue data for PCBs are based on Aroclor data, and the detection limits for site tissue data were lower than the reference levels. Thus, given the representativeness of the Aroclor data relative to toxicity data, PCB risks were not considered underestimated.

- Most EPA Method 8082 analyses for Aroclors ultimately involve a comparison of the chromatographic pattern of a sample with one or several prominent peaks of a commercial product. This approach typically gives a reasonable value for total PCB concentrations in abiotic media, provided that the PCB pattern in the sample is similar to that found in the commercial PCB standard (Schwartz et al., 1987). Because invertebrates are low on the food chain, the potential for alteration of the standard chromatographic pattern of Aroclors via metabolism is reduced (Field, 1998). However, because interpreting the complexity of chromatograms from biological samples introduces uncertainty, Aroclor measurements in tissues collected from this site should be regarded as only approximate concentrations.

- No PCB congener data were collected. Therefore, any impacts from the dioxin-like PCBs were not evaluated in this risk assessment. Dioxin-like PCBs are usually evaluated using the concept of toxicity equivalency relative to 2,3,7,8- tetrachlorodibenzo-p-dioxin (TCDD) toxicity (Van den Berg et al., 1998). While the existing PCB data at Salt Chuck Mine did not allow for this comparison, because the vast majority of the toxicity equivalency factors (TEFs) presented within Van den Berg et al. (1998) are based on enzyme induction studies, the theory behind the TCDD toxic equivalency concept, that the level of aryl hydrocarbon hydrolase (Ah) enzyme induction relative to that of TCDD can represent the toxic effects of the coplanar PCBs, has come into question. When combinations of PCB congeners or PCBs and TCDD were tested, non-additivity was observed in the context of enzyme activity, as well as for the expression of adverse effects (e.g., Bannister et al., 1987; Angelique et al., 1996; Bager et al., 1995; Zhao et al., 1997). This suggests that the toxicity, or even enzymatic activity, of a PCB mixture cannot be effectively estimated using an additive equivalency method such as that described by Van den Berg et al. (1998). Non-additivity in this context suggests that using a summation approach would tend to

be an overestimate of risks. Given these uncertainties, the lack of congener data at Salt Chuck Mine for dioxin-like PCBs was not considered a significant data gap.

- Quantative surveys of benthic community assemblages were not performed as part of this investigation. However, field observations indicate that softshell clams were present in the intertidal tailings and butter clams were absent. This may be due to the fact that softshell clams prefer areas of low salinity, and several freshwater streams are located near the intertidal tailings. Butter clams prefer quiet bays and estuaries with muddy sand or muddy/sandy gravel. Substrate composition appears to be an important limiting factor for littleneck and butter clams (Tillamook Bay National Estuary Project [TBNEP], 1998). Salinities as low as 5 to 15 parts per thousand (ppt) are known to reduce growth in this species, and butter clams generally do not move around after the larvae have metamorphosed. This reduces the ability of the species to move out of suboptimal conditions and make them more vulnerable to environmental stressors, including the influx of freshwater and contaminants (Dethier, 2006). Although it is possible the copper concentrations in the tailings may be a limiting factor in the presence of butter clams, other environmental factors (e.g, influx of freshwater) cannot be ruled out as the reason for the absence of this species.

2.5.4 Ecological Risk Summary and Conclusions

The SRE involved the identification of chemicals with maximum concentrations above ecological risk-based levels and background. The primary chemical of concern in all media was copper due to ecological impacts and impacts to the beneficial use of shellfish harvesting (i.e., concentrations of copper in tailings could potentially be affecting shellfish abundance and diversity). Other chemicals of concern included DRO, PCBs, benzo(a)pyrene, and various inorganics (i.e,., lead, mercury, selenium, and zinc). In general, source removal of the intertidal tailings is recommended to address the impacts observed in intertidal water and shellfish. In conclusion, the results of site investigations and SRE conducted for Salt Chuck Mine indicate that the tidally inundated site media contain concentrations that could be causing impacts to the environment. Further action to soils at Building C4, unsaturated tailings, stream tailings, intertidal tailings piles (Zones A through C, and a portion of Zone D tailings), tailings piles D14 and D15 adjacent to the unnamed stream, the tailings spit, and intertidal saltwater is recommended to address these impacts. RAOs that would address these compounds and media are presented in the following section.

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

Risk-based Removal Action Objectives (RAOs) represent residual levels of chemicals in soil/tailings, sediment, or surface water at the site which are health- protective for the specific exposure pathways and human or ecological receptors evaluated in the SRE. RAOs were developed to identify whether an interim action is warranted. Typically an interim action is implemented when it is necessary to prevent, minimize, or mitigate damage to public health or the environment.

3.1 REMOVAL ACTION OBJECTIVES

The SRE (Section 2.5) identified the media and the exposure pathways that should be addressed by the removal actions. For the purposes of this EE/CA, the SRE integrated both the assessment of risk typically provided in risks assessments, and information to support reasonable risk-management decisions. Thus, while typical SREs use the most conservative screening criteria for risk purposes, remedial actions required to further reduce or eliminate contamination to this level can cause substantive ecological losses. As such, less stringent screening criteria were sometimes utilized. Rationale for the use of these criteria is provided on a case-by-case basis in Section 2.5.

The RAOs for the Salt Chuck Mine site are as follows:

- Prevent unacceptable risks to recreational users and future miners being exposed to chemicals in surface soils and tailings via dermal contact, inhalation, or incidental ingestion.
- Prevent unacceptable impacts to groundwater and surface water from petroleum hydrocarbons in surface soil and sludge.
- Reduce risks to human recreational users consuming shellfish from the intertidal zone, including subsistence users.
- Prevent unacceptable impacts to aquatic organisms, including shellfish, by targeting source removal to achieve a target water quality goal.
- Prevent unacceptable impacts to the beneficial use of shellfish harvesting from copper found in intertidal tailings by targeting source removal to achieve a critical body residue in invertebrate tissue.

To address the above RAOs, quantitative target removal goals were established as listed in Table 3-1, and discussed in the context of ARARs in the following section.

3.2 IDENTIFICATION OF POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section describes potential applicable or relevant and appropriate requirements (ARARs) identified for the removal action alternatives, which are identified in accordance with NCP and EPA guidance. Removal actions must achieve potential ARARs to the extent practicable, considering site-specific conditions, including the urgency of the situation, the scope of the removal action, and the impact of potential ARARs on cost and duration of the removal action (40 CFR 300.415(9)(j)).

No federal, state, or local permits are required for remedial actions conducted wholly onsite (CERCLA 121(e), 42 U.S.C. 9621(e) and 40 CFR 300.400(e)(1)). Onsite remedial actions meet only substantive requirements, not administrative requirements, of potential ARARs. Administrative requirements, such as permits, reports, and records, along with substantive requirements, apply only to hazardous materials sent offsite for further management. The substantive requirements identified as potential ARARs for the Salt

Chuck Mine site removal action were based on a review of federal environmental laws and more stringent state environmental and facility siting laws. Several terms used throughout this section are identified below:

Applicable Requirements. Under the NCP, applicable requirements are defined as, "those cleanup standards, standards of control and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site" [40 CFR 300.5].

Relevant and Appropriate Requirements. Relevant and appropriate requirements are, "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" [40 CFR 300.5].

To-Be-Considereds (TBCs). TBCs are non-promulgated advisories or guidance issued by federal or state government that are not legally binding and do not have the status of potential ARARs.

State Standards. State standards are ARARs if they are "promulgated, are identified by the state in a timely manner, and are more stringent than federal requirements." The term "promulgated" means that the standards are of general applicability and are legally enforceable [40 CFR 300.400(g)(4)].

Potential ARARs include chemical-, location-, and action-specific ARARs.

- Chemical-specific ARARs are human health or ecological risk-based numerical values or methodologies, which when applied to site-specific conditions, are used to determine acceptable concentrations of chemicals that may be found in or discharged to the environment.
- Location-specific ARARs restrict certain types of activities such as those located in wetlands, floodplains, and historic sites.
- Action-specific ARARs are technology- or activity-based restrictions that are triggered by the type of remedial action under consideration.

The selected removal action must comply with ARARs identified for the site as a threshold consideration. The three types of ARARs are discussed below. A summary of potential ARARs for the Salt Chuck Mine site is provided in Table 3-2. This is a preliminary list of ARARs that may apply to the site or potential removal actions. The final list of ARARs will be developed though negotiations with state and federal agencies and included in an Action Memorandum.

ARARs may be waived under certain circumstances. The waiver criteria include the following:

- The remedial action is being conducted as an interim measure;
- Compliance with the ARAR would result in greater risk to health and the environment;
- Compliance with the ARAR is technically impractical;
- Equivalent standard of performance; and
- Inconsistent application of state requirements.

No ARAR waivers are specifically identified or requested in the EE/CA at this time. The following sections provide summaries of potential chemical-specific, location-specific, and action-specific ARARs identified for the four alternatives evaluated in this EE/CA.

3.2.1 Chemical-Specific ARARs

Potential chemical-specific ARARs are health-based or risk-based numerical values for constituents of concern that are considered acceptable for material remaining onsite. ADEC regulations for potential impacts to groundwater from waste materials, and soil lead standards for commercial/industrial land uses are examples of potential chemical-specific ARARs for the site metals concentrations. A summary of the types of chemical-specific ARARs potentially applicable to the Salt Chuck Mine site are presented in Table 3-2. Specific chemical levels proposed for use as RAOs in the removal action are listed in Table 3-1. The areal extent of concentrations in site media that exceed these values is presented on Figures 2-8 through 2-10 and Figure 2-14.

Wastes generated from the extraction of minerals are excluded from Resource Conservation and Recovery Act (RCRA) Subtitle C hazardous waste requirements under the Bevill Amendment and EPA's subsequent regulatory determination. Under 40 CFR 261.4(b)(7), the following wastes are excluded from regulation as a hazardous waste:

- Solid waste from the extraction, beneficiation, and processing of ores and minerals (including coal, phosphate rock, and overburden from the mining of uranium ore).
- Beneficiation of ores and minerals is restricted to the following activities: crushing; grinding; washing; dissolution; crystallization; filtration; sorting; sizing; drying; sintering; palletizing; briquetting; calcining to remove water and/or carbon dioxide; roasting, autoclaving, and/or chlorination in preparation for leaching (except where the roasting (and/or autoclaving and/or chlorination)/leaching sequence produces a final or intermediate product that does not undergo further beneficiation or processing); gravity concentration; magnetic and/or electrostatic separation; flotation; ion exchange; solvent extraction; electrowinning; precipitation; amalgamation; and heap, dump, vat, tank, and *in situ* leaching.

Based upon available information, mine tailings from the Salt Chuck Mine meet the RCRA exemption and would not be regulated as a hazardous waste.

Although not a hazardous waste, mine tailings are generally considered a solid waste and are therefore regulated by Alaska Solid Waste Regulations. Unless it is determined to have the potential to generate acid-rock drainage (ARD), waste rock is exempt from the requirements of 18 AAC 60. Surface waters draining from waste rock at the Salt Chuck site have not been identified as acidic. Based on the available information, waste rock at the site meets this exemption and would not be regulated as a solid waste.

3.2.2 Location-Specific ARARs

Potential location-specific ARARs are requirements that affect the affect the management of hazardous constituents due to the location of the management unit. Potential location-specific ARARs can be triggered for example, if the removal action involved would cause discharge to sensitive locations such as wetlands, floodplains, historic areas, or wildlife refuges. These requirements may limit the type of potential remedial action that can be implemented, or may impose additional constraints on remedial alternatives.

As indicated in Section 2.1.1, mining features and artifacts present throughout the site are eligible for National Register listing under the National Historic Preservation Act of 1966. Hand excavation work proposed under Alternatives 3 and 4 (Section 4.3.1) would maintain the structural integrity of the remaining mill features in compliance with the Historic Preservation Act.

For construction of an onsite repository to contain contaminated materials, a Jurisdictional determination would need to be made for the proposed repository location in accordance with the U.S. Army Corps of Engineers Wetland Delineation Manual to ensure that the repository would not be placed within a designated wetland area. No additional permitting requirements would be made for excavation of the intertidal tailings, although the action would be required to adhere to specifications of Section 404 of the Clean Water Act, and Section 10 of the Rivers and Harbors Act.

Since the removal action would occur on both State and Federal land, an interagency review process would be required, as coordinated by the Alaska Division of Governmental Coordination (DGC).

Potential location-specific ARARs are identified and discussed in Table 3-2. These potential location-specific ARARs will continue to be evaluated and refined as the selected removal action is developed and finalized.

3.2.3 Action-Specific ARARs

Potential action-specific ARARs are usually technology- or activity-based requirements or restrictions on actions taken with respect to hazardous substance(s). These potential requirements are triggered by the particular remedial alternative, and set performance, design, or other standards that will be used to implement the proposed remedial action. Potential action-specific ARARs do not affect the selection of the removal action, but instead may pose restrictions on the methods by which a selected alternative may be achieved. Examples of action-specific ARARs include stockpiling of treated or untreated tailings from the site, and discharge of pollutants into surface waters (subject to the Clean Water Act).

Potential action-specific ARARs are presented and discussed in Table 3-2. These ARARs will continue to be evaluated and refined as the selected removal action is developed and finalized.

3.2.4 Other Guidance To Be Considered

TBCs are guidance only and are not legally enforceable. TBCs include non-promulgated criteria, advisories, guidance, and proposed standards issued by Federal, state, or local governments. TBCs may be useful in evaluating numerical constituent-specific cleanup goals regarding metals in the tailings. Examples of TBCs applied to the Salt Chuck site include ecological risk-based sediment concentrations, and the use of site-specific background levels. The chemical-specific remedial goals listed in Table 3-1 include the use of TBCs in a number of instances, particularly those developed for the protection of ecological receptors.

3.3 SCOPE OF THE REMOVAL ACTION

The overall approach for identifying the scope of the removal action was to select physical boundaries that would minimize the possibility of leaving sufficient residual risk as to require further remedial action beyond implementation of the removal action. The boundaries of the removal action are approximated by the cross-hatched areas depicted on Figures 2-8 through 2-10. Actual boundaries in the intertidal tailings zones were also influenced by the anticipated location of additional fine-grained materials in tailings/sediment depositional areas where existing sampled density is low. Thus, for the purpose of volume calculations, boundaries for both the north and south removal areas were extended slightly to encompass additional anticipated fine-grained materials in these locations. Since the proposed intertidal boundaries based on copper data included PCB sample points areas as well, the use of PCB cleanup levels to select the boundaries was not considered necessary.

The removal action encompasses four upland areas, including approximately 3,450 cubic yards (CY) in the mill area, approximately 975 CY at Building C4, approximately 1,023 CY in the drum cache area, and approximately 1,400 CY at tailings piles D14 and D15. Within the intertidal area and mouth of the unnamed stream, approximately 1,890 CY of material comprise the tailings spit, and roughly 58,000 CY of material comprise the remaining saturated areas (Tailings Zones A through D and stream tailings).

4.0 REMOVAL ACTION TECHNOLOGY SCREENING AND ALTERNATIVE DEVELOPMENT

This section documents the process of identifying and screening removal technologies that are potentially applicable to the Salt Chuck Mine site. Potentially applicable technologies are identified based on available site characterization data and known physical site conditions. Technologies identified are then either retained for further consideration or screened out, based on an evaluation of their ability to effectively address site concerns. The technologies that are retained for further consideration in the EE/CA are then assembled into removal action alternatives to address the site-specific RAOs established in Section 3.0.

The following subsections present the results of the technology identification and screening, and descriptions of the removal action alternatives developed. The removal alternatives are evaluated in greater detail in Section 5.0.

4.1 TECHNOLOGY IDENTIFICATION AND SCREENING

In accordance with EE/CA guidance, technologies and associated process options having the highest potential for success at the Salt Chuck Mine site were identified for preliminary screening evaluation. Technologies and process options identified as potentially applicable at the site are summarized in Table 4-1. A brief description and screening determination for each process option is also given. The screening determination identifies whether the given process option will be retained for further consideration in assembling candidate removal action alternatives. A discussion of the rationale used to retain or eliminate technologies and process options is provided in this section.

No Action. Evaluation of the no action scenario is required by the National Contingency Plan (NCP), 40 CFR § 300.430(e)(6). The no action scenario represents a baseline condition against which other removal actions are compared.

Site Fencing. Physical access restrictions prevent access for recreational users, future miners, or other site visitors to impacted areas of the site using fencing, signage, and routine security inspections. Physical access restrictions are retained for further consideration because they are a reliable method of controlling direct human contact with physical and chemical site hazards.

Deed Restrictions. Deed restrictions may include modifying conditions of the current property and mine claim deeds to limit certain types of land uses to supplement the protectiveness of other actions taken as part of an overall site remedy. Such restrictions typically continue into the future or "run with the land." Deed restrictions remain in effect with property transfers to new owners. Future building restrictions in certain portions of the site, such as for an information kiosk, may be an appropriate type of deed restriction when combined with other site control measures. Deed restrictions would be subject to approval between the Forest Service and mine claim owners.

Proprietary land use or deed restriction agreements may be required between the Forest Service, ADEC, and/or EPA related to title considerations for land used in a removal action. Agreements would specify restrictions on future earthwork or construction of dwellings on or near the site. These restrictions would be enforced by the Forest Service, and would remain in force unless removed by a court order. Legal access restrictions are retained for further consideration because they are potentially applicable if impacted materials remain onsite as part of the removal action.

Grading. Grading is used to alter the ground surface contour of an area such that surface water runoff is directed along desired routes. Site plans are developed to establish an overall grading design to optimize surface water conveyance around and away from impacted areas of the site, or in strategic locations across the site. Grading is considered potentially applicable to restore excavated areas and to limit

infiltration rates into areas where tailings and impacted soil remain onsite, and is retained for further consideration.

Diversion. Diversion may include construction or modification of features such as ditches, channels, and berms used to direct or divert surface water flow downslope, away from tailings or impacted soils. Diversion is considered applicable to reduce erosion to areas where tailings and impacted soil remain onsite, and is retained for further consideration.

Surface Water Collection. Surface water storage in a surface impoundment or reservoir in a desired location is used to equalize surface water runoff from a site. This technique is implemented in conjunction with diversion structures (e.g., ditches or channels). The surface water collection process option is eliminated from further consideration since surface water runoff from the site can be adequately conveyed without equalization.

Revegetation. Replacing vegetation following disturbance of the ground surface will mitigate soil erosion and surface water infiltration and runoff. Roots from cover plants hold the soil in place, preventing wind and water erosion. Revegetation can also reduce infiltration of water into surface materials through interception of water by plant root systems and transpiration mechanisms.

Revegetation is typically performed in conjunction with placement of clean fill and soil covers. For this site, revegetation includes topsoil replacement and planting native ground cover. Establishing vegetation can also be effective in enhancing the stability and permanence of cover systems. Revegetation is retained for further consideration.

Monitored Natural Attenuation. Natural attenuation processes are commonly used for remediation of contaminated sites. A variety of natural processes occur without human intervention at all sites at varying rates and degrees of effectiveness to attenuate (i.e., decrease) the mass, toxicity, mobility, volume, or concentrations of organic and inorganic contaminants in soil, groundwater, and surface water systems. The EPA uses the term "monitored natural attenuation" (MNA) when referring to the reliance on natural attenuation processes, within the context of a carefully controlled and monitored site cleanup approach, to achieve site-specific remedial objectives within a time frame that is reasonable compared to other more active methods. MNA requires more complex and costly site characterization prior to implementation, long-term monitoring, and potential of continued migration, and/or cross-media transfer of contaminants. Metals do not degrade over time and natural attenuation of the intertidal tailings has not occurred to date and it is not expected that it will occur in the future. As such, MNA has not been retained for further consideration.

HDPE Liner and Cover. High-density polyethylene (HDPE) is used as a liner material and a cover for stockpiled tailings and impacted materials. Placement of HDPE liner and cover would prevent direct exposure of the materials to the environment or receptors, and significantly reduce the potential for leaching of the constituents of concern. HDPE liners and covers are retained for further consideration.

Soil and Waste Rock Cover. Onsite waste rock can be used to prevent direct contact with tailings and impacted materials to human and ecological receptors, reduce erosion, and provide a media for revegetation. Soil materials at the site are limited in quantity, and any soil to be used as cover material would have to be imported from an offsite borrow source. Soil and waste rock covers are retained for further consideration.

Clay Cover. A clay cover consists of low permeability clay layers approximately 6 to 12 inches thick. Clay covers are commonly specified instead of soil covers to further minimize surface water infiltration. Clay covers are typically used in landfill cover designs where strict control of leaching constituents of concern into the subsurface environment is desired. Due to the lack of local material sources and remoteness of the site, and since adequate infiltration control could be achieved by other means, clay covers are not retained for further consideration.

Clean Fill. Clean fill material is used to perform grading activities and to place in excavated areas. A source for fill materials such as borrow material (soil) would have to be identified and transported to the site from an offsite borrow source; waste rock, however, is available onsite and can be crushed as needed. Thus, this option is retained for further consideration.

Excavation. Excavation techniques employ the physical removal of impacted materials to eliminate future receptor exposure. Excavation technologies typically involve conventional earthmoving construction equipment. Equipment such as backhoes and dozers would be satisfactory for excavating and moving tailings. Tailings and impacted soil beneath the mill site itself would be excavated by hand to preserve the structural integrity of the remaining historic mill features. Excavation techniques used at the site may require dust control measures in disturbed areas to prevent particulate inhalation. Dust control typically involves using water sprays to suppress particulate suspension.

Excavation would be required under scenarios which involve removal of tailings from the intertidal zone. Excavated materials may require appropriate segregation based on cleanup levels as indicated by the SRE, and to remove miscellaneous debris such as timber and logs in various portions of the tailings. Excavation is retained for further consideration.

Transportation. Transportation technologies typically involve the use of conventional materials handling equipment, such as excavators, to transport excavated materials either onsite or offsite. As with excavation activities, transportation activities would include dust control measures to prevent particulate suspension around the site when equipment is in use. Transportation is retained since it is necessary to move excavated materials for most removal options.

Consolidation, Onsite Stockpile. An onsite repository would be constructed to consolidate the materials in one location for long-term care. Repositories are typically capped with an engineered low-permeability cover system, and may also be revegetated. Consolidation in an onsite repository allows for maintaining tailings and impacted materials in a controlled environment, and with an appropriate cover can minimize or eliminate exposure pathways to potential human and ecological receptors. Consolidation in an onsite repository is retained for further consideration.

Capping In-Place. Capping in-place involves the use of covers described above on top of contaminated materials, without transporting and consolidating materials in a controlled stockpile first. Capping in-place typically works best under the following conditions:

- Contaminant sources have been sufficiently abated to prevent recontamination of the cap;
- Contaminants are of moderate to low toxicity and mobility;
- Costs and/or environmental effects are very high; and
- Site conditions do not necessitate removal of contaminated sediment.

The dynamic intertidal environment and site RAOs in the case necessitate removal of the intertidal tailings.

Conceptually an onshore cap would consist of a geotextile layer over the impacted areas followed by a sand isolation layer, a gravel erosion control layer, and then an organic soil habitat layer to support vegetation. At the Salt Chuck site, this technology would include the following elements: placement of soil caps over the upland removal areas consisting of: Building C4 (approximately 650 square feet [SF]), mill area tailings (approximately 30,150 SF), and D14 and D15 piles (approximately 12,040 SF); periodic monitoring and inspection of the cap(s); and periodic maintenance as needed. Capping in-place would not include placement of an underlying impermeable liner, and as such, would not be completely effective in meeting RAOs involving migration-to-groundwater/surface water pathways. After cap construction is completed, deed restrictions would be implemented to prevent future excavation at the site, and signs stating that excavation is prohibited will be erected at the site. The capped areas as well as the mill area could be fenced for to limit access.

Sediment capping in saturated environments is a well-developed and documented cleanup alternative that can isolate contaminants from the overlying water column. Capping of intertidal tailings, however, poses technical challenges such as the ability to lay down the first lift of capping material immediately after excavation and prior to inundation by each tide, as well as placement of the geotextile liner prior to the next tide, and preventing cross-contamination of areas excavated from those that are not. In addition, because impermeable isolation would be difficult to achieve in this dynamic intertidal environment, the intertidal tailings would respect a potential continuing source of contaminants to intertidal waters, aquatic organisms, fishermen, and shellfish customers.

Capping in-place of onshore materials would meet the RAO of preventing unacceptable risks in recreational users and future miners in the upland areas (surface soils and unsaturated tailings) by eliminating the exposure pathways of dermal contact, inhalation, or incidental ingestion by isolating the material with a cap, but would not be completely effective in eliminating migration-to-groundwater/surface water pathways. Exposure pathways to materials in the intertidal zone would remain potentially complete to aquatic organisms and recreational fishers. Thus, this alternative is not retained for further consideration.

Permitted Offsite Disposal. Offsite disposal involves transporting and placing material in an engineered containment facility located outside of the site boundaries. Advantages of using existing offsite disposal facilities include removing tailings and impacted materials from the site for permanent disposal for long-term protection of human health and the environment. Offsite disposal is retained for further consideration.

Stabilization. Stabilization techniques commonly use Portland cement as the primary stabilization agent, and can be conducted as either an in-situ or ex-situ process. For ex-situ stabilization, the work would involve excavation, crushing or processing of impacted materials, and adding a stabilization agent, such as Portland cement and potentially other pozzolanic materials, to reduce or eliminate the mobility of metal constituents through chemical and physical binding into a stable mass. This option may be combined with a cover option to further reduce potential exposure pathways.

Cement-based stabilization involves mixing the materials with an appropriate ratio of cement, pozzolan, and water. The composition of the mixture determines set time, cure time, and material properties for placing the treated waste. Binder addition would increase waste volumes to be handled and disposed, typically ranging from 10 to 30 percent depending on the chemical nature of the waste materials. The ratio of cement and need for pozzolans to effectively treat waste materials is determined through pre-design laboratory treatability testing.

Most metals are amenable to cement-based stabilization, which tend to form insoluble hydroxides in the basic pH ranges commonly found in cement. The required proportions for the tailings at the Salt Chuck Mine site would be based on treatability testing results. Although this technology is viable, it is not retained for further consideration because leaching tests do not indicate that the waste is particularly susceptible to leaching, repository design includes a liner, stabilization would increase the volume of materials requiring disposal, and stabilized materials are subject to weathering, so a soil cover would still be required.

Metals Recovery. Metals recovery from mine waste materials may be achieved using various reprocessing techniques including pyrometallurgical and hydrometallurgical processes. Pyrometallurgical processes expose materials to elevated temperatures under controlled conditions to recover pure metals or metal oxides. Hydrometallurgical processes involve the dissolution of target metal species in the solid materials into a solution using pH control, followed by their precipitation as elemental or other commercially acceptable chemical forms. Both pyrometallurgical and hydrometallurgical processes are commercially available, and well understood. However, metals recovery from site waste materials is not retained for further consideration because metals concentrations in the tailings are below concentrations necessary for cost-effective use of the technology.

Soil Washing. Soil washing is an ex-situ soil remediation technique combining aqueous extraction and constituent separation to reduce residual metal concentrations in treated materials to specified levels. The process uses mechanical and/or chemical scrubbing to remove metals by dissolving or suspending them in a wash solution, or by concentrating them into a smaller volume of soil through particle size separation

techniques. Soil washing uses various additives such as surfactants, acids, or chelating agents to increase separation efficiencies. Washed soil can be returned to the site or further reclaimed if proven to pass specified chemical concentrations. The recovered aqueous phase and the resulting sludge fraction may contain high concentrations of constituents, requiring additional separation or concentration, recovery, or disposal. Soil treatment verification sampling should be conducted for all contaminants the treatment system was designed to remove. Based on one analytical sample per 100 CY treated soil, approximately 670 analytical samples would need to be collected for this site.

Economies of scale would make soil washing cost effective for a large volume of materials, as in this case. A soil analysis including soil type and organic content would have to be conducted for materials to be treated through soil washing to assess whether these materials would be amenable to the soil washing process. Materials with less than 50-70% sands, or high percentages of silt or clay, would make soil washing ineffective. Preliminary classification of the tailings indicates that they are very fine sand (similar to silt) which may not be amenable to the soil washing technology. A treatability study would have to be completed prior to application of this technology as a remedial solution. A water source would have to be identified or water would have to be transported to the site. To set up a soil washing unit would require approximately 0.5 acres for a 20 ton/hour unit. Any oversized contaminated material that could not be processed through the unit would still have to be treated or disposed of in another manner. The separated contaminants, sludge, and wastewater would have to be treated and/or disposed of. Because of the difficult logistics of transporting in a unit and washwater, and disposal of spent washwater and sludge, as well as the need for a treatability study and large number of verification samples, this technology has not been retained for further consideration.

4.2 REMOVAL ALTERNATIVE DEVELOPMENT

Based on the analysis of the nature and extent of contamination presented in Section 2.0 and on the RAOs developed in Section 3.0, this section identifies and assesses a limited number of alternatives that are either appropriate for meeting RAOs, or are provided for comparative analysis purposes as required by the NCP. The alternatives identified and analyzed in the following subsections are considered well established remedies because they have been selected in the past at similar sites and/or for similar contaminants. Remedial options and technologies were screened and assembled into the following four removal action alternatives identified and evaluated in this section:

- Alternative 1 – No Action
- Alternative 2 – Institutional Controls
- Alternative 3 – Excavation, Consolidation in Onsite Repository, and Capping
- Alternative 4 – Excavation and Offsite Disposal

Physical hazards present at the site, such as those associated with the underground mine workings and glory holes, do not constitute a release of hazardous substances at the site and are outside the scope of this EE/CA report.

The four removal alternatives retained for consideration are summarized in Table 4-1 and are described in the following Sections.

4.2.1 Common Elements to All Alternatives

Chemical hazards at the Salt Chuck Mine site include exposure of metals and organics present in soil and tailings to human and ecological receptors. The concentrations of these constituents detected in onsite media were used to complete the SRE and to develop site-specific RAOs (Sections 2.5 and 3.0, respectively).

Legal and/or physical access restrictions are a common element to each alternative proposed except the no action alternative. All equipment and materials required to implement the selected removal action would be mobilized to the site, including provisions for power and fuel to operate equipment, and temporary living facilities for work crews. Equipment and unused materials would be demobilized from the site after completing the removal action.

An historical and archaeological survey of the site was performed by Bruder (2002). The actions included under Alternatives 2, 3, and 4 would disturb the lower mill site, judged eligible for placement on the National Register. Actions conducted at the site, specifically for tailings present beneath the former mill structure, would need to comply with Section 106 of the National Historic Preservation Act. The USFS and the contractor selected for implementing the removal action would coordinate with the State Historic Preservation Office (SHPO) to mitigate potential damage to historical features of the millsite, as appropriate. Hand excavation work would be used to remove materials beneath the mill ruins to maintain the integrity of existing features.

Following implementation of the Alternatives 2, 3, or 4, sampling and analysis would be conducted the following year, and on an annual basis. If annual monitoring indicates no continued impacts, sampling frequency can be reduced, and a 5-year review would be conducted to evaluate effectiveness and the need for implementation of a contingency plan in the event that impacted areas require further action.

4.2.2 Alternative 1 – No Action

Evaluation of the no action scenario is required by the National Contingency Plan (NCP), 40 CFR § 300.430(e)(6). This alternative is retained throughout the process and represents a baseline condition against which other removal actions are compared. The No Action Alternative consists of allowing the site to remain in its present condition, with no measures taken to reduce or monitor contaminant concentrations; therefore contaminant levels would not be reduced and no short-term risk reduction would be achieved. Long-term risk reduction would occur only through natural attenuation mechanisms, but the extent of natural attenuation would be unknown since no monitoring would occur. This alternative would not meet the RAOs identified for the removal action.

4.2.3 Alternative 2 – Institutional Controls

Under this alternative, institutional controls would be implemented at the site to minimize contact of larger receptors with the identified chemical hazards. Deed restrictions would be used to control future mining activities immediately surrounding the existing mine features. Mining claims administered under the Mining Act of 1872 that predate the deed restrictions would be negotiated between the claimants and the USFS to control or eliminate further mining on the site. No further claims would be allowed on the site and surrounding land.

Environmental monitoring would be performed the year following implementation to evaluate effectiveness of the remedial measure. Approximately 30 samples consisting of intertidal tailings/sediment samples, surface water samples, and tissue samples would be collected from those areas where sampling previously indicated exceedances of COCs to evaluate potential future impacts to sensitive aquatic receptors due to the continued presence of the tailings in the intertidal zone. If adverse impacts were identified, additional measures may be taken to mitigate potential impacts from the tailings. If annual monitoring indicates no continued impacts, sampling frequency can be reduced and a 5- year review implemented.

Approximately 2,000 lineal feet of chain link fence, fitted with top strands of barbed wire, would be erected to surround the upland tailings/soils areas, as well as the mill building, to prevent direct access to future visitors to reduce human exposure to and disturbances of contaminated soil and tailings. Fencing would not be erected in the intertidal zone due to challenges of maintaining the fencing in an area subject to tidal action. Miscellaneous debris including abandoned equipment observed at various locations around the site would not be moved. A locked security gate would be provided in the fence(s) for future access to the impacted areas, as may be required for environmental monitoring. Appropriate signage would be posted along the fence and on the mill building indicating, "Danger, No Trespassing", as well as warning of the presence of COCs in soils contained by the fence and beneath the mill buildings. Routine inspections regarding the condition of the security fence would be made during environmental monitoring activities, and maintenance would be performed as necessary.

4.2.4 Alternative 3 – Excavation, Consolidation in Onsite Repository, and Capping

Alternative 3 involves excavating site soils in the vicinity of Building C4, tailings in the intertidal zone (Zones A through D), the unsaturated tailings (mill area, D14 and D15 and the unnamed stream), and the tailings spit, and consolidating the material in a suitable area (onsite repository) to be determined. This alternative also includes excavation of DRO-contaminated soils in the drum cache area, packaging them in supersacks, and shipping them offsite for disposal in order to keep the soils with highest levels of organics separate from the dominantly metals-contained media. The extent of site materials to be removed during this alternative is shown on Figures 2-8 through 2-10. A liner and cap would be designed to accomplish the following objectives:

- Prevent exposure by dermal contact, inhalation, or incidental ingestion of tailings and impacted soils;

- Prevent access from burrowing animals;
- Provide stability against slope failure and resist erosion; and
- Limit infiltration and migration of water through the materials.

The institutional controls would include deed restrictions, signage, and perimeter fencing at the mill site. Physical access restrictions such as a boulder barrier around the impoundment or fencing around the footprint of the repository to prevent activities that could compromise the soil cover, such as damage from ATVs or backhoes, would also be implemented.

A total of 66,000 CY (excluding drum cache area) of tailings, sediment, and impacted soil are estimated to require removal based on field measurements and visual observations during characterization investigations. Assuming a bulk density of 1.4 tons/CY, approximately 92,000 tons of material would require removal.

The removal action would begin by identifying a suitable repository site. An area located between the mill site and the western side of Salt Chuck Bay in the vicinity of the abandoned railroad is being considered for a repository site (Figure 4-1). This area is relatively level although heavily wooded with dense underbrush of vegetation, and can be developed to be set back from the waters edge to prevent future flood/tidal inundation. To accommodate the wastes, the repository would require a footprint of approximately 3 acres with a 3:1 slope, and stockpiling of the materials to a thickness of up to 20 feet. The area would be cleared of trees, brush, and other miscellaneous debris, and prepared for material placement by establishing a level ground surface. Prior to detailed design of the repository, the area would require further investigation for suitability, including depth to groundwater and subsurface soils.

An HDPE liner would be installed over the ground surface prior to placement of impacted materials. Conceptually, the cap covering the placed materials would consist of a geotextile layer over the impacted areas followed by a sand isolation layer, a gravel erosion control layer, and an organic soil habitat layer to support vegetation. The gravel layer could be constructed using onsite waste rock. The soil needed to construct the cover would be transported from an offsite borrow source. The cover would be keyed into a perimeter toe drain system to carry surface water away from the stockpile.

A considerable amount of heavy equipment/machinery would be necessary to efficiently implement this alternative. To construct the repository, excavate and transfer impacted materials, as well as construct runon-runoff control structures as necessary, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders, and excavators. The field procedure may involve construction of a temporary roadway or bridge across Lake Ellen Creek to provide access to the repository site. Silt fencing may need to be installed across the Lake Ellen Creek or other areas of Salt Chuck Bay during excavation work in the intertidal area.

Removal of the tailings in the intertidal zone would require the construction of a rock platform to the intertidal zone and excavation of the tailings from the platform. Excavation of intertidal tailings would

occur during low tides using an excavator. It is not anticipated that the tailings would be dewatered prior to placement in the repository

The excavation work in all areas, with the exception of the immediate area of the mill, would be performed using conventional excavation and material handling equipment, and the tailings and impacted soil would be segregated from non-impacted debris, such as logs and miscellaneous timbers. Hand excavation work would be used for the materials around the mill building to maintain structural integrity of the remaining mill features. Material segregation would be accomplished using visual observations to direct the horizontal and vertical extent of the excavation work. Laboratory confirmation samples would be collected to ensure RAOs are met in the excavated areas.

The excavated areas would be regraded as necessary and shaped to ensure positive drainage. Native grass seed would be placed in regraded areas located above the high tide water line to initiate the revegetation process to the extent practicable.

Land use restrictions would be implemented at the repository to prevent activities that could compromise the soil cover. Prohibited activities would include: excavation, spreading, or disturbance of surface and subsurface soils and would be specified in deed restrictions at the Salt Chuck Mine site. Periodic monitoring and maintenance would be required indefinitely to verify that the cover remains intact and performs as intended.

Environmental monitoring would be performed the year following implementation to evaluate effectiveness of the remedial measure. Approximately 30 samples consisting of intertidal tailings/sediment samples, surface water samples, and tissue samples would be collected from those areas where sampling previously indicated exceedances of COCs to evaluate potential future impacts to sensitive aquatic receptors due to the continued presence of the tailings in the intertidal zone. If adverse impacts were identified, additional measures may be taken to mitigate potential impacts from the tailings. If annual monitoring indicates, no continued impacts, sampling frequency can be reduced and a 5-year review implemented.

4.2.5 Alternative 4 – Excavation and Offsite Disposal

Alternative 4 involves excavating the tailings and impacted soils and sediments and transporting them to a permitted offsite disposal facility. Because the affected materials would be excavated and removed from the site, institutional controls, such as fencing or deed restrictions would not be needed. Confirmatory sampling would be performed to verify complete removal of materials exceeding the RAOs, and long-term monitoring and maintenance would not be required.

A total of approximately 67,000 CY of tailings and impacted soil (including the drum cache area) are estimated to require removal based on field measurements and visual observations during site characterization investigations. A majority of the excavation work would be performed using a conventional excavator and front-end loader, and the tailings would be segregated from non-impacted debris such as logs and miscellaneous timbers. Hand excavation work would be used as required to

minimize impacts to features of historical significance, such as the former mill building structure and equipment. As required, available logs and timber would be placed to minimize disturbances to the sensitive intertidal area during transportation and placement of materials into the shipping containers.

Approximately 3,900 20-foot shipping containers would be required to transport this volume of material from the Salt Chuck Mine site to the disposal facility. The shipping containers would be lined with visqueen, filled with a maximum of 25-tons of tailings each, and covered. The containers would be designed to transport the excavated tailings without the need for secondary containment in drums or other smaller containment vessels.

Visual observations and confirmatory sampling would be used to direct the horizontal and vertical extent of the excavation. While transporting excavated materials to the disposal site, 73 composite samples would be collected for TCLP analysis. This includes 10 composite samples for the initial 2,000 CY, and then one composite sample for each additional 1,000 CY of material. Prior to shipment, a waste characterization profile would be conducted.

Both U.S. and Canadian manifests would be required to accompany the waste during transport through International and Canadian waters en route to Seattle. From Seattle, the material would then be transported by rail or truck to a suitable landfill. The landfill identified during this study for disposal of non-hazardous materials is the Columbia Ridge Landfill in Arlington, Oregon. TCLP and SPLP data for samples obtained from the removal action areas indicate that materials are not considered hazardous waste.

Laboratory confirmatory samples would be collected to ensure that RAOs are achieved in the excavated areas. The upland areas would then be regraded and shaped as necessary, if needed, to ensure positive drainage and minimize erosion. Native grass seed would be placed in regraded areas located above the high tide water line to initiate revegetation to the extent practicable.

5.0 ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Each of the four removal alternatives considered was evaluated using criteria established in the EE/CA guidance (USEPA, 1993b). This section provides a description of these criteria and an evaluation of each removal alternative. Potential ARARs for the site are described in Section 3.2.

5.1 EVALUATION CRITERIA

The four removal action alternatives were evaluated individually with respect to effectiveness, implementability, and cost. Effectiveness is assessed based on the components of: (1) overall protectiveness of human health and the environment; (2) short-term effectiveness; (3) long-term effectiveness; (4) reduction of toxicity, mobility, or volume; and (5) compliance with ARARs.

Implementability is assessed based on the components of: (1) technical feasibility, (2) availability of services and materials, and (3) administrative feasibility.

Costs comprise estimated capital costs, and operation and maintenance costs, including environmental monitoring costs.

5.2 ANALYSIS OF ALTERNATIVES

As specified in EE/CA guidance, the purpose of the detailed analysis is to evaluate each alternative for their effectiveness, implementability, and cost to achieve RAOs identified in Table 3-1. The four alternatives under consideration are: (1) no action, in which constituents of concern are not removed; (2) institutional controls where specific portions of the site are physically restricted from further access, and deed restrictions are incorporated to minimize future site development; (3) consolidation and stockpiling of tailings and impacted soils in a central onsite repository with a cap; and (4) excavation of tailings and impacted soils and transfer to an offsite disposal facility. The alternatives evaluated are applicable to the contaminated solid media; no removal alternatives for groundwater or surface water are analyzed in detail. The rationale for not directly developing alternatives for these environmental media is based primarily on the presumption that reclaiming the contaminant source(s) will subsequently reduce any problems associated with groundwater, or surface water at a significantly reduced cost.

Results of the alternatives evaluation of effectiveness and implementability using the criteria identified in Section 5.1 are summarized in Table 5-1. Capital costs and annual O&M costs are summarized in Appendix H. Alternative evaluation descriptions are provided in the following subsections.

5.2.1 Alternative 1 – No Action

Effectiveness. The No Action alternative was retained for comparison purposes, pursuant to the NCP. The short- and long-term effectiveness of this alternative is low. Taking no action to remove tailings and impacted soils and sediments would mean that the site remains in its present condition, with no reduction in contaminant concentrations. Alternative 1 would not be effective because it would not achieve RAOs and thus is not protective of human health or the environment. Alternative 1 does not comply with ARARs.

In the short-term, the No-Action Alternative would likely pose no additional threats to human health or the environment compared to current site conditions. Long-term risk reduction would only occur through natural attenuation mechanisms, and it is possible that continued natural attenuation could result in additional threats to downgradient media (e.g., sediment and tissue in southern Salt Chuck Bay. The extent of natural attenuation would be unknown under this alternative since no monitoring would occur. It is notable that current levels of COCs represent more than 65 years of natural attenuation since the mine closed in 1941. Since no baseline data from the 1940s are available, however, long-term rates of attenuation are unknown. Thus, the time required until reclamation objectives are reached by natural attenuation would be indefinite.

Implementability. This alternative is technically feasible to implement and would not be dependent on the availability of services and materials. The No Action Alternative is unacceptable, however, because it would not meet RAOs.

Cost. Neither monitoring nor operations and maintenance would be implemented under Alternative 1; therefore, there are no costs associated with this alternative.

Uncertainties and Assumptions. With the exception of unknown surrounding natural attenuation, there are no significant uncertainties or assumptions associated with the performance of this alternative.

5.2.2 Alternative 2 –Institutional Controls

Effectiveness. Taking no action to remove tailings and impacted soils would mean that the site remains in its present condition, with no reduction in contaminant concentrations. Limited protection of human health and large mammals would be provided as a result of fencing, because access would be prevented to the impacted upland areas. Access would not be prevented to the intertidal areas. No additional protection to human health or the environment would be provided because the constituent exposure pathways would remain in place and would therefore achieve no short-term risk reduction. Implementing specific institutional controls such as land use restrictions to prevent land development on or near the impacted areas and erecting fences would eliminate access by recreational users and future miners to these areas, and thus minimize direct exposure to untreated tailings and impacted soils in the D14 and D15 piles, the drum cache area, Building C4, and around the mill building. Exposure pathways in the intertidal zone would remain complete for recreational users and future miners. No protection would be provided to aquatic organisms. Exposure pathways would remain complete. Because the exposure pathway to aquatic organism would remain complete, long-term risks to the recreational fisher or subsistence harvester through ingestion of seafood would not be abated.

There would be no significant short-term human-health protection concerns with installing the security fencing. Workers would receive personnel protective equipment and training to reduce exposure to dust and dermal contact with tailings and soil.

This alternative would not reduce the toxicity, mobility, or volume of tailings, hence COCs at the site would remain. Constituent mobility would remain unchanged. The total volume of tailings and other impacted materials remaining at the site is estimated to be 67,000 cy.

Because this alternative has the least construction activity (excluding the No Action alternative), it has the lowest level of short-term risks. Construction activities are limited to erections of fencing around the upland removal areas and posting of signage. This alternative would not meet all RAOs identified for the removal action. Long-term risk reduction would only occur through natural attenuation mechanisms, and it is possible that continued natural attenuation could result in increased threats to downgradient media. The time required until reclamation objectives are reached by natural attenuation would be indefinite.

Implementability. This alternative would be feasible both technically and administratively, and would be easily implemented in general.

Institutional controls are readily implementable since the equipment and labor resources necessary for installing the perimeter fence would be available in the region. Annual visual inspections of the security

fence would be readily completed and repairs would be made as needed. These activities would be adequate and reliable to prevent direct exposure to recreational users and future miners, but would not prevent continued exposure of most ecological receptors. There would be no permanence for controlling future potential environmental impacts. Deed or land use restrictions would be required to limit access to the tailings zones and abandoned mine workings, but land use restrictions may be difficult to enforce due to remoteness of the Salt Chuck Mine site.

Cost. Estimated capital costs for this Alternative are $206,000. This estimate includes material and equipment, mobilization, fence installation, engineering support and construction management oversight, taxes and bonding, and a 20 percent contingency. Annual O&M costs to inspect the site to ensure the integrity of the security features, collect up to 30 water, soil, sediment, and tissue samples for analytical testing, and prepare a summary report documenting results are estimated to be $53,000.

Uncertainties and Assumptions. With the exception of unknowns surrounding natural attenuation, there are no significant uncertainties or assumptions associated with the performance of this alternative.

5.2.3 Alternative 3 – Excavation, Consolidation in Onsite Repository, and Capping

Effectiveness. Alternative 3 would provide protection of public health and the environment and generally achieve RAOs. There would be no reduction in the mass or toxicity of COCs, however, since the impacted materials would still remain onsite but consolidated in a repository. This alternative would effectively reduce contaminant mobility at the site by removing the highest risk solid media contaminant sources and disposing of the waste in a lined and capped repository. DRO-contaminated soils at the drum cache area would be excavated, placed into supersacks, and transported to an offsite permitted disposal facility. Confirmation samples would be collected and submitted for laboratory analysis to document that all impacted materials have been removed to cleanup levels. Long-term monitoring and control programs would be established to ensure continued effectiveness.

Alternative 3 would be protective of human health and the environment, because the risks associated with the COCs and complete exposure pathways are mitigated by physically isolating the tailings and soils in a properly constructed and maintained capped repository. Mobility of contaminants is also reduced by limiting potential for contaminants to leach from the soil by placement of a liner in the repository.

This alternative involves extensive construction activities in most portions of the site. Although short-term risks would be high due to the large volumes of tailings and impacted soils that would have to be excavated, handled, and relocated, these risks can be controlled. Risks to workers during construction would be managed using standard health and safety practices such as dust suppression to protect workers from incidental inhalation and ingestion of dust particulates. No significant risks to members of the community during removal actions have been identified. No environmental long-term impacts would result from the implementation of the removal action. It is possible that resuspension of contaminants in the water column may occur during excavation of intertidal tailings. Excavation of tailings in the intertidal zone would use appropriate methods to minimize water quality impacts, such as silt fencing.

This alternative would provide a high degree of effectiveness and would achieve RAOs and ARARs. The long-term effectiveness would depend on an O&M plan ensuring the integrity of the repository and its cover.

The use of signs and deed restrictions to prevent future excavation at the repository and at the mill site would be effective in managing the risks posed by contaminants remaining onsite. Inspection and maintenance of the cap will be required on a regular basis to meet this criterion over the long term. The repository area would be fenced off to prevent access and signage posted.

Implementability. This alternative is both technically and administratively feasible. Soil capping technologies are reliable, and the effectiveness of this remedy can be monitored easily. The construction steps required are considered conventional construction practices. Cap construction materials would be transported in from an offsite borrow source or may be produced from onsite crushing of waste rock.

This alternative involves extensive construction activities in most portions of the site. It is possible that resuspension of contaminants in the water column may occur during excavation of intertidal tailings. Excavation of tailings in the intertidal zone would use appropriate methods to minimize water quality impacts. Tailings transportation and placement at the onsite repository would need to prevent adverse water quality impacts. Hand excavation would be used in the vicinity of the mill building. It is anticipated that construction could be completed and RAOs achieved within a single construction season. If work cannot be completed during one construction season, appropriate measures would be taken to stabilize the remaining tailings and minimize exposure prior to completion during the following season.

Although some difficulty would be involved in transporting the required equipment, material, and personnel to this remote site, all the required services and materials are available. Salt Chuck Bay is navigable by barges and shallow-draft boats at high tide only. All intertidal work would be performed during low tide so that as much work as possible can be performed "in the dry". The greatest difficulty in implementing this alternative would be water management issues. Lake Ellen Creek flows through the intertidal tailings and may need to be silt-screened to allow for removal and consolidation of tailings. Other areas downstream of the removal area may need to have turbidity control measures such as silt fences and/or silt screens installed.

Some minor road construction and site preparation work, including construction of staging, loading, and decontamination areas would be required to prepare the site for removal actions. Temporary stockpiles of contaminated materials would be created prior to placement in the onsite repository. The stockpile area would be prepared by placing visqueen under removed materials, and the area bermed to contain runoff and soil.

Periodic inspections and maintenance, as needed, would ensure the long-term integrity and effectiveness of the cap.

Cost. The estimated total capital cost for Alternative 3 is $4,600,000 (Appendix H). This includes equipment and materials mobilization, onsite earthwork to prepare the staging and repository areas,

construction of the repository, fencing, water quality control measures, offsite disposal of DRO-contaminated soils, post-removal confirmatory sampling, and demobilization. There is an on-going monitoring component to this alternative. O&M costs include cap inspections and environmental monitoring. Annual O&M costs to inspect the site to ensure the integrity of the security features, collect up to 30 water, soil/sediment, and tissue samples for analytical testing, and prepare a summary report documenting results are estimated to be $53,000.

Uncertainties and Assumptions. There is uncertainty regarding selection of a suitable repository area. Although cursory visual inspections were conducted of the wider area surrounding the site during the 2002 and 2006 investigations, the proposed repository site requires a more complete survey to assess site conditions such as underlying soil conditions, depth to groundwater to assess potential for impact to groundwater resources, precipitation, and local or regional availability of potential cover materials, in particular sand or an organic substrate for revegetation.

The cover would be designed to intercept and store as much of the infiltrating precipitation as possible until this water can be removed by evapotranspiration. The design would also consider stresses imposed by snow loads and freezing ground conditions. Cover design depends on the physical and hydraulic properties of the cover material. The availability of suitable cover material at the site would need to be further assessed; while the waste rock can be used onsite and used as cover material, a soil source would also need to be identified.

There is uncertainty associated with Alternative 3 relating to the amount of post-removal residual contamination that would remain. Risk estimates have not been calculated for post-removal, and would be based on the results of confirmatory testing.

There is also some uncertainty regarding the volume of materials within the removal area, particularly in areas such as Zone D with lower sample density. Material thickness is highly variable throughout the removal area.

Conceptual cap designs would be evaluated in detail during remedial design, including cap requirements to limit movement of COCs. The cover would be designed of material that would not degrade the quality of runoff water as it flows from the repository.

The most significant uncertainty is in the cost estimate. Without a visit to assess site-specific conditions such as channel navigability issues, physical conditions of the proposed repository, availability of suitable staging areas, and the amount of site preparation necessary, potential civil contractors are reluctant to provide a detailed estimate of the tasks, equipment, labor and costs involved to implement the alternative. Once a remedial action is selected, a detailed cost estimate would need to be prepared.

5.2.4 Alternative 4 – Excavation and Offsite Disposal

Effectiveness. This alternative would effectively reduce contaminant mobility at the site by completely removing the highest risk solid media contaminant sources from the site. Contaminant toxicity and volume at the site would be reduced by transferring the risk to a managed offsite disposal facility.

This alternative would meet site-specific RAOs, and be compliant with the potential ARARs identified. Confirmation samples would be collected and submitted for laboratory analysis to document that all impacted materials have been removed to cleanup levels. Excavation and offsite disposal protects human health and the environment by removing impacted materials with metals concentrations above RAOs, and placing them into a licensed and properly managed disposal facility.

Short-term risks of exposure to the contaminated material may occur during excavation and transport of the large volume of materials to the disposal facility. Short-term effectiveness is achieved through typical dust control and other best management practices identified and implemented as required, as well as the use of appropriate personnel protective equipment (PPE) to reduce exposure to tailings and other impacted materials.

Long-term effectiveness and permanence would be insured through removal of impacted materials.

The tailings are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulations under the RCRA, 42 U.S.C. 6921 (b)(3) (A)(iii)(1994) as a hazardous waste.

Implementability. Alternative 4 is technically feasible and readily implementable since the equipment and labor resources necessary for excavation, removal, transportation and disposal would be available in the region. Conventional earth moving equipment would be used for excavation and placement of materials within prepared containers. Both U.S. and Canadian manifests would be required prior to transport to Seattle via cargo vessel.

Although some difficulty would be involved in transporting the required equipment, material and personnel to this remote site, all the required services and materials are available. Salt Chuck Bay itself is navigable by barges and shallow-draft boats at high tide only. All intertidal work would have to be performed during low tide so that as much work as possible can be performed "in the dry". The greatest difficulty in implementing this alternative will be water management issues. Lake Ellen Creek flows through the intertidal tailings and may need to be silt-screened to allow for removal and consolidation of tailings. Other areas downstream of the removal area may need to have turbidity control measures such as silt fences and/or silt screens installed.

Some minor road construction and site preparation work, including construction of staging, loading and decontamination areas would be required to prepare the site for removal actions. Temporary stockpiles of contaminated materials would be created prior to placement in the onsite repository. The stockpile area would be prepared by placing visqueen under removed materials, and the area bermed to contain runoff and soil.

After excavation and loadout are complete, the upland excavated areas would be revegetated as appropriate. Cover/fill soil may be required in the excavated areas to level out and contour the areas to match the surrounding terrain.

This excavation is not expected to be completed within a single construction season. If work cannot be completed during one construction season, appropriate measures would be taken to stabilize the remaining tailings and minimize exposure prior to completion during the following season.

Costs. Estimated capital costs for Alternative 4 would be approximately $21,800,000 (Appendix H). This includes equipment mobilization, onsite earthwork, pre- and post-removal characterization, transportation, and disposal costs. Also included in the cost are engineering support, construction management oversight, taxes and bonding requirements, and a 20 percent contingency. Annual costs for site inspection, sampling and analyses, and reporting are estimated to be $53,000.

Uncertainties and Assumptions. There is some uncertainty regarding the volume of sediment within the removal areas, particular in locations such as Zone D where sample density is lower. Sediment thickness is highly variable throughout the removal area.

The most significant uncertainty for this alternative is in the cost estimate. Without a site visit to assess site-specific conditions such as channel navigability issues, availability of suitable staging areas, and the amount of site preparation necessary, potential civil contractors are reluctant to provide a detailed estimate of the tasks, equipment, labor, and costs involved to implement the alternative. At such time that a remedial action is decided upon, a detailed cost estimate would need to be prepared.

5.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

A comparative analysis of alternatives to identify relative advantages and disadvantages of each is made in this section based on their effectiveness, implementability, and costs. Although Alternative 1, the No Action Alternative, fails to meet threshold criteria of protection of human health and compliance with ARARs, this alternative is used as a baseline comparison with the other alternatives.

5.3.1 Effectiveness

The No Action alternative is the least effective action in reducing potential risks to human health and the environment. Alternative 1 would not meet RAOs and would not be compliant with ARARs. Alternative 2 ranks slightly higher than Alternative 1 in reducing exposure by limiting access to the impacted areas. Alternative 2 would be ranked slightly higher for short-term effectiveness by reducing the time required to implement the alternative. This alternative is more effective than No Action, but would not provide a suitable level of protection for ecological receptors, and would thus not comply with ARARs. The intertidal areas would not be fenced, however, and would still provide exposure pathways.

Alternative 3 ranks higher than either Alternative 1 or 2 in effectiveness, because it would physically isolate contaminants from receptor contact in a capped onsite repository and would comply with potential ARARs. Exposure pathways to receptors would be eliminated by reducing direct contact with, and

mobility of, the COCs. Alternative 4 ranks highest for protection of human health and the environment and long-term effectiveness, because it removes the sources of COCs from the site. Both Alternatives 3 and 4 create a new material disposal site with their own long-tern management risks. Alternative 4 would comply with all ARARs. Alternatives 3 and 4 present the same short-term hazards to the community, workers, and environment from airborne dust, erosion, and material contact with site workers during excavation and material transfer activities. Short-term construction risks associated with excavation of intertidal tailings for both Alternatives 3 and 4 include risks to water quality, risks of sediment /tailings recontamination through resuspension of contaminants in the water column, and safety risks associated with implementation with a large and complex construction project. While Alternative 3 may be completed within a single construction season, it is unlikely that Alternative 4 can be implemented in a single construction season, and may require 2 to 3 construction seasons. The factors that most distinguish Alternatives 3 and 4 are the impacts to toxicity and volumes of waste. Under Alternative 3, toxicity and volume onsite are not reduced; rather, they are consolidated onsite and isolated. Under Alternative 4, they are reduced onsite through removal and disposal in a permitted, managed disposal facility offsite, but there would be no reduction in toxicity or volume of the original material. Both alternatives reduce or eliminate potential exposure pathways to human and ecological receptors.

5.3.2 Implementability

Alternative 1, the No Action Alternative, would be feasible from a technical and administrative perspective and would be easily implemented in general, because no actions would be taken. Of the three remaining alternatives, Alternative 2, Institutional Controls would be the most technically implementable with the installation of physical access controls and completion within one construction season. This alternative requires the least construction activities of any of the alternatives, excluding the No Action alternative. Alternative 2 is administratively feasible with deed restrictions on land use. This alternative would not, however, meet RAOs.

Alternative 3 is implementable. The construction methods to be used rely on available technologies for which experienced contractors are available within the region. The DRO-contaminated soils can easily be transported offsite to a permitted disposal facility. Further site investigation would be required to verify a suitable location for an onsite repository. There appears to be sufficient space to construct a repository on the west side of the Salt Chuck channel. The area is however, heavily timbered with dense underbrush. Technical feasibility challenges exist in transporting equipment and materials to the Salt Chuck Mine site. Transport of shallow-draft barges can only occur during conditions of high tide. Excavation work in the intertidal zones can only occur during low tide. Excavation around the mill area would have to be conducted by hand to preserve the integrity of the structure and would be time and labour intensive. A temporary bridge may need to be constructed across Lake Ellen Creek for transport of equipment and material, unless a suitable landing area can be found along the shoreline. Waste rock onsite could be utilized for cover material. A rock crusher would be transported to the site. A sand cover source would be identified and brought to the site. A silt fence may need to be constructed across Lake Ellen Creek or other downstream areas of the channel that may be impacted during excavation activities. Alternative 3 is administratively feasible, although a determination would have to be made regarding wetlands and

whether a Section 404 permit would be required to work in the area. Deed restrictions would still be implemented to prevent excavation.

Alternative 4 poses similar technical transportation challenges to Alternative 3 with regard to transporting the number of containers required to transfer materials offsite. A staging area would have to be created to store containers, excavated material, and equipment necessary to excavate materials and load them into the containers. Limited numbers of containers can be transported to the site and stored there at any one time. Alternative 4 has a lower implementability rating than Alternative 3 associated with the logistical complexity of transporting equipment and containers to and from the site, and time required to complete the action. Alternative 4 is administratively feasible as well. A determination would have to be made regarding wetlands, and whether a Section 404 permit would be required to work in the area.

Due to the remote location of the Salt Chuck Mine site, its distance to a suitable landfill, concerns over safe loading and transportation of the waste materials, associated costs of offsite transportation, and the ability to easily manage the excavated material onsite in a manner protective of human health and the environment, offsite disposal is not rated high for implementability.

5.3.3 Cost

There are no associated costs with Alternative 1, the No Action alternative, since there are no activities associated with this alternative.

The estimated total capital cost for Alternative 2, Institutional Controls is $206,000. Capital costs include fencing of the mill area, Building C4, drum cache area, tailings piles D14 and D15, and the intertidal spit. It would be technically impracticable to fence the intertidal tailings. Long-term monitoring would consist of periodic inspections of the fences and signs and replacement/maintenance as required. Because all of the impacted media would be left in place under Alternative 2, there is an on-going environmental monitoring component to this alternative.

Alternative 3, Consolidation and Onsite Disposal and Capping has an estimated cost of $4,600,000. The estimated capital cost assumes that cap materials are both imported from an offsite source as well as utilizing onsite waste rock. Long-term monitoring would consist of periodic inspections of the cap, fences, and signs, and replacement/maintenance as required. There is an on-going environmental monitoring component to this alternative.

Alternative 4, Excavation and Transfer to an Offsite Disposal Facility has an estimated capital cost of $21,800,000 and is the most expensive because of the material transport and disposal costs. Because Alternative 4 involves the permanent removal of impacted media from the removal action areas, the effectiveness of this alternative with regard to the removed material is not expected to change over time. There is, however, an ongoing monitoring component associated with this alternative to monitor remaining COCs and the effectiveness of source removal in reducing exposure to receptors.

5.4 RECOMMENDED ALTERNATIVE

Based on the alternatives evaluation using EE/CA guidance, and from the comparative analysis of the removal action alternatives, Alternative 3, which involves consolidation in an onsite repository and capping, is recommended for the Salt Chuck Mine site. This alternative meets the threshold criteria of human health and environmental protection and compliance with ARARs, and has for less capital costs than Alternative 4.

The following are the primary features of Alternative 3 that result in its selection as the preferred alternative:

- Alternative 3 is the least costly alternative that is expected to meet the RAOs within the removal action areas.
- Alternative 3 would provide excellent short and long-term effectiveness.
- Despite the technical challenges of the site, Alternative 3 would be implementable using standard construction equipment and methods.

The following steps would be required to implement Alternative 3:

- Perform a detailed site survey to confirm the proposed repository location is suitable, or to identify alternative locations.
- Further investigate possible sources of sand and organic cover materials.
- Reduce other data gaps, such as those concerning volume estimates in Zone D.
- Select a staging area for equipment.
- Thoroughly evaluate alternate conceptual cap designs.
- Prepare design drawings and specifications for the selected cap design.
- Address deed restrictions, land use agreements, Jurisdictional Determination, and Section 404 permitting issues.
- Complete a detailed cost estimate.
- Conduct a site visit for prospective contractors.
- Contract for construction.
- Conduct work during low tide.

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TABLES

TABLE 2-1
COMMON MARINE INTERTIDAL INVERTEBRATES, SOUTHEAST ALASKA

Common Name	Scientific Name	Feeding Habits	Habitats
Lugworm**	*Abarenicola pacifica*	Omnivorous	Marine/ intertidal/subtidal
Black chiton	*Katherina tunicata*	Herbivorous	Marine/ intertidal/subtidal
Gumboot chiton	*Cryptochiton stelleri*	Herbivorous	Marine/ intertidal/subtidal
Lined chitons	*Tonicella lineata*	Herbivorous	Marine/ intertidal
	T. insignus	Herbivorous	Marine/ intertidal
Moss chiton	*Mopalia spp.*	Herbivorous	Marine/ intertidal
Limpets	*Acmaea mitra*	Herbivorous	Marine/ intertidal
	Notoacmea scutum	Herbivorous	Marine/ intertidal
	Notoacmea persona	Herbivorous	Marine/ intertidal
Snails	*Littorina scutulata*	Herbivorous	Marine/ intertidal
	Littorina sitkana	Herbivorous	Marine/ intertidal
	Lacuna carinata	Herbivorous	Marine/ intertidal
	Natica clausa	Carnivorous	Marine/ intertidal/subtidal
	Fusitrition oregonensis	Carnivorous	Marine/ intertidal/subtidal
	Neptunia lyrata	Carnivorous	Marine/ intertidal/subtidal
Blue mussel *	*Mytilus trossulus*	Filter feeder	Marine/ intertidal
Horse mussel	*Modiolus modiolus*	Filter feeder	Marine/subtidal
Littleneck clam *	*Protothacea staminea*	Filter feeder	Marine/ intertidal/subtidal
Butter clam**	*Saxidomus giganteus*	Filter feeder	Marine/ intertidal/subtidal
Softshell clam *	*Mya arenaria*	Filter feeder	Marine/ intertidal/subtidal
Acorn barnacle	*Balanus glandula*	Filter feeder	Marine/ intertidal
Thatched barnacle	*Semibalanus cariosus*	Filter feeder	Marine/ intertidal
Dungenes crab**	*Cancer magister*	Carnivorous	Marine/ intertidal/ subtidal
Helmet crab	*Telmessus cheiragonus*	Carnivorous	Marine/ intertidal/ subtidal
Rock crab	*Cancer productus*	Carnivorous	Marine/ intertidal/ subtidal
Tanner crab	*Chionoecetes bairdi*	Carnivorous	Marine/ subtidal
Ochra sea star	*Piaster ochraceus*	Carnivorous	Marine/ intertidal/subtidal
Sun star	*Pycnopodia helianthoides*	Carnivorous	Marine/ intertidal/subtidal
Mottled star	*Evasterias troschelii*	Carnivorous	Marine/ intertidal/subtidal
Green sea urchin	*Stongylocentrotus droebachiensis*	Herbivorous	Marine/ intertidal/subtidal
Red sea urchin	*Strongylocentrotus franciscanus*	Herbivorous	Marine/ subtidal

* Observed in Salt Chuck area (USBLM, 1998).
** Observed in Salt Chuck area by URS during 2006 field work.

TABLE 2-2
COMMON FISH AND AMPHIBIAN SPECIES, SOUTHEAST ALASKA

Common name	Scientific name	Group	Feeding Habits	Habitat
Pacific herring	*Clupea harengus*	Marine	Carnivorous	Offshore/inshore marine
Pacific cod	*Gadus macrocephalus*	Marine	Carnivorous	Offshore rocky/inshore sand-gravel
Walleye pollock	*Theragra chalcogramma*	Marine	Carnivorous	Inshore sand-gravel
Sablefish (black cod)	*Anaplopoma fimbria*	Marine	Carnivorous	Offshore rocky/inshore sand-gravel
Sockeye salmon	*Oncorhynchus nerka*	Anadromous	Carnivorous	Inshore marine/freshwater lakes and streams
Chinook salmon	*Onchorynchus tshawytscha*	Anadromous	Carnivorous	Nearshore marine/freshwater streams
Coho salmon*	*Onchohynchus kisutch*	Anadromous	Carnivorous	Nearshore marine/freshwater streams
Chum salmon*	*Onchorhynchus keta*	Anadromous	Carnivorous	Nearshore marine/freshwater streams
Pink salmon*	*Oncorhynchus gorbuscha*	Anadromous	Carnivorous	Nearshore marine/freshwater streams
Dolly Varden*	*Salvalinus malma*	Anadromous	Carnivorous	Inshore marine/freshwater lakes and streams
Cutthroat trout	*Oncorhynchus clarki*	Anadromous	Carnivorous	Inshore marine/freshwater streams
Steelhead trout*	*Oncorhynchus mykiss*	Anadromous	Carnivorous	Inshore marine/freshwater streams
Yellowfin sole	*Limanda aspera*	Marine	Carnivorous	Offshore rocky/inshore sand-gravel
Rock Sole	*Lepidosetta bilineata*	Marine	Carnivorous	Offshore rocky/inshore sand-gravel
Arrowtooth flounder	*Atheresthes stomias*	Marine	Carnivorous	Offshore rocky/inshore sand-gravel
Red Irish Lord	*Hemilepidotus hemilepidotus*	Marine	Carnivorous	Offshore rocky/inshore sand-gravel
Starry flounder	*Platicthys stellatus*	Marine	Carnivorous	Inshore marine
Pacific halibut	*Hippoglossus stenolepis*	Marine	Carnivorous	Offshore rocky/inshore sand-gravel
Slimy Sculpin*	*Cottus cognatus*	Marine	Carnivorous	Intertidal/inshore marine
Wood frog*	*Rana sylvatica*	Amphibian	Carnivorous	Streams/grassland/forest/muskeg

* Observed in Salt Chuck area (USBLM, 1998).

TABLE 2-3
COMMON BIRD SPECIES, SOUTHEAST ALASKA

Common Name	Scientific Name	Feeding Habits	Habitat
Loons and Grebes			
Pacific Loon	*Gavia pacifica*	Carnivorous	Lakes/inshore and offshore marine waters
Red-necked Grebe	*Podiceps grisegena*	Carnivorous	Nearshore marine/lakes and streams
Cormorants			
Pelagic Cormorant	*Phalacrocorax pelagicus*	Carnivous/Picivous	Inshore/offshore marine waters
Herons			
Great Blue Heron*		Carnivorous	Lakes/intertidal waters
Ducks, Geese and Swans			
Tundra Swan	*Cygnus columbianus*	Herbivorous	Inshore marine waters
Trumpeter Swan	*Cygnus buccinator*	Herbivorous	Inshore marine waters
Canada Goose*	*Branta canadensis*	Herbivorous	Lakes/intertidal wetlands
Mallard	*Anas platyrhynchos*	Omnivorous	Lakes/inshore marine waters
Harlequin Duck	*Histrionicus histrionicus*	Carnivorous	Inshore/offshore/intertidal
Surf Scoter	*Melanitta perspicillata*	Carnivorous	Inshore/offshore/intertidal
Bufflehead	*Bucephala albeola*	Carnivorous	Lakes/ nearshore marine
Barrow's Goldeneye	*Bucephala islandica*	Carnivorous	Lakes/ nearshore marine
Common Merganser	*Mergus merganser*	Piscivorous	Lakes/streams
Red-breasted Merganser	*Mergus serrator*	Piscivorous	Lakes/nearshore marine
Hawks and Eagles			
Bald Eagle*	*Haliaeetus leucocephalus*	Carnivorous/ scavenger	Coniferous forests
Sharp-shined Hawk	*Accipiter striatus*	Carnivorous	Coniferous/mixed deciduous-
Northern Goshawk	*Accipiter gentilis*	Carnivorous	Coniferous forests
Red-tailed Hawk	*Buteo jamaicensis*	Carnivorous	Coniferous/mixed deciduous-coniferous forest
Grouse			
Blue Grouse	*Dendragapus obscurus*	Herbivorous	Coniferous forests
Shorebirds			
Greater Yellowlegs	*Tringa melanoleuca*	Carnivorous	Muskegs
Spotted Sandpiper	*Actitis macularia*	Carnivorous	Rivers and streams
Black Turnstone	*Arenaria melanocephala*	Carnivorous	Intertidal
Common Snipe	*Gallinago gallinago*	Carnivorous	Rivers and streams/muskegs
Gulls and Terns			
Mew Gull	*Larus canus*	Carnivorous	Inshore/offshore/intertidal/
Herring Gull	*Larus argentatus*	Carnivorous/ scavenger	Inshore/offshore/intertidal/
Glaucous-winged Gull	*Larus glaucescens*	Carnivorous/ scavenger	Inshore/offshore/intertidal/
Arctic Tern	*Sterna paradisaea*	Carnivorous	Inshore/offshore/intertidal/
Alcids			
Marbled Murrelet	*Brachyramphus marmoratus*	Carnivourous	Inshore/offshore/intertidal/
Owls			
Great Horned Owl	*Bubo virginianus*	Carnivorous	Coniferous/mixed deciduous-coniferous forests
Northern Pygmy Owl	*Glaucidium gnoma*	Carnivorous	Coniferous forest

TABLE 2-3 (Cont.)
COMMON BIRD SPECIES, SOUTHEAST ALASKA

Common Name	Scientific Name	Feeding Habits	Habitat
Hummingbirds			
Rufous Hummingbird	*Selasphorus rufus*	Herbivorous	Coniferous/mixed deciduous-coniferous forests
Kingfishers			
Belted Kingfisher*	*Ceryle alcyon*	Carnivorous	Rivers/lakes/estuaries
Woodpeckers			
Red-headed Sapsucker	*Sphyrapicus ruber*	Carnivorous/ Insectivorous	Coniferous/mixed deciduous-coniferous forests
Flycatchers			
Pacific-slope Flycatcher	*Empidonax difficilis*	Carnivorous/ Insectivorous	Coniferous/mixed deciduous-coniferous forests
Swallows			
Tree Swallow	*Tachycineta bicolor*	Carnivorous/ Insectivorous	Coniferous/mixed deciduous-coniferous forests
Corvids			
Steller's Jay	*Cyanocitta stelleri*	Omnivorous	Coniferous/mixed deciduous-coniferous
Common Raven	*Corvus corax*	Omnivorous/ scavenger	Coniferous/mixed deciduous-coniferous
Northwestern Crow*	*Corvus caurinus*	Omnivorous	Coniferous/mixed deciduous-coniferous
Chickadees			
Chestnut-backed Chickadee	*Poecile rufescens*	Herbivorous/ Insectivorous	Coniferous/mixed deciduous-coniferous forests
Dippers			
American Dipper	*Cinclus mexicanus*	Carnivorous/ Piscivorous	Stream banks
Wrens			
Winter Wren	*Troglodytes troglodytes*	Carnivorous	Coniferous/mixed deciduous-coniferous forests
Thrushes and Kinglets			
Golden-crowned Kinglet	*Regulus satrapa*	Carnivorous	Coniferous forest
Ruby-crowned Kinglet	*Regulus calendula*	Carnivorous	Coniferous/mixed deciduous-
Swainson's Thrush	*Catharus ustulatus*	Omnivorous	coniferous forests
Hermit Thrush	*Catharus guttatus*	Omnivorous	Coniferous/mixed deciduous-coniferous
American Robin	*Turdus migratorius*	Omnivorous	Coniferous/mixed deciduous-coniferous
Warblers and Sparrows			
Orange-crowned Warbler	*Vermivora celata*	Carnivorous/	Coniferous/mixed deciduous-
Yellow-rumped Warbler	*Dendroica coronata*	Insectivorous	Coniferous/mixed deciduous-coniferous forests
Townsend's Warbler	*Dendroica townsendi*	Insectivorous	Coniferous forests
Wilson's Warbler	*Wilsonia pusilla*	Insectivorous	Coniferous/mixed deciduous-coniferous forests
Savannah Sparrow	*Passerculus sandwichensis*	Herbivorous	Coniferous/mixed deciduous-coniferous forests

TABLE 2-3 (Cont.)
COMMON BIRD SPECIES, SOUTHEAST ALASKA

Common Name	Scientific Name	Feeding Habits	Habitat
Fox Sparrow	*Passerella iliaca*	Herbivorous	Coniferous/mixed deciduous-coniferous forests
Warblers and Sparrows (Cont.)			
Song Sparrow	*Melospiza melodia*	Omnivorous	Coniferous/mixed deciduous-coniferous forests
Lincoln's Sparrow	*Melospiza lincolnii*	Herbivorous	Shrub communities/grasslands
Golden-crowned Sparrow	*Zonotrichia atricapilla*	Herbivorous	Coniferous/mixed deciduous-coniferous forests
Dark-eyed Junco	*Junco hyemalis*	Herbivorous	Coniferous/mixed deciduous-coniferous forests
Finches			
Red Crossbill	*Loxia curvirostra*	Herbivorous	Coniferous/mixed deciduous-coniferous forests
Pine Siskin	*Carduelis pinus*	Herbivorous	Coniferous/mixed deciduous-coniferous forests

* Observed in Salt Chuck area by URS during 2006 field work.

TABLE 2-4
COMMON TERRESTRIAL AND MARINE MAMMALS, SOUTHEAST ALASKA

Common name	Scientific name	Feeding Habits	Habitat
Terrestrial Mammals			
Dusky shrew	*Sorex monticolus*	Insectivorous	Muskegs/coniferous forests/dry hillsides
Northern water shrew	*Sorex palustris*	Insectivorous	Small streams/muskegs
Keen's myotis	*Myotis keenii*	Carnivorous/ insectivorous	Caves/mine tunnels/tree cavities
Little brown bat	*Myotis lucifigus*	Carnivorous/ Insectivorous	Caves/mine tunnels/tree cavities
Red fox	*Vulpes vulpes*	Carnivorous	Coniferous forests
Wolf	*Canis lupis*	Carnivorous	Coniferous forests
River otter**	*Lontra canadensis*	Carnivorous	Coniferous forests
Marten	*Martes americana*	Carnivorous	Coniferous forests
Ermine	*Mustela erminea*	Carnivorous	Coniferous forests
Mink	*Mustela vison*	Carnivorous	Coniferous forests along streams
Black bear*	*Ursus americanus*	Omnivorous	Coniferous forests
Brown bear	*Ursus arctos*	Omnivorous	Coniferous forests
Hoary marmot	*Marmota caligata*	Herbivorous	Alpine shrub
Red squirrel	*Tamiasciurus hudsonicus*	Herbivorous	Coniferous/mixed deciduous-coniferous forests
Northern flying squirrel	*Glaucomys sabrinus*	Herbivorous	Coniferous/mixed deciduous-coniferous forests
Beaver	*Castor canadensis*	Herbivorous	Streams and lakes in mixed deciduous-coniferous forests
Northern bog lemming	*Synaptomys borealis*	Herbivorous	Low moist areas near streams and lakes.
Meadow vole	*Microtus pennsylvanicus*	Herbivorous	Low moist areas near streams and lakes.
Muskrat	*Ondatra zibethicus*	Herbivorous	Marshes/weedy borders of lakes
Norway rat	*Rattus norvegicus*	Omnivorous	Coniferous/mixed deciduous-coniferous forests
House mouse	*Mus musculus*	Omnivorous	Coniferous/mixed deciduous-coniferous forests
Heather vole	*Phenacomys intermedius*	Herbivorous	Coniferous forest
Porcupine	*Erethizon dorsatum*	Herbivorous	Mixed deciduous-coniferous forests
Sitka black-tailed deer*	*Odocoileus hemionus sitkensis*	Herbivorous	Coniferous forest/alpine/subalpine
Marine Mammals			
Steller sea lions	*Eumetopias jubatus*	Piscivorous	Offshore/rocky shores (haulouts)
Harbor seals**	*Phoca vitulina*	Piscivorous	Nearshore/gravel beaches and rocky shores (haulouts)
Minke whale	*Balaenoptera acutorostrata*	Planktivorous	Nearshore/offshore marine
Humpback whales	*Megaptera novaeangliae*	Planktivorous	Nearshore/offshore marine
Gray whale	*Eschrichtius robustus*	Carnivor	Nearshore/offshore marine
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	Piscivorous	Nearshore/offshore marine
Killer whale	*Orcinus orca*	Piscivorous	Nearshore/offshore marine
Harbor porpoise	*Phocoena phocoena*	Piscivorous	Nearshore/offshore marine
Dall's porpoise	*Phocoenoides dalli*	Piscivorous	Nearshore/offshore marine

* Scat and tracks observed in Salt Chuck area (USBLM, 1998).
** Observed in Salt Chuck area by URS during 2006 field work.

TABLE 2-5
TOTAL METALS DATA FOR SOIL
Salt Chuck Mine – Tongass National Forest, Alaska

			Media	Site Soil						Background Soil				
			Sample Location	Adjacent to Building C4				Near Electric Locomotive		West Side of Salt Chuck Bay	East of Unnamed Island	Trailhead Near Power Lake	East Side of Lake No. 3	700' North of Gloryhole
			Sample Number	SCSS-1	SCSS-2	SCSS-26a/26b[1]	SCSS-27a/27b[1]	SO10	SCSS-3	SCSSBG-1	SCSSBG-2	SCSSBG-3	SCSSBG-4	SCSSBG-5
			Date Collected	7/23/02		9/27-28/06		7/25/97	7/23-26/02					
			Units	mg/kg										
	EPA Method													
Analyte	1997 Samples	2002 Samples	2006 Samples	Metals										
Antimony	7041	6020	6020	ND(1.32)[J]	15.4[J]	0.143	1.35[J]	1.0	ND(0.526)[J]	ND(0.355)[J]	ND(0.367)[J]	ND(0.359)[J]	ND(0.342)[J]	ND(0.384)
Arsenic	--	6020	6020	ND(4.40)	4.95	4.41	2.74[J]	--	4.52	2.57	4.06	ND(1.20)	3.10	3.86
Beryllium	--	6020	6020	ND(0.440)	ND(0.118)	--	--	--	0.258	ND(0.118)	0.173	ND(0.120)	0.272	0.201
Cadmium	--	6020	6020	ND(0.880)	ND(0.236)	--	--	--	ND(0.350)	ND(0.237)	ND(0.245)	ND(0.239)	ND(0.228)	ND(0.256)
Chromium	--	6020	6020	ND(4.40)	8.09	--	--	--	25.6	5.58	17.5	ND(1.20)	14.0	40.0
Copper	--	6020	6020	825	7,320	65.8	5,770[J]	--	147	10.2	45.6	ND(2.39)	21.5	23.0
Lead	7421	6020	6020	651	6,170	15.4	184[J]	21	19.0	16.1	3.23	0.286	3.40	8.26
Mercury	--	7471A	1631E	25.3	311	0.178[J]	10.5[J]	--	ND(6.99)	ND(4.65)[J]	ND(4.78)[J]	ND(4.52)[J]	ND(4.56)[J]	0.0922
Nickel	--	6020	6020	ND(8.80)	16.0	--	--	--	16.8	3.10	11.1	ND(2.39)	7.71	6.59
Selenium	--	6020	7742	ND(4.40)	8.36	0.19	1.60	--	ND(1.75)	ND(1.18)	ND(1.22)	ND(1.20)	ND(1.14)	ND(1.28)
Silver	--	6020	6020	0.497	17.8	--	--	--	0.196	ND(0.118)	ND(0.122)	ND(0.120)	ND(0.114)	0.205
Thallium	--	6020	6020	ND(0.0880)	0.0624	--	--	--	ND(0.0350)	ND(0.0237)	ND(0.0245)	ND(0.0239)	ND(0.0228)	ND(0.0256)
Vanadium	--	6020	6020	24.7	237	138	204	--	120	13.2	62.6	36.3	76.2	460
Zinc	--	6020	6020	290[J]	215[J]	38.8	64.6	--	68.7[J]	12.0[J]	30.2[J]	ND(1.20)	30.9[J]	21.1

Notes:
- -- = Not analyzed or available
- ( ) = Detection limits shown in parentheses
- J = 2002 data qualified as estimated due to matrix spike recoveries outside of laboratory QC criteria. 2006 data estimated due to duplicate RPD outside of control limits; high bias due to matrix interference (SCSS-26 Hg only); or result less than reporting limit (SCSS-27 Ag only).
- EPA = U.S. Environmental Protection Agency
- mg/kg = Milligrams per kilogram
- ND = Not detected
- QC = Quality control
- RPD = Relative % difference
- 1 = Average of duplicate samples shown.

Sources: 1997 data from USBLM (1998); 2002 data from URS (2003).

TABLE 2-6
TCLP/SPLP DATA FOR SOIL AND TAILINGS
Salt Chuck Mine – Tongass National Forest, Alaska

			Media	Soil	Intertidal Tailings – Head of Salt Chuck Bay							Toxicity Characteristic for Leachate[3]
			Sample Location	Adjacent to Building C4	Zone A - NW Pile Surrounding Rock Jetty and Tailings Spit				Zone B – NE Pile Next to Piers	Zone C – Thinned Tailings Next to Low Tide Seep	Zone D – West Side	
			Map Number[1]	SCSS-25	3-2	3-5	SCUT-7	SCIT-11	3-17	3-23	SCIT-13	
			Sample Number[2]		SC-11	SC-24			SC-21	SC-35		
			Date Collected	9/27/06	7/23-25/97		9/27-29/06		7/23-25/97		10/6/06	
			Units	mg/L								
	EPA Method 1997	EPA Method 2006		TCLP	TCLP	TCLP	TCLP	SPLP	TCLP	TCLP	SPLP	
	TCLP	TCLP	SPLP									
Arsenic	1311/6010	1311/6010B	1312/6010B	ND (0.05)	ND (0.50)	ND (0.50)	ND (0.05)	ND (0.05)	ND (0.50)	ND (0.50)	ND (0.05)	5.0
Barium	1311/6010	1311/6010B	1312/6010B	0.5[J]	0.08	0.15	0.4[J]	--	0.13	0.16	--	10.0
Cadmium	1311/6010	1311/6010B	1312/6010B	ND (0.003)	ND (0.005)	0.006	ND (0.003)	--	ND (0.005)	ND (0.005)	--	1.0
Chromium	1311/6010	1311/6010B	1312/6010B	ND (0.005)	ND (0.01)	ND (0.01)	ND(0.005)	--	ND (0.01)	ND (0.01)	--	5.0
Copper	1311/6010	1311/6010B	1312/6010B	--	0.75	1.37	--	0.725	6.87	1.73	0.009[J]	NE
Lead	1311/6010	1311/6010B	1312/6010B	0.78	ND (0.10)	ND (0.10)	ND (0.03)	--	ND (0.10)	ND (0.10)	--	5.0
Mercury	1311/7471	1311/7470A	1312/7470A	0.0008[J]	ND (0.002)	ND (0.002)	ND (0.0005)	ND (0.0005)	ND (0.002)	ND (0.002)	ND (0.0005)	0.20
Nickel	--	--	1312/6010B	--	--	--	--	ND(0.02)	--	--	ND(0.02)	NE
Selenium	1311/6010	1311/6010B	1312/6010B	ND (0.04)	ND (0.50)	ND (0.50)	ND (0.04)	ND (0.04)	ND (0.50)	ND (0.50)	ND (0.04)	1.0
Silver	1311/6010	1311/6010B	1312/6010B	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	--	ND (0.01)	ND (0.01)	--	5.0
Vanadium	--	--	1312/6010B	--	--	--	--	0.007[J]	--	--	0.009[J]	NE
Zinc	1311/6010	1311/6010B	1312/6010B	--	0.48	0.63	--	--	0.46	0.54	--	NE

TABLE 2-6 (continued)
TCLP/SPLP DATA FOR SOIL AND TAILINGS
Salt Chuck Mine – Tongass National Forest, Alaska

Notes: – = Not analyzed or available.
( ) = Detection limits shown in parentheses.
J = Data is estimated; result is greater than the method detection limit, but less than method reporting limit.
EPA = U.S. Environmental Protection Agency
ND = Not detected
NE = Not established
mg/L = Milligrams per liter
SPLP = Synthetic Precipitation Leaching Procedure, using site water.
TCLP = Toxicity Characteristic Leaching Procedure
1 = Map numbers shown on Figure 2-2 (assigned by USBLM [1998]).
2 = Original sample numbers assigned in field and used by laboratory (USBLM, 1998). Samples collected across depth intervals ranging from 0-9" to 0-20".
3 = Regulatory level for toxicity characteristic solid waste, Federal hazardous waste regulations (40CFR261.24).

Source: 1997 data from USBLM (1998).

TABLE 2-7
ORGANICS DATA FOR SOIL
Salt Chuck Mine – Tongass National Forest, Alaska

Analyte	Method: 1995 Samples	Method: 1997 Samples	Method: 2002 Samples	Site Soil												Background Soil				
				Upper AST Area					Fuel Drum Cache Composite	Lower AST Area: Near Upper Drum Cache	Lower AST Area: Between Drum Caches				Lower AST Area: Near Lower Drum Cache	West Side of Salt Chuck Bay	East of Unnamed Island	Trailhead Near Power Lake	East Side of Lake No. 3	700' North of Gloryhole
Media																				
Sample Number				SO07[1]	SCSS-14	SCSS-16/17[2]	SCSS-20	SCSS-22	SO06[1]	SCSS-15	SCSS-18	SCSS-19	SCSS-21	SCSS-23	SCSS-24	SCSSBG-1	SCSSBG-2	SCSSBG-3	SCSSBG-4	SCSSBG-5
Date Collected				7/25/1997	7/25/2002				7/25/1997	7/25-26/02										
Units[3]				mg/kg																
				Analytical Results																
Hydrocarbon Mixtures																				
DRO/EPH	AK 102	–	AK 102/103	–	6,680 [1,4]	174 [4]	2,270 [1,5]	5,500 [1,4]	–	2,180 [1,4]	7,290 [1,4]	17,400 [1,4]	1,120 [1,5]	1,120 [1,4]	8,540 [1,4]	ND(24.0)	251 [1,5]	685 [1,5]	ND(23.2)	304 [5]
DRO Silica Gel	–	–	AK 102/103SG	–	4,150 [1,4]	ND(29.8)	–	4,580 [1,4]	–	2,210 [1,4]	–	–	–	–	–	–	–	–	–	–
RRO	–	–	AK 102/103	–	693 [1,4]	195 [1,5,7]	3,530 [1,5]	1,640 [1,4]	–	593 [1,4]	6,290 [1,5]	7,400 [1,5]	1,570 [1,5]	1,010 [1,5]	6,390 [1,5]	ND(26.2) [5]	392 [1,5]	907 [1,5]	ND(25.5) [5]	384 [1,2]
RRO Silica Gel	–	–	AK 102/103SG	–	375 [1,4]	ND(29.8)	–	1,210 [1,4]	–	509 [1,4]	–	–	–	–	–	–	–	–	–	–
TRPH	–	EPA 418.1	–	9,100	–	–	–	–	ND(2,600)	–	–	–	–	–	–	–	–	–	–	–
TOC	–	–	TOC CTE SOP	–	37,370	27,820 [7]	457,500	66,680	–	35,850	178,100	503,600	151,100	122,000	529,600	63,160	132,500	94,760	30,170	59,640
PAHs																				
High Molecular Weight PAHs:																				
Benzo(a)anthracene	–	–	PAH SIM	–	0.0103	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Benzo(a)pyrene	–	–	PAH SIM	–	0.00844	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Benzo(b)fluoranthene	–	–	PAH SIM	–	ND(0.00646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Benzo(k)fluoranthene	–	–	PAH SIM	–	ND(0.00646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Benzo(g,h,i)perylene	–	–	PAH SIM	–	ND(0.00646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Chrysene	–	–	PAH SIM	–	0.0256	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Dibenzo(a,h)anthracene	–	–	PAH SIM	–	ND(0.00646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Indeno(1,2,3-cd)pyrene	–	–	PAH SIM	–	ND(0.00646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Pyrene	–	–	PAH SIM	–	ND(0.00646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Low Molecular Weight PAHs:																				
Acenaphthene	–	–	PAH SIM	–	ND(0.0646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Acenaphthylene	–	–	PAH SIM	–	ND(0.0646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Anthracene	–	–	PAH SIM	–	ND(0.00646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Fluoranthene	–	–	PAH SIM	–	ND(0.00646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Fluorene	–	–	PAH SIM	–	ND(0.0646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Napthalene	–	–	PAH SIM	–	ND(0.00646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Phenanthrene	–	–	PAH SIM	–	ND(0.00646)	–	–	ND(0.0759)	–	–	–	–	–	–	–	–	–	–	–	–
Total PAHs (Sum of 10)[8]			PAH SIM	–	0.0674 [6]	–	–	ND(0.380[6])	–	–	–	–	–	–	–	–	–	–	–	–
Microbiology and Nutrients																				
Heterotrophic Plate Count (MPN/gm)	–	–	SM19 9215	–	210,000 [1]	–	–	1,100,000 [1]	–	–	–	–	–	–	–	–	–	–	–	–
Oil Degrading Bacteria (MPN/gm)	–	–	Sheen Screen	–	3,400	–	–	17,000	–	–	–	–	–	–	–	–	–	–	–	–
Nitrate	–	–	EPA 300.0	–	ND(2.60)	–	–	2.90	–	–	–	–	–	–	–	–	–	–	–	–
Nitrite	–	–	EPA 300.0	–	ND(2.60)	–	–	ND(2.85)	–	–	–	–	–	–	–	–	–	–	–	–
Phosphorus	–	–	ASA 1982:24-5	–	6.97	–	–	3.36	–	–	–	–	–	–	–	–	–	–	–	–

Notes:
- – = Not analyzed or available
- ( ) = Detection limits shown in parentheses
- CTE = CT&E Laboratory
- DRO = Diesel Range Organics
- EPA = U.S. Environmental Protection Agency
- EPH = Extractable Petroleum Hydrocarbons
- J = Data qualified as estimated: DRO and RRO results biased high due to surrogate recoveries above laboratory QC criteria; plate count samples exceeded holding time; RPD for duplicate TOC samples >50%.
- mg/kg = Milligrams per kilogram
- MPN/gm = Most Probable Number per gram
- ND = Not detected
- NE = Not established
- PAHs = Polynuclear Aromatic Hydrocarbons
- RPD = Relative percent difference
- RRO = Residual Range Organics
- QC = Quality control
- SG = Silica Gel cleanup procedure
- SIM = Selective Ion Monitoring
- SOP = Standard Operating Procedure
- TOC = Total Organic Carbon
- TRPH = Total Recoverable Petroleum Hydrocarbons
- 1 = Composite sample.
- 2 = Average of duplicate samples.
- 3 = All results are in mg/kg unless otherwise noted.
- 4 = Chromatograph pattern is consistent with weathered middle distillate.
- 5 = Chromatograph contains unknown hydrocarbon with several peaks.
- 6 = Summation calculated using 1/2 detection limit for ND results.
- 7 = One result was non-detect and the other detected; average calculated using 1/2 the detection limit for non-detect sample.
- 8 = Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, napthalene, and phenanthrene.

Sources: 1995-1997 data from USBLM(1998); 2002 data from URS (2003).

TABLE 2-8
TOTAL METALS DATA FOR UNSATURATED TAILINGS [1]
Salt Chuck Mine – Tongass National Forest, Alaska

		Media	Unsaturated Tailings						
			Piles at Mouth of Unnamed Creek		Mill Area[2]				Mill Tailings Spit
		Sample Location	Pile D14	Pile D15	SW of Mill – Base of Slope at Edge of Intertidal Zone	SW Corner of Mill	South of Mill	SE of Mill Next to Barge	
		Sample Number	SCUT-1	SO04[3,4]	SCUT-3	SCUT-4/5[5]	SO03[3,4]	SCUT-6	3-4[6] SC-12[4,7]
		Date Collected	7/25/02	9/15/95	7/25/02		9/15/95	7/25/02	7/21/95
		Units	mg/kg or ppm						
Analyte	Method		Metals						
	1995 Samples	2002 Samples							
Antimony	NS	EPA 6020	ND(0.315)[J]	2	4.93[J]	5.11[J]	8	2.51[J]	ND(2)
Arsenic	NS	EPA 6020	ND(1.05)	2	8.89	1.66	4	10.2	ND(2)
Barium	NS	--	--	20	--	--	30	--	30
Beryllium	NS	EPA 6020	ND(0.105)	ND(0.5)	ND(0.116)	ND(0.109)	ND(0.5)	ND(0.119)	ND(0.5)
Cadmium	NS	EPA 6020	ND(0.210)	ND(0.5)	0.350	0.976	1.0	0.832	ND(0.5)
Chromium	NS	EPA 6020	1.50	50	3.72	2.23	21	5.87	27
Copper	NS	EPA 6020	1,450	1,085	53,400	9,510	>10,000	11,000	3,160
Iron	NS	--	--	82,300	--	--	95,600	--	71,000
Lead	NS	EPA 6020	0.426	2	83.9	73.2	98	143	2
Mercury	NS	EPA 7471A	ND(4.18)	0.080	ND(4.69)	ND(4.28)	0.13	ND(4.65)	0.05
Nickel	NS	EPA 6020	11.9	17	14.6	11.9	21	17.1	16
Selenium	--	EPA 6020	ND(1.05)	--	65.4	8.38	--	11.3	--
Silver	NS	EPA 6020	0.927	0.6	34.1	5.72	43	7.86	2.0
Thallium	NS	EPA 6020	ND(0.0210)	ND(1.0)	ND(0.0233)	ND(0.0217)	ND(10)	ND(0.0237)	ND(10)
Vanadium	NS	EPA 6020	294	451	290	220	401	314	407
Zinc	NS	EPA 6020	31.1[J]	64	82.7[J]	256[J]	230	266[J]	62

TABLE 2-8 (continued)
TOTAL METALS DATA FOR UNSATURATED TAILINGS [1]
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:

--	=	Not analyzed or available
( )	=	Detection limits shown in parentheses
J	=	Data qualified as estimated due to matrix spike recoveries outside of Laboratory QC criteria.
EPA	=	U.S. Environmental Protection Agency
mg/kg	=	Milligrams per kilogram
ND	=	Not detected
NS	=	Non-standardized geochemical assay test: CVAA-type method used for mercury; ICP-type method used for all other metals.
ppm	=	Part per million. All character sample data reported in ppm.
QC	=	Quality control
1	=	Includes tailings above intertidal zone. Tailings in stream and intertidal zones included in Tables 2-5 through 2-8.
2	=	Material in mill area is mixture of waste rock and tailings; samples are from tailings fraction.
3	=	Composite sample.
4	=	Character sample; non-standardized laboratory methods used.
5	=	Average of duplicate samples.
6	=	Map number shown on Figure 2-2 (assigned by USBLM [1998]).
7	=	Original sample number assigned in field and used by laboratory.

Sources: 1995 data from USBLM (1998); 2002 data from URS (2003).

TABLE 2-9
ORGANICS DATA FOR SLUDGE AND UNSATURATED TAILINGS[1]
Salt Chuck Mine – Tongass National Forest, Alaska

		Media	Sludge	Unsaturated Tailings		
				Mill Area		
		Sample Location	NW Floor of Mill Below Diesel Engines	SW of Mill – Base of Slope at Edge of Intertidal Zone	SW Corner of Mill	SE of Mill Next to Barge
		Sample Number	SO01[2]	SCUT-3	SCUT-4/5[3]	SCUT-6
		Date Collected	9/15/95	7/25/02		
		Units	mg/kg			
Analyte	Method: 1995 Sample	Method: 2002 Samples	Analytical Results			
Petroleum Hydrocarbon Mixtures						
DRO	AK102 EPH	AK 102/103	163,000[4]	247	849[J]	ND(23.9)
RRO	--	AK 102/103	--	529	2,918[J]	ND(27.7)
PAHs						
High Molecular Weight PAHs:						
Benzo(a)anthracene	--	PAH SIM	--	4.05	0.00731	1.50
Benzo(a)pyrene	--	PAH SIM	--	2.69	0.0149	2.22
Benzo(b)fluoranthene	--	PAH SIM	--	4.87	ND(0.00554)	2.34
Benzo(k)fluoranthene	--	PAH SIM	--	3.13	ND(0.00554)	1.77
Benzo(g,h,i)perylene	--	PAH SIM	--	3.37	0.0179	2.07
Chrysene	--	PAH SIM	--	5.68	0.0193	2.19
Dibenzo(a,h)anthracene	--	PAH SIM	--	0.0772	ND(0.00554)	ND(0.00587)
Indeno(1,2,3-cd)pyrene	--	PAH SIM	--	3.41	0.0151	1.82
Pyrene	--	PAH SIM	--	13.4	0.0163	3.17
Lower Molecular Weight PAHs:						
Acenaphthene	--	PAH SIM	--	ND(0.0577)	ND(0.00554)	ND(0.00587)
Acenaphthylene	--	PAH SIM	--	0.0657	ND(0.00554)	0.0827
Anthracene	--	PAH SIM	--	0.0589	0.00433	0.0877
Fluoranthene	--	PAH SIM	--	14.8	0.0119	2.46
Fluorene	--	PAH SIM	--	ND(0.0577)	ND(0.00554)	ND(0.0587)
Napthalene	--	PAH SIM	--	0.0579	ND(0.00554)	ND(0.0587)
Phenanthrene	--	PAH SIM	--	ND(0.0577)	ND(0.00554)	1.26
Total PAHs (sum of 10)[5,6]	--	PAH SIM	--	37.6	0.0987	15.5
PCBs						
Arochlor 1016	--	EPA 8082	--	ND(0.0349)	ND(0.0329)	ND(0.0358)
Arochlor 1221	--	EPA 8082	--	ND(0.0349)	ND(0.0329)	ND(0.0358)
Arochlor 1232	--	EPA 8082	--	ND(0.0349)	ND(0.0329)	ND(0.0358)
Arochlor 1242	--	EPA 8082	--	ND(0.0349)	ND(0.0329)	ND(0.0358)
Arochlor 1248	--	EPA 8082	--	ND(0.0349)	ND(0.0329)	ND(0.0358)
Arochlor 1254	--	EPA 8082	--	0.120	0.244	ND(0.0358)
Arochlor 1260	--	EPA 8082	--	0.121	0.175	ND(0.0358)
Total PCBs[6]	--	EPA 8082	--	0.329	0.501	ND(0.125)

TABLE 2-9 (CONTINUED)
ORGANICS DATA FOR SLUDGE AND UNSATURATED TAILINGS[1]
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:
- -- = Not analyzed or available
- ( ) = Detection limits shown in parentheses
- DRO = Diesel Range Organics
- EPA = U.S. Environmental Protection Agency
- EPH = Extractable Petroleum Hydrocarbons
- J = Data qualified as estimated: results for SCUT-5 biased high due to surrogate recoveries above laboratory QC criteria.
- mg/kg = Milligrams per kilogram
- ND = Not detected
- NE = Not established
- PAHs = Polynuclear Aromatic Hydrocarbons
- PCBs = Polychlorinated Biphenyls
- QC = Quality control
- 1 = Includes tailings above intertidal zone. Tailings in stream and intertidal zones included in Tables 2-6 through 2-8.
- 2 = Composite sample.
- 3 = Average of duplicate sample results.
- 4 = Chromatograph pattern is consistent with lube oil.
- 5 = Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, napthalene, and phenanthrene.
- 6 = Summation calculated using ½ detection limit for ND results.

Sources: 1995 data from USBLM (1998); 2002 data from URS (2003).

TABLE 2-10
TOTAL METALS DATA FOR STREAM TAILINGS
Salt Chuck Mine – Tongass National Forest, Alaska

		Media	Stream Tailings	
		Sample Location	Near Mouth of Unnamed Stream	
		Sample Number	SO05[1]	SCST-1
		Date Collected	9/15/95	7/23/02
		Units	mg/kg or ppm	
Analyte	Method		Metals	
	1995 Sample	2002 Sample		
Antimony	NS	EPA 6020	ND(2)	ND(0.684)
Arsenic	NS	EPA 6020	6	ND(2.28)
Barium	NS	EPA 6020	30	--
Beryllium	NS	EPA 6020	ND(0.5)	ND(0.228)
Cadmium	NS	EPA 6020	ND(0.5)	ND(0.456)
Chromium	NS	EPA 6020	40	ND(2.28)
Copper	NS	EPA 6020	493	709
Iron	NS	EPA 6020	43,700	--
Lead	NS	EPA 6020	12	4.51
Mercury	NS	EPA 7471A	0.44	ND(8.97)
Nickel	NS	EPA 6020	15	9.35
Selenium	--	EPA 6020	--	ND(2.28)
Silver	NS	EPA 6020	0.2	0.373
Thallium	NS	EPA 6020	ND(1)	ND(0.0456)
Vanadium	NS	EPA 6020	219	225
Zinc	NS	EPA 6020	92	29.9

Notes:
- -- = Not analyzed or available
- ( ) = Detection limits shown in parentheses
- mg/kg = Milligrams per kilogram
- EPA = U.S. Environmental Protection Agency
- NA = None assigned
- ND = Not detected
- NS = Non-standardized geochemical assay test: CVAA-type method used for mercury; ICP-type method used for all other metals.
- ppm = Parts per million. All character sample data reported in ppm.
- 1 = Composite character sample.

Sources: 1995 data from USBLM (1998); 2002 data from URS (2003).

TABLE 2-11
METALS AND BIOASSAY DATA FOR INTERTIDAL TAILINGS [1]
Salt Chuck Mine – Tongass National Forest, Alaska

				Media	Intertidal Tailings – Head of Salt Chuck Bay															
				Sample Location	Zone A – NW Pile Surrounding Rock Jetty and Tailings Spit															
				Map Number[2]	3-1	NA	3-2	3-3	SCTT-J	3-5	3-8	3-9	3-10	3-11	3-14	3-16	3-18	3-20	3-21	3-22
				Sample Number[3]	SC28[4]	SC10[4]	SC11[4]	SC39[4]		SC24[4]	SC13[4]	SC23[4]	SC37[4]	SC14[4]	SC9[4]	SC15[4]	SC8[4]	SC38[4]	SC16[4]	SC22[4]
				Date Collected	7/21/95				7/23/02	7/21/95										
Analyte	Method				Total Metals (mg/kg or ppm)															
	1995 Samples	1997 Samples	2002 Samples	2006 Samples																
Antimony	NS	–	EPA 6020	–	ND (2)	ND (2)	ND (2)	ND (2)	ND (0.329)[7]	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
Arsenic	NS	–	EPA 6020	EPA 6020	6	2	2	ND (2)	1.68	4	ND (2)	4	6	2	2	ND (2)	2	6	4	8
Barium	NS	–	EPA 6020	–	40	30	20	40	–	30	20	30	30	20	20	30	20	30	20	30
Beryllium	NS	–	EPA 6020	–	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.110)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Cadmium	NS	–	EPA 6020	EPA 6020	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.220)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Chromium	NS	XRF[4]	EPA 6020	–	49	35	36	52	3.31	33	20	23	31	25	36	34	41	64	26	54
Copper	NS	XRF[4]	EPA 6020	EPA 6020	979	1,880	1,155	1,485	2,580	3,880	3,180	1,255	2,520	1,135	1,445	1,290	975	852	804	664
Iron	NS	–	EPA 6020	–	69,800	96,800	129,000	106,000	–	73,400	80,200	70,500	85,500	69,600	94,300	89,500	94,600	72,500	72,100	60,100
Lead	NS	ICP-MS	EPA 6020	EPA 6020	ND (2)	4	2	4	0.721	58	2	ND (2)	2	ND (2)	2	2	ND (2)	4	4	2
Mercury	NS	CVAA	EPA 7471A	EPA 7471A	0.05	0.04	0.07	0.06	ND (4.31)	0.09	0.05	0.07	0.04	0.03	0.04	0.04	0.04	0.04	0.03	0.04
Nickel	NS	XRF[4]	EPA 6020	EPA 6020	14	15	20	19	14.6	16	17	17	16	16	17	16	16	16	16	13
Selenium	–	–	EPA 6020	EPA 6020/7742	–	–	–	–	1.48	–	–	–	–	–	–	–	–	–	–	–
Silver	NS	ICP-MS	EPA 6020	–	0.8	0.4	1.0	0.6	1.02	2.0	1.8	0.6	1.0	ND (0.2)	0.2	1.0	0.6	ND (0.2)	0.2	0.2
Thallium	NS	–	EPA 6020	–	ND (10)	ND (10)	ND (10)	ND (10)	ND (0.0220)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)
Vanadium	NS	–	EPA 6020	EPA 6020	439	590	801	684	256	465	464	458	543	100	551	540	558	448	423	391
Zinc	NS	XRF[4]	EPA 6020	EPA 6020	44	46	44	50	47.6[7]	66	46	60	46	52	44	42	36	56	50	48
AVS/SEM Metals (mg/kg or ppm)																				
Cadmium	–	–	–	EPA 6010B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Copper	–	–	–	EPA 6010B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lead	–	–	–	EPA 6010B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nickel	–	–	–	EPA 6010B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Zinc	–	–	–	EPA 6010B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total SEM	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
AVS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SEM/AVS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Bioassay Results (%)																				
Survival Rate[8]	–	–	–	EPA 1006.0[8]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE 2-11 (CONTINUED)
METALS AND BIOASSAY DATA FOR INTERTIDAL TAILINGS [1]
Salt Chuck Mine – Tongass National Forest, Alaska

				Media	Intertidal Tailings – Head of Salt Chuck Bay																									
				Sample Location	Zone B – NE Pile Next to Piers						Zone C – Thinned Tailings Next to Low Tide Seep and Lake Ellen Creek[3]														Zone D-North of Unnamed Island					
				Map Number[2]	3-6	SCIT-5	3-7	3-12	3-17	3-24	3-15	3-23	3-25	3-26[5]	3-27	SCIT-4/ SD-20[6]	SCIT-12	3-29	3-30	3-31	3-32	3-33	3-34	Transect 1 3a-1	SCSD-9/10[6]	SCSD-18	SCIT-7/8[6]	SCIT-10	SCIT-13	SCSD-27
				Sample Number[3]	SC33[4]		SC19[4]	SC20[4]	SC21[4]	SC35[4]	SC34[4]	SC7[4]	SC31[4]	SC17/SC18[4,6]	SC26[4]				SC25[4]	SC6[4]	SC26[4]	SC30[4]	SC5[4]	SC66						
				Date Collected	7/21/95	7/23/02	7/21/95									7/24/02	10/4/06	7/21/95						7/25/97	7/24-26/02		9/27-10/6/06			
Analyte	Method				Total Metals (mg/kg or ppm)																									
	1995 Samples	1997 Samples	2002 Samples	2006 Samples																										
Antimony	NS	–	EPA 6020	EPA 6020	ND (2)	ND (0.340)[7]	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2) ND (2)	ND (2)	ND (0.393)[7]	–	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	–	ND (0.374)[7]	ND (0.369)[7]	–	–	–	–
Arsenic	NS	–	EPA 6020	EPA 6020	2	ND (1.13)	2	4	2	4	2	4	2	5	2	1.37	2.21	ND (2)	4	ND (2)	4	6	2	–	2.812	1.28	2.53	5.42	2.87	5.15
Barium	NS	–	EPA 6020	EPA 6020	30	–	30	30	40	30	20	10	30	25	20	–	–	20	20	20	20	50	20	–	–	–	–	–	–	–
Beryllium	NS	–	EPA 6020	EPA 6020	ND (0.5)	ND (0.113)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.131)	–	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	–	ND (0.125)	ND (0.123)	–	–	–	–
Cadmium	NS	–	EPA 6020	EPA 6020	ND (0.5)	ND (0.227)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.262)	ND (0.013)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	–	ND (0.250)	ND (0.246)	0.060[7]	0.045[7]	0.246	–
Chromium	NS	XRF[4]	EPA 6020	EPA 6020	37	3.29	31	54	25	39	36	23	66	21	39	2.91	–	29	37	29	28	74	45	137[4]	3.39	3.95	–	–	–	–
Copper	NS	XRF[4]	EPA 6020	EPA 6020	1,330	2,110	1,475	737	512	1,080	1,085	794	677	736	769	1,150[7]	1,370	1,490	1,290	653	1,240	803	1,415	501[4]	667[7]	270	1,590	22.0	153	50.1
Iron	NS	–	EPA 6020	EPA 6020	81,600	–	88,300	72,100	56,600	64,300	73,100	68,200	68,400	68,600	66,700	–	–	62,600	70,800	59,100	64,400	62,300	108,000	–	–	–	–	–	–	–
Lead	NS	ICP-MS	EPA 6020	EPA 6020	2	1.38	4	2	ND (2)	2	2	2	8	2	2	1.09	1.47	ND (20)	6	ND (2)	2	4	ND (2)	3.30	1.73	0.855	1.54	1.58	1.55	–
Mercury	NS	CVAA	EPA 7471A	EPA 7471A	0.06	ND (4.57)[7]	0.03	0.01	0.03	0.04	0.08	0.04	0.06	0.09	0.05	ND (2.41)[7]	0.243	0.06	0.04	0.06	0.08	0.03	0.02	0.185	ND (5.02)[7]	ND (4.59)[7]	0.095	0.011[7]	0.072	0.014[7]
Nickel	NS	XRF[4]	EPA 6020	EPA 6020	15	14.0	16	14	12	15	17	14	15	16	14	16.3	14.0	15	15	15	16	17	18	30.3[4]	13.0	9.26	12.5	8.66	10.7	16.5
Selenium	–	–	EPA 6020	EPA 6020/7742	–	ND (1.13)	–	–	–	–	–	–	–	–	–	1.55	1.3[7]	–	–	–	–	–	–	–	ND (1.25)	ND (1.23)	1.3[7]	ND (0.9)	ND (0.9)	0.28
Silver	NS	ICP-MS	EPA 6020	EPA 6020	ND (2)	0.320	0.2	0.2	ND (0.2)	0.6	0.2	ND (0.2)	ND (2)	0.3	0.2	1.26	1.26	0.6	0.4	0.2	0.4	0.2	0.8	0.234	0.485	0.227	0.980	0.152	0.163	–
Thallium	NS	–	EPA 6020	EPA 6020	ND (10)	ND (0.0277)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	0.0279	–	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	–	ND (0.0250)	0.0378	–	–	–	–
Vanadium	NS	–	EPA 6020	EPA 6020	516	438	562	456	372	413	469	397	438	395	419	281	296	392	446	335	408	368	635	–	291[7]	170	163	79.0	82.4	92.1
Zinc	NS	XRF[4]	EPA 6020	EPA 6020	40	28.8[7]	40	36	46	56	58	42	50	58	52	51.1	48.5	50	56	54	58	60	42	87.5[4]	34.9[7]	28.0[7]	109	37.2	35.6	–
AVS/SEM Metals (mg/kg or ppm)																														
Cadmium	–	–	–	EPA 6010B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	ND (0.1)	–
Copper	–	–	–	EPA 6010B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	40.5	–
Lead	–	–	–	EPA 6010B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	ND (2.7)	–
Nickel	–	–	–	EPA 6010B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.9	–
Zinc	–	–	–	EPA 6010B	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7.4	–
Total SEM	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	50.2	–
AVS	–	–	–	Draft 1991	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	46.9	–
SEM/AVS	–	–	–	–																									1.07	
Bioassay Results (%)																														
Survival Rate[8]	–	–	–	EPA 1006.0[9]	–	–	–	–	–	–	–	–	–	–	–	–	100	–	–	–	–	–	–	–	–	–	–	–	95[10]	–

TABLE 2-11 (CONTINUED)
METALS AND BIOASSAY DATA FOR INTERTIDAL TAILINGS [1]
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:
-- = Not analyzed or available
( ) = Detection limits shown in parentheses
AVS/SEM = Acid-volatile sulfide/simultaneously extractable metals; EPA Draft Method, 1991. The total SEM was calculated using ½ of the detection limit for non-detect metals.
CVAA = Cold vapor atomic absorption; equivalent to EPA Method 245.6.
DRO = Diesel range organics
EPA = U.S. Environmental Protection Agency
ICP-MS = Inductively coupled plasma – mass spectrometer; equivalent to EPA Method 6020.
J = 2002 Data qualified as estimated: for copper and vanadium, RPDs for field duplicates were >50%; for antimony, lead, and zinc, matrix spike recoveries were outside of laboratory QC criteria. 2006 data estimated due to results greater than the method detection limit, but less than method reporting limit.
mg/kg = Milligrams per kilogram
NA = None assigned
ND = Not detected
NS = Non-standardized geochemical assay test: CVAA-type method used for mercury; ICP-type method used for all other metals.
ppm = parts per million. All character sample data reported in ppm.
QC = Quality control
XRF = X-ray fluorescence; no equivalent EPA method.
1 = Includes tailings in intertidal zone only. Unsaturated tailings and stream bottom tailings included in Tables 2-4 through 2-6.
2 = Map or transect numbers shown on Figure 2-4 (assigned by USBLM [1998]).
3 = Original sample numbers assigned in field and used by laboratory (USBLM [1998]). Sample depth intervals range from 2-5" to 0-20".
4 = Character sample or analyte; EPA methods not used.
5 = At map location 3-26, SC17 is composite sample over 0-16" depth interval, and SC18 is from iron-stained layer at 8-13".
6 = Average of duplicate samples.
7 = Includes tailings southeast of approximate 2-foot thickness contour on Figure 2-5.
8 = At 100% elutriate solution (undiluted).
9 = Chronic toxicity test: 7-day survival and growth of estuarine fish *Menidia beryllina*.
10 = Mortality considered insignificant: standard deviation ± 5.8%.

Sources: 1995–1997 data from USBLM (1998); 2002 data from URS (2003).

TABLE 2-12
ORGANICS DATA FOR INTERTIDAL TAILINGS [1]
Salt Chuck Mine – Tongass National Forest, Alaska

		Media	Intertidal Tailings – Head of Salt Chuck Bay				
		Sample Location	Zone A – NW Pile Surrounding Rock Jetty and Tailings Spit		Zone B – Pile NE of Piers	Zone D – North of Unnamed Island	
		Sample Number[3]	SO02[2]	SCIT-3	SCIT-5	SCSD-9/10[3]	SCSD-18
		Date Collected	9/15/95	7/23-26/02			
		Units	mg/kg				
Analyte	Method: 1995 Sample	Method: 2002 Samples	Analytical Results				
Petroleum Hydrocarbon Mixtures							
DRO	AK102 EPH	--	86[4]	--	--	--	--
PAHs							
High Molecular Weight PAHs:							
Benzo(a)anthracene	--	PAH SIM	--	0.0313	ND(0.00582)	0.0149	ND(0.00620)
Benzo(a)pyrene	--	PAH SIM	--	0.0401	0.0148	0.0256	0.0115
Benzo(b)fluoranthene	--	PAH SIM	--	0.0373	0.0129	0.0206	0.00890
Benzo(k)fluoranthene	--	PAH SIM	--	0.0197	0.00816	0.0136	0.00686
Benzo(g,h,i)perylene	--	PAH SIM	--	0.0397	0.0161	0.0195	0.0103
Chrysene	--	PAH SIM	--	0.0290	ND(0.00582)	0.0148	ND(0.00620)
Dibenzo(a,h)anthracene	--	PAH SIM	--	0.00779	ND(0.00582)	ND(0.00634)	ND(0.00620)
Indeno(1,2,3-cd)pyrene	--	PAH SIM	--	0.0335	0.0191	0.0170	0.00882
Pyrene	--	PAH SIM	--	0.0572	ND(0.0582)	0.0269	0.0111
Total HMW PAHs	--	PAH SIM	--	0.296	0.0827	0.156	0.0668
Low Molecular Weight PAHs:							
Acenaphthene	--	PAH SIM	--	ND(0.00550)	ND(0.00582)	ND(0.00634)	ND(0.00620)
Acenaphthylene	--	PAH SIM	--	0.0177	ND(0.00582)	0.00967	ND(0.00620)
Anthracene	--	PAH SIM	--	0.0102	ND(0.00582)	0.00551	ND(0.00620)
Fluoranthene	--	PAH SIM	--	0.0660	ND(0.00582)	0.0202	0.00658
Fluorene	--	PAH SIM	--	ND(0.00550)	ND(0.00582)	ND(0.00634)	ND(0.00620)
Naphthalene	--	PAH SIM	--	ND(0.00550)	ND(0.00582)	ND(0.00634)	ND(0.00620)
Phenanthrene	--	PAH SIM	--	0.0181	ND(0.00582)	0.00577	ND(0.00620)
Total LMW PAHs	--	PAH SIM	--	0.120	0.0204	0.0507	0.0252
Total PAHs[5]	--	PAH SIM	--	0.416	0.103	0.207	0.0920
PCBs							
Arochlor 1016	--	EPA 8082	--	ND(0.0331)	ND(0.0349)	ND(0.114)	ND(0.0372)
Arochlor 1221	--	EPA 8082	--	ND(0.0331)	ND(0.0349)	ND(0.114)	ND(0.0372)
Arochlor 1232	--	EPA 8082	--	ND(0.0331)	ND(0.0349)	ND(0.114)	ND(0.0372)

TABLE 2-12 (CONTINUED)
ORGANICS DATA FOR INTERTIDAL TAILINGS[1]
Salt Chuck Mine – Tongass National Forest, Alaska

			Media	Intertidal Tailings – Head of Salt Chuck Bay				
			Sample Location	Zone A – NW Pile Surrounding Rock Jetty and Tailings Spit		Zone B – Pile NE of Piers	Zone D – North of Unnamed Island	
			Sample Number[3]	SO02[2]	SCIT-3	SCIT-5	SCSD-9/10[3]	SCSD-18
			Date Collected	9/15/95	7/23-26/02			
			Units	mg/kg				
Analyte	Method			Analytical Results				
	1995 Sample	2002 Samples						
PCBs (CONTINUED)								
Arochlor 1242	--	EPA 8082	--	ND(0.0331)	ND(0.0349)	ND(0.114)	ND(0.0372)
Arochlor 1248	--	EPA 8082	--	ND(0.0331)	ND(0.0349)	ND(0.114)	ND(0.0372)
Arochlor 1254	--	EPA 8082	--	ND(0.0331)	0.235	1.10	ND(0.0372)
Arochlor 1260	--	EPA 8082	--	ND(0.0331)	0.221	0.804	ND(0.0372)
Total PCBs[5]	--	EPA 8082	--	ND(0.116)	0.544	2.19	ND(0.130)

Notes:
- -- = Not analyzed or available
- ( ) = Detection limits shown in parentheses
- DRO = Diesel range organics
- EPA = U.S. Environmental Protection Agency
- EPH = Extractable petroleum hydrocarbons
- HMW = High molecular weight
- LMW = Low molecular weight
- mg/kg = Milligrams per kilogram
- NA = None assigned
- ND = Not detected
- PAHs = Polynuclear Aromatic Hydrocarbons
- PCBs = Polychlorinated Biphenyls
- SIM = Selective Ion Monitoring
- 1 = Includes tailings in intertidal zone only. Unsaturated tailings and stream bottom tailings included in Tables 2-4 through 2-6.
- 2 = Composite sample.
- 3 = Average of duplicate samples.
- 4 = Chromatograph pattern indicative of vegetative organic type compounds.
- 5 = Summation calculated using ½ detection limit for ND results.

Sources: 1995 data from USBLM (1998); 2002 data from URS (2003).

TABLE 2-13
TOTAL METALS AND BIOASSAY DATA FOR SEDIMENT
Salt Chuck Mine - Tongass National Forest, Alaska

				Media	Northern Salt Chuck Bay Sediment																	
				Sample Location[1]	Adjacent to East Edge of Tailings		West of Tailings-Near Mouth of Lake Ellen Creek		Between Lake Ellen Creek and Grass Strip							East End of Grass Strip			South Bank of Grass Strip	South of Grass Strip		
				Map Number[2]	3-13	3-19		3-28		3-36	3-37		Transect 2	Transect 3		3-35				3-38	3-39	3-40
				Sample Number[3]	SC32[4]	SC27[4]	SCSD-11	SC3[4]	SCSD-4	SC67[4]	SC4[4]	SCSD-8	3a-2 SC71	3a-3 SC49	3a-4 SC47	SC2[4]	SCSD-7	SCIT-6	SCSD-6	SC70[4]	SC68[4]	SC69[4]
				Date Collected	7/21/95		7/24/02	7/21/95	7/24/02	7/25/97	7/20/95	7/24/02	7/23-24/97			7/20/95	7/24/02	9/27/06	7/24/02	7/23-25/97		
Analyte	Method 1995 Samples	Method 1997 Samples	Method 2002 Samples	Method 2006 Samples	Metals (mg/kg or ppm)																	
Antimony	NS	--	EPA 6020	--	ND(2)	ND(2)	--	ND(2)	--	ND(2)	ND(2)	ND(0.359)[5]	--	--	--	2	--	--	--	ND(2)	ND(2)	2
Arsenic	NS	--	EPA 6020	EPA 6020	2	2	5.25	6	3.50	12	8	4.66	--	--	--	6	6.11	5.97	1.68	6	6	2
Barium	NS	--	EPA 6020	--	20	20	--	20	--	30	20	--	--	--	--	30	--	--	--	30	30	20
Beryllium	NS	--	EPA 6020	--	ND(0.5)	ND(0.5)	--	ND(0.5)	--	ND(0.5)	ND(0.5)	0.138	--	--	--	ND(0.5)	--	--	--	ND(0.5)	ND(0.5)	ND(0.5)
Cadmium	NS	--	EPA 6020	EPA 6020	ND(0.5)	ND(0.5)	ND(0.276)	ND(0.5)	ND(0.246)	0.5	ND(0.5)	ND(0.240)	--	--	--	ND(0.5)	ND(0.258)	0.075[8]	ND(0.226)	0.5	0.5	0.5
Chromium	NS	XRF[4]	EPA 6020	--	28	31	16.3	31	15.0	82	70	12.9	93.8	86.8	69.6	67	14.3	--	16.5	85	74	77
Copper	NS	XRF[4]	EPA 6020	EPA 6020	637	641	190	672	102	80	229	40.1	159	154	43.0	452	121	177	31.9	53	64	39
Iron	NS	--	EPA 6020	--	73,700	68,100	--	52,900	--	40,100	37,000	--	--	--	--	51,000	--	--	--	38,900	38,900	25,900
Lead	NS	ICP-MS	EPA 6020	EPA 6020	2	16	2.78	2	2.27	2	2	1.98	3.8	3.42	3.42	ND(2)	2.17	2.05	1.54	4	4	6
Mercury	NS	CVAA	EPA 7471A	EPA 7471A	0.04	0.04	--	0.07	--	0.02	0.05	ND(4.81)[5]	0.0308	0.0342	0.0354	0.04	ND(2.54)[5]	0.052	ND(0.0426)[5]	0.01	0.01	0.03
Nickel	NS	XRF[4]	EPA 6020	EPA 6020	16	16	19.1	12	12.4	16	14	8.64	28.3	27.8	20.1	14	10.9	10.6	8.03	15	14	13
Selenium	--	--	EPA 6020	EPA 6020	--	--	ND(1.38)	--	ND(1.23)	--	--	ND(1.20)	--	--	--	--	ND(1.29)	1.3[5]	ND(1.13)	--	--	--
Silver	NS	ICP-MS	EPA 6020	EPA 6020	ND(2)	0.02	--	ND(0.2)	--	ND(0.2)	ND(0.2)	ND(0.120)	0.132	0.130	0.0863	ND(0.2)	--	0.437	--	ND(0.2)	ND(0.2)	ND(0.2)
Thallium	NS	--	EPA 6020	--	ND(10)	ND(10)	--	ND(10)	--	ND(10)	ND(10)	0.0438	--	--	--	ND(10)	--	--	--	ND(10)	ND(10)	ND(10)
Vanadium	NS	--	EPA 6020	EPA 6020	467	430	210	223	157	143	164	72.0	--	--	--	276	93.9	92.9	59.4	132	141	95
Zinc	NS	XRF[4]	EPA 6020	EPA 6020	50	50	42.6	60	32.4	68	56	34.9[5]	71.7	80.9	67.9	58	39.0	41.0	28.9	70	74	50
					Bioassay Results (%)																	
Survival Rate[7]	--	--	--	EPA 1006.0[9]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 2-13 (continued)
TOTAL METALS AND BIOASSAY DATA FOR SEDIMENT
Salt Chuck Mine - Tongass National Forest, Alaska

Analyte	Method: 1995 Samples	Method: 1997 Samples	Method: 2002 Samples	Method: 2006 Samples	Northern Salt Chuck Bay Sediment (cont.)											Southern Salt Chuck Bay Sediment				Sediment South of Salt Chuck Bay Mouth				Background Sediment				
Sample Location[1]					South of Grass Strip (cont.)							NE of Unnamed Island				Alder Point		SE End of Unnamed Island	South End of Salt Chuck Bay	Linderman Cove		Cove in NE Browns Bay		Control Site West of Gozil Island, Browns Bay				
Map Number[2]					Transect 4	3-41	Transect 5	SCSD-26	SCSD-2	SCSD-28	SCSD-1	SCSD-3	SCSD-19	SCSD-21	SCSD-20	SCSD-25	SCSD-17	SCSD-15	SCSD-16	SCSD-14	SCSD-24	SCSD-13	SCSD-23	Transect C	Transect B	Transect A	SCSD-12	SCSD-22
Sample Number[3]					3a-5		3a-6																	4-1	4-2	4-4		
					SC43	SC1[4]	SC44																	SC58	SC62	SC53/54[6]		
Date Collected					7/23-25/97	7/20/95	7/23/97	10/4/06	7/23-25/02	10/6/06	7/23-25/02			9/28-30/06		7/23-25/02					9/30/06	7/25/06	9/30/06	7/24/97			7/25/02	9/30/06
Media					Metals (mg/kg or ppm)																							
Antimony	NS	--	EPA 6020	--	--	ND(2)	--	--	ND(0.371)[J]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND(0.343)[J]	--
Arsenic	NS	--	EPA 6020	EPA 6020	--	8	--	3.49	2.94	3.65	2.67	2.07	--	7.87	3.60	3.54	--	--	--	--	3.13	--	2.28	--	--	--	1.63	2.45
Barium	NS	--	EPA 6020	--	--	40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium	NS	--	EPA 6020	--	--	ND(0.5)	--	--	ND(0.124)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND(0.114)	--
Cadmium	NS	--	EPA 6020	EPA 6020	--	ND(0.5)	--	--	ND(0.247)	--	ND(0.226)	ND(0.249)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND(0.229)	--
Chromium	NS	XRF[4]	EPA 6020	--	66.6	83	66.4	--	8.13	--	8.28	8.01	--	--	--	--	--	--	--	--	--	--	--	57.0	49.8	51.8	15.4	--
Copper	NS	XRF[4]	EPA 6020	EPA 6020	121	55	157	136	78.3	205	324	55.3	--	76.5	18.6	--	--	--	--	--	--	--	--	21.4	22.2	25.5	11.2	14.4
Iron	NS	--	EPA 6020	--	--	29,200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lead	NS	ICP-MS	EPA 6020	--	3.62	2	3.39	--	1.29	--	1.34	1.14	--	--	--	--	--	--	--	--	--	--	--	2.71	3.01	2.38	0.876	--
Mercury	NS	CVAA	EPA 7471A	EPA 7471A	0.303	0.02	0.0544	0.047	5.53[J]	0.045	ND(4.40)[J]	ND(2.44)[J]	ND(2.41)[J]	0.036	0.023	--	ND(2.22)[J]	ND(2.53)[J]	ND(2.16)[J]	ND(2.47)[J]	--	ND(2.30)[J]	--	0.0072	0.0181	0.0128	ND(2.07)[J]	0.009[J]
Nickel	NS	XRF[4]	EPA 6020	EPA 6020	22.5	12	19.1	9.30	8.17	8.46	8.99	9.07	--	23.1	7.08	--	--	--	--	--	--	--	--	14.7	18.5	14.8	5.88	8.45
Selenium	--	--	EPA 6020	EPA 7742	--	--	--	0.27	ND(1.24)	0.25	ND(1.13)	ND(1.24)	--	0.23	0.17	--	--	--	--	--	--	--	--	--	--	--	ND(1.14)	0.17
Silver	NS	ICP-MS	EPA 6020	--	0.134	ND(0.2)	0.168	--	ND(0.124)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0533	0.0591	0.0667	ND(0.114)	--
Thallium	NS	--	EPA 6020	--	--	ND(10)	--	--	0.0389	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.12	--
Vanadium	NS	--	EPA 6020	EPA 6020	--	112	--	100	88.6	96.7	133	63.2	--	156	49.0	--	--	--	--	--	--	--	--	--	--	--	40.8	59.3
Zinc	NS	XRF[4]	EPA 6020	--	61.3	56	64.5	--	33.7[J]	--	33.5	31.2	--	--	--	--	--	--	--	--	--	--	--	50.0	52.1	45.4	26.4	--
					Bioassay Results (%)																							
Survival Rate[7]	--	--	--	EPA 1006.0[8]	--	--	--	--	--	100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100

Notes:
- -- = Not analyzed or available
- ( ) = Detection limits shown in parentheses
- CVAA = Cold vapor atomic absorption; equivalent to EPA Method 245.6.
- EPA = U. S. Environmental Protection Agency
- ICP-MS = Inductively coupled plasma - mass spectrometer; equivalent to EPA Method 6020.
- J = 2002 data qualified as estimated due to matrix spike recoveries outside of laboratory QC criteria. 2006 data estimated due to result greater than the method detection limit, but less than method reporting limit.
- mg/kg = Milligrams per kilogram
- NA = None assigned
- ND = Not detected
- NS = Non-standardized geochemical assay test; CVAA-type method used for mercury; ICP-type used for all other metals.
- ppm = Parts per million. All character sample data reported in ppm.
- QC = Quality control
- XRP = X-ray fluorescence; no equivalent EPA method.
- 1 = Sample columns ordered roughly west to east, and north to south, within each location category.
- 2 = Map of transect numbers shown on Figure 2-2(assigned by USBLM[1998]).
- 3 = Original sample numbers assigned in field and used by laboratory (USBLM[1998]). Sample depth intervals range from 2-5" to 0-20".
- 4 = Character sample or analyte: EPA methods not used.
- 5 = At Transect 3, Sample 3a-3/SC49 is composite of whole transect, and Sample 3-4/SC47 is olive green sand (possible tailings-like material) collected in central zone of transect.
- 6 = Average of duplicate samples.
- 7 = At 100% elutriate solution (undiluted).
- 8 = Chronic toxicity test: 7-day survival and growth of estuarine fish *Menidia beryllina*.

Sources: 1995-1997 data from USBLM (1998); 2002 data from URS (2003).

TABLE 2-14
ORGANICS DATA FOR SEDIMENT
Salt Chuck Mine – Tongass National Forest, Alaska

	Media	Northern Salt Chuck Bay Sediment			
	Sample Location	Between Lake Ellen Creek and Grass Strip	South of Grass Strip		
	Sample Number	SCSD-8	SCSD-26	SCSD-2	SCSD-28
	Date Collected	7/24/02	10/4/06	7/23/02	10/6/06
	Units	mg/kg			
Analyte	**Method**	**Analytical Results**			
PAHs					
High Molecular Weight PAHs:					
Benzo(a)anthracene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Benzo(a)pyrene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Benzo(b)fluoranthene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Benzo(k)fluoranthene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Benzo(g,h,i)perylene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Chrysene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Dibenzo(a,h)anthracene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Indeno(1,2,3-cd)pyrene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Pyrene	PAH SIM	0.00901	--	ND (0.00621)	--
Total HMW PAHs[1]	PAH SIM	0.0335	--	ND (0.0279)	--
Low Molecular Weight PAHs:					
Acenaphthene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Acenaphthylene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Anthracene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Fluoranthene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Fluorene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Naphthalene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Phenanthrene	PAH SIM	ND(0.00611)	--	ND (0.00621)	--
Total LMW PAHs[1]	PAH SIM	ND (0.0214)	--	ND (0.0217)	--
Total PAHs[1]	PAH SIM	0.0549	--	ND (0.0496)	--
PCBs					
Arochlor 1016	EPA 8082	ND(0.0362)	ND(0.016)	ND (0.0376)	ND(0.015)
Arochlor 1221	EPA 8082	ND(0.0362)	ND(0.016)	ND (0.0376)	ND(0.015)
Arochlor 1232	EPA 8082	ND(0.0362)	ND(0.016)	ND (0.0376)	ND(0.015)
Arochlor 1242	EPA 8082	ND(0.0362)	ND(0.016)	ND (0.0376)	ND(0.015)
Arochlor 1248	EPA 8082	ND(0.0362)	ND(0.016)	ND (0.0376)	ND(0.015)
Arochlor 1254	EPA 8082	ND(0.0362)	ND(0.016)	0.868	ND(0.015)
Arochlor 1260	EPA 8082	0.177	ND(0.016)	0.540	ND(0.015)
Total PCBs[1]	EPA 8082	0.286	ND (0.056)	1.50	ND (0.0525)

Notes:
- -- = Not analyzed or available
- ( ) = Detection limits shown in parentheses
- EPA = U.S. Environmental Protection Agency
- HMW = High molecular weight
- LMW = Low molecular weight
- mg/kg = Milligrams per kilogram
- NA = None assigned
- ND = Not detected
- PAHs = Polynuclear Aromatic Hydrocarbons
- PCBs = Polychlorinated Biphenyls
- SIM = Selective Ion Monitoring
- 1 = Summation calculated using ½ detection limit for ND results.

Source: 2002 data from URS (2003).

TABLE 2-15
INORGANICS DATA FOR SURFACE WATER
Salt Chuck Mine - Tongass National Forest, Alaska

					Media	Freshwater										Intertidal Water				
					Sample Location	Mine Workings Area										Mill and Tailings Area				
						Water from Main Adit			Unnamed Steam							Tailings Seep at Low Tide				
									Just Upstream of Adit Confluence		Downstream of Adit Confluence			Upstream of Tailings Piles D14 and D15						
					Sample Number	WA81/WFS1	SCSW-4T/WFS7[1]	SCSW-4D	WFS1	WFS6	WFS3	SCSW-3T	SCSW-3D	WA82/WFS4	WA86/87[1]	SCSW-5/6T[1]	SCSW-5/6D[1]	SCSW-7		
					Sample Type	Unfiltered		Filtered	Unfiltered/Field Measurements			Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Filtered		
					Date Collected	9/14/1995	7/23-24/03		9/14/1995	7/24/2002	9/14/1995	7/23/2002		7/25/1997		7/16/2002		9/29/2006		
					Units	µg/L[2]														
	RPA Method					Metals														
Analyte	1995 Samples	1997 Samples	2002 Samples	2006 Samples																
	Non-RPPT Preparation			RPPT Preparation for EPA 6020	Non-RPPT Preparation	Total Metals		Dissolved Metals	(Field Measurements Only)			Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Dissolved Metals		
																Non-RPPT Preparation		Non-RPPT Preparation	RPPT Preparation	
Antimony	EPA 200.9	EPA 204.2	EPA 6020	–	–	ND(5)	ND(1.00)	ND(1.00)	–	–	–	ND(1.00)	ND(1.00)	ND(5)	ND(5)	ND(1.00)	ND(1.00)	–	–	
Arsenic	EPA 200.9	EPA 206.2	EPA 6020	EPA 6020/7062	EPA 6020	1.8	ND(5.00)	ND(5.00)	–	–	–	ND(5.00)	ND(5.00)	ND(0.5)	ND(0.5)	64.3[7]	61.3[7]	4.33[7]	ND(0.4)	
Beryllium	EPA 200.9	EPA 210.2	EPA 6020	–	–	ND(1)	ND(1.00)	ND(1.00)	–	–	–	ND(1.00)	ND(1.00)	ND(1)	ND(1)	ND(1.00)	ND(1.00)	–	–	
Cadmium	EPA 200.9	EPA 213.2	EPA 6020	–	–	ND(0.2)	ND(2.00)	ND(2.00)	–	–	–	ND(2.00)	ND(2.00)	ND(0.2)	ND(0.2)	ND(2.00)	ND(2.00)	–	–	
Chromium	EPA 218.1	EPA 218.2	EPA 6020	–	–	ND(20)	ND(4.00)	ND(4.00)	–	–	–	117	ND(4.00)	ND(20)	ND(15)	ND(4.00)	ND(4.00)	–	–	
Copper	EPA 200.9	EPA 220.2	EPA 6020	EPA 6020/7211	EPA 6020	60	97.0	45.5	–	–	–	ND(6.00)	ND(6.00)	4.9	4.4	74.9[7]	67.8[7]	565	596	
Lead	EPA 200.9	EPA 239.2	EPA 6020	–	–	ND(2)	ND(2.00)	ND(2.00)	–	–	–	ND(2.00)	ND(2.00)	ND(2)	ND(2)	ND(2.00)	ND(2.00)	–	–	
Mercury	EPA 245.2	EPA 245.1	EPA 7470/245.1	EPA 1631E	–	ND(0.2)	ND(0.200)	ND(0.200)	–	–	–	ND(0.209)	ND(0.200)	ND(0.2)	ND(0.2)	ND(0.200)	ND(0.200)	–	0.0881	
Nickel	EPA 200.9	EPA 249.2	EPA 6020	EPA 6020/6010B	EPA 6020	ND(10)	ND(2.00)	ND(3.81)	–	–	–	169	ND(2.00)	ND(10)	ND(10)	13.5	14.4	ND (1.6)	ND(2)	
Selenium	EPA 200.9	EPA 270.2	EPA 6020	EPA 7742	–	11	13.1	14.7	–	–	–	ND(5.00)	ND(5.00)	ND(5)	ND(5)	233[7]	229[7]	–	0.5[7]	
Silver	EPA 200.9	EPA 272.2	EPA 6020	–	–	ND(0.5)	ND(2.00)	ND(2.00)	–	–	–	ND(2.00)	ND(2.00)	ND(0.5)	ND(0.5)	ND(2.00)	ND(2.00)	–	–	
Thallium	EPA 200.9	EPA 279.2	EPA 6020	–	–	ND(1)	ND(1.00)	ND(1.00)	–	–	–	ND(1.00)	ND(1.00)	ND(1)	ND(1)	ND(1.00)	ND(1.00)	–	–	
Vanadium	–	–	EPA 6020	EPA 6010B	EPA 6020	–	ND(20.0)	ND(20.0)	–	–	–	ND(20.0)	ND(20.0)	–	–	ND(20.0)	ND(20.0)	ND(0.4)	ND(4)	
Zinc	EPA 289.1	EPA 289.2	EPA 6020	–	–	19	ND(50.0)	ND(50.0)	–	–	–	ND(50.0)	ND(50.0)	11	ND(7)	ND(50.0)	ND(50.0)	–	–	
Hardness	EPA 130.2	EPA 130.2	SM17 2340C	–	–	91,000	102,000	–	–	–	–	10,700	–	14,000	90,003	4,375,000	–	–	–	
						Field Measurements														
pH						7.7	6.61	–	7.1	6.6	7.0	6.74	–	7.0	8.0	7.3	–	6.16		
Conductivity (uS/Cm)						190	207	–	30	20	30	25	–	30	30	39,000	–	4,050		
Temperature (°C)						6	6.8	–	15.5	18	15.5	16.7	–	15	18	18	–	12.3		
Salinity/TDS (%)						–	0.0	–	–	0.0	–	0	–	–	–	2.6	–	0.2		
Turbidity (NTU)						–	21	–	–	–	–	0	–	–	–	–	–	311		
Dissolved Oxygen (mg/L)						–	11.2	–	–	7.0	–	7.18	–	–	–	11.9	–	11.47		
Flow Rate (cfs)						<0.1	0.002 - 0.005	–	–	–	–	0.66	–	–	10	trickle - 0.002[4]	–	low flows on flats		

TABLE 2-15 (continued)
INORGANICS DATA FOR SURFACE WATER
Salt Chuck Mine - Tongass National Forest, Alaska

Media	Intertidal Water (continued)																															
Sample Location	Mill and Tailings Area (continued)																		Salt Chuck Bay Beyond Tailings Area		South of Salt Chuck Bay	Background Freshwater								Background Intertidal Water	
	Lake Ellen Creek																		Adjacent to Unnamed Island							Unnamed Stream					
	600' Upstream of Confluence with Unnamed Stream		50' Upstream of Confluence with Unnamed Stream/Near SW Corner of Tailings			400' Downstream of Confluence with Unnamed Stream/Adjacent to Tailings		100' Downstream of Confluence with Tailings Seep				SE Extent of Zone D Tailings	West Side, South of Grass Strip	East Side at Pinch Point	Lindeman Cove	Lake No. 3		Lake Ellen Outlet		Upstream of Mine Workings		Gustl Island	Mills Bay
Sample Number	WA05		SCSW-2T	SCSW-2D	SCSW-11	WA04		SCSW-1T	SCSW-1D	SCSW-9/10[1]	SCSW-13	SCSW-16	SCSW-8	SCSW-12	SCSWBG-2T	SCSWBG-2D	SCSWBG-1T	SCSWBG-1D	WA03/WFS5	WA08	SCSW-15	SCSW-14
Sample Type	Unfiltered	Filtered	Unfiltered	Filtered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Filtered					Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Filtered	
Date Collected	7/25/1997		7/23/2002		9/29/2006	7/25/1997		7/23/2002		9/29-10/6/06					7/24-26/02				9/14/1995	7/25/1997	9/30-10/5/06	
Units	µg/L[2]																					
Analyte (EPA Method: 1995 Samples / 1997 Samples / 2002 Samples / 2006 Samples)	Metals																					
	Non-RPPT Preparation			RPPT Preparation for EPA 6020	Non-RPPT Preparation	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Dissolved Metals				Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Dissolved Metals			
						Non-RPPT Preparation				RPPT Preparation	Non-RPPT Preparation				RPPT Preparation				Non-RPPT Preparation						Non-RPPT Preparation	RPPT Preparation	Non-RPPT Preparation	RPPT Preparation
Antimony	EPA 200.9	EPA 204.2	EPA 6020	--	--	--	ND(5)	ND(1.00)	ND(1.00)	--	--	ND(5)	ND(1.02)	ND(1.00)	--	--	--	--	--	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(5)	ND(5)	--	--	--	--
Arsenic	EPA 200.9	EPA 206.2	EPA 6020	EPA 6020/7062	EPA 6020	--	ND(0.5)	12.4[J]	12.5[J]	ND(0.4)	--	ND(0.5)	38.6[J]	38.2[J]	ND(0.4)	0.56	0.57	0.23[J]	4.20	ND(5.00)	ND(5.00)	ND(5.00)	ND(5.00)	ND(0.5)	ND(0.5)	15.2	1.07	11.8	0.05[J]
Beryllium	EPA 200.9	EPA 210.2	EPA 6020	--	--	--	ND(1)	ND(1.00)	ND(1.00)	--	--	ND(1)	ND(1.02)	ND(1.00)	--	--	--	--	--	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1)	ND(1)	--	--	--	--
Cadmium	EPA 200.9	EPA 213.2	EPA 6020	--	--	--	ND(0.2)	ND(2.00)	ND(2.00)	--	--	ND(0.2)	ND(2.05)	ND(2.00)	--	--	--	--	--	ND(2.00)	ND(2.00)	ND(2.00)	ND(2.00)	ND(0.2)	ND(0.2)	--	--	--	--
Chromium	EPA 218.1	EPA 218.2	EPA 6020	--	--	--	ND(15)	ND(4.00)	ND(4.00)	--	--	ND(15)	ND(4.09)	ND(4.00)	--	--	--	--	--	ND(4.00)	ND(4.00)	ND(4.00)	ND(4.00)	ND(20)	ND(20)	--	--	--	--
Copper	EPA 200.9	EPA 229.2	EPA 6020	EPA 6020/7211	EPA 6020	--	3.1	7.58[J]	7.42[J]	2.90[J]	--	2.1	19.8[J]	19.6[J]	16.5	1.58	2.07	2.52	6.70	ND(6.00)	ND(6.00)	ND(6.00)	ND(6.00)	ND(2)	ND(2)	1.68[J]	0.851	1.47[J]	0.328
Lead	EPA 200.9	EPA 239.2	EPA 6020	--	--	--	ND(2)	ND(2.00)	ND(2.00)	--	--	ND(2)	ND(2.05)	ND(2.00)	--	--	--	--	--	ND(2.00)	ND(2.00)	ND(2.00)	ND(2.00)	ND(2)	ND(2)	--	--	--	--
Mercury	EPA 245.2	EPA 245.1	EPA 7470/245.1	EPA 1631E	--	--	ND(0.2)	ND(0.200)	ND(0.200)	0.0111	--	ND(0.2)	ND(0.200)	ND(0.200)	0.0032	0.0015	0.0021	0.0034	0.0065	ND(0.200)	ND(0.200)	ND(0.200)	ND(0.200)	ND(0.2)	ND(0.2)	--	0.0010	--	0.0042
Nickel	EPA 200.9	EPA 249.2	EPA 6020	EPA 6020/6010B	EPA 6020	--	ND(10)	ND(2.00)	ND(2.07)	ND(2)	--	ND(10)	ND(4.64)	ND(4.79)	ND(2)	0.16[J]	0.19[J]	ND(0.02)	ND(2)	ND(2.00)	ND(2.00)	ND(2.00)	ND(2.00)	ND(10)	ND(10)	3.69[J]	0.39	ND(1.6)	ND(0.02)
Selenium	EPA 200.9	EPA 270.2	EPA 6020	EPA 7742	--	--	ND(5)	57.5[J]	55.0[J]	0.2[J]	--	ND(5)	128[J]	136[J]	0.3[J,3]	0.2[J]	ND(0.2)	ND(0.2)	0.3[J]	5.63	ND(5.00)	23.1	10.4	ND(5)	ND(5)	--	0.3[J]	--	0.3[J]
Silver	EPA 200.9	EPA 272.2	EPA 6020	--	--	--	ND(0.5)	ND(2.00)	ND(2.00)	--	--	ND(0.5)	ND(2.05)	ND(2.00)	--	--	--	--	--	ND(2.00)	ND(2.00)	ND(2.00)	ND(2.00)	ND(0.5)	ND(0.5)	--	--	--	--
Thallium	EPA 200.9	EPA 279.2	EPA 6020	--	--	--	ND(1)	ND(1.00)	ND(1.00)	--	--	ND(1)	ND(1.02)	1.25	--	--	--	--	--	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1)	ND(1)	--	--	--	--
Vanadium	--	--	EPA 6020	EPA 6010B	EPA 6020	--	--	ND(20.0)	ND(20.0)	ND(4)	--	--	ND(20.5)	ND(20.0)	ND(4)	ND(4)	ND(4)	ND(4)	ND(4)	ND(20.0)	ND(20.0)	ND(20.0)	ND(20.0)	--	--	1.92[J]	ND(4)	2.22[J]	ND(4)
Zinc	EPA 289.1	EPA 289.2	EPA 6020	--	--	--	ND(7)	ND(50.0)	ND(50.0)	--	--	ND(7)	ND(51.1)	ND(50.0)	--	--	--	--	--	ND(50.0)	ND(50.0)	ND(50.0)	ND(50.0)	ND(10)	ND(7)	--	--	--	--
Hardness	EPA 130.2	EPA 130.2	SM17 2340C	--	--	--	95,000	391,000	--	--	--	85,000	983,000	--	--	--	--	--	--	12,500	--	162,000	--	13,000	ND(10,000)	--	--	--	--
Field Measurements																													
pH						8.1	--	7.07	--	5.86	8.1	--	6.98	--	6.19	7.15	7.16	6.52	--	6.0	--	6.4	--	6.6	8.3	7.11	--		
Conductivity (uS/Cm)						1,500	--	4,420	--	94	930	--	9,760	--	423	19,500	22,300	11,700	--	50	--	1,300	--	20	30	33,700	--		
Temperature (°C)						19	--	18.8	--	11.9	18	--	17.5	--	12.2	10.6	10.7	12.3	--	16	--	19	--	15	18	11.5	--		
Salinity (%)						--	--	0.22	--	0.0	--	--	0.54	--	0.01	1.14	1.32	0.65	--	0.0	--	0	--	--	--	2.08	--		
Turbidity (NTU)						--	--	0	--	6	--	--	0	--	16	25	10	4	--	10 - 20[J]	--	--	--	--	--	313	--		
Dissolved Oxygen (mg/L)						--	--	8.4	--	7.69	--	--	9.07	--	7.70	8.28	6.69	7.1	--	4.5	--	6.5	--	--	--	5.83	--		
Flow Rate (cfs)						20	--	30	--	420	20	--	23	--	--	--	--	--	0	0	--	0	--	~1	8	0	0		

Notes:
- -- = Not analyzed or available
- () = Detection limits shown in parentheses
- % = Percent
- B = Data is
- °C = Degrees Celsius
- cfs = Cubic feet per second
- EPA = Environmental Protection Agency
- ICP/MS = Inductively coupled plasma/mass spectrometer
- J = 2002 data qualified as estimated due to high bias from matrix interference by salts in intertidal water. 2006 data estimated due to result greater than method detection limit, but less than method reporting limit.
- µg/L = Micrograms per liter
- mg/L = Milligrams per liter
- NA = Not applicable
- NC = Natural conditions
- ND = Not detected
- NE = Not established
- NTU = Nephelometric Turbidity Units
- RPPT = Reductive Precipitation: sample preparation to separate certain metals from salt-rich matrix.
- uS/cm = Microsiemens per centimeter
- 1 = Average of duplicate samples. WFS7 and SCSW-4T are duplicates for field measurements only.
- 2 = All results in ug/L unless otherwise noted.
- 3 = One result was non-detect and the other detected; average calculated using 1/2 the detection limit for non-detect sample.
- 4 = Flow varies with tidal cycle.
- 5 = Visual estimate based on tannic appearance.

Sources: 1995-1997 data from USBLM (1998); 2002 data from URS (2003).

TABLE 2-16
ORGANICS DATA FOR SURFACE WATER
Salt Chuck Mine – Tongass National Forest, Alaska

	Media	Water in Intertidal Zone
	Sample Location	Tailings Seep at Low Tide
	Sample Number	SCSW-5/6[1]
	Date Collected	7/26/02
	Units	µg/L
Analyte	**Method**	**Analytical Results**
Petroleum Hydrocarbon Mixtures		
DRO	AK102	ND(498)
PAHs		
High Molecular Weight PAHs:		
Benzo(a)anthracene	PAH SIM	ND(0.0995)
Benzo(a)pyrene	PAH SIM	ND(0.0995)
Benzo(b)fluoranthene	PAH SIM	ND(0.0995)
Benzo(k)fluoranthene	PAH SIM	ND(0.0995)
Benzo(g,h,i)perylene	PAH SIM	ND(0.0995)
Chysene	PAH SIM	ND(0.0995)
Dibenzo(a,h)anthracene	PAH SIM	ND(0.0995)
Indeno(1,2,3-cd)pyrene	PAH SIM	ND(0.0995)
Pyrene	PAH SIM	ND(0.0995)
Low Molecular Weight PAHs:		
Acenapthene	PAH SIM	ND(0.0995)
Acenaphthylene	PAH SIM	ND(0.0995)
Anthracene	PAH SIM	ND(0.0995)
Fluoranthene	PAH SIM	ND(0.0995)
Fluorene	PAH SIM	ND(0.0995)
Napthalene	PAH SIM	ND(0.0995)
Phenanthrene	PAH SIM	ND(0.0995)
Total PAHs[2]	PAH SIM	ND (0.796)
PCBs		
Arochlor 1016	EPA 8082	ND(0.101)
Arochlor 1221	EPA 8082	ND(0.101)
Arochlor 1232	EPA 8082	ND(0.101)
Arochlor 1242	EPA 8082	ND(0.101)
Arochlor 1248	EPA 8082	ND(0.101)
Arochlor 1254	EPA 8082	ND(0.101)
Arochlor 1260	EPA 8082	ND(0.101)
Total PCBs[2]	EPA 8082	ND (0.354)

Notes:
- -- = Not analyzed or available
- ( ) = Detection limits shown in parentheses.
- DRO = Diesel range organics
- EPA = U.S. Environmental Protection Agency
- µg/L = micrograms per liter
- NA = Not applicable
- ND = Not detected
- NE = Not established
- PAHs = Polynuclear aromatic hydrocarbons
- PCBs = Polychlorinated biphenyls
- SIM = Selective ion monitoring
- 1 = Average of duplicate samples.
- 2 = Summation calculated using ½ detection limit for non-detect results.

Source: Site data from URS (2003).

TABLE 2-17
METALS DATA FOR TISSUE
Salt Chuck Mine – Tongass National Forest, Alaska

			Media	Bivalves in Intertidal Tailings												Bivalves in Northern Salt Chuck Bay Sediment													
			Sample Location[1]	Zone C						Zone D						Between Lake Ellen Creek and Grass Strip										East End of Grass Strip		South Bank of Grass Strip	
			Map Number[3]	SCTISS-11		SCTIBM-23/24[4]		Transect 1 3a-1 SCM22		SCTISS-9/10[4]		SCTILN-28		SCTISS-35		SCTISS-4		Transect 2 3a-2 SCC13		Transect 3 3a-3 SCM9		Transect 3 3a-3 SCCA		SCTISS-8		SCTISS-7		SCTISS-6	
			Sample Number[4,13]																										
			Species	Softshell Clams[5]		Blue Mussels[6]				Softshell Clams[7]		Littleneck Clams[7]				Softshell Clams[5]				Blue Mussels[6]				Softshell Clams[5]					
			Bivalve Size	–				3/4-1"+		–				1-3"		–		2-2 1/2"		1"		1 1/2-2"		–					
			Depth in Sediment	–				0-1"		–				1/2-1'		1/2'+		–		0"+		1/2-1'		–					
			Sediment Elevation above MLLW	~9-10'						~6-8'						~10-12'		~9-10'		11.5'				~10-12'					
			Date Collected	7/24-26/02				1997-07-25		7/24-26/02				2006-10-04		7/24-26/02		1997-07-25						2002-07-24					
	Method			Metals (µg/g)																									
Analyte	1997 Samples	2002 Samples	2006 Samples	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]
Antimony	–	ICP-MS	EPA 6020	0.148	0.0141	ND (0.063)	ND (0.0098)	–	–	0.166	0.0156	ND (0.063)	ND (0.0062)	0.017[J]	0.0018[J]	ND (0.063)	ND (0.062)	–	–	–	–	–	–	0.109	0.0109	ND (0.063)	ND (0.0057)	ND (0.063)	ND (0.0045)
Arsenic, Total	–	ICP-MS	EPA 6020	9.66	0.918	9.23	1.44	–	–	11.4	1.08	27	2.68	9.37	0.994	9.34	0.915	–	–	–	–	–	–	13.5	1.35	8.85	0.849	9.43	0.679
Arsenic, Inorganic	–	FHAA	Hydride AA[12]	3.37	0.320	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5.19	0.519	–	–	–	–
Beryllium	–	ICP-MS	EPA 6020	ND (0.074)	ND (0.0070)	ND (0.074)	ND (0.012)	–	–	ND (0.0912)	ND (0.00857)	ND (0.074)	ND (0.0073)	0.019[J]	0.0020[J]	ND (0.074)	ND (0.0073)	–	–	–	–	–	–	ND (0.105)	ND (0.0105)	ND (0.074)	ND (0.0067)	ND (0.121)	ND (0.00871)
Cadmium	–	ICP-MS	EPA 6020	0.991	0.094	3.16	0.493	–	–	0.676	0.0635	1.72	0.170	0.872	0.0924	0.846	0.0829	–	–	–	–	–	–	0.595	0.0595	1.32	0.119	1.57	0.113
Chromium	ICP-MS	ICP-MS	EPA 6010B	3.06	0.291	3.98	0.621	1.12	0.0715	3.32	0.302	1.71	0.169	5.6	0.59	3.62	0.355	1.21	0.104	1.37	0.117	1.95	0.186	6.36	0.636	3.26	0.294	2.64	0.190
Copper	*ICP-MS*	*ICP-MS*	*EPA 6020*	*146*	*13.9*	*23.9*	*3.73*	*48.3*	*3.09*	*133*	*12.5*	*18.5*	*1.84*	*34.8*	*3.69*	*30.1*	*2.95*	*29.8*	*2.55*	*22.8*	*2.39*	*48*	*4.58*	*45.9*	*4.59*	*25.4*	*2.29*	*23.3*	*1.65*
Lead	ICP-MS	ICP-MS	EPA 6020	0.563	0.0535	0.227	0.0355	0.368	0.0235	0.746	0.0701	0.269	0.0267	0.353	0.03744	0.315	0.0309	0.11	0.0094	0.404	0.0428	0.442	0.0421	1.01	0.101	0.26	0.0234	0.229	0.0165
Mercury	CVAF	CVAA	EPA 7471A	0.0999	0.00949	0.0899	0.0141	0.045	0.0029	0.0931	0.00875	0.0549	0.00544	0.05	0.005	0.178	0.0174	0.145	0.0124	0.101	0.0106	0.14	0.0133	0.11	0.0110	0.136	0.0122	0.174	0.0125
Nickel	ICP-MS	ICP-MS	EPA 6020	4.7	0.447	0.984	0.154	0.984	0.0628	4.92	0.462	3.7	0.366	4.6	0.488	2.23	0.219	1.51	0.129	1.48	0.155	2.78	0.265	3.89	0.389	1.62	0.146	2.08	0.150
Selenium	–	ICP-MS	EPA 7740	3.57	0.339	4.13	0.644	–	–	3.11	0.292	4.41	0.437	1.4	0.15	3.88	0.380	–	–	–	–	–	–	4.1	0.410	4.32	0.389	4.87	0.351
Silver	ICP-MS	ICP-MS	EPA 6020	0.126[J]	0.0119[J]	0.0396[J,11]	0.00618[J,11]	0.122	0.00778	0.129[J]	0.0122[J]	–[R]	–[R]	0.083[J]	0.0088[J]	0.0725[J]	0.00711[J]	0.0591	0.00506	0.0443	0.00465	0.0605	0.00577	0.0791[J]	0.0791[J]	0.0704[J]	0.00634[J]	0.0994[J]	0.00716[J]
Thallium	–	ICP-MS	EPA 6020	ND (0.05)	ND (0.005)	ND (0.05)	NE (0.008)	–	–	ND (0.05)	NE (0.005)	ND (0.05)	ND (0.005)	0.027	0.0029	ND (0.05)	ND (0.005)	–	–	–	–	–	–	ND (0.05)	ND (0.005)	ND (0.05)	ND (0.005)	ND (0.05)	ND (0.004)
Vanadium	–	ICP-MS	EPA 6010B	93.5	8.89	5.35	0.835	–	–	102	9.59	11.7	1.16	16	1.70	15.2	1.49	–	–	–	–	–	–	54.4	5.44	9.22	0.830	6.99	0.503
Zinc	ICP-MS	ICP-MS	EPA 6020	70.8[J]	6.73	68.4[J]	10.67	123	7.85	73.0[J]	6.87	60.2[J]	5.96[J]	99.9	10.6	101[J]	9.90	134	11.5	86	9.0	157	15.0	69.6[J]	6.96[J]	137[J]	12.3[J]	108[J]	7.78[J]
				Moisture Content (%)																									
Moisture Content	NR	Freeze Dry	Freeze Dry	90.5		84.4		93.62		90.6		90.1		89.4		90.2		91.44		89.5		90.47		90		91.0		92.8	

TABLE 2-17 (continued)
METALS DATA FOR TISSUE
Salt Chuck Mine – Tongass National Forest, Alaska

			Media	Bivalves in Northern Salt Chuck Bay Sediment (continued)																	
			Sample Location[1]	South of Grass Strip, West Side Unnamed Island																	
			Map Number[2]	Transect 4				Transect 5				SCTIBC-34		SCTIBM-26		SCTILN-2		SCTIBC-36		SCTILN-1	
				3a-5				3a-6													
			Sample Number[3,13]	SCM4		SCC1		SCM5		SCC2											
			Species	Blue Mussels[6]		Littleneck Clams[7]		Blue Mussels[6]		Littleneck Clams[7]		Butter Clams[8]		Blue Mussels[6]		Littleneck Clams[7]		Butter Clams[8]		Littleneck Clams[7]	
			Bivalve Size	1-1 1/2"		1"		< 2"		1"		2 1/2-3"		–				2 1/2-3"		–	
			Depth in Sediment	0-4"		~1'		0" +		–		1-1 1/3'		0"+				1-1 1/3'		0"+	
			Sediment Elevation above MLLW	9.4'				7.7'				~5-6'									
			Date Collected	1997-07-25								2006-10-04		7/23-26/02				2006-10-06		2002-07-23	
	Method			Metals (µg/g)																	
Analyte	1997 Samples	2002 Samples	2006 Samples	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]
Antimony	–	ICP-MS	EPA 6020	–	–	–	–	–	–	–	–	0.014[J]	0.0017[J]	ND (0.063)	ND (0.0010)	ND (0.063)	ND (0.0060)	0.010[J]	0.0016[J]	ND (0.063)	ND (0.0073)
Arsenic, Total	–	ICP-MS	EPA 6020	–	–	–	–	–	–	–	–	26.9	3.34	7.58	1.20	27	2.57	19.8	3.23	25.1	2.91
Arsenic, Inorganic	–	FHAA	Hydride AA[12]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.265	0.0432	–	–
Beryllium	–	ICP-MS	EPA 6020	–	–	–	–	–	–	–	–	0.016[J]	0.0020[J]	ND (0.074)	ND (0.012)	ND (0.074)	ND (0.0070)	0.006[J]	0.001[J]	ND (0.109)	ND (0.0126)
Cadmium	–	ICP-MS	EPA 6020	–	–	–	–	–	–	–	–	0.888	0.111	1.79	0.283	1.39	0.132	0.535	0.0872	1.44	0.167
Chromium	ICP-MS	ICP-MS	EPA 6010B	0.813	0.0862	2	0.2	0.862	0.0862	0.812	0.0800	7.5	0.93	2.55	0.403	1.75	0.166	3.4	0.56	1.22	0.142
Copper	ICP-MS	ICP-MS	EPA 6020	10.7	1.14	9.58	1.02	11.6	1.16	13.2	1.30	29.4	3.65	17.3	2.74	8.72	0.829	17.5	2.86	17.9	2.08
Lead	ICP-MS	ICP-MS	EPA 6020	0.261	0.0277	0.257	0.0272	0.277	0.0277	0.103	0.0101	0.210	0.0260	0.220	0.0345	0.118	0.0112	0.150	0.0245	0.130	0.0151
Mercury	CVAF	CVAA	EPA 7471A	0.0717	0.00760	0.0597	0.00633	0.0873	0.00873	0.078	0.0077	0.07	0.009	0.0616	0.00973	0.0842	0.00800	0.04	0.007	0.0966	0.0112
Nickel	ICP-MS	ICP-MS	EPA 6020	1.27	0.135	6.95	0.734	0.808	0.0808	4.66	0.459	6.43	0.797	1.09	0.172	3.09	0.294	4.87	0.794	3.22	0.374
Selenium	–	ICP-MS	EPA 7740	–	–	–	–	–	–	–	–	0.9[J]	0.1[J]	4.18	0.660	5.36	0.509	ND (1)	ND (0.2)	3.57	0.414
Silver	ICP-MS	ICP-MS	EPA 6020	0.135	0.0143	0.0345	0.00366	0.0598	0.00598	ND (0.03)	ND (0.003)	0.142[J]	0.0176[J]	–[R]	–[R]	–[R]	–[R]	0.078[J]	0.013[J]	–[R]	–[R]
Thallium	–	ICP-MS	EPA 6020	–	–	–	–	–	–	–	–	0.009[J]	0.002[J]	ND (0.05)	ND (0.008)	ND (0.05)	ND (0.005)	0.008[J]	0.001[J]	ND (0.05)	ND (0.006)
Vanadium	–	ICP-MS	EPA 6010B	–	–	–	–	–	–	–	–	5.2	0.65	5.98	0.995	2.65	0.252	3.2	0.52	2.07	0.240
Zinc	ICP-MS	ICP-MS	EPA 6020	113	12.0	103	10.9	88.9	8.89	104	10.3	69.7	8.65	79.5[J]	12.6[J]	78.7[J]	7.48[J]	75.1	12.3	79.7[J]	9.25[J]
Moisture Content (%)																					
Moisture Content	NR	Freeze Dry	Freeze Dry	89.4		89.4		90.0		90.15		87.6		84.2		90.5		83.7		88.4	

TABLE 2-17 (continued)
METALS DATA FOR TISSUE
Salt Chuck Mine – Tongass National Forest, Alaska

			Media	Bivalves in Northern Salt Chuck Bay Sediment (cont.)						Bivalves in Southern Salt Chuck Bay Sediment								Bivalves in Sediment South of Salt Chuck Bay							
			Sample Location[5]	NE of Unnamed Island						Alder Point		SE End of Unnamed Island		South End of Salt Chuck Bay				Linderman Cove		Cove in NE Browns Bay		Fourth-of-July Island			
			Map Number[7]																						
			Sample Number[2,13]	SCTILN-3		SCTIBM-27		SCTISS-29		SCTILN-25		SCTIBC-19		SCTILN-21		SCTIBM-22		SCTIBC-17		SCTILN-15		SCTIBC-32a (Not Purged)		SCTIBC-32b (Purged)	
			Species	Littleneck Clams[7]		Blue Mussels[4]		Softshell Clams[8]		Littleneck Clams[7]		Butter Clams[8]		Littleneck Clams[7]		Blue Mussels[4]		Butter Clams[8]		Littleneck Clams[7]		Butter Clams[8]			
			Bivalve Size	–				1-3"		–												2 1/2-3"			
			Depth in Sediment	0"+				1/2-1'		–												1-1 1/3'			
			Sediment Elevation above MLLW	~6-8'						–															
			Date Collected	7/23-26/02				2006-09-28		7/23-26/02												2006-10-05			
	Method			Metals (µg/g)																					
Analyte	1997 Samples	2002 Samples	2006 Samples	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]
Antimony	–	ICP-MS	EPA 6020	ND (0.063)	ND (0.0059)	ND (0.063)	ND (0.0067)	0.016[J]	0.0017[J]	ND (0.063)	ND (0.0071)	ND (0.063)	ND (0.012)	ND (0.063)	ND (0.0067)	ND (0.063)	ND (0.011)	ND (0.063)	ND (0.0089)	ND (0.063)	ND (0.0065)	0.007[J]	0.001[J]	0.010[J]	0.002[J]
Arsenic, Total	–	ICP-MS	EPA 6020	47.6	4.47	10.9	1.17	9.24	0.979	30.7	3.44	13.3	2.49	13.5	1.45	8.26	1.42	32.7	4.65	25.1	2.59	13.9	2.87	18	3.59
Arsenic, Inorganic	–	FHAA	Hydride AA[12]	–	–	–	–	1.27	0.135	–	–	–	–	–	–	–	–	–	–	–	–	0.091[J]	0.019	–	–
Beryllium	–	ICP-MS	EPA 6020	ND (0.074)	ND (0.0070)	ND (0.109)	ND (0.0117)	0.015[B]	0.0016[J]	ND (0.108)	ND (0.0121)	ND (0.106)	ND (0.0198)	ND (0.123)	ND (0.0132)	ND (0.121)	ND (0.0207)	ND (0.0849)	ND (0.0121)	ND (0.0955)	ND (0.00984)	0.006[J]	0.002	0.005[J]	0.001[J]
Cadmium	–	ICP-MS	EPA 6020	2.07	0.195	3.14	0.336	0.957	0.101	1.69	0.189	0.61	0.114	1.57	0.168	2.32	0.397	0.794	0.113	1.57	0.162	0.53	0.109	0.619	0.124
Chromium	ICP-MS	ICP-MS	EPA 6010B	1.71	0.161	1.5	0.161	2.5	0.27	3.04	0.340	1.17	0.219	1.18	0.126	2.89	0.494	3.71	0.527	2.02	0.208	2	0.42	1.1	0.22
Copper	ICP-MS	ICP-MS	EPA 6020	6.47	0.608	8.01	0.857	25.9	2.75	9.81	1.10	8.5	1.59	7.46	0.798	11	1.89	8.36	1.19	4.63	0.477	8.25	1.70	8.19	1.63
Lead	ICP-MS	ICP-MS	EPA 6020	0.243	0.0228	0.244	0.0261	0.249	0.0264	0.183	0.0205	0.0799	0.0149	0.0664	0.00710	0.262	0.0448	0.111	0.0158	0.057	0.00587	0.058	0.012	0.054	0.011
Mercury	CVAF	CVAA	EPA 7471A	0.0925	0.00870	0.72	0.0770	0.04	0.004	0.0694	0.00736	0.0403	0.00754	0.0684	0.00732	0.0778	0.0133	0.0586	0.00832	0.0702	0.00723	0.02	0.004	0.02	0.004
Nickel	ICP-MS	ICP-MS	EPA 6020	5.22	0.491	1.04	0.111	2.62	0.278	3.88	0.411	3.54	0.669	1.96	0.210	1.2	0.205	5.57	0.791	2.82	0.290	3.01	0.620	2.28	0.454
Selenium	–	ICP-MS	EPA 7740	5.75	0.541	3.73	0.399	1.5	0.16	3.92	0.439	1.55	0.290	3.3	0.353	3.76	0.643	3.1	0.449	3.69	0.380	ND (1)	ND (0.2)	0.7[J]	0.1[J]
Silver	ICP-MS	ICP-MS	EPA 6020	–[R]	–[R]	0.0551[J]	0.00590	0.195[J]	0.0207[J]	0.420[J]	0.0470	0.643[J]	0.121[J]	0.0833[J]	0.00891[J]	0.0613[J]	0.0105[J]	1.35[J]	0.192[J]	0.218[J]	0.225[J]	0.326[J]	0.671[J]	1.26[J]	0.251[J]
Thallium	–	ICP-MS	EPA 6020	ND (0.05)	ND (0.005)	ND (0.05)	ND (0.005)	0.012[J]	0.0013[J]	ND (0.05)	ND (0.005)	ND (0.05)	ND (0.009)	ND (0.05)	ND (0.005)	ND (0.05)	ND (0.009)	ND (0.05)	ND (0.007)	ND (0.05)	ND (0.005)	0.007[J]	0.001[J]	0.007[J]	0.001[J]
Vanadium	–	ICP-MS	EPA 6010B	1.64	0.154	1.83	0.196	3.2	0.34	4.68	0.0524	0.715	0.134	0.783	0.0834	3.29	0.563	1.53	0.217	1.09	0.112	1.0	0.21	ND (1)	ND (0.2)
Zinc	ICP-MS	ICP-MS	EPA 6020	89.5[J]	8.41[J]	72.0[J]	7.70[J]	122	12.9	78.1[J]	8.75[J]	70.6[J]	13.2[J]	65.6[J]	7.02[J]	87.6[J]	15.0[J]	68.8[J]	9.77[J]	63.7[J]	6.57[J]	67.6	13.9	69.2	13.8
				Moisture Content (%)																					
Moisture Content	NR	Freeze Dry	Freeze Dry	90.6		89.3		89.4		88.8		81.3		89.3		82.9		85.8		89.7		79.4		80.1	

TABLE 2-17 (continued)
METALS DATA FOR TISSUE
Salt Chuck Mine – Tongass National Forest, Alaska

			Media	Bivalves in Background Intertidal Sediment																Reference Bivalves[9]	
			Sample Location[6]	Control Site West of Gosti Island														4-3		274 NOAA Sites Nationwide	
			Map Number[2]	SCTILN-12		SCTIBC-33		Transect A 4-4		Transect B 4-2		Transect A 4-4		Transect C 4-1		Transect B 4-3					
			Sample Number[3,13]					SCM13/14[4]		SCM18		SCC6		SCC10		SCC11		SCC12			
			Species	Littleneck Clams[7]		Butter Clams[8]		Blue Mussels[6]				Littleneck Clams[7]						Softshell Clams[5]		7 Species of Mussels and Oysters	
			Bivalve Size	~1"		2 1/2-3"		1 1/2-2"		≤ 1"		1 1/2-2"		1/2-2"		3/4-1 1/2"		2-3"		–	
			Depth in Sediment	–		1-1 1/3'		0" +		0" +		–		2-6"				–			
			Sediment Elevation above MLLW	~10-15'		–		15.5'		15.0'		15.5'		10.9'		15.0'		15'		–	
			Date Collected	2002-07-25		2006-10-05		1997-07-25												1986-1997	
	Method			Metals (µg/g)																	
Analyte	1997 Samples	2002 Samples	2006 Samples	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]	Dry Weight	Wet Weight[14]
Antimony	–	ICP-MS	EPA 6020	ND (0.063)	ND (0.0075)	0.012[J]	0.0023[J]	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Arsenic, Total	–	ICP-MS	EPA 6020	16.4	2.02	14.6	2.84	–	–	–	–	–	–	–	–	–	–	–	–	8.22-10.14[10]	1.6-2.0[15]
Arsenic, Inorganic	–	FHAA	Hydride AA[12]	–	–	0.162	0.0314	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Beryllium	–	ICP-MS	EPA 6020	ND (0.074)	ND (0.0091)	0.009[J]	0.002[J]	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cadmium	–	ICP-MS	EPA 6020	1.44	0.177	0.546	0.106	–	–	–	–	–	–	–	–	–	–	–	–	2.15-3.20[10]	0.43-0.64[15]
Chromium	ICP-MS	ICP-MS	EPA 6010B	1.43	0.176	4.3	0.84	0.769	0.0724	0.705	0.0726	1.09	0.113	0.98	0.11	1.2	0.13	0.897	0.0665	–	–
Copper	ICP-MS	ICP-MS	EPA 6020	4.68	0.576	8.54	1.66	4.16	0.392	4.72	0.486	5.4	0.562	5.32	0.601	5.44	0.555	5.31	0.393	8.6-9.97[10]	1.7-2.0[15]
Lead	ICP-MS	ICP-MS	EPA 6020	0.144	0.0177	0.175	0.0340	0.187	0.0176	0.151	0.0156	0.115	0.0120	0.109	0.0123	0.116	0.0118	0.124	0.0919	1.55-2.32[10]	0.31-0.46[15]
Mercury	CVAF	CVAA	EPA 7471A	0.0385	0.00474	0.02	0.0039	0.049	0.0046	0.114	0.0117	0.0482	0.00501	0.0506	0.00572	0.0724	0.00738	0.0434	0.00322	0.09-0.12[10]	0.018-0.024[15]
Nickel	ICP-MS	ICP-MS	EPA 6020	3.24	0.399	5.31	1.03	0.737	0.0694	0.737	0.0755	5.24	0.545	4.91	0.555	4.81	0.491	1.39	0.103	1.50-2.19[10]	0.30-0.44[15]
Selenium	–	ICP-MS	EPA 7740	3.32	0.408	ND (1)	ND (0.2)	–	–	–	–	–	–	–	–	–	–	–	–	2.28-3.28[10]	0.46-0.66[15]
Silver	ICP-MS	ICP-MS	EPA 6020	0.255[J]	0.0314[J]	1.29[J]	0.250[J]	0.109	0.0103	0.0733	0.0076	0.127	0.0132	0.0842	0.00951	0.103	0.00105	0.437	0.0324	–	–
Thallium	–	ICP-MS	EPA 6020	ND (0.05)	ND (0.006)	0.008[J]	0.002[J]	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Vanadium	–	ICP-MS	EPA 6010B	1.96	0.241	2.4	0.47	–	–	–	–	–	–	–	–	-	-	–	–	–	–
Zinc	ICP-MS	ICP-MS	EPA 6020	70.4[J]	8.66[J]	70.7	13.7	78.4	7.39	81.9	8.44	90.6	9.43	101	11.4	91.9	9.38	139	10.3	120-143[10]	24-29[15]
Moisture Content (%)																					
Moisture Content	NR	Freeze Dry	Freeze Dry	87.7		80.6		90.58		89.7		89.6		88.7		89.8		92.59		NR	

TABLE 2-17 (continued)
METALS DATA FOR TISSUE
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:

1 = Sample columns ordered roughly west to east, and north to south, within each location category.
2 = Map and transect numbers assigned to 1997 samples in USBLM (1998) report.
3 = For 1997 data, these are original sample numbers assigned in field, used on laboratory data (USBLM, 1998) and shown on Figures 2-2 and 2-3. Samples are composites across transects: samples collected at 15' intervals along each transect zone and compositied. Sample depths typically 0-1'.
4 = Average of duplicate sample results.
5 = *Mya arenaria*
6 = *Mytilius trossolus*
7 = *Protothaca staminea*
8 = *Saxidomus giganteus*
9 = NOAA Mussel Watch Program (O'Connor, 1998); data reported in dry weight concentrations only.
10 = Range of annual median concentrations
11 = Result for SCTIBM-24 only; non-detect result for SCTIBM-23 rejected per "R" footnote.
12 = Brooks Rand method: inorganic As quantified as total inorganic As and As3+; As5+ determined by subtraction.
13 = Samples not purged unless otherwise noted.
14 = Dry weight concentration (D) converted to wet weight concentration (W): W=Dx(1-fraction moisture content).
15 = Moisture content not reported; wet weight conversions calculated using average moisture content for benthic infauna and fish species of 80% (Stephan et al., 1985).
– = Not analyzed or available.
() = Detection limits shown in parentheses
AA = Atomic absorption
CVAF = Cold vapor atomic fluorescence; equivalent to EPA Method 1631.
CVAA = Cold vapor atomic absorption; equivalent to EPA Method 7471.
EPA = U.S. Environmental Protection Agency
FHAA = Flame hydride-generation atomic absorption: Batelle SOP 1632A.
ICP-MS = Inductively coupled plasma mass spectrometer; equivalent to EPA Method 6020.
J = 2002 Data qualified as estimated due to blank spike +/or matrix spike recoveries outside laboratory QC criteria. 2006 data estimated due to result less than method reporting limit, or low bias from matrix interference (silver only).
µg/g = Micrograms per gram (equivalent to mg/kg)
mg/kg = Milligrams per kilogram
MLLW = Mean lowest low water
NOAA = National Oceanographic and Atmospheric Administration
NR = Not reported
QC = Quality control
R = Non-detect data rejected due to both blank spike and matrix spike recoveries below laboratory QC criteria.
SOP = Standard Operating Procedures

Source: 1997 data from USBLM (1998).

TABLE 2-18
ORGANICS DATA FOR TISSUE
Salt Chuck Mine - Tongass National Forest, Alaska

		Media	Bivalves in Intertidal Tailings						Bivalves in Northern Salt Chuck Bay Sediment										Bivalves in Sediment South of Salt Chuck Bay		Bivalves in Background Sediment		Reference Bivalves[4]	
		Sample Location6	Zone C		Zone D				Between Lake Ellen Creek and Grass Strip		South of Grass Strip, West Side Unnamed Island						East Side Unnamed Island		Fourth-of-July Island		Control Site West of Gosti Island		274 NOAA Sites Nationwide	
		Sample Number	SCTISS-11		SCTISS-9/10[1]		SCTILN-28		SCTISS-8		SCTIBC-34		SCTILN-2		SCTIBC-36		SCTISS-29		SCTIBC-32a		SCTILN-12			
		Species	Softshell Clams[2]				Littleneck Clams[3]		Softshell Clams[2]		Butter Clams [7]		Littleneck Clams[3]		Butter Clams [7]		Softshell Clams[2]		Butter Clams [7]		Littleneck Clams[3]		7 species of Mussels and Oysters	
		Bivalve Size	–								2 1/2-3"		–		2 1/2-3"		1-3"		2 1/2-3"		~1"		–	
		Depth in Sediment	–								1-1 1/3 '		0"+		1-1 1/3 '		1/2-1'		1-1 1/3 '		–			
		Sediment Elevation above MLLW	~10-12'		~6-8'				~10-12'		~5-6'						~6-8'		–		~10-15'		–	
		Date Collected	7/23-26/02								10/4/06		7/23-26/02		9/28-10/6/06						7/23-26/02		1986-1997	
		Method	PCBs (µg/g)																					
Analyte	2002 Samples	2006 Samples	Dry Weight	Wet Weight [10]	Dry Weight	Wet Weight [10]	Dry Weight	Wet Weight [10]	Dry Weight	Wet Weight [10]	Dry Weight	Wet Weight [10]	Dry Weight	Wet Weight [10]	Dry Weight	Wet Weight [10]	Dry Weight	Wet Weight [10]	Dry Weight	Wet Weight [10]	Dry Weight	Wet Weight [10]	Dry Weight	Wet Weight [10]
Arochlor 1016	Batelle SOP (8082M)	8082	ND (0.017)	ND (0.0016)	ND (0.017)	ND (0.0056)	ND (0.017)	ND (0.0017)	ND (0.017)	ND (0.0017)	ND (0.010)	ND (0.0012)	ND (0.017)	ND (0.0016)	ND (0.010)	ND (0.0016)	ND (0.010)	ND (0.0011)	ND (0.010)	ND (0.0021)	ND (0.017)	ND (0.0021)	–	–
Arochlor 1221	Batelle SOP (8082M)	8082	ND (0.017)	ND (0.0016)	ND (0.017)	ND (0.0056)	ND (0.017)	ND (0.0017)	ND (0.017)	ND (0.0017)	ND (0.020)	ND (0.0025)	ND (0.017)	ND (0.0016)	ND (0.020)	ND (0.0033)	ND (0.021)	ND (0.0022)	ND (0.020)	ND (0.0041)	ND (0.017)	ND (0.0021)	–	–
Arochlor 1232	Batelle SOP (8082M)	8082	ND (0.017)	ND (0.0016)	ND (0.017)	ND (0.0056)	ND (0.017)	ND (0.0017)	ND (0.017)	ND (0.0017)	ND (0.010)	ND (0.0012)	ND (0.017)	ND (0.0016)	ND (0.010)	ND (0.0016)	ND (0.023)	ND (0.0024)	ND (0.010)	ND (0.0021)	ND (0.017)	ND (0.0021)	–	–
Arochlor 1242	Batelle SOP (8082M)	8082	ND (0.017)	ND (0.0016)	ND (0.017)	ND (0.0056)	ND (0.017)	ND (0.0017)	ND (0.017)	ND (0.0017)	ND (0.010)	ND (0.0012)	ND (0.017)	ND (0.0016)	ND (0.010)	ND (0.0016)	ND (0.011)	ND (0.0012)	ND (0.010)	ND (0.0021)	ND (0.017)	ND (0.0021)	–	–
Arochlor 1248	Batelle SOP (8082M)	8082	ND (0.017)	ND (0.0016)	ND (0.017)	ND (0.0056)	ND (0.017)	ND (0.0017)	ND (0.017)	ND (0.0017)	ND (0.010)	ND (0.0012)	ND (0.017)	ND (0.0016)	ND (0.010)	ND (0.0016)	ND (0.011)	ND (0.0012)	ND (0.010)	ND (0.0021)	0.058-0.1455	ND (0.0021)	–	–
Arochlor 1254	Batelle SOP (8082M)	8082	ND (0.017)	ND (0.0016)	ND (0.017)	ND (0.0056)	ND (0.017)	ND (0.0017)	ND (0.017)	ND (0.0017)	ND (0.010)	ND (0.0012)	ND (0.017)	ND (0.0016)	ND (0.010)	ND (0.0016)	ND (0.010)	ND (0.0011)	ND (0.010)	ND (0.0021)	ND (0.017)	ND (0.0021)	–	–
Arochlor 1260	Batelle SOP (8082M)	8082	ND (0.017)	ND (0.0016)	ND (0.017)	ND (0.0056)	ND (0.017)	ND (0.0017)	ND (0.017)	ND (0.0017)	ND (0.010)	ND (0.0012)	ND (0.017)	ND (0.0016)	ND (0.010)	ND (0.0016)	ND (0.010)	ND (0.0011)	ND (0.010)	ND (0.0021)	ND (0.017)	ND (0.0021)	–	–
Total PCBs			ND (0.060)	ND (0.0057)	ND (0.060)	ND (0.0056)	ND (0.060)	ND (0.0059)	ND (0.060)	ND (0.0060)	ND (0.040)	ND (0.0050)	ND (0.060)	ND (0.0057)	ND (0.040)	ND (0.0049)	ND (0.050)	ND (0.0053)	ND (0.040)	ND (0.0082)	ND (0.060)	ND (0.0074)	0.058-0.145[5]	0.012-0.029[11]
			Moisture Content (%)																					
Moisture Content	Freeze Dry	Freeze Dry	90.5		90.6		90.1		90.0		87.6		90.5		83.7		89.4		79.4		87.7		NR	

Notes:
- – = Not analyzed or available
- ( ) = Detection limits shown in parentheses.
- µg/g = Micrograms per gram (equivalent to mg/kg)
- mg/kg = Milligrams per kilogram
- MLLW = Mean lowest low water
- ND = Not detected
- NOAA = National Oceanographic and Atmospheric Administration
- NR = Not reported
- SOP = Standard Operating Procedures
- 1 = Average of duplicate sample results.
- 2 = *Mya arenaria*
- 3 = *Protothaca staminea*
- 4 = NOAA Mussell Watch Program (O'Connor, 1998)
- 5 = Range of annual median concentrations
- 6 = All samples not purged.
- 7 = *Saxidomus giganteus*
- 8 = With freeze-dry and homogenization preparation.
- 9 = Summation calculated using ½ detection limit for ND results.
- 10 = Dry weight concentration (D) converted to net weight concentration (W): W=D x (1-fraction moisture content).
- 11 = Moisture content not reported; wet weight conversions calculated using average moisture content for benthic infauna and fish species of 80% (Stephan et al., 1985).

Source: 2002 data from URS (2003).

TABLE 2-19
HUMAN RISK-BASED SCREENING LEVELS AND ECOLOGICAL BENCHMARKS FOR SOIL
Salt Chuck Mine – Tongass National Forest, Alaska

Chemical	ADEC Soil Cleanup Levels[a]			Ecological Benchmarks		
	Ingestion (mg/kg)	Inhalation (mg/kg)	Migration to Groundwater (mg/kg)	ADEC Soil ERBSC (mg/kg)	Other Applicable Benchmarks[b] (mg/kg)	Reference
Metals						
Antimony	33	NE	3	0.5	5(78)	e
Arsenic	4.5	NE	1.8	0.3	9.9	c
Barium	5,800	NE	982	5	283	c
Beryllium	170	NE	38	2	10	e
Cadmium	83	NE	4.5	0.2	4.2	c
Chromium, total[g]	250	NE	23	60	16.1	c
Copper	3,320[j]	NE	6,260[j]	1	370 (28)	c
Iron	NE (100,000)	NE	NE	10	200	d
Lead	400[h]	400[h]	NE[h]	5	40.5 (11)	c
Mercury	NE (310)	13	1.24	0.3	0.00051	c
Nickel	1,700	NE	78	30	121	c
Selenium	420	NE	3	0.02	0.21 mouse, 0.93 fox	c
Silver	420	NE	19	2	50	d
Thallium	NE (79)	NE	NE (8)	0.01	2.1	c
Vanadium	580	NE	3050	2	55	c
Zinc	25,000	NE	8,100	0.9	8.5 woodcock, 100 inverte-brates	c,d
Hydrocarbons						
Petroleum Hydrocarbon Mixtures:						
DRO	8,250	12,500	230	NE	NE	--
RRO	8,300	22,000	9,700	NE	NE	--
High Molecular Weight PAHs:						
Benzo(a)anthracene	9	NE	5.5	3	NE	--
Benzo(a)pyrene	0.9	NE	2.4	0.1	NE	--
Benzo(b)fluoranthene	9	NE	17	NE	NE	--
Benzo(k)fluoranthene	93	NE	170	40	NE	--
Benzo(g,h,i)perylene	2,500[j]	NE	1,400[j]	30	NE	--
Chrysene	930	NE	550	40	NE	--
Dibenzo(a,h)anthracene	0.9	NE	5	NE	NE	--
Indeno(1,2,3-cd)pyrene	9	NE	50	2	NE	--
Pyrene	2,500	NE	1,400	NE	NE	--
Low Molecular Weight PAHs:						
Acenaphthene	5,000	NE	190	NE	20	e
Acenaphthylene	5,000[j]	NE	190[j]	NE	20	1
Anthracene	24,900	NE	3,900	2	NE	--
Fluoranthene	3,300	NE	1,900	300	NE	--
Fluorene	3,300	NE	240	30	30	d
Naphthalene	1,700	92	19	0.1	10	e
Phenanthrene	24,900[j]	NE	3,900[j]	30	NE	--
Total PAHs (Sum of 10[k])	NE	NE	NE	40	40	f
PCBs						

TABLE 2-19 (CONTINUED)
HUMAN RISK-BASED SCREENING LEVELS AND ECOLOGICAL BENCHMARKS FOR SOIL
Salt Chuck Mine – Tongass National Forest, Alaska

Chemical	ADEC Soil Cleanup Levels[a]			Ecological Benchmarks		
	Ingestion (mg/kg)	Inhalation (mg/kg)	Migration to Groundwater (mg/kg)	ADEC Soil ERBSC (mg/kg)	Other Applicable Benchmarks[b]	
					(mg/kg)	Reference
Arochlor 1016	NE (24)	NE	NE	NE	NE	--
Arochlor 1221	NE (0.83)	NE	NE	NE	NE	--
Arochlor 1232	NE (0.83)	NE	NE	NE	NE	--
Arochlor 1242	NE (0.83)	NE	NE	NE	NE	--
Arochlor 1248	NE (0.83)	NE	NE	NE	NE	--
Arochlor 1254	NE (0.83)	NE	NE	NE	NE	--
Arochlor 1260	NE (0.83)	NE	NE	NE	NE	--
Total PCBs	1	1	NE	0.5	0.371	c

Notes:
- ADEC = Alaska Department of Environmental Conservation
- Cr = Chromium
- DRO = Diesel range organics
- Eco-SSL = Ecological soil screening level
- ERBSC = Environmental Risk-Based Screening Concentration
- mg/kg = Milligrams per kilogram
- NE = Not established.
- NEIC = Netherlands Ecotoxicity Intervention Criteria
- ORNL = Oak Ridge National Laboratory
- PAHs = Polynuclear aromatic hydrocarbons
- PRG = Preliminary Remediation Goal
- QAPP = Quality Assurance Project Plan
- RBSL = Risk-based screening levels
- RRO = Residual range organics

References:
- a = ADEC (2006) Method Two soil cleanup levels for over 40-inch zone. Where ADEC values not established, numbers in parentheses are USEPA (2006b) Region 6 human health screening levels for direct contact with Industrial Soil-Outdoor Worker, or soil screening levels for migration to groundwater using a dilution factor (DAF) of 20 due to high precipitation (USEPA, 2002).
- b = Values in parentheses are Eco-SSLs (USEPA, 2005c, 2005d, 2006c) as available, and represent lowest Eco-SSL greater than ADEC value. Other benchmarks selected in the following order of preference:
  - c = ORNL (1997a) Preliminary Remediation Goals for Ecological Endpoints: Wildlife.
  - d = ORNL (1997c) Toxicological Benchmarks for Soil Invertebrates: 1997 Revision
  - e = ORNL (1997b) Toxicological Benchmarks for Terrestrial Plants: 1997 Revision
  - f = NEIC (Netherlands Dept. of Soil Protection, 2000, value is for class of chemicals.
- g = Industrial processes for development of Cr VI at this site are not suspected.
- h = Pathway-specific values not established for lead. ADEC (2005a) residential land use value listed.
- i = ADEC (2007a) Appendix D: Environmental media-specific conservative screening values.
- j = ADEC (2003a) additional cleanup values corresponding to Method Two soil cleanup levels.
- k = Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluorathene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene, and phenanthrene.
- l = NE, acenaphthene used as a surrogate.

TABLE 2-20
HUMAN RISK-BASED SCREENING LEVELS AND ECOLOGICAL BENCHMARKS FOR WATER
Salt Chuck Mine – Tongass National Forest, Alaska

Chemical	Human Health RBSLs		Ecological Benchmarks			
	ADEC Drinking Water MCLs[a] (µg/L)	WQC for Fish Ingestion[b] (µg/L)	ADEC Freshwater ERBSC[e] (µg/L)	Other Freshwater WQC[f] (µg/L)	ADEC Marine ERBSC[e] (µg/L)	Other Saltwater WQC[g] (µg/L)
Metals						
Antimony	6	4,300	30	30[j]	500	500[j]
Arsenic	10	0.14	13[u]	150	50[u]	36
Beryllium	4	4[t]	0.5	5.3[j]	NE	8.8
Cadmium	5	5[t]	0.05	0.23[q]	9	9.3
Chromium, Total or III[p]	100	100[t]	8	68[q]	100	NE
Copper	1,000	1,300[h]	0.2	8.18[q]	3	3.1
Lead	15[i]	NE	1	2.24[q]	8	8.1
Mercury	2	0.051	0.01[v]	0.77	0.03[v]	0.94
Nickel	100[m]	4,600	5	48[q]	8	8.2
Selenium	50	11,000	0.4	5.0	70	71
Silver	100	NE	0.05	2.88[kq]	0.4	1.9[k]
Thallium	2	6.3	0.4	40[j]	20	NE
Vanadium	NE	NE	NE	20[n]	NE	NE
Zinc	5,000	69,000	20	108[q]	80	81
Hydrocarbons						
Petroleum Hydrocarbon Mixtures						
DRO	No Sheen	No Sheen[s]	NE	No Sheen[l]	NE	No Sheen[l]
RRO	No Sheen	No Sheen[s]	NE	No Sheen[l]	NE	No Sheen[l]
High Molecular Weight PAHs:						
Benzo(a)anthracene	NE	0.018	0.02	0.027[n]	NE	NE
Benzo(a)pyrene	0.2	0.018	0.01	0.014[n]	NE	NE
Benzo(b)fluoranthene	NE	0.018	NE	NE	NE	NE
Benzo(k)fluoranthene	NE	0.018	NE	NE	NE	NE
Benzo(g,h,i)perylene	NE	NE	NE	NE	NE	NE
Chrysene	NE	0.018	NE	NE	0.5	NE
Dibenzo(a,h)anthracene	NE	0.018	0.03	NE	0.5	NE
Indeno(1,2,3-cd)pyrene	NE	0.018	NE	NE	NE	NE
Pyrene	960[m]	11,000	0.03	NE	NE	NE
Low Molecular Weight PAHs:						
Acenaphthene	1,200[m]	2,700	6	520[j]	10	710[j]
Acenaphthylene	NE	NE	NE	NE	NE	NE
Anthracene	9,600[m]	110,000	NE	NE	NE	NE
Fluoranthene	300[m]	370	0.04	3,980[j,k]	2	16[j]
Fluorene	1,300[m]	14,000	3	NE	NE	NE
Naphthalene	NE	NE	1	620[j]	20	2,350[j,k]
Phenanthrene	NE	NE	0.4	6.3[j]	8	4.6[j]
Total PAHs	NE	NE	NE	15[l,r]	NE	15[l,r]
PCBs						
Arochlor 1016	NE	NE	NE	NE	NE	0.03
Arochlor 1221	NE	NE	NE	NE	NE	0.03
Arochlor 1232	NE	NE	NE	NE	NE	0.03
Arochlor 1242	NE	NE	NE	NE	NE	0.03
Arochlor 1248	NE	NE	NE	NE	NE	0.03
Arochlor 1254	NE	NE	NE	NE	NE	0.03
Arochlor 1260	NE	NE	NE	NE	NE	0.03

TABLE 2-20 (CONTINUED)
HUMAN RISK-BASED SCREENING LEVELS AND ECOLOGICAL BENCHMARKS FOR WATER
Salt Chuck Mine – Tongass National Forest, Alaska

Chemical	Human Health RBSLs		Ecological Benchmarks			
	ADEC Drinking Water MCLs[a] (µg/L)	WQC for Fish Ingestion[b] (µg/L)	ADEC Freshwater ERBSC[e] (µg/L)	Other Freshwater WQC[f] (µg/L)	ADEC Marine ERBSC[e] (µg/L)	Other Saltwater WQC[g] (µg/L)
Total PCBs	0.5	0.000064	0.0007	0.014	0.03	0.03
Water Quality Parameters						
pH	6.0-8.5[m]	NA	NE	6.5-8.5, and ≤ 0.5±NC[l]	NE	6.5-8.5, and ≤ 0.2±NC[l]
Temperature (°C)	15[m]	NA	NE	15[l]	NE	1>NC[l]
TDS (%)	0.05[m]	NA	NE	0.1[l]	NE	0.4>NC[l]
Turbidity (NTU)	5	NA	NE	25>NC[l]	NE	25
Dissolved Oxygen	>4[m]	NA	NE	7-17[l]	NE	5-17[l]

Notes:
- ADEC = Alaska Department of Environmental Conservation
- AWQC = Ambient Water Quality Criteria
- ERBSC = Ecological risk-based screening concentration
- MCL = Maximum Contaminant Level
- mg/L = Milligrams per liter
- µg/L = Micrograms per liter
- NA = Not applicable
- NC = Natural conditions
- NE = Not established
- PAHs = Polynuclear Aromatic Hydrocarbons
- PCBs = Polychlorinated Biphenyls
- RBSL = Risk-based screening level
- SQuiRT = Screening Quick Reference Tables
- TAqH = Total aqueous hydrocarbons
- USEPA = U.S. Environmental Protection Agency
- WQC = Water Quality Criteria

References:
- a = ADEC (2006c) drinking water MCLs, unless otherwise noted. Applicable to freshwater only.
- b = WQC applicable to both freshwater and saltwater, selected in the following order of preference:
- c = ADEC (2003b) criteria for noncarcinogens, consumption of aquatic organisms only.
- d = USEPA (2004) AWQC: Human Health for Consumption of Organism Only, unless otherwise noted.
- e = ADEC (2007a) Environmental media-specific conservative screening values.
- f = ADEC (2003b, 2006a) AWQC: Freshwater Aquatic Life chronic, unless otherwise noted.
- g = ADEC (2003b, 2006a)/USEPA (2004) AWQC: Saltwater Aquatic Life chronic, unless otherwise noted.
- h = NE, USEPA (2002a) value for consumption of water and organism listed.
- i = Lead action level for drinking water systems under ADEC (2006b) and USEPA (2005b).
- j = Proposed AWQC [USEPA (1986) and/or NOAA (1999) SQuiRT values].
- k = NE, acute value listed.
- l = ADEC (2006a) WQC for aquatic life and/or aquaculture water supply.
- m = ADEC (2003b, 2006a) WQC for freshwater drinking water supply.
- n = Secondary chronic value as cited in ORNL (1996, 1997a).
- p = Industrial processes for development of Cr VI not suspected at this site.
- q = Average of site hardness data (filtered), 90 mg/L, used to derive criteria using ADEC (2005) calculator.
- r = Value for TAqH, equals sum of PAHs + BTEX (not suspected onsite).
- s = ADEC (2006a) WQC for seafood processing water supply.
- t = NE, USEPA (2004) defaults to drinking water MCL.
- u = ERBSCs for Arsenic III and Arsenic V.
- v = ERBSC for inorganic mercury.

TABLE 2-21
HUMAN RISK-BASED SCREENING LEVELS AND ECOLOGICAL BENCHMARKS FOR TISSUE
Salt Chuck Mine – Tongass National Forest, Alaska

Chemical	Human Health RBSLs		Ecological Benchmarks		
	Shellfish Ingestion RBSL (µg/g tissue)	Reference	Screening Values (µg/g)		Reference
			Dry Weight	Wet Weight	
Metals					
Antimony	0.54	c	NE	NE	--
Arsenic	0.003/0.026	b	NE	NE	--
Barium	270	c	NE	NE	--
Beryllium	2.7	c	NE	NE	--
Cadmium	0.49/4.0	b	NE	NE	--
Chromium	2,000	c	NE	NE	--
Copper	54	c	23.9/80.3	NE	h
Iron	NE	--	NE	NE	--
Lead	NA[d]	--	NE	NE	--
Mercury	0.049/0.4	b	NE	0.033/3	i/j
Nickel	27	c	NE	NE	--
Selenium	2.5/20	b	NE	1.0	k
Silver	6.8	c	NE	NE	--
Thallium	0.095	c	NE	NE	--
Vanadium	1.4	c	NE	NE	--
Zinc	410	c	NE	NE	--
Hydrocarbons					
Petroleum Hydrocarbon Mixtures:					
DRO	NE	--	NE	NE	--
RRO	NE	--	NE	NE	--
High Molecular Weight PAHs:					
Benzo(a)anthracene	0.0043	c	NE	NE	--
Benzo(a)pyrene	0.000673/0.00547	b	NE	NE	--
Benzo(b)fluoranthene	0.0043	c	NE	NE	--
Benzo(k)fluoranthene	0.043	c	NE	NE	--
Benzo(g,h,i)perylene	0.0043[e]	c	NE	NE	--
Chrysene	0.43	c	NE	NE	--
Dibenzo(a,h)anthracene	0.00043	c	NE	NE	--
Indeno(1,2,3-cd)pyrene	0.0043	c	NE	NE	--
Pyrene	41	c	NE	NE	--
Low Molecular Weight PAHs:					
Acenaphthene	81	c	NE	NE	--
Acenaphthylene	81[f]	c	NE	NE	--
Anthracene	410	c	NE	NE	--
Fluoranthene	54	c	NE	NE	--
Fluorene	54	c	NE	NE	--
Naphthalene	27	c	NE	NE	--
Phenanthrene	410[g]	c	NE	NE	--
Total PAHs	0.000673/0.00547	b	NE	NE	--
PCBs:					
Arochlor 1016	0.045	c	NE	NE	--
Arochlor 1221	0.0016	c	NE	NE	--
Arochlor 1232	0.0016	c	NE	NE	--
Arochlor 1242	0.0016	c	NE	NE	--
Arochlor 1248	0.0016	c	NE	NE	--
Arochlor 1254	0.0016	c	NE	NE	--
Arochlor 1260	0.0016	c	NE	NE	--
Total PCBs	0.00245/0.02	b	NE	0.436	l

TABLE 2-21 (CONTINUED)
HUMAN RISK-BASED SCREENING LEVELS AND ECOLOGICAL BENCHMARKS FOR TISSUE
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:

CCME	=	Canadian Council of the Ministers of the Environment
DRO	=	Diesel range organics
ECW	=	environmental contaminant in wildlife
Hg	=	mercury
µg/g	=	Micrograms per gram (= mg/kg or ppm)
NA	=	Not applicable
NE	=	Not established
NEHC	=	Navy Environmental Health Center
NOEC	=	No Observed Effects Concentration
PAHs	=	Polynuclear aromatic hydrocarbons
PCBs	=	Polychorinated biphenyls
PRG	=	Preliminary Remediation Goal
RRO	=	Residual range organics
Se	=	selenium
USEPA	=	U.S. Environmental Protection Agency

References:

a	=	Benchmarks selected in the following order of preference:
	b	= USEPA (2000b) Screening Value for fish ingestion (subsistence/recreational).
	c	= USEPA (2006a) Region 3 values for fish/shellfish ingestion.
d	=	Lead evaluated separately in Table 4-5.
e	=	Indeno(1,2,3-cd)pyrene used as surrogate.
f	=	Acenaphthene used as surrogate.
g	=	Anthracene used as surrogate.
h	=	Salazar and Salazar (2003) tissue levels indicating harm to invertebrates: NOEC/mean effects concentration.
i	=	CCME (1991a, 2006) maximum concentration of methyl Hg in fish/shellfish consumed by wildlife.
j	=	Beyer et al. (1996) total Hg ECW for protection of fish.
k	=	CCME (1991b, 2006) aquatic life (tissue) guideline for Se.
l	=	NEHC (2005) bioaccumulation endpoint for saltwater invertebrate tissue.

TABLE 2-22
ECOLOGICAL BENCHMARKS FOR SEDIMENT
Salt Chuck Mine – Tongass National Forest, Alaska

Chemical	Freshwater Stream Tailings Benchmarks			Saltwater Sediment/ Intertidal Tailings Benchmarks[g]			
	ADEC Screening Values[a] (mg/kg)	Other Benchmarks		ADEC Screening Values[h] (mg/kg)	TELs/ PELs[j]	Other Benchmarks	
		mg/kg	Reference[b]			mg/kg	Reference
Metals							
Antimony	NE	3	e,o	NE	NE	9.3	l, p
Arsenic	6	5.9/17	c	8	7.24/41.6	8.2/70	i
Barium	NE	48	f	NE	NE	48	l, q
Beryllium	NE	NE	--	NE	NE	NE	--
Cadmium	0.6	0.596/3.53	c	1	0.676/4.21	1.2/9.6	i
Chromium	40	37.3/90	c	80	52.3/160.4	81/370	i
Copper	40	35.7/197	c	30	18.7/108.4	34/270	i
Iron	NE	40,000	e,p	NE	NE	220,000	l, r
Lead	40	35/91.3	c	50	30.2/112.18	47/218	i
Mercury	0.2	0.174/0.486	c	0.2	0.13/0.696	0.15/0.71	i
Nickel	2	18/35.9	c	2	15.9/42.8	21/52	i
Selenium	NE	1.0	f	NE	NE	1.0	l, q
Silver	NE	1.0/3.7	d	1	0.73/1.77	1.0/3.7	i
Thallium	NE	NE	--	NE	NE	NE	--
Vanadium	NE	57	f	NE	NE	57	l, r
Zinc	100	123.1/315	c	200	124/271	150/410	i
Hydrocarbons							
Petroleum Hydrocarbon Mixtures:							
DRO	NA	NA	--	NE	NE	NE	--
RRO	NA	NA	--	NE	NE	NE	--
High Molecular Weight PAHs							
Benzo(a)anthracene	NA	NA	--	0.3	0.07483/0.69253	0.261/1.6	i
Benzo(a)pyrene	NA	NA	--	0.4	0.08881/0.76322	0.43/1.6	i
Benzo(b)fluoranthene	NA	NA	--	NE	NE	2.8	k
Benzo(k)fluoranthene	NA	NA	--	NE	NE	2.8	k
Benzo(g,h,i)perylene	NA	NA	--	NE	NE	0.72	k
Chrysene	NA	NA	--	0.4	0.10777/0.84598	0.384/2.8	i
Dibenzo(a,h)anthracene	NA	NA	--	0.06	0.00622/0.13461	0.063/0.26	i
Indeno(1,2,3-cd)pyrene	NA	NA	--	NE	0.02021/0.20128	0.69	k
Pyrene	NA	NA	--	0.7	0.15266/1.3976	0.665/2.6	i
Total High Molecular Weight PAHs	NA	NA	--	0.5	0.65534/6. 67614	1.7/9.6	i
Low Molecular Weight PAHs:							
Acenaphthene	NA	NA	--	0.007	0.00671/0.0889	0.016/0.5	i
Acenaphthylene	NA	NA	--	0.006	0.00587/0.12787	0.044/0.64	i
Anthracene	NA	NA	--	0.09	0.04685/0.245	0.085/1.1	i
Fluoranthene	NA	NA	--	0.1	0.11282/1.49354	0.6/5.1	i
Fluorene	NA	NA	--	0.5	0.02187/0.14435	0.019/0.54	i
Naphthalene	NA	NA	--	0.2	0.03457/0.39064	0.16/2.1	i
Phenanthrene	NA	NA	--	0.2	0.08668/0.54353	0.24/1.5	i
Total Low Molecular Weight PAHs	NA	NA	--	2	0.3117/1.442	0.552/3.16	i
Total PAHs	NA	NA	--	4	1.68406/16.7704	4.0/45	l
PCBs:							
Arochlor 1016	NA	NA	--	NE	NE	0.53	m
Arochlor 1221	NA	NA	--	NE	NE	0.12	m
Arochlor 1232	NA	NA	--	NE	NE	0.60	m
Arochlor 1242	NA	NA	--	NE	NE	29	m
Arochlor 1248	NA	NA	--	NE	NE	1.0	m
Arochlor 1254	NA	NA	--	NE	NE	72	m
Arochlor 1260	NA	NA	--	NE	NE	63	m
Total PCBs	NA	NA	--	0.02	0.02155/0.18879	0.023/0.180	i

TABLE 2-22 (CONTINUED)
ECOLOGICAL BENCHMARKS FOR SEDIMENT
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:

AET	=	Apparent effects threshold
DRO	=	Diesel range organics
ERL	=	Effects range low
ERM	=	Effects range medium
mg/kg	=	Milligrams per kilogram
NA	=	Not applicable; organics analyses not conducted for this media
NE	=	Not established
NOAA	=	National Oceanic and Atmospheric Administration
ORNL	=	Oak Ridge National Laboratory
PAHs	=	Polynuclear aromatic hydrocarbons
PCBs	=	Polychorinated biphenyls
PRG	=	Preliminary remedial goal
PEL	=	Probable effects level
RRO	=	Residual range organics
SQuiRT	=	Screening Quick Reference Tables
SQG	=	Sediment Quality Guidelines
TEL	=	Threshold effects level
UET	=	Upper effects threshold
USEPA	=	U.S. Environmental Protection Agency

References:

- a = ADEC (2007a) Environmental media-specific conservative screening values: freshwater sediment.
- b = Other benchmarks selected for stream tailings in the following order of preference:
  - c = TELs/PELs (ADEC, 2004b; NOAA, 1999; MacDonald, 1994)
  - d = ERL/ERM NOAA marine benchmarks (Long et al., 1995; NOAA, 1999)
  - e = NOAA freshwater UET (NOAA, 1999)
  - f = NOAA marine SQuiRT values (NOAA, 1999)
- g = Other saltwater benchmarks selected in the following order of preference:
  - h = ADEC (2007a) Environmental media-specific conservative screening values: saltwater sediment
  - i = ERL/ERM NOAA marine benchmarks (Long et al., 1995; NOAA, 1999)
  - j = Marine sediment TELs/PELs (ADEC, 2004b; NOAA, 1999)
  - k = Sediment Cleanup Objectives for Commencement Bay (USEPA, 1993a)
  - l = NOAA marine AET (NOAA, 1999)
  - m = ORNL (1997a) PRGs for sediment
- n = UET based on microtoxicity bioassay (NOAA, 1999)
- o = UET based on informal community impacts (NOAA, 1999)
- p = Lowest AET for echinoderm larvae (NOAA, 1999)
- q = Lowest AET for amphipods (NOAA, 1999)
- r = Lowest AET based on *Neanthes* bioassay (NOAA, 1999)

TABLE 2-23
HUMAN HEALTH RISK SCREENING RESULTS FOR SOIL
Salt Chuck Mine – Tongass National Forest, Alaska

Compound	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Detection Frequency	Range of Detection Limits (mg/kg)	Background Concentration (mg/kg)[1]	RBSL		Detection Frequency Above RBSL	Risk Factor Score[3]/ Background Ratio[5]	Retained as COHC for Further Evaluation in SRE?
						mg/kg	Source[2]			
Total Metals										
Antimony	0.143	15.4	4/6	0.526-1.32	ND (0.384)	3(33)	a	1/6	5.1 (0.47)[6]	**Yes**
Arsenic	2.74	4.95	4/5	0.22-4.40	4.06	1.8(4.5)	a	3/5	2.8(1.1)[6]/ 1.2[5]	**Yes**
Beryllium	0.258	0.258	1/3	0.118-0.440	0.272	38	a	0/3	0.0068	No
Cadmium	ND	ND	0/3	0.236-0.880	ND (0.256)	4.5	a	0/3	0.098	No
Chromium	8.09	25.6	2/3	1.18-4.40	40.0	23	a	1/3	1.1/ 0.64[5]	No[4]
Copper	65.8	7,320	5/5	0.27-11.8	45.6	3,320	b	2/5	2.2	**Yes**
Lead	19.0	6,170	6/6	0.07-1.18	13.5	400	A	2/6	15	**Yes**
Mercury	0.178	311	4/5	0.2-6.99	0.0922	1.24(13)	A	3/5	250(24)[6]	**Yes**
Nickel	16.0	16.8	2/3	2.36-8.80	11.1	78	A	0/5	0.22	No
Selenium	0.19	8.36	3/5	0.02-4.40	ND (1.28)	3(420)	A	1/5	2.8(0.020)[6]	**Yes**
Silver	0.196	17.8	3/3	0.118-0.440	0.205	19	a	0/3	0.94	No
Thallium	ND	0.0624	1/3	0.0236-0.0880	ND (0.0256)	8	c	0/3	0.0078	No
Vanadium	24.7	237	5/5	0.07-8.80	460	580	d	0/5	0.41	No
Zinc	38.8	290	5/5	1.1-5.9	30.9	8,100	a	0/5	0.036	No
Petroleum Hydrocarbon Mixtures										
DRO/EPH	174	17,400	10/10	26.1-2,090	685	230 (8,250)	a	9/10	76(2.1)[6]/ 25[5]	**Yes**
DRO Silica Gel	2,210	4,580	3/4	25.8-149	NA	230 (8,250)	a	3/4	20(0.56)[6]	**Yes**
RRO	195	7,400	10/10	26.1-2,090	907	8,300	d	0/10	0.89	No
RRO Silica Gel	375	1,210	3/4	25.8-149	NA	8,300	d	0/4	0.15	No
TRPH	9,100	9,100	1/2	2,600-3,600	NA	230 (8,250)	a,e	1/2	40(1.1)[6]	**Yes**
PAHs										
High Molecular Weight PAHs:										
Benzo(a)anthracene	0.0103	0.0103	1/2	0.00646-0.0759	NA	5.5	a	0/2	0.0019	No
Benzo(a)pyrene	0.00844	0.00844	1/2	0.00646-0.0759	NA	0.9	d	0/2	0.042	No
Benzo(b)fluoranthene	ND	ND	0/2	0.00646-0.0759	NA	9	d	0/2	0.0042	No
Benzo(k)fluoranthene	ND	ND	0/2	0.00646-0.0759	NA	93	d	0/2	0.00041	No
Benzo(g,h,i)perylene	ND	ND	0/2	0.00646-0.0759	NA	1,400	f	0/2	0.000027	No
Chrysene	0.0256	0.0256	0/2	0.013-0.17	NA	550	a	0/2	0.000047	No
Dibenzo(a,h)anthracene	ND	ND	0/2	0.00646-0.0759	NA	0.9	d	0/2	0.042	No
Indeno(1,2,3-cd)pyrene	ND	ND	0/2	0.00646-0.0759	NA	9	d	0/2	0.0042	No
Pyrene	ND	ND	0/2	0.00646-0.0759	ND	1,400	a	0/2	0.000027	No
Low Molecular Weight PAHs:										
Acenaphthene	ND	ND	0/2	0.0646-0.0759	NA	190	a	0/2	0.00020	No

TABLE 2-23 (continued)
HUMAN HEALTH RISK SCREENING RESULTS FOR SOIL
Salt Chuck Mine – Tongass National Forest, Alaska

Compound	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Detection Frequency	Range of Detection Limits (mg/kg)	Background Concentration (mg/kg)[1]	RBSL		Detection Frequency Above RBSL	Risk Factor Score[3]/ Background Ratio[5]	Retained as COHC for Further Evaluation in SRE?
						mg/kg	Source[2]			
Acenaphthylene	ND	ND	0/2	0.0646-0.0759	NA	190	f	0/2	0.00020	No
Anthracene	ND	ND	0/2	0.00646-0.0759	NA	3,900	a	0/2	0.0000097	No
Fluoranthene	ND	ND	0/2	0.00646-0.0759	NA	1,900	a	0/2	0.000020	No
Fluorene	ND	ND	0/2	0.0646-0.0759	NA	240	a	0/2	0.00016	No
Naphthalene	ND	ND	0/2	0.00646-0.0759	NA	19	a	0/2	0.0020	No
Phenanthrene	ND	ND	0/2	0.00646-0.0759	NA	3,900	f	0/2	0.0000097	No

Notes:
1 = Background soil data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects (ADEC, 2003c).
2 = Most conservative human health value listed in Table 2-19:
a = ADEC (2006) Method Two soil cleanup level for over 40-inch zone: migration-to-groundwater pathway. (Value for ingestion or inhalation shown in parentheses where migration-to-groundwater value is exceeded.)
b = ADEC (2003a) additional cleanup values corresponding to Method Two soil cleanup levels: ingestion pathway.
c = USEPA (2006b) Region 6 human health screening level: migration-to-groundwater pathway using dilution factor of 20 due to high precipitation (USEPA, 2002).
d = ADEC (2006) Method Two soil cleanup level for over 40-inch zone: ingestion pathway
e = No RBSL established for TRPH; RBSL for DRO is listed.
f = ADEC (2003a) additional cleanup values corresponding to Method Two soil cleanup levels: migration-to-groundwater pathway.
3 = RFS = MDC/RBSL; or ½ maximum DL/RBSL if MDC is ND.
4 = Based on MDC< background.
5 = Second value is MDC/background where background > RBSL.
6 = RFS in parentheses based on ingestion or inhalation RBSL; listed only where migration-to-groundwater RBSL exceeded.
CL = Confidence level
COHC = Chemical of potential human health concern
DL = Detection limit
DRO = Diesel range organics
EPH = Extractable Petroleum Hydrocarbons
MDC = Maximum detected concentration
mg/kg = Milligrams per kilogram
NA = Not analyzed or not applicable
ND = Not detected
PAHs = Polynuclear aromatic hydrocarbons
RBSL = Risk-based screening level
RFS = Risk factor score
RRO = Residual Range Organics
SRE = Streamlined Risk Evaluation
TRPH = Total Recoverable Petroleum Hydrocarbons
Bold = Detected COHC with RFS>1.0

TABLE 2-24
HUMAN HEALTH RISK SCREENING RESULTS FOR UNSATURATED TAILINGS AND SLUDGE
Salt Chuck Mine – Tongass National Forest, Alaska

Compound	Minimum Detected Concentration[1] (mg/kg)	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits (mg/kg)[1,3]	Background Concentration (mg/kg)[4]	RBSL		Detection Frequency Above RBSL and Background		Risk Factor Score[6]/ Background Ratio[7]	Retained as COHC for Further Evaluation in SRE?
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]			mg/kg	Source[5]	All Samples	Non-Character Samples Only[2]		
Total Metals													
Antimony	2	8	5.11	5/7	4/4	0.315-2	ND (0.384)	3(33)	a	3/7	2/4	1.7 (0.15)[9]	**Yes**
Arsenic	1.66	10.2	10.2	5/7	3/4	1.05-2	4.06	1.8(4.5)	a	4/7	2/4	5.7 (2.3)[9]/ 2.5[7]	**Yes**
Beryllium	ND	ND	ND	0/7	0/4	0.105-0.5	0.272	38	a	0/7	0/7	0.0016	No
Cadmium	0.350	1.0	0.976	4/7	3/4	0.210-0.5	ND (0.256)	4.5	a	0/7	0/4	0.22	No
Chromium	1.50	50	5.87	7/7	4/4	1.05-2.28	40.0	23	a	2/7	0/4	0.26/0.15[7]	No
Copper	1,085	53,400	53,400	7/7	4/4	2.10-4.56	45.6	3,320	b	4/7	3/4	16	**Yes**
Lead	0.426	143	143	7/7	4/4	0.210-2	13.5	400	a	0/7	0/4	0.36	No
Mercury	0.05	0.13	ND	3/7	0/4	0.01-4.69	0.0922	1.24	a	0/7	0/4	1.9	*DL*
Nickel	11.9	21	17.1	7/7	4/4	2.10-4.56	11.1	78	a	0/7	0/4	0.22	No
Selenium	8.38	65.4	65.4	3/4	3/4	1.05-2.28	ND (1.28)	3(420)	a	3/4	3/4	22(0.16)[9]	**Yes**
Silver	0.6	43	34.1	7/7	4/4	0.105-0.228	0.205	19(420)	a	2/7	1/4	1.8(0.081)[9]	**Yes**
Thallium	ND	ND	ND	0/7	0/4	0.0210-10	ND (0.0256)	8	c	0/7	0/4	0.0015	No
Vanadium	220	451	314	7/7	4/4	2.10-4.56	460	580	d	0/7	0/4	0.54	No
Zinc	31.1	266	266	7/7	4/4	1.05-2.28	30.9	8,100	a	0/7	0/4	0.033	No
Petroleum Hydrocarbon Mixtures[8]													
DRO (unsaturated tailings)	247	849		2/3		22.1-556	685	230 (8,250)	a	2/3		3.7(0.10)[9]/ 1.2[7]	**Yes**
DRO (sludge)	NA	163,000		1/1		12,000	685	230 (8,250)	a	1/1		710 (20)[9]/ 240	**Yes**
RRO	529	2,918		2/3		22.1-1,090	907	8,300	d	0/4		0.35	No
PAHs[8]													
High Molecular Weight PAHs:													
Benzo(a)anthracene	0.00731	4.05		3/3		0.00554-0.587	NA	5.5	a	0/3		0.74	No
Benzo(a)pyrene	0.0149	2.69		3/3		0.00554-0.587	NA	0.9	d	2/3		3.0	**Yes**
Benzo(b)fluoranthene	2.34	4.87		2/3		0.00554-0.587	NA	9	d	0/3		0.54	No
Benzo(k)fluoranthene	1.77	3.13		2/3		0.00554-0.587	NA	93	d	0/3		0.034	No
Benzo(g,h,i)perylene	0.0179	3.37		3/3		0.00554-0.587	NA	1,400	e	0/3		0.0024	No

TABLE 2-24 (continued)
HUMAN HEALTH RISK SCREENING RESULTS FOR UNSATURATED TAILINGS AND SLUDGE
Salt Chuck Mine – Tongass National Forest, Alaska

Compound	Minimum Detected Concentration[1] (mg/kg)	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits (mg/kg)[1,3]	Background Concentration (mg/kg)[4]	RBSL		Detection Frequency Above RBSL and Background		Risk Factor Score[6]/ Background Ratio[7]	Retained as COHC for Further Evaluation in SRE?
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]			mg/kg	Source[5]	All Samples	Non-Character Samples Only[2]		
Chrysene	0.0193	5.68		3/3		0.00554-0.0587	NA	550	a	0/3		0.010	No
Dibenzo(a,h)anthracene	0.0772	0.0772		1/3		0.00554-0.0587	NA	0.9	d	0/3		0.086	No
Indeno(1,2,3-cd)pyrene	0.0151	3.41		3/3		0.00554-0.587	NA	9	d	0/3		0.38	No
Pyrene	0.0163	13.4		3/3		0.00554-0.587	ND	1,400	a	0/3		0.0096	No
Low Molecular Weight PAHs:													
Acenaphthene	ND	ND		0/3		0.00554-0.0587	NA	190	a	0/3		0.00015	No
Acenaphthylene	0.0657	0.0827		2/3		0.00554-0.0587	NA	190	e	0/3		0.00044	No
Anthracene	0.00433	0.0877		3/3		0.00554-0.0587	NA	3,900	a	0/3		0.000022	No
Fluoranthene	0.0119	14.8		3/3		0.00554-0.587	NA	1,900	a	0/3		0.0078	No
Fluorene	ND	ND		0/3		0.00554-0.0587	NA	240	a	0/3		0.00012	No
Naphthalene	0.0579	0.0579		1/3		0.00554-0.0587	NA	19	a	0/3		0.0030	No
Phenanthrene	1.26	1.26		1/3		0.00554-0.587	NA	3,900	e	0/3		0.00032	No
PCBs[8]:													
Arochlor 1016	ND	ND		0/3		0.0329-0.0358	NA	24	f	0/3		0.00075	No
Arochlor 1221	ND	ND		0/3		0.0329-0.0358	NA	0.83	f	0/3		0.022	No
Arochlor 1232	ND	ND		0/3		0.0329-0.0358	NA	0.83	f	0/3		0.022	No
Arochlor 1242	ND	ND		0/3		0.0329-0.0358	NA	0.83	f	0/3		0.022	No
Arochlor 1248	ND	ND		0/3		0.0329-0.0358	NA	0.83	f	0/3		0.022	No

TABLE 2-24 (continued)
HUMAN HEALTH RISK SCREENING RESULTS FOR UNSATURATED TAILINGS AND SLUDGE
Salt Chuck Mine – Tongass National Forest, Alaska

Compound	Minimum Detected Concentration[1] (mg/kg)	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits (mg/kg)[1,3]	Background Concentration (mg/kg)[4]	RBSL		Detection Frequency Above RBSL and Background		Risk Factor Score[6]/ Background Ratio[7]	Retained as COHC for Further Evaluation in SRE?
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]			mg/kg	Source[5]	All Samples	Non-Character Samples Only[2]		
Arochlor 1254	0.120	0.244		2/3		0.0330-0.0358	NA	0.83	f	0/3		0.29	No
Arochlor 1260	0.121	0.175		2/3		0.0330-0.0358	NA	0.83	f	0/3		0.21	No
Total PCBs	0.329	0.501		2/3		NA	NA	1	b	0/3		0.50	No

Notes:
1 = For all samples.
2 = Non-standardized laboratory methods used for character samples.
3 = DLs not available for some character sample analytes.
4 = Background soil data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects (ADEC, 2003c).
5 = Most conservative human health value listed in Table 2-19:
a = ADEC (2006) Method Two soil cleanup level for over 40-inch zone: migration-to-groundwater pathway. (Value for ingestion shown in parentheses where migration-to-groundwater value is exceeded.)
b = ADEC (2003a) additional cleanup values corresponding to Method Two soil cleanup levels: ingestion pathway.
c = USEPA (2006b) Region 6 human health screening level: migration-to-groundwater pathway using dilution factor of 20 due to high precipitation (USEPA, 2002).
d = ADEC (2006) Method Two soil cleanup level for over 40-inch zone: ingestion pathway
e = ADEC (2003a) additional cleanup values corresponding to Method Two soil cleanup levels: migration-to-groundwater pathway.
f = USEPA (2006b) Region 6 human health screening level: ingestion pathway for industrial-outdoor worker.
6 = Based on MDC or DLs for non-character samples only: RFS = MDC/RBSL; or ½ maximum DL/RBSL if MDC is ND.
7 = Second value is MDC/background where background > RBSL.
8 = All data are from non-character samples.
9 = RFS in parentheses based on ingestion RBSL; listed only where migration-to-groundwater RBSL exceeded.
CL = Confidence level
COHC = Chemical of potential human health concern
DL = Detection limit
DL = ½ maximum DL>RBSL.
DRO = Diesel range organics
MDC = Maximum detected concentration
mg/kg = Milligrams per kilogram
NA = Not analyzed or not applicable
ND = Not detected
PAHs = Polynuclear aromatic hydrocarbons
PCBs = Polychlorinated Biphenyls
RBSL = Risk-based screening level
RFS = Risk factor score
RRO = Residual Range Organics
SRE = Streamlined Risk Evaluation
Bold = Detected COHC with RFS>1.0

TABLE 2-25
HUMAN HEALTH RISK SCREENING RESULTS FOR STREAM TAILINGS
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration[1] (mg/kg)	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits[1,3] (mg/kg)	Background Concentration (mg/kg)[4]	RBSL		Detection Frequency Above RBSL		Risk Factor Score[6]	Retained as COHC for Further Evaluation in SRE?
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]			mg/kg	Source[5]	All Samples	Non-Character Samples Only[2]		
Total Metals													
Antimony	ND	ND	ND	0/2	0/1	0.684-2	ND (0.384)	3	a	0/2	0/1	0.12	No
Arsenic	6	6	ND	1/2	0/1	2-2.28	4.06	1.8	a	1/2	0/1	0.63	No
Beryllium	ND	ND	ND	0/2	0/1	0.228-0.5	0.272	38	a	0/2	0/1	0.0030	No
Cadmium	ND	ND	ND	0/2	0/1	0.456-0.5	ND (0.256)	4.5	a	0/2	0/1	0.051	No
Chromium	40	40	ND	1/2	0/1	2.28	40.0	23	a	1/2	0/1	0.050	No
Copper	493	709	709	2/2	1/1	4.56	45.6	3,320	b	0/2	0/1	0.21	No
Lead	4.51	12	4.51	1/2	1/1	0.456-2	13.5	400	a	0/2	0/1	0.011	No
Mercury	0.44	0.44	ND	1/2	0/1	0.01-8.97	0.0922	1.24	a	0/2	0/1	3.6	*DL*
Nickel	9.35	15	9.35	2/2	1/1	4.56	11.1	78	a	0/2	0/1	0.12	No
Selenium	ND	ND	ND	0/2	0/1	2.28	ND (1.28)	3	a	0/2	0/1	0.38	No
Silver	0.2	0.373	0.373	2/2	1/1	0.2-0.228	0.205	19	a	0/2	0/1	0.020	No
Thallium	ND	ND	ND	0/2	0/1	0.0456-1	ND (0.0256)	8	c	0/2	0/1	0.0029	No
Vanadium	219	225	225	2/2	1/1	4.56	460	580	d	0/2	0/1	0.39	No
Zinc	29.9	92	29.9	2/2	1/1	2.28	30.9	8,100	a	0/2	0/1	0.0037	No

Notes:
1 = For all samples.
2 = Non-standard laboratory methods used for character samples.
3 = DLs not available for some character sample analytes.
4 = Background soil data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects (ADEC, 2003c).
5 = Most conservative human health value listed in Table 2-19:
a = ADEC (2006) Method Two soil cleanup level for over 40-inch zone: migration-to-groundwater pathway.
b = ADEC (2003a) additional cleanup values corresponding to Method Two soil cleanup levels: ingestion pathway.
c = USEPA (2006b) Region 6 human health screening level: migration-to-groundwater pathway using dilution factor of 20 due to high precipitation (USEPA, 2004b).
d = ADEC (2006) Method Two soil cleanup level for over 40-inch zone: ingestion pathway
6 = Based on MDC or DL from non-character sample only: RFS = MDC/RBSL; or ½ maximum DL/RBSL if MDC is ND.
CL = Confidence level
COHC = Chemical of potential human health concern
DL = Detection limit
DL = Based on ½ maximum DL>RBSL
MDC = Maximum detected concentration
mg/kg = Milligrams per kilogram
NA = Not applicable or not analyzed
ND = Not detected
RBSL = Risk-based screening level
RFS = Risk factor score
SRE = Streamlined Risk Evaluation

TABLE 2-26
HUMAN HEALTH RISK SCREENING RESULTS FOR INTERTIDAL TAILINGS
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration (mg/kg)[1]	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits[1,3] (mg/kg)	Background Concentration (mg/kg)[4]	RBSL		Detection Frequency Above RBSL		Risk Factor Score[6]/ Background Ratio[8]	Retained as COHC for Further Evaluation in SRE?
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]			mg/kg	Source[5]	All Samples	Non-Character Samples Only[2]		
Total Metals													
Antimony	ND	ND	ND	0/36	0/5	0.329-2	ND (0.343)	3	a	0/36	0/5	0.066	No
Arsenic	1.28	8	5.42	35/41	9/10	0.26-2	2.45	1.8(4.5)	a	32/41	6/10	3.0(1.2)[9]/ 2.2[8]	**Yes**
Beryllium	ND	ND	ND	0/36	0/6	0.11-0.5	ND (0.114)	38	a	0/36	0/16	0.0017	No
Cadmium	0.045	0.246	0.246	3/40	3/9	0.013-0.5	ND (0.229)	4.5	a	0/40	0/9	0.055	No
Chromium	2.91	137	3.95	37/37	10/10	1.1-1.39	90.8	23	a	30/37	0/10	0.17/0.044[8]	No
Copper	22	3,880	2,580	42/42	10/10	0.26-2.78	37.0	3,320	b	1/42	0/10	0.78	No
Lead	0.721	58	3.30	33/41	10/10	0.09-2	5.01	NA[c]	c	NA[c]	NA[c]	NA[c]	NA[c]
Mercury	0.01	0.243	0.243	37/42	6/11	0.004-5.10	0.0181	1.24	a	0/42	0/11	0.20	No
Nickel	8.66	30.3	16.5	42/42	10/10	0.22-2.78	27.4	78	a	0/42	0/10	0.21	No
Selenium	0.28	1.55	1.55	5/10	5/10	0.02-1.39	0.17	3	a	0/10	0/10	0.52	No
Silver	0.152	2.0	1.26	35/41	10/10	0.006-0.2	0.0667	19	a	0/41	0/10	0.066	No
Thallium	0.0279	0.0378	0.0378	2/36	2/5	0.022-10	0.12	8	d	0/36	0/5	0.0047	No
Vanadium	79.0	801	438	41/41	10/10	0.09-2.78	59.3	580	e	0/41	0/10	0.76	No
Zinc	28.0	109	109	41/41	9/9	1.1-1.4	78.1	8,100	a	0/41	0/9	0.013	No
Petroleum Hydrocarbon Mixtures[7]													
DRO	86	86		1/1		8.3	685	230	a	0/1		0.37/0.13[8]	No
PAHs[7]													
High Molecular Weight PAHs:													
Benzo(a)anthracene	0.0149	0.0313		2/4		0.00550-0.00634	NA	5.5	a	0/4		0.0057	No
Benzo(a)pyrene	0.0115	0.0401		4/4		0.00550-0.00634	NA	0.9	e	0/4		0.045	No
Benzo(b)fluoranthene	0.00890	0.0373		4/4		0.00550-0.00634	NA	9	e	0/4		0.0041	No
Benzo(k)fluoranthene	0.00686	0.0197		4/4		0.00550-0.00634	NA	93	e	0/4		0.00021	No
Benzo(g,h,i)perylene	0.0103	0.0397		4/4		0.00550-0.00634	NA	1,400	f	0/4		0.000028	No
Chrysene	0.0148	0.0290		2/4		0.00550-0.00634	NA	550	a	0/4		0.000058	No
Dibenzo(a,h)anthracene	0.00779	0.00779		1/4		0.00550-0.00634	NA	0.9	e	0/4		0.087	No

TABLE 2-26 (continued)
HUMAN HEALTH RISK SCREENING RESULTS FOR INTERTIDAL TAILINGS
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration (mg/kg)[1]	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits[1,3] (mg/kg)	Background Concentration (mg/kg)[4]	RBSL		Detection Frequency Above RBSL		Risk Factor Score[6]/ Background Ratio[8]	Retained as COHC for Further Evaluation in SRE?
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]			mg/kg	Source[5]	All Samples	Non-Character Samples Only[2]		
Indeno(1,2,3-cd)pyrene	0.00882	0.0335		4/4		0.00550-0.00634	NA	9	e	0/4		0.0037	No
Pyrene	0.0111	0.0572		3/4		0.00550-0.00634	NA	1,400	a	0/4		0.000041	No
Low Molecular Weight PAHs:													
Acenaphthene	ND	ND		0/4		0.00550-0.00634	NA	190	a	0/4		0.000017	No
Acenaphthylene	0.00967	0.0177		2/4		0.00550-0.00634	NA	190	f	0/4		0.000093	No
Anthracene	0.00551	0.0102		2/4		0.00550-0.00634	NA	3,900	a	0/4		0.0000026	No
Fluoranthene	0.00658	0.0660		3/4		0.00550-0.00634	NA	1,900	a	0/4		0.000035	No
Fluorene	ND	ND		0/4		0.00550-0.00634	NA	240	a	0/4		0.000013	No
Naphthalene	ND	ND		0/4		0.00550-0.00634	NA	19	a	0/4		0.00017	No
Phenanthrene	0.00577	0.0181		2/4		0.00550-0.00634	NA	3,900	f	0/4		0.0000046	No
PCBs[7]													
Arochlor 1016	ND	ND		0/4		0.0331-0.114	NA	24	g	0/4		0.0024	No
Arochlor 1221	ND	ND		0/4		0.0331-0.114	NA	0.83	g	0/4		0.069	No
Arochlor 1232	ND	ND		0/4		0.0331-0.114	NA	0.83	g	0/4		0.069	No
Arochlor 1242	ND	ND		0/4		0.0331-0.114	NA	0.83	g	0/4		0.069	No
Arochlor 1248	ND	ND		0/4		0.0331-0.114	NA	0.83	g	0/4		0.069	No
Arochlor 1254	0.235	1.10		2/4		0.0331-0.114	NA	0.83	g	1/4		1.3	**Yes**
Arochlor 1260	0.221	0.804		2/4		0.0331-0.114	NA	0.83	g	0/4		0.97	No
Total PCBs	0.554	2.19		2/4		NA	NA	1	b	1/4		2.2	**Yes**

TABLE 2-26 (continued)
HUMAN HEALTH RISK SCREENING RESULTS FOR INTERTIDAL TAILINGS
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:
1 = For all samples.
2 = Non-standard laboratory methods used for character samples.
3 = DLs not available for some character sample analytes.
4 = Background intertidal sediment data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects, or fewer than 4 samples (ADEC, 2003c).
5 = Most conservative human health value listed in Table 2-19:
a = ADEC (2006) Method Two soil cleanup level for over 40-inch zone: migration-to-groundwater pathway. (Value for ingestion shown in parentheses where migration-to-groundwater value is exceeded.)
b = ADEC (2003a) additional cleanup values corresponding to Method Two soil cleanup levels: ingestion pathway.
c = Lead evaluated separately in Table 2-31.
d = USEPA (2006b) Region 6 human health screening level: migration-to-groundwater pathway using dilution factor of 20 due to high precipitation (USEPA, 2004).
e = ADEC (2006) Method Two soil cleanup level for over 40-inch zone: ingestion pathway
f = ADEC (2003a) additional cleanup values corresponding to Method Two soil cleanup levels: migration-to-groundwater pathway.
g = USEPA (2006b) Region 6 human health screening level: ingestion pathway for industrial-outdoor worker.
6 = Based on MDC or DLs for non-character samples only: RFS = MDC/RBSL; or ½ maximum DL/RBSL if MDC is ND.
7 = All data are from non-character samples.
8 = Second value is MDC/background where background > RBSL.
9 = RFS in parentheses based on ingestion RBSL; listed only where migration-to-groundwater RBSL exceeded.
CL = Confidence level
COHC = Chemical of potential human health concern
DL = Detection limit
DRO = Diesel range organics
MDC = Maximum detected concentration
mg/kg = Milligrams per kilogram
NA = Not applicable or not analyzed
ND = Not detected
PAHs = Polynuclear aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
RBSL = Risk-based screening level
RFS = Risk factor score
SRE = Streamlined Risk Evaluation
Bold = Detected COHC with RFS>1.0

TABLE 2-27
HUMAN HEALTH RISK SCREENING RESULTS FOR SEDIMENT
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration (mg/kg)[1]	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits[1,3] (mg/kg)	Background Concentration (mg/kg)[4]	RBSL		Detection Frequency Above RBSL		Risk Factor Score[6]/ Background Ratio[7]	Retained as COHC for Further Evaluation in SRE?
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]			mg/kg	Source[5]	All Samples	Non-Character Samples Only[2]		
Total Metals													
Antimony	2	2	ND	2/12	0/2	0.359-2	ND (0.343)	3	a	0/12	0/2	0.062	No
Arsenic	1.68	8	7.87	26/26	16/16	0.25-2	2.45	1.894.5)	a	25/26	15/16	4.4(1.7)[8]/ 3.2[7]	**Yes**
Beryllium	1.38	1.38	1.38	1/12	1/2	0.12-0.5	ND (0.114)	38	a	0/12	0/2	0.036	No
Cadmium	0.075	0.5	0.075	5/19	1/9	0.013-0.5	ND (0.229)	4.5	a	0/19	0/9	0.017	No
Chromium	8.01	93.8	16.5	23/23	8/8	1.13-1.29	90.8	23	a	15/23	0/8	0.72	No
Copper	18.6	672	324	28/28	13/13	0.25-2.58	37.0	3,320	b	0/28	0/13	0.098	No
Lead	1.14	16	3.8	23/24	14/14	0.09-2	5.01	NA[c]	c	NA[c]	NA[c]	NA[c]	NA[c]
Mercury	0.01	5.53	5.53	21/32	11/22	0.004-4.91	0.0181	1.24 (13)	a	1/32	1/22	4.5(0.43)[8]	**Yes**
Nickel	7.08	28.3	23.1	28/28	13/13	0.21-2.58	27.4	78	a	0/28	0/13	0.30	No
Selenium	0.17	1.3	1.3	5/13	5/13	0.02-1.29	0.17	3	a	0/13	0/13	0.43	No
Silver	0.02	0.437	0.437	7/18	6/13	0.007-0.2	0.0667	19	a	0/18	0/13	0.052	No
Thallium	0.0389	0.0438	0.0438	2/12	2/2	0.024-10	0.12	8	d	0/12	0/2	0.0055	No
Vanadium	49.0	467	210	23/23	12/12	0.08-2.58	59.3	580	e	0/23	0/12	0.36	No
Zinc	28.9	80.9	80.9	24/24	10/10	1.2-1.3	78.1	8,100	a	0/24	0/10	0.010	No
PAHs[9]													
High Molecular Weight PAHs:													
Benzo(a)anthracene	ND	ND		0/2		0.00611-0.00621	NA	5.5	a	0/2		0.00056	No
Benzo(a)pyrene	ND	ND		0/2		0.00611-0.00621	NA	0.9	e	0/2		0.0034	No
Benzo(b)fluoranthene	ND	ND		0/2		0.00611-0.00621	NA	9	e	0/2		0.00034	No
Benzo(k)fluoranthene	ND	ND		0/2		0.00611-0.00621	NA	93	e	0/2		0.000033	No
Benzo(g,h,i)perylene	ND	ND		0/2		0.00611-0.00621	NA	1,400	f	0/2		0.0000022	No
Chrysene	ND	ND		0/2		0.00611-0.00621	NA	550	a	0/2		0.0000056	No
Dibenzo(a,h)anthracene	ND	ND		0/2		0.00611-0.00621	NA	0.9	e	0/2		0.0034	No
Indeno(1,2,3-cd)pyrene	ND	ND		0/2		0.00611-0.00621	NA	9	e	0/2		0.00034	No

TABLE 2-27 (continued)
HUMAN HEALTH RISK SCREENING RESULTS FOR SEDIMENT
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration (mg/kg)[1]	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits[1,3] (mg/kg)	Background Concentration (mg/kg)[4]	RBSL		Detection Frequency Above RBSL		Risk Factor Score[6]/ Background Ratio[7]	Retained as COHC for Further Evaluation in SRE?
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]			mg/kg	Source[5]	All Samples	Non-Character Samples Only[2]		
Pyrene	0.00901	0.00901		1/2		0.00611-0.00621	NA	1,400	a	0/2		0.0000064	No
Low Molecular Weight PAHs:													
Acenaphthene	ND	ND		0/2		0.00611-0.00621	NA	190	a	0/2		0.000016	No
Acenaphthylene	ND	ND		0/2		0.00611-0.00621	NA	190	f	0/2		0.000016	No
Anthracene	ND	ND		0/2		0.00611-0.00621	NA	3,900	a	0/2		0.00000079	No
Fluoranthene	ND	ND		0/2		0.00611-0.00621	NA	1,900	a	0/2		0.0000016	No
Fluorene	ND	ND		0/2		0.00611-0.00621	NA	240	a	0/2		0.00013	No
Naphthalene	ND	ND		0/2		0.00611-0.00621	NA	19	a	0/2		0.00016	No
Phenanthrene	ND	ND		0/2		0.00611-0.00621	NA	3,900	f	0/2		0.00000079	No
PCBs[9]													
Arochlor 1016	ND	ND		0/4		0.015-0.0376	NA	24	g	0/4		0.00078	No
Arochlor 1221	ND	ND		0/4		0.015-0.0376	NA	0.83	g	0/4		0.023	No
Arochlor 1232	ND	ND		0/4		0.015-0.0376	NA	0.83	g	0/4		0.023	No
Arochlor 1242	ND	ND		0/4		0.015-0.0376	NA	0.83	g	0/4		0.023	No
Arochlor 1248	ND	ND		0/4		0.015-0.0376	NA	0.83	g	0/4		0.023	No
Arochlor 1254	0.868	0.868		1/4		0.015-0.0376	NA	0.83	g	1/4		1.05	**Yes**
Arochlor 1260	0.177	0.540		2/4		0.015-0.0376	NA	0.83	g	0/4		0.65	No
Total PCBs	0.286	1.50		2/4		NA	NA	1	b	1/4		1.5	**Yes**

TABLE 2-27 (continued)
HUMAN HEALTH RISK SCREENING RESULTS FOR SEDIMENT
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:
1 = For all samples.
2 = Non-standard laboratory methods used for character samples.
3 = DLs not available for some character sample analytes.
4 = Background sediment data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects, or fewer than 4 samples (ADEC, 2003c).
5 = Most conservative human health value listed in Table 2-19:
a = ADEC (2006) Method Two soil cleanup level for over 40-inch zone: migration-to-groundwater pathway. (Value for ingestion or inhalation shown in parentheses where migration-to-groundwater value is exceeded.)
b = ADEC (2003a) additional cleanup values corresponding to Method Two soil cleanup levels: ingestion pathway.
c = Lead evaluated separately in Table 2-31.
d = USEPA (2006b) Region 6 human health screening level: migration-to-groundwater pathway using dilution factor of 20 due to high precipitation (USEPA, 2002).
e = ADEC (2006) Method Two soil cleanup level for over 40-inch zone: ingestion pathway
f = ADEC (2003a) additional cleanup values corresponding to Method Two soil cleanup levels: migration-to-groundwater pathway.
g = USEPA (2006b) Region 6 human health screening level: ingestion pathway for industrial-outdoor worker.
6 = Based on MDC or DLs for non-character samples only: RFS = MDC/RBSL; of ½ maximum DL/RBSL if MDC is ND.
7 = Second value is MDC/background where background>RBSL.
8 = RFS in parentheses based on ingestion or inhalation RBSL; listed only where migration-to-groundwater RBSL exceeded.
9 = All data are from non-character samples.
CL = Confidence level
COHC = Chemical of potential human health concern
DL = Detection limit
MDC = Maximum detected concentration
mg/kg = Milligrams per kilogram
NA = Not applicable or not analyzed
ND = Not detected
PAHs = Polynuclear aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
RBSL = Risk-based screening level
RFS = Risk factor score
SRE = Streamlined Risk Evaluation
Bold = Detected COHC with RFS>1.0

TABLE 2-28
HUMAN HEALTH RISK SCREENING RESULTS FOR FRESHWATER
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration (µg/L)[1]	Maximum Detected Concentration (µg/L)		Detection Frequency		Range of Detection Limits[1] (µg/L)	Background Concentration (µg/L)[2]		RBSL[3]		Detection Frequency Above RBSL and Background		Risk Factor Score[4]		Retained as COHC for Further Evaluation in SRE?	
		Total Metals	Dissolved Metals	Total Metals	Dissolved Metals		Total Metals	Dissolved Metals	µg/L	Source	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals
Antimony	ND	ND	ND	0/4	0/3	1.00-5	ND (5)	ND (5)	6	a	0/4	0/3	0.42	0.42	No	No
Arsenic	ND	1.8	ND	1/4	0/3	0.5-5.00	ND (5.00)	ND (5.00)	0.14	c	1/4	0/3	13	17	**Yes**	*DL*
Beryllium	ND	ND	ND	0/4	0/3	1.00	ND (1.00)	ND (1.00)	4	a	0/4	0/3	0.13	0.13	No	No
Cadmium	ND	ND	ND	0/4	0/3	0.2-2.00	ND (2.00)	ND (2.00)	5	a	0/4	0/3	0.2	0.20	No	No
Chromium	ND	117	ND	1/4	0/3	4.00-15	ND (20)	ND (20)	100	a	1/4	0/3	1.2	0.10	**Yes**	No
Copper	4.4	97.0	45.5	3/4	2/3	2-6.00	ND (6)	ND (6)	1,000	a	0/4	0/3	0.097	0.046	No	No
Lead	ND	ND	ND	0/4	0/3	2.00	ND (2.00)	ND (2.00)	15	d	0/4	0/3	0.067	0.067	No	No
Mercury	ND	ND	ND	0/4	0/3	0.2	ND (0.200)	ND (0.200)	0.051	b	0/4	0/3	2.0	2.0	No	*DL*
Nickel	ND	169	ND	1/4	0/3	2.00-10	ND (10)	ND (10)	100	e	1/4	0/3	1.7	0.050	**Yes**	No
Selenium	14.7	13.1	14.7	2/4	1/3	5.00	23.1	10.4	50	a	0/4	0/3	0.26	0.29	No	No
Silver	ND	ND	ND	0/4	0/3	0.5-2.00	ND (2.00)	ND (2.00)	100	a	0/4	0/3	0.010	0.010	No	No
Thallium	ND	ND	ND	0/4	0/3	1.00	ND (1.00)	ND (1.00)	2	a	0/4	0/3	0.25	0.25	No	No
Vanadium	ND	ND	ND	0/2	0/2	20.0	ND (20.0)	ND (20.0)	NE	NA	0/2	NE	NA	NA	No	No
Zinc	ND	19	ND	2/4	0/3	7-50.0	ND (50.0)	ND (50.0)	5,000	a	0/4	0/3	0.0038	0.0050	No	No

Notes:
1 = For all samples.
2 = Background freshwater data: maximum detected concentration where >15% non-detects, or maximum detection limit if all NDs (ADEC, 2003c).
3 = Most conservative of drinking water or fish ingestion values listed in Table 2-20:
a = ADEC (2006b) drinking water MCLs.
b = ADEC (2003b) fish ingestion criteria for noncarcinogens, consumption of aquatic organisms only.
c = USEPA (2004) AWQC: Human health for consumption of organism only.
d = Lead action level for drinking water systems under ADEC (2006c) and USEPA (2005b).
e = ADEC (2003b, 2006a) WQC for freshwater drinking water supply.
4 = RFS=MDC/RBSL; or ½ maximum DL/RBSL if MDC is ND.
AWQC = Ambient water quality criteria
CL = Confidence level
COHC = Chemical of potential human health concern
DF = Detection frequency
DL = Detection limit
DL = ½ maximum DL>RBSL.
MCL = Maximum contaminant level
MDC = Maximum detected concentration
µg/L = Micrograms per liter
NA = Not applicable or not analyzed
ND = Not detected
NE = Not established
RBSL = Risk-based screening level
RFS = Risk factor score
SRE = Streamlined Risk Evaluation
WQC = Water quality criteria
bold = **Detected COHC with RFS > 1.0**

TABLE 2-29
HUMAN HEALTH RISK SCREENING RESULTS FOR SALTWATER
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration[1] (µg/L)	Maximum Detected Concentration (µg/L)			Detection Frequency			Range of Detection Limits (µg/L)[1]	Background Concentration (µg/L)[2]		RBSL[3]		Detection Frequency Above RBSL and Background[4]		Risk Factor Score[4]/ Background Ratio[5]		Retained as COHC for Further Evaluation in SRE?
		Total Metals	Dissolved Metals		Total Metals	Dissolved Metals			Dissolved Metals		Concentration (µg/L)	Source	Dissolved Metals		Dissolved Metals		
			Non-RPPT Data	RPPT Data		Non-RPPT Data	RPPT Data		Non-RPPT Data	RPPT Data			Non-RPPT Data	RPPT Data	Non-RPPT Data	RPPT Data	
Antimony	ND	ND	ND	NA	0/3	0/5	NA	1.00-5	NA	NA	4,300	a	0/5	NA	0.0006	NA	No
Arsenic	0.23	64.3	61.3	4.2	3/3	4/5	4/7	0.4-5.11	15.2	1.07	0.14	b	2/5	1/7	440/4.0[5]	30/3.9[5]	Yes
Beryllium	NA	ND	ND	NA	0/3	0/5	NA	1.00-1.02	NA	NA	4	c	0/5	NA	0.13	NA	No
Cadmium	NA	ND	ND	NA	0/3	0/5	NA	0.2-2.05	NA	NA	5	c	0/5	NA	0.20	NA	No
Chromium	NA	ND	ND	NA	0/3	0/5	NA	4.00-15	NA	NA	100	c	0/5	NA	0.075	NA	No
Copper	1.58	74.9	596	565	3/3	6/6	7/7	2-2.05	1.68	0.851	1,300	d	0/6	0/7	0.46	0.43	No
Lead	NA	ND	ND	NA	0/3	0/5	NA	2-2.05	NA	NA	NE	NA	NA	NA	NA	NA	No
Mercury	0.0015	ND	ND	0.0881	0/3	0/5	7/7	0.00006-0.2	NA	0.0042	0.051	a	0/6	1/7	6.7	1.7	Yes
Nickel	0.15	13.5	14.4	0.16	1/3	1/6	2/7	2.0-10	3.69	0.39	4,600	a	0/6	0/7	0.0031	0.000035	No
Selenium	0.2	233	229	0.5	3/3	3/5	5/7	0.2-5.11	NA	0.3	11,000	a	0/5	0/7	0.021	0.000045	No
Silver	NA	ND	ND	NA	0/3	0/5	NA	0.5-2.05	NA	NA	NE	NA	NA	NA	NA	NA	No
Thallium	NA	ND	1.25	NA	0/3	1/5	NA	1-1.02	NA	NA	6.3	a	0/5	NA	0.20	NA	No
Vanadium	ND	ND	ND	ND	0/3	0/4	0/7	4-20.5	2.22	ND (4)	NE	NA	NA	NA	NA	NA	No
Zinc	NA	ND	ND	NA	0/3	0/5	NA	4-51.1	NA	NA	69,000	a	0/5	NA	0.00036	NA	No
Petroleum Hydrocarbon Mixtures																	
DRO	ND	ND			0/1			498	NA		No Sheen	e	0/1		NA		No
PAHs																	
High Molecular Weight PAHs:																	
Benzo(a)anthracene	ND	ND			0/1			0.0995	NA		0.018	b	0/1		2.8		*DL*
Benzo(a)pyrene	ND	ND			0/1			0.0995	NA		0.018	b	0/1		2.8		*DL*
Benzo(b)fluoranthene	ND	ND			0/1			0.0995	NA		0.018	b	0/1		2.8		*DL*
Benzo(k)fluoranthene	ND	ND			0/1			0.0995	NA		0.018	b	0/1		2.8		*DL*
Benzo(g,h,i)perylene	ND	ND			0/1			0.0995	NA		NE	NA	NE		NA		No
Chrysene	ND	ND			0/1			0.0995	NA		0.018	b	NE		2.8		*DL*
Dibenzo(a,h)anthracene	ND	ND			0/1			0.0995	NA		0.018	b	NE		2.8		*DL*
Indeno(1,2,3-cd)pyrene	ND	ND			0/1			0.0995	NA		0.018	b	NE		2.8		*DL*
Pyrene	ND	ND			0/1			0.0995	NA		11,000	a	NE		0.0000045		No
Low Molecular Weight PAHs:																	
Acenaphthene	ND	ND			0/1			0.0995	NA		2,700	a	0/1		0.000018		No
Acenaphthylene	ND	ND			0/1			0.0995	NA		NE	NA	0/1		NA		No
Anthracene	ND	ND			0/1			0.0995	NA		110,000	a	0/1		0.00000045		No
Fluoranthene	ND	ND			0/1			0.0995	NA		370	a	0/1		0.00013		No
Fluorene	ND	ND			0/1			0.0995	NA		14,000	a	0/1		0.0000036		No
Naphthalene	ND	ND			0/1			0.0995	NA		NE	NA	NE		NA		No
Phenanthrene	ND	ND			0/1			0.0995	NA		NE	NA	NE		NA		No
PCBs																	
Arochlor 1016	ND	ND			0/1			0.101	NA		NE	NA	NE		NA		No
Arochlor 1221	ND	ND			0/1			0.101	NA		NE	NA	NE		NA		No
Arochlor 1232	ND	ND			0/1			0.101	NA		NE	NA	NE		NA		No
Arochlor 1242	ND	ND			0/1			0.101	NA		NE	NA	NE		NA		No
Arochlor 1248	ND	ND			0/1			0.101	NA		NE	NA	NE		NA		No
Arochlor 1254	ND	ND			0/1			0.101	NA		NE	NA	NE		NA		No
Arochlor 1260	ND	ND			0/1			0.101	NA		NE	NA	NE		NA		No
Total PCBs	ND	ND			0/1			NA	NA		0.000064	b	0/1		790		*DL*

TABLE 2-29 (continued)
HUMAN HEALTH RISK SCREENING RESULTS FOR SALTWATER
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:
1 = For all samples.
2 = Background intertidal/saltwater data: maximum detected concentration where >15% non-detects, or maximum DL if all NDs (ADEC, 2003c).
3 = Fish ingestion values listed in Table 2-20:
a = ADEC (2003b) fish ingestion criteria for noncarcinogens, consumption of aquatic organisms only.
b = USEPA (2004) AWQC: Human health for consumption of organism only.
c = USEPA (2004) *defaults to drinking water MCL.*
d = USEPA (2004) value for consumption of water and organism.
e = ADEC (2006a) WQC for seafood processing water supply.
4 = DF and RFS based on dissolved data only: RFS=MDC/RBSL; or ½ maximum DL/RBSL if MDC is ND.
5 = Second value is MDC/background where background > RBSL.
CL = Confidence level
COHC = Chemical of potential human health concern
DF = Detection frequency
DL = *Detection limit*
DL = ½ maximum DL>RBSL.
DRO = Diesel range organics
MDC = Maximum detected concentration
µg/L = Micrograms per liter
NA = Not applicable
ND = Not detected
NE = Not established
PAHs = *Polynuclear aromatic hydrocarbons*
PCBs = Polychlorinated biphenyls
RBSL = Risk-based screening level
RFS = Risk factor score
RPPT = Reductive Precipitation: Sample preparation to separate certain metals from salt-rich matrix.
SRE = Streamlined Risk Evaluation
Bold = Detected COHC with RFS>1.0

TABLE 2-30
HUMAN HEALTH RISK SCREENING RESULTS FOR TISSUE
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration[1] (µg/g wet weight)	Maximum Detected Concentration (µg/g wet weight)[2]					Detection Frequency[2]					Range of Detection Limits[1] (µg/g wet weight)	Background Concentration (µg/g wet weight)[2,3]					NOAA Reference Bivalves (µg/g wet weight)[4]
		BC[12]	BM	LN	SS	All Data	BC	BM	LN	SS	All Data		BC	BM	LN	SS	All Data	Mussels/Oysters
Metals																		
Antimony	0.001	0.0017	ND	ND	0.0156	0.015	4/6	0/4	0/7	5/8	9/25	0.0007-0.012	0.0023	NA	ND (0.0075)	NA	0.0023	NA
Arsenic, Total	0.915	4.65	1.44	4.47	1.35	4.65	6/6	4/4	7/7	8/8	25/25	0.006-0.02	2.84	NA	2.02	NA	2.84	1.6-2.0
Arsenic, Inorganic	0.019	0.0432	NA	NA	0.519	0.519	2/2	NA	NA	3/3	5/5	0.0004-0.004	0.0314	NA	NA	NA	0.0314	NA
Beryllium	0.001	0.002	ND	ND	ND	0.002	3/6	4/4	0/7	2/8	5/25	0.0002-0.0207	0.002	NA	ND (0.0091)	NA	0.002	NA
Cadmium	0.0595	0.124	0.493	0.170	0.119	0.493	6/6	8/8	7/7	8/8	25/25	0.0007-0.002	0.106	NA	0.177	NA	0.177	0.43-0.64
Chromium	0.0715	0.93	0.621	0.340	0.636	0.93	6/6	8/8	9/9	10/10	33/33	0.007-0.05	0.84	0.0726	0.204	0.0665	0.273	NA
Copper	0.477	3.65	3.73	2.08	13.9	13.9	6/6	8/8	9/9	10/10	33/33	0.002-0.007	1.66	0.481	0.626	0.393	0.857	1.7-2.0
Lead	0.00587	0.0260	0.0448	0.277	0.101	0.101	6/6	8/8	9/9	10/10	33/33	0.0004-0.006	0.0340	0.0176	0.0184	0.0919	0.0440	0.31-0.46
Mercury	0.0029	0.009	0.0770	0.0112	0.0174	0.0770	6/6	8/8	9/9	10/10	33/33	0.0001-0.001	0.0039	0.0117	0.0073	0.00322	0.00937	0.018-0.024
Nickel	0.0628	0.797	0.205	0.734	0.488	0.797	6/6	8/8	9/9	10/10	33/33	0.003-0.004	1.03	0.0753	0.726	0.103	1.37	0.30-0.44
Selenium	0.1	0.290	0.660	0.41	0.410	0.660	5/6	3/3	7/7	8/8	23/24	0.05-0.06	ND (0.2)	NA	0.408	NA	0.408	0.46-0.66
Silver	0.00366	0.251	0.0143	0.0470	0.0207	0.251	4/6	7/7	5/5	10/10	26/28	0.0004-0.004	0.250	0.0103	0.0365	0.0324	0.0559	NA
Thallium	0.001	0.002	ND	ND	0.0013	0.002	4/6	4/4	0/7	2/8	10/25	0.0004-0.009	0.002	NA	ND (0.006)	NA	0.002	NA
Vanadium	0.0524	0.65	0.995	1.16	9.59	9.59	5/6	4/4	7/7	8/8	24/25	0.04-0.05	0.47	NA	0.241	NA	0.47	NA
Zinc	5.96	13.9	15.0	10.9	12.9	15.0	6/6	8/8	9/9	10/10	33/33	0.007-0.15	13.7	8.44	12.2	10.3	14.1	24-29
PCBs																		
Arochlor 1016	ND	ND	ND	NA	ND	ND	0/9	0/3	NA	0/2	0/4	0.0011-0.0021	NA	NA	ND (0.0021)	NA	ND (0.0021)	NA
Arochlor 1221	ND	ND	ND	NA	ND	ND	0/9	0/3	NA	0/2	0/4	0.0016-0.0041	NA	NA	ND (0.0021)	NA	ND (0.0021)	NA
Arochlor 1232	ND	ND	ND	NA	ND	ND	0/9	0/3	NA	0/2	0/4	0.0012-0.0024	NA	NA	ND (0.0021)	NA	ND (0.0021)	NA
Arochlor 1242	ND	ND	ND	NA	ND	ND	0/9	0/3	NA	0/2	0/4	0.0012-0.0021	NA	NA	ND (0.0021)	NA	ND (0.0021)	NA
Arochlor 1248	ND	ND	ND	NA	ND	ND	0/9	0/3	NA	0/2	0/4	0.0012-0.0021	NA	NA	ND (0.0021)	NA	ND (0.0021)	NA
Arochlor 1254	ND	ND	ND	NA	ND	ND	0/9	0/3	NA	0/2	0/4	0.0011-0.0021	NA	NA	ND (0.0021)	NA	ND (0.0021)	NA
Arochlor 1260	ND	ND	ND	NA	ND	ND	0/9	0/3	NA	0/2	0/4	0.0011-0.0021	NA	NA	ND (0.0021)	NA	ND (0.0021)	NA
Total PCBs[11]	ND	ND (0.0082)	NA	ND (0.0059)	ND (0.0060)	ND (0.0060)	0/9	0/3	NA	0/2	0/4	NA	NA	NA	ND (0.0074)	NA	ND (0.0074)	0.012-0.029

TABLE 2-30 (continued)
HUMAN HEALTH RISK SCREENING RESULTS FOR TISSUE
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	RBSL		Detection Frequency Above RBSL and Background[2,4]					Risk Factor Score[3,7]/Background Ratio[6,8]									
	µg/g	Source[5]	BC	BM	LN	SS	All Data	BC	Retained as COHC for Further Evaluation in SRE?	BM	Retained as COHC for Further Evaluation in SRE?	LN	Retained as COHC for Further Evaluation in SRE?	SS	Retained as COHC for Further Evaluation in SRE?	All Data	Retained as COHC for Further Evaluation in SRE?
Metals																	
Antimony	0.54	b	0/6	0/4	0/7	0/8	0/25	0.0031	No	0.011	No	0.011	No	0.029	No	0.029	No
Arsenic, Total	0.003/0.026	a	5/6	0/4	6/7	0/8	11/25	180/1.6[8]	**Yes**	55/0.51[8]	No[10]	170/2.2[8]	**Yes**	52/0.48[8]	No[10]	180/1.6[8]	**Yes**
Arsenic, Inorganic	0.003/0.026	a	1/2	NA	NA	3/3	4/5	1.7/1.4[8]	**Yes**	NA	NA	NA	NA	20/17[8]	**Yes**	20/17[8]	**Yes**
Beryllium	2.7	b	0/6	0/4	0/7	0/8	0/25	0.00074	No	0.0038	No	0.0038	No	0.0038	No	0.00074	No
Cadmium	0.49/4.0	a	0/6	0/4	0/7	0/8	0/25	0.031	No	0.12	No	0.043	No	0.030	No	0.12	No
Chromium	2,000	b	0/6	0/8	0/9	0/10	0/33	0.00047	No	0.00031	No	0.00017	No	0.00032	No	0.00047	No
Copper	54	b	0/6	0/8	0/9	0/10	0/33	0.068	No	0.069	No	0.039	No	0.26	No	0.26	No
Lead	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]
Mercury	0.049/0.4	a	0/6	0/8	0/9	0/10	0/33	0.023	No	0.19	No	0.028	No	0.044	No	0.19	No
Nickel	27	b	0/6	0/8	0/9	0/10	0/33	0.030	No	0.0076	No	0.020	No	0.018	No	0.030	No
Selenium	2.5/20	a	0/6	0/3	0/7	0/8	0/24	0.015	No	0.033	No	0.027	No	0.021	No	0.033	No
Silver	6.8	b	0/6	0/7	0/5	0/10	0/28	0.037	No	0.0021	No	0.0069	No	0.0030	No	0.037	No
Thallium	0.095	b	0/6	0/4	0/7	0/8	0/25	0.021	No	0.047	No	0.047	No	0.014	No	0.047	No
Vanadium	1.4	b	0/6	0/4	0/7	5/8	5/25	0.46	No	0.71	No	0.83	No	6.9	**Yes**	6.9	**Yes**
Zinc	410	b	0/6	0/8	0/9	0/10	0/33	0.034	No	0.036	No	0.027	No	0.031	No	0.036	No
PCBs																	
Arochlor 1016	0.045	b	0/3	NA	0/2	0/4	0/9	0.047	No	NA	NA	0.019	No	0.019	No	0.047	No
Arochlor 1221	0.0016	b	0/3	NA	0/2	0/4	0/9	1.3	*DL*	NA	NA	0.53	No	0.53	No	1.3	*DL*
Arochlor 1232	0.0016	b	0/3	NA	0/2	0/4	0/9	0.66	No	NA	NA	0.53	No	0.53	No	0.66	No
Arochlor 1242	0.0016	b	0/3	NA	0/2	0/4	0/9	0.66	No	NA	NA	0.53	No	0.53	No	0.66	No
Arochlor 1248	0.0016	b	0/3	NA	0/2	0/4	0/9	0.66	No	NA	NA	0.53	No	0.53	No	0.66	No
Arochlor 1254	0.0016	b	0/3	NA	0/2	0/4	0/9	0.66	No	NA	NA	0.53	No	0.53	No	0.66	No
Arochlor 1260	0.0016	b	0/3	NA	0/2	0/4	0/9	0.66	No	NA	NA	0.53	No	0.53	No	0.66	No
Total PCBs[11]	0.00245/0.02	a	0/3	NA	0/2	0/4	0/9	0.41	No	NA	NA	0.30	No	0.30	No	0.41	No

Notes:
1 = For all samples.
2 = Species-specific data columns: BC = butter clams, BM = blue mussels; LN = littleneck clams; SS = softshell clams.
3 = Site-specific background tissue data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects or fewer than 4 samples (ADEC, 2003c).
4 = NOAA mussel water program (O'Connor, 1998): range of annual median concentrations from 274 sites nationwide. See Tables 2-17 and 2-18 for dry to wet weight conversions.
5 = Shellfish ingestion values listed in Table 2-22:
a = USEPA (2000b) subsistence/recreational screening values for fish ingestion. Local harvest data (ADFG, 2001) support use of recreational screening values.
b = USEPA (2006a) Region 3 values for fish/shellfish ingestion.
c = Lead evaluated separately in Table 2-31.
6 = Background value for "all data" used where no species-specific background available.
7 = RFS = MDC/RBSL; or ½ maximum DL/RBSL if MDC is ND.
8 = Second value is MDC/background where background > RBSL.
10 = Based on MDC < background
11 = Summation calculated using ½ DLs for ND results.
12 = No substantial difference between purged and unpurged butter clam data (1 sample location). MDC is for all data.
CL = Confidence level
COHC = Chemical of potential human health concern
DL = Detection limit
DL = ½ maximum DL>RBSL.
MDC = Maximum detected concentration
µg/g = Micrograms per gram
NA = Not applicable or not analyzed
ND = Not detected
PCBs = Polychlorinated biphenyls

RBSL = Risk-based screening level
RFS = Risk factor score
SRE = Streamlined Risk Evaluation
Bold = **Detected COHC with RFS>1.0**

TABLE 2-31
HUMAN HEALTH LEAD MODEL FORSHELLFISH INGESTION[1]
Salt Chuck Mine - Tongass National Forest, Alaska

INPUT	
MEDIUM	LEVEL
LEAD IN AIR (ug/m^3)	0.1
LEAD IN TAILINGS (ug/g)	3.8
LEAD IN WATER (ug/l)	15
PLANT UPTAKE? 1=YES 0=NO	1
RESPIRABLE DUST (ug/m^3)	50

OUTPUT	UCL percentiles					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
BLOOD Pb, ADULT (ug/dl)	2.0	3.1	3.5	4.1	4.5	891.7	1309.3
BLOOD Pb, CHILD (ug/dl)	3.2	5.1	5.8	6.7	7.4	140.3	270.8
BLOOD Pb, PICA CHILD (ug/dl)	3.3	5.3	6.0	6.9	7.6	21.3	41.1
BLOOD Pb, INDUSTRIAL (ug/dl)	1.0	1.5	1.7	2.0	2.2	4361.5	6405.5

EXPOSURE PARAMETERS	units	residential			industrial
		adults	children	children with pica	adults
General					
Days per week	days/wk	7	7	7	5
Dermal Contact					
Skin area	cm^2	3700	2800	2800	5800
Sediment adherence	mg/cm^2	0.5	0.5	0.5	0.5
Route-specific constant	(ug/dl)/(ug/day)	0.00011	0.00011	0.00011	0.00011
Tailings/Sediment ingestion					
Ingestion rate	mg/day	25	55	790	25
Route-specific constant	(ug/dl)/(ug/day)	0.0176	0.0704	0.0704	0.0176
Inhalation					
Breathing rate	m^3/day	20	10	10	20
Route-specific constant	(ug/dl)/(ug/day)	0.082	0.192	0.192	0.082
Water ingestion					
Water ingestion	l/day	1.4	0.4	0.4	1.4
Route-specific constant	(ug/dl)/(ug/day)	0.04	0.16	0.16	0.04
Food ingestion					
Food ingestion	kg/day	2.2	1.3	1.3	2.2
Fish ingestion	kg/day	0.035	0.006	0	0
Route-specific constant	(ug/dl)/(ug/day)	0.04	0.16	0.16	0.04
Dietary concentration	ug/kg	9.5	9.5	9.5	10.0
Conc. Lead in produce	ug/kg	1.7	1.7	1.7	0
Con. Lead in fish tissue	ug/kg wet wt	101.0	101.0	0	0

Must be below 10 ug/dl blood lead concentration (CDTSC, 1992)

Maximum intertidal tailings and sediment lead concentration (2).

Maximum wet weight site shellfish tissue lead concentration

PATHWAYS, ADULTS	Residential		Industrial			
Pathway	Blood Pb ug/dl	percent of total	Blood Pb ug/dl	percent of total	Concentration in medium	
Tailings/Sediment Contact:	0.00	0%	0.00	0%	4	ug/g
Tailings/Sediment Ingestion:	0.00	0%	0.00	0%	4	ug/g
Inhalation:	0.16	8%	0.12	12%	0.10	ug/m^3
Water Ingestion:	0.84	42%	0.84	88%	15	ug/l
Food (Produce) Ingestion:	0.84	42%	0	0%	2	ug Pb/kg diet
Food (Fish) Ingestion:	0.14	7%	0	0%	101	ug Pb/kg diet
PATHWAYS, CHILDREN	Typical		With pica			
Pathway	Blood Pb ug/dl	Percent of total	Blood Pb ug/dl	Percent of total	Concentration in medium	
Tailings/Sediment Contact:	0.00	0%	0.00	0%	4	ug/g
Tailings/Sediment Contact:	0.01	0%	0.21	6%	4	ug/g
Inhalation:	0.19	6%	0.19	6%	0.10	ug/m^3
Water Ingestion:	0.96	30%	0.96	29%	15	ug/l
Food (Produce) Ingestion:	1.99	61%	1.99	59%	2	ug Pb/kg diet
Food (Fish) Ingestion:	0.10	3%	0	0%	101	ug Pb/kg diet

1. Model from California Department of Toxic Substances Control (CDTSC, 1992
2. Based on non-character samples only; non-standard laboratory methods used for character sample:

Pb = lead
PRG = Preliminary Remediation Goal
UCL = upper confidence level
ug/dl = micrograms per deciliter
ug/g = micrograms per gram (=mg/kg)
ug/kg = micrograms per kilogram
ug/m^3 = micrograms per cubic meter

TABLE 2-32
ECOLOGICAL RISK SCREENING RESULTS FOR SOIL
Salt Chuck Mine – Tongass National Forest, Alaska

Compound	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Detection Frequency	Range of Detection Limits (mg/kg)	Background Concentration (mg/kg)[1]	Ecological Benchmarks[2]					Hazard Quotient[3]/ Background Ratio[4]	Retained as COEC for Further Evaluation in SRE?
						ADEC Soil ERBSCs[a]		Other Applicable Benchmarks[b]				
						mg/kg	Detection Frequency above Benchmark and Background	mg/kg	Source	Detection Frequency above Benchmark and Background		
Total Metals												
Antimony	0.143	15.4	4/6	0.526-1.32	ND (0.384)	0.5	1/6	5 (78)	c	1/6	3.1	Yes
Arsenic	2.74	4.95	4/5	0.22-4.40	4.06	0.3	3/5	9.9	d	0/5	0.50	No
Beryllium	0.258	0.258	1/3	0.118-0.440	0.272	2	0/3	NA	NA	NA	0.13	No
Cadmium	ND	ND	0/3	0.236-0.880	ND (0.256)	0.2	0/3	4.2	d	0/3	0.10	No
Chromium, total[6]	8.09	25.6	2/3	1.18-4.40	40.0	60	0/3	NA	NA	NA	0.43	No
Copper	65.8	7,320	5/5	0.27-11.8	45.6	1	5/5	370 (28)	d	3/5	20	Yes
Lead	19.0	6,170	6/6	0.07-1.18	13.5	5	6/6	40.5 (11)	d	3/6	150	Yes
Mercury	0.178	311	4/5	0.2-6.99	0.0922	0.3	4/5	0.00051	d	4/5	1,000	Yes
Nickel	16.0	16.8	2/3	2.36-8.80	11.1	30	0/3	NA	NA	NA	0.56	No
Selenium	0.19	8.36	3/5	0.02-4.40	ND (1.28)	0.02	3/5	0.21	d	2/5	40	Yes
Silver	0.196	17.8	3/3	0.118-0.440	0.205	2	1/3	50	d	0/3	0.36	No
Thallium	ND	0.0624	1/3	0.0236-0.0880	ND (0.0256)	0.01	1/3	2.1	d	0/3	0.030	No
Vanadium	24.7	237	5/5	0.07-8.80	460	2	0/5	55	d	0/5	4.3/0.52[5]	No[8]
Zinc	38.8	290	5/5	1.1-5.9	30.9	0.9	5/5	8.5	d	5/5	34/9.4[5]	Yes
Petroleum Hydrocarbon Mixtures												
DRO/EPH	174	17,400	10/10	26.1-2,090	685	NE	NA	NE	NA	NA	NA	No
DRO Silica Gel	2,210	4,580	3/4	25.8-149	NA	NE	NA	NE	NA	NA	NA	No
RRO	195	7,400	10/10	26.1-2,090	907	NE	NA	NE	NA	NA	NA	No
RRO Silica Gel	375	1,210	3/4	25.8-149	NA	NE	NA	NE	NA	NA	NA	No
TRPH	9,100	9,100	1/2	2,600-3,600	NA	NE	NA	NE	NA	NA	NA	No
PAHs												
High Molecular Weight PAHs:												
Benzo(a)anthracene	0.0103	0.0103	1/2	0.00646-0.0759	NA	3	0/2	NA	NA	NA	0.0034	No
Benzo(a)pyrene	0.00844	0.00844	1/2	0.00646-0.0759	NA	0.1	0/2	NA	NA	NA	0.084	No
Benzo(b)fluoranthene	ND	ND	0/2	0.00646-0.0759	NA	NE	NA	NE	NA	NA	NA	No
Benzo(k)fluoranthene	ND	ND	0/2	0.00646-0.0759	NA	40	0/2	NA	NA	NA	0.00095	No
Benzo(g,h,i)perylene	ND	ND	0/2	0.00646-0.0759	NA	30	0/2	NA	NA	NA	0.0013	No
Chrysene	0.0256	0.0256	0/2	0.013-0.17	NA	40	0/2	NA	NA	NA	0.00064	No
Dibenzo(a,h)anthracene	ND	ND	0/2	0.00646-0.0759	NA	NE	0/2	NE	NA	NA	NA	No
Indeno(1,2,3-cd)pyrene	ND	ND	0/2	0.00646-0.0759	NA	2	0/2	NA	NA	NA	0.0019	No
Pyrene	ND	ND	0/2	0.00646-0.0759	ND	NE	0/2	NE	NA	NA	NA	No
Low Molecular Weight PAHs:												
Acenaphthene	ND	ND	0/2	0.0646-0.0759	NA	NE	NA	20	c	0/2	0.0019	No
Acenaphthylene	ND	ND	0/2	0.0646-0.0759	NA	NE	NA	20	e	0/2	0.0019	No
Anthracene	ND	ND	0/2	0.00646-0.0759	NA	2	0/2	NA	NA	NA	0.019	No
Fluoranthene	ND	ND	0/2	0.00646-0.0759	NA	300	0/2	NA	NA	NA	0.00013	No
Fluorene	ND	ND	0/2	0.0646-0.0759	NA	30	0/2	NA	NA	NA	0.0013	No
Naphthalene	ND	ND	0/2	0.00646-0.0759	NA	0.1	0/2	NA	NA	NA	0.38	No
Phenanthrene	ND	ND	0/2	0.00646-0.0759	NA	30	0/2	NA	NA	NA	0.0013	No
Total PAHs (Sum of 10[7])	ND	0.0674	1/2	NA	NA	40	0/2	NA	NA	NA	0.0017	No

Notes:
1 = Background soil data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects (ADEC, 2003c).
2 = Ecological values listed in Table 2-19:
a = ADEC (2007a) Environmental media-specific conservative screening values.
b = Considered for these compounds exceeding ADEC ERBSCs, or where these benchmarks are NE. Values in parentheses are Eco-SSLs (USEPA, 2005c, 2005d, 2006c), and represent lowest Eco-SSL greater than ADEC value.
c = ORNL (1997b) Toxicological Benchmarks for Terrestrial Plants: 1997 Revision.
d = ORNL (1997b) Preliminary Remediation Goals for Ecological Endpoints: Wildlife.
e = ADEC (2006) Method Two soil cleanup level for over 40-inch zone: ingestion pathway
3 = MDC/highest applicable benchmark; or ½ maximum DL/benchmark if MDC is ND. Note some DLs for character samples are above ecological benchmarks; this data quality issue is addressed in the uncertainty section.
4 = Industrial processes for development of Cr VI at this site are not suspected.
5 = Second value is MDC/background where background >benchmark.
6 = Based on MDC< background.
7 = Anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene, and phenanthrene.
CL = Confidence level
COEC = Chemical of potential ecological concern
DL = Detection limit
DRO = Diesel range organics
EPH = Extractable Petroleum Hydrocarbons
ERBSC = Ecological risk-based screening concentration
HQ = Hazard quotient
MDC = Maximum detected concentration
mg/kg = Milligrams per kilogram
NA = Not analyzed or not applicable; other applicable benchmarks listed only if MDC exceeds ADEC criterion.
ND = Not detected
NE = Not established
PAHs = Polynuclear aromatic hydrocarbons
RBSL = Risk-based screening level
RRO = Residual Range Organics
SRE = Streamlined Risk Evaluation
TRPH = Total Recoverable Petroleum Hydrocarbons
Bold = Detected COEC with HQ>1.0

TABLE 2-33
ECOLOGICAL RISK SCREENING RESULTS FOR UNSATURATED TAILINGS AND SLUDGE
Salt Chuck Mine – Tongass National Forest, Alaska

Compound	Minimum Detected Concentration[1] (mg/kg)	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits (mg/kg)[1,3]	Background Concentration (mg/kg)[4]	Ecological Benchmarks[5]							Hazard Quotient[6]/ Background Ratio[7]	Retained as COEC for Further Evaluation in SRE?
								ADEC Soil ERBSCs[a]			Other Applicable Benchmarks[b]					
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]			mg/kg	Detection Frequency Above Benchmark and Background: All Samples	Detection Frequency Above Benchmark and Background: Non-Character Samples Only[2]	mg/kg	Source	Detection Frequency Above Benchmark and Background: All Samples	Detection Frequency Above Benchmark and Background: Non-Character Samples Only[2]		
Total Metals																
Antimony	2	8	5.11	5/7	4/4	0.315-2	ND (0.384)	0.5	5/7	4/4	5 (78)	c	2/7	1/4	1.0	**Yes**
Arsenic	1.66	10.2	10.2	5/7	3/4	1.05-2	4.06	0.3	2/7	2/4	9.9	d	1/7	1/4	1.0	**Yes**
Beryllium	ND	ND	ND	0/7	0/4	0.105-0.5	0.272	2	0/7	0/4	NA	NA	NA	NA	0.13	No
Cadmium	0.350	1.0	0.976	4/7	3/4	0.210-0.5	ND (0.256)	0.2	4/7	3/4	4.2	d	0/7	0/4	0.23	No
Chromium, total[7]	1.50	50	5.87	7/7	4/4	1.05-2.28	40.0	60	0/7	0/4	NA	NA	NA	NA	0.010	No
Copper	1,085	53,400	53,400	7/7	4/4	2.10-4.56	45.6	1	7/7	7/4	370 (28)	d	7/7	4/4	140	**Yes**
Lead	0.426	143	143	7/7	4/4	0.210-2	13.5	5	4/7	3/4	40.5 (11)	d	4/7	3/4	3.5	**Yes**
Mercury	0.05	0.13	ND	3/7	0/4	0.01-4.69	0.0922	0.3	0/7	0/4	NA	NA	NA	NA	2.3	*DL*
Nickel	11.9	21	17.1	7/7	4/4	2.10-4.56	11.1	30	0/7	0/4	NA	NA	NA	NA	0.57	No
Selenium	8.38	65.4	65.4	3/4	3/4	1.05-2.28	ND (1.28)	0.02	3/4	3/4	0.21	d	3/4	3/4	300	**Yes**
Silver	0.6	43	34.1	7/7	4/4	0.105-0.228	0.205	2	5/7	3/4	50	e	0/7	0/4	0.68	No
Thallium	ND	ND	ND	0/7	0/4	0.0210-10	ND (0.0256)	0.01	0/7	0/4	2.1	d	0/7	0/4	0.0056	No
Vanadium	220	451	314	7/7	4/4	2.10-4.56	460	2	0/7	0/4	55	d	0/7	0/4	5.7/0.68[9]	No[10]
Zinc	31.1	266	266	7/7	4/4	1.05-2.28	30.9	0.9	7/7	4/4	8.5	d	7/7	4/4	31/8.6[7]	**Yes**
Petroleum Hydrocarbon Mixtures[11]																
DRO	247	849/163,000[12]		3/4		22.1-12,000	685	NE	NA		NE	NA	NA		NA	No
RRO	529	2,918		2/3		22.1-1,090	907	NE	NA		NE	NA	NA		NA	No
PAHs[11]																
High Molecular Weight PAHs:																
Benzo(a)anthracene	0.00731	4.05		3/3		0.00554-0.587	NA	3	1/3		NE	NA	NA		1.4	**Yes**
Benzo(a)pyrene	0.0149	2.69		3/3		0.00554-0.587	NA	0.1	2/3		NE	NA	NA		27	**Yes**
Benzo(b)fluoranthene	2.34	4.87		2/3		0.00554-0.587	NA	NE	NA		NE	NA	NA		NA	No
Benzo(k)fluoranthene	1.77	3.13		2/3		0.00554-0.587	NA	40	0/3		NE	NA	NA		0.078	No
Benzo(g,h,i)perylene	0.0179	3.37		3/3		0.00554-0.587	NA	30	0/3		NE	NA	NA		0.11	No
Chrysene	0.0193	5.68		3/3		0.00554-0.587	NA	40	0/3		NE	NA	NA		0.14	No
Dibenzo(a,h)anthracene	0.0772	0.0772		1/3		0.00554-0.0587	NA	NE	NA		NE	NA	NA		NA	No
Indeno(1,2,3-cd)pyrene	0.0151	3.41		3/3		0.00554-0.587	NA	2	1/3		NE	NA	NA		1.7	**Yes**
Pyrene	0.0163	13.4		3/3		0.00554-0.587	ND	NE	NA		NE	NA	NA		NA	No
Low Molecular Weight PAHs:																
Acenaphthene	ND	ND		0/3		0.00554-0.0587	NA	NE	NA		20	c	0/3		0.0015	No
Acenaphthylene	0.0657	0.0827		2/3		0.00554-0.0587	NA	NE	NA		20	e	0/3		0.0041	No
Anthracene	0.00433	0.0877		3/3		0.00554-0.0587	NA	2	0/3		NA	NA	NA		0.044	No
Fluoranthene	0.0119	14.8		3/3		0.00554-0.0587	NA	300	0/3		NA	NA	NA		0.049	No
Fluorene	ND	ND		0/3		0.00554-0.587	NA	30	0/3		NA	NA	NA		0.00098	No
Naphthalene	0.0579	0.0579		1/3		0.00554-0.0587	NA	0.1	0/3		NA	NA	NA		0.58	No
Phenanthrene	1.26	1.26		1/3		0.00554-0.587	NA	30	0/3		NA	NA	NA		0.042	No
Total PAHs (Sum of 10[8])	0.0987	37.6		3/3		NA	NA	40	0/3		NA	NA	NA		0.94	No
PCBs[11]:																
Arochlor 1016	ND	ND		0/3		0.0329-0.0358	NA	NE	NA		NE	NA	NA		NA	No
Arochlor 1221	ND	ND		0/3		0.0329-0.0358	NA	NE	NA		NE	NA	NA		NA	No
Arochlor 1232	ND	ND		0/3		0.0329-0.0358	NA	NE	NA		NE	NA	NA		NA	No
Arochlor 1242	ND	ND		0/3		0.0329-0.0358	NA	NE	NA		NE	NA	NA		NA	No
Arochlor 1248	ND	ND		0/3		0.0329-0.0358	NA	NE	NA		NE	NA	NA		NA	No
Arochlor 1254	0.120	0.244		2/3		0.0330-0.0358	NA	NE	NA		NE	NA	NA		NA	No
Arochlor 1260	0.121	0.175		2/3		0.0330-0.0358	NA	NE	NA		NE	NA	NA		NA	No
Total PCBs	0.329	0.501		2/3		NA	NA	0.5	1/3		0.371	d	1/3		1.0	**Yes**

TABLE 2-33 (continued)
ECOLOGICAL RISK SCREENING RESULTS FOR UNSATURATED TAILINGS AND SLUDGE
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:
1 = For all samples.
2 = Non-standardized laboratory methods used for character samples.
3 = DLs not available for some character sample analytes and some DLs for character samples were above ecological benchmarks. This data quality issue was addressed in the uncertainty section.
4 = Background soil data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects (ADEC, 2003c).
5 = Ecological values listed in Table 2-19:
a = ADEC (2007a) Environmental media-specific conservative screening values.
b = Considered for those compounds exceeding ADEC ERBSCs, or where these benchmarks are NE. Values in parentheses are Eco-SSLs (USEPA, 2005c, 2005d, 2006c), and represent lowest Eco-SSL greater than ADEC value.
c = ORNL (1997b) Toxicological Benchmarks for Terrestrial Plants: 1997 Revision.
d = ORNL (1997b) Preliminary Remediation Goals for Ecological Endpoints: Wildlife.
e = ORNL (1997c) Toxicological Benchmarks for Soil Invertebrates: 1997 Revision
6 = Based on MDC or DLs for non-character samples only: HQ = MDC/highest applicable benchmark; or ½ maximum DL/benchmark if MDC is ND.
7 = Industrial processes for development of Cr VI at this site are not suspected.
8 = Anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene, and phenanthrene.
9 = Second value is MDC/background where background > benchmark.
10 = Based on MDC < background.
11 = All data are from non-character samples.
12 = *Data for unsaturated tailings/sludge listed separately.*
CL = Confidence level
COEC = Chemical of potential ecological concern
DL = Detection limit
DL = ½ maximum DL>benchmark.
DRO = Diesel range organics
HQ = Hazard quotient
MDC = Maximum detected concentration
mg/kg = Milligrams per kilogram
NA = Not analyzed or not applicable; other applicable benchmarks listed only if MDC exceeds ADEC criterion.
ND = Not detected
NE = Not established.
PAHs = Polynuclear aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
RRO = Residual Range Organics
SRE = Streamlined Risk Evaluation
Bold = Detected COEC with HQ>1.0

TABLE 2-34
ECOLOGICAL RISK SCREENING RESULTS FOR STREAM TAILINGS
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration[1] (mg/kg)	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits[1,3] (mg/kg)	Soil Background Concentration (mg/kg)[4]	Freshwater Sediment Ecological Benchmarks[5]							Hazard Quotient[6]/ Background Ratio[7]	Retained as COEC for Further Evaluation in SRE?
								ADEC Screening Values[a]			Other Applicable Benchmarks[b]					
								mg/kg	Detection Frequency Above Benchmark and Background				Detection Frequency Above Benchmark and Background			
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]				All Samples	Non-Character Samples Only[2]	All Samples	Source	All Samples	Non-Character Samples Only[2]		
Total Metals																
Antimony	ND	ND	ND	0/2	0/1	0.684-2	ND (0.384)	NE	NA	NA	3	c	0/2	0/1	0.11	No
Arsenic	6	6	ND	1/2	0/1	2-2.28	4.06	6	1/2	0/1	NA	NA	NA	NA	0.19	No
Beryllium	ND	ND	ND	0/2	0/1	0.228-0.5	0.272	NE	NA	NA	NE	NA	NA	NA	NA	No
Cadmium	ND	ND	ND	0/2	0/1	0.456-0.5	ND (0.256)	0.6	0/2	0/1	NA	NA	NA	NA	0.38	No
Chromium, Total	40	40	ND	1/2	0/1	2.28	40.0	40	1/2	0/1	NA	NA	NA	NA	0.29	No
Copper	493	709	709	2/2	1/1	4.56	45.6	40	2/2	1/1	35.7/197	d	2/2	1/1	3.6	Yes
Lead	4.51	12	4.51	1/2	1/1	0.456-2	13.5	40	0/2	0/1	NA	NA	NA	NA	0.11	No
Mercury	0.44	0.44	ND	1/2	0/1	0.01-8.97	0.0922	0.2	1/2	0/1	0.174/0.486	d	0/2	0/1	9.2	*DL*
Nickel	9.35	15	9.35	2/2	1/1	4.56	11.1	2	1/2	1/1	18/35.9	d	0/2	0/1	0.26	No
Selenium	ND	ND	ND	0/2	0/1	2.28	ND (1.28)	NE	NA	NA	1.0	e	0/2	0/1	1.1	*DL*
Silver	0.2	0.373	0.373	2/2	1/1	0.2-0.228	0.205	NE	NA	NA	1.0/3.7	f	0/2	0/1	0.010	No
Thallium	ND	ND	ND	0/2	0/1	0.0456-1	ND (0.0256)	NE	NA	NA	NE	NA	NA	NA	NA	No
Vanadium	219	225	225	2/2	1/1	4.56	460	NE	NA	NA	57	e	2/2	1/1	3.9/ 0.49[7]	No[8]
Zinc	29.9	92	29.9	2/2	1/1	2.28	30.9	100	0/1	0/1	NA	NA	NA	NA	0.30	No

Notes:
1 = For all samples.
2 = Non-standard laboratory methods used for character samples.
3 = DLs not available for some character sample analytes.
4 = Background soil data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects (ADEC, 2003c).
5 = Ecological values listed in Table 2-21:
a = ADEC (2007a) Environmental media-specific conservative screening values: freshwater sediment.
b = Considered for those compounds exceeding ADEC (2007) screening benchmarks, or where these benchmarks are NE:
c = NOAA freshwater UET (NOAA, 1999).
d = Freshwater TELs/PELs (ADEC, 2004; NOAA, 1999; MacDonald, 1994).
e = NOAA marine SQuiRT values (NOAA, 1999).
f = ERL/ERM NOAA marine benchmarks (Long et al., 1995; NOAA, 1999).
6 = Based on MDC or DLs from non-character samples only: HQ = MDC/highest applicable benchmark; or ½ maximum DL/benchmark if MDC is ND.
7 = Second value is MDC/background where background > benchmark.
8 = Based on MDC < background.
CL = Confidence level
COEC = Chemical of potential ecological concern
DL = Detection limit
DL = ½ maximum DL>benchmark.
ERL = Effects range low
ERM = Effects range medium
HQ = Hazard quotient
MDC = Maximum detected concentration
mg/kg = Milligrams per kilogram
NA = Not applicable or not analyzed; other applicable benchmarks only listed if maximum concentration was higher than the ADEC criterion.
ND = Not detected
NE = Not established
PEL = Probable effects level
SQuiRT = Screening Quick Reference Tables
SRE = Streamlined Risk Evaluation
TEL = Threshold effects level
UET = Upper effects threshold

TABLE 2-35
ECOLOGICAL RISK SCREENING RESULTS FOR INTERTIDAL TAILINGS
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration (mg/kg)[1]	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits[1,3] (mg/kg)	Background Concentration (mg/kg)[4]	Ecological Benchmarks[5]							Hazard Quotient[7]/ Background Ratio[9]	Retained as COEC for Further Evaluation in SRE?
								ADEC Screening Values[6]			Other Applicable Benchmarks[5]					
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]			mg/kg	Detection Frequency Above Benchmark and Background		mg/kg	Source	Detection Frequency Above Benchmark and Background			
									All Samples	Non-Character Samples Only[2]			All Samples	Non-Character Samples Only[2]		
Total Metals																
Antimony	ND	ND	ND	0/36	0/5	0.329-2	ND (0.343)	NE	NA	NA	9.3	c	0/36	0/5	0.021	No
Arsenic	1.28	8	5.42	35/41	9/10	0.26-2	2.45	8	1/41	0/10	NA	NA	NA	NA	0.68	No
Beryllium	ND	ND	ND	0/36	0/6	0.11-0.5	ND (0.114)	NE	NA	NA	NE	NA	NA	NA	NA	No
Cadmium	0.045	0.246	0.246	3/40	3/9	0.013-0.5	ND (0.229)	1	0/40	0/9	NA	NA	NA	NA	0.25	No
Chromium	2.91	137	3.95	37/37	10/10	1.1-1.39	90.8	80	1/37	0/10	NA	NA	NA	NA	0.049	No
Copper	22	3,880	2,580	42/42	10/10	0.26-2.78	37.0	30	41/42	9/10	34/270	d	39/42	7/10	76/9.6[10]	Yes
Lead	0.721	58	3.30	33/41	10/10	0.09-2	5.01	50	1/41	0/10	NA[8]	NA	NA	NA	0.66	No
Mercury	0.01	0.243	0.243	37/42	6/11	0.004-5.10	0.0181	0.2	1/42	1/11	0.15/0.71	d	0/42	0/11	1.6/0.34[10]	No
Nickel	8.66	30.3	16.5	42/42	10/10	0.22-2.78	27.4	2	1/42	0/10	21/52	d	0/42	0/10	0.79/0.32[10]	No
Selenium	0.28	1.55	1.55	5/10	5/10	0.02-1.39	0.17	NE	NA	NA	1.0	c	4/10	4/10	1.6	Yes
Silver	0.152	2.0	1.26	35/41	10/10	0.006-0.2	0.0667	1	8/41	3/10	1.0/3.7	d	0/41	0/10	1.3/0.34[10]	No
Thallium	0.0279	0.0378	0.0378	2/36	2/5	0.022-10	0.12	NE	NA	NA	NE	NA	NA	NA	NA	No
Vanadium	79.0	801	438	41/41	10/10	0.09-2.78	59.3	NE	NA	NA	57	C	41/41	10/10	7.7/7.4[9]	Yes
Zinc	28.0	109	109	41/41	9/9	1.1-1.4	78.1	200	0/41	0/9	NA	NA	NA	NA	0.55	No
Petroleum Hydrocarbon Mixtures[8]																
DRO	86	86		1/1		8.3	685	NE	NA		NE	NA	NA	NA	NA	No
PAHs[8]																
High Molecular Weight PAHs:																
Benzo(a)anthracene	0.0149	0.0313		2/4		0.00550-0.00634	NA	0.3	0/4		NA	NA	NA		0.10	No
Benzo(a)pyrene	0.0115	0.0401		4/4		0.00550-0.00634	NA	0.4	0/4		NA	NA	NA		0.10	No
Benzo(b)fluoranthene	0.00890	0.0373		4/4		0.00550-0.00634	NA	NE	NA		2.8	e	0/4		0.013	No
Benzo(k)fluoranthene	0.00686	0.0197		4/4		0.00550-0.00634	NA	NE	NA		2.8	e	0/4		0.0070	No
Benzo(g,h,i)perylene	0.0103	0.0397		4/4		0.00550-0.00634	NA	NE	NA		0.72	e	0/4		0.055	No
Chrysene	0.0148	0.0290		2/4		0.00550-0.00634	NA	0.4	0/4		NA	NA	NA		0.073	No
Dibenzo(a,h)anthracene	0.00779	0.00779		1/4		0.00550-0.00634	NA	0.06	0/4		NA	NA	NA		0.13	No
Indeno(1,2,3-cd)pyrene	0.00882	0.0335		4/4		0.00550-0.00634	NA	NE	NA		0.69	e	0/4		0.049	No
Pyrene	0.0111	0.0572		3/4		0.00550-0.00634	NA	0.7	0/4		NA	NA	NA		0.082	No
Total HMW PAHs	0.0668	0.296		4/4		NA	NA	0.5	0/4		NA	NA	NA		0.59	No
Low Molecular Weight PAHs:																
Acenaphthene	ND	ND		0/4		0.00550-0.00634	NA	0.007	0/4		NA	NA	NA		0.45	No
Acenaphthylene	0.00967	0.0177		2/4		0.00550-0.00634	NA	0.006	2/4		0.044/0.64	d	0/4		0.40/0.028[10]	No
Anthracene	0.00551	0.0102		2/4		0.00550-0.00634	NA	0.09	0/4		NA	NA	NA		0.11	No
Fluoranthene	0.00658	0.0660		3/4		0.00550-0.00634	NA	0.1	0/4		NA	NA	NA		0.66	No
Fluorene	ND	ND		0/4		0.00550-0.00634	NA	0.5	0/4		NA	NA	NA		0.0063	No
Naphthalene	ND	ND		0/4		0.00550-0.00634	NA	0.2	0/4		NA	NA	NA		0.016	No
Phenanthrene	0.00577	0.0181		2/4		0.00550-0.00634	NA	0.2	0/4		NA	NA	NA		0.091	No
Total LMW PAHs	0.0204	0.120		3/4		NA	NA	2	0/4		NA	NA	NA		0.060	No
Total PAHs	0.0920	0.416		4/4		NA	NA	4	0/4		NA	NA	NA		0.10	No
PCBs[8]																
Arochlor 1016	ND	ND		0/4		0.0331-0.114	NA	NE	NA		0.53	f	0/4		0.11	No
Arochlor 1221	ND	ND		0/4		0.0331-0.114	NA	NE	NA		0.12	f	0/4		0.48	No
Arochlor 1232	ND	ND		0/4		0.0331-0.114	NA	NE	NA		0.60	f	0/4		0.095	No
Arochlor 1242	ND	ND		0/4		0.0331-0.114	NA	NE	NA		29	f	0/4		0.0020	No
Arochlor 1248	ND	ND		0/4		0.0331-0.114	NA	NE	NA		1.0	f	0/4		0.057	No
Arochlor 1254	0.235	1.10		2/4		0.0331-0.114	NA	NE	NA		72	f	1/4		0.015	No
Arochlor 1260	0.221	0.804		2/4		0.0331-0.114	NA	NE	NA		63	f	0/4		0.013	No
Total PCBs	0.554	2.19		2/4		NA	NA	0.02	2/4		0023/0.180	d	2/4		95/12[10]	Yes

TABLE 2-35 (continued)
ECOLOGICAL RISK SCREENING RESULTS FOR INTERTIDAL TAILINGS
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:
1 = For all samples.
2 = Non-standard laboratory methods used for character samples.
3 = DLs not available for some character sample analytes.
4 = Background intertidal sediment data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects, or fewer than 4 samples (ADEC, 2003c).
5 = Ecological values listed in Table 2-21:
a = ADEC (2007a) Environmental media-specific conservative screening values: saltwater sediment.
b = Considered for those compounds exceeding ADEC (2007a) screening benchmarks, or where these benchmarks are NE:
c =NOAA marine (NOAA, 1999).
d = ERL/ERM NOAA marine benchmarks (Long et al., 1995; NOAA, 1999).
e = Sediment Cleanup Objectives for Commencement Bay (USEPA, 1993).
f = ORNL (1997a) PRGs for sediment.
6 = Detections compared to highest applicable benchmark.
7 = Based on MDC or DLs for non-character samples only: HQ = MDC/benchmark; or ½ maximum DL/benchmark if MDC is ND.
8 = All data are from non-character samples.
9 = Second value is MDC/background where background > benchmark.
10 = HQs given for both ERL/ERM benchmarks.
CL = Confidence level
COEC = Chemical of potential ecological concern
DL = Detection limit
DRO = Diesel range organics
HMW = High molecular weight
HQ = Hazard quotient
LMW = Low molecular weight
MDC = Maximum detected concentration
mg/kg = Milligrams per kilogram
NA = Not applicable or not analyzed
ND = Not detected
NE = Not established
PAHs = Polynuclear aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
SRE = Streamlined Risk Evaluation
Bold = Detected COEC with HQ>1.0

TABLE 2-36
ECOLOGICAL RISK SCREENING RESULTS FOR SEDIMENT
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration (mg/kg)[1]	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits[1,3] (mg/kg)	Background Concentration (mg/kg)[4]	Ecological Benchmarks[5]							Hazard Quotient[7]/ Background Ratio[9]	Retained as COEC for Further Evaluation in SRE?
								ADEC Screening Values[a]			Other Applicable Benchmarks[b]					
								mg/kg	Detection Frequency Above Benchmark[6] and Background		mg/kg	Source	Detection Frequency Above Benchmark[6] and Background			
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]				All Samples	Non-Character Samples Only[2]			All Samples	Non-Character Samples Only[2]		
Total Metals																
Antimony	2	2	ND	2/12	0/2	0.359-2	ND (0.343)	NE	NA	NA	9.3	c	0/12	0/2	0.020	No
Arsenic	1.68	8	7.87	26/26	16/16	0.25-2	2.45	8	3/26	0/16	NA	NA	NA	NA	0.98	No
Beryllium	1.38	1.38	1.38	1/12	1/2	0.12-0.5	ND (0.114)	NE	NA	NA	NE	NA	NA	NA	NA	No
Cadmium	0.075	0.5	0.075	5/19	1/9	0.013-0.5	ND (0.229)	1	0/19	0/9	NA	NA	NA	NA	0.075	No
Chromium	8.01	93.8	16.5	23/23	8/8	1.13-1.29	90.8	80	1/23	0/8	NA	NA	NA	NA	0.21	No
Copper	18.6	672	324	28/28	13/13	0.25-2.58	37.0	30	26/28	11/13	34/270	d	5/28	1/13	9.5/1.2[10]	Yes[8]
Lead	1.14	16	3.8	23/24	14/14	0.09-2	5.01	50	0/24	0/14	NA	NA	NA	NA	0.076	No
Mercury	0.01	5.53	5.53	21/32	11/22	0.004-4.91	0.0181	0.2	2/32	2/22	0.15/0.71	d	1/32	1/22	25/7.8[10]	Yes[8]
Nickel	7.08	28.3	23.1	28/28	13/13	0.21-2.58	27.4	2	0/28	0/13	21/52	d	0/28	0/13	1.3/0.44[10]	No
Selenium	0.17	1.3	1.3	5/13	5/13	0.02-1.29	0.17	NE	NA	NA	1.0	c	1/13	1/13	1.3	Yes[8]
Silver	0.02	0.437	0.437	7/18	6/13	0.007-0.2	0.0667	1	0/18	0/13	NA	NA	NA	NA	0.44	No
Thallium	0.0389	0.0438	0.0438	2/12	2/2	0.024-10	0.12	NE	NA	NA	NE	NA	NA	NA	NA	No
Vanadium	49.0	467	210	23/23	12/12	0.08-2.58	59.3	NE	NA	NA	57	c	22/23	11/12	3.7/3.5[9]	Yes
Zinc	28.9	80.9	80.9	24/24	10/10	1.2-1.3	78.1	200	0/24	0/10	NA	NA	NA	NA	0.40	No
PAHs[11]																
High Molecular Weight PAHs:																
Benzo(a)anthracene	ND	ND		0/2		0.00611-0.00621	NA	0.3	0/2		NA	NA	NA		0.010	No
Benzo(a)pyrene	ND	ND		0/2		0.00611-0.00621	NA	0.4	0/2		NA	NA	NA		0.0078	No
Benzo(b)fluoranthene	ND	ND		0/2		0.00611-0.00621	NA	NE	0/2		2.8	e	0/2		0.0011	No
Benzo(k)fluoranthene	ND	ND		0/2		0.00611-0.00621	NA	NE	0/2		2.8	e	0/2		0.0011	No
Benzo(g,h,i)perylene	ND	ND		0/2		0.00611-0.00621	NA	NE	0/2		0.72	e	0/2		0.0043	No
Chrysene	ND	ND		0/2		0.00611-0.00621	NA	0.4	0/2		NA	NA	NA		0.0078	No
Dibenzo(a,h)anthracene	ND	ND		0/2		0.00611-0.00621	NA	0.06	0/2		NA	NA	NA		0.052	No
Indeno(1,2,3-cd)pyrene	ND	ND		0/2		0.00611-0.00621	NA	NE	0/2		0.69	e	0/2		0.0045	No
Pyrene	0.00901	0.00901		1/2		0.00611-0.00621	NA	0.7	0/2		0.69	e	0/2		0.0044	No
Total HMW PAHs	0.0335	0.0355		1/2		NA	NA	0.5	0/2		0.69	e	0/2		0.071	No
Low Molecular Weight PAHs:																
Acenaphthene	ND	ND		0/2		0.00611-0.00621	NA	0.007	0/2		NA	NA	NA		0.44	No
Acenaphthylene	ND	ND		0/2		0.00611-0.00621	NA	0.006	0/2		NA	NA	NA		0.52	No
Anthracene	ND	ND		0/2		0.00611-0.00621	NA	0.09	0/2		NA	NA	NA		0.034	No
Fluoranthene	ND	ND		0/2		0.00611-0.00621	NA	0.1	0/2		NA	NA	NA		0.031	No
Fluorene	ND	ND		0/2		0.00611-0.00621	NA	0.5	0/2		NA	NA	NA		0.0062	No

TABLE 2-36 (continued)
ECOLOGICAL RISK SCREENING RESULTS FOR SEDIMENT
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration (mg/kg)[1]	Maximum Detected Concentration (mg/kg)		Detection Frequency		Range of Detection Limits[1,3] (mg/kg)	Background Concentration (mg/kg)[4]	Ecological Benchmarks[5]							Hazard Quotient[7]/ Background Ratio[9]	Retained as COEC for Further Evaluation in SRE?
								ADEC Screening Values[a]			Other Applicable Benchmarks[b]					
								mg/kg	Detection Frequency Above Benchmark[6] and Background		mg/kg	Source	Detection Frequency Above Benchmark[6] and Background			
		All Samples	Non-Character Samples Only[2]	All Samples	Non-Character Samples Only[2]				All Samples	Non-Character Samples Only[2]			All Samples	Non-Character Samples Only[2]		
Naphthalene	ND	ND		0/2		0.00611-0.00621	NA	0.2	0/2		NA	NA	NA		0.0016	No
Phenanthrene	ND	ND		0/2		0.00611-0.00621	NA	0.2	0/2		NA	NA	NA		0.016	No
Total LMW PAHs	ND	ND (0.0217)		0/2		NA	NA	2	0/2		NA	NA	NA		0.011	No
Total PAHs	0.0549	0.0549		0/2		NA	NA	4	0/2		NA	NA	NA		0.014	No
PCBs[11]																
Arochlor 1016	ND	ND		0/4		0.015-0.0376	NA	NE	NA		0.53	f	0/4		0.035	No
Arochlor 1221	ND	ND		0/4		0.015-0.0376	NA	NE	NA		0.12	f	0/4		0.16	No
Arochlor 1232	ND	ND		0/4		0.015-0.0376	NA	NE	NA		0.60	f	0/4		0.031	No
Arochlor 1242	ND	ND		0/4		0.015-0.0376	NA	NE	NA		29	f	0/4		0.00065	No
Arochlor 1248	ND	ND		0/4		0.015-0.0376	NA	NE	NA		1.0	f	0/4		0.019	No
Arochlor 1254	0.868	0.868		1/4		0.015-0.0376	NA	NE	NA		72	f	0/4		0.012	No
Arochlor 1260	0.177	0.540		2/4		0.015-0.0376	NA	NE	NA		63	f	0/4		0.0086	No
Total PCBs	0.286	1.50		2/4		NA	NA	0.02	2/4		0.023/0.180	d	2/4		65/8.3[10]	**Yes**

Notes:
1 = For all samples.
2 = Non-standard laboratory methods used for character samples.
3 = DLs not available for some character sample analytes.
4 = Background sediment data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects, or fewer than 4 samples (ADEC, 2003c).
5 = Ecological values listed in Table 2-21:
a = ADEC (2007a) Environmental media-specific conservative screening values: saltwater sediment.
b = Considered for those compounds exceeding ADEC (2007) screening benchmarks, or where these benchmarks are NE:
c =NOAA marine (NOAA, 1999).
d = ERL/ERM NOAA marine benchmarks (Long et al., 1995; NOAA, 1999).
e = Sediment Cleanup Objectives for Commencement Bay (USEPA, 1993).
f = ORNL (1997a) PRGs for sediment.
6 = Detections compared to highest applicable benchmark.
7 = Based on MDC or DLs for non-character samples only: HQ = MDC/highest applicable benchmark; or ½ maximum DL/RBSL if MDC is ND.
8 = Note low frequency of detection above highest benchmark.
9 = Second value is MDC/background where background > benchmark.
10 = HQs given for both ERL/ERM benchmarks.
11 = All data are from non-character samples.
CL = Confidence level
COEC = Chemical of potential ecological concern
DL = Detection limit
HMW = High molecular weight
HQ = Hazard quotient
LMW = Low molecular weight
MDC = Maximum detected concentration
mg/kg = Milligrams per kilogram
NA = Not applicable or not analyzed
ND = Not detected
NE = Not established
PAHs = Polynuclear aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
SRE = Streamlined Risk Evaluation
Bold = **Detected COEC with HQ>1.0**

TABLE 2-37
ECOLOGICAL RISK SCREENING RESULTS FOR FRESHWATER
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration (µg/L)[1]	Maximum Detected Concentration (µg/L)		Detection Frequency		Range of Detection Limits[1] (µg/L)	Background Concentration (µg/L)[2]		Ecological Benchmarks[3]					Hazard Quotient[4]/ Background Ratio[5]	Retained as COEC for Further Evaluation in SRE?
									ADEC Freshwater ERBSCs[a]		Other Applicable Benchmarks[b]				
		Total Metals	Dissolved Metals	Total Metals	Dissolved Metals		Total Metals	Dissolved Metals	µg/L	Detection Frequency[4] Above Benchmark and Background	µg/L	Source	Detection Frequency[4] Above Benchmark and Background		
Antimony	ND	ND	ND	0/4	0/3	1.00-5	ND (5)	ND (5)	30	0/3	NA	NA	NA	0.083	No
Arsenic	ND	1.8	ND	1/4	0/3	0.5-5.00	ND (5.00)	ND (5.00)	13	0/3	NA	NA	NA	0.096	No
Beryllium	ND	ND	ND	0/4	0/3	1.00	ND (1.00)	ND (1.00)	0.5	0/3	5.3	c	0/3	0.094	No
Cadmium	ND	ND	ND	0/4	0/3	0.2-2.00	ND (2.00)	ND (2.00)	0.05	0/3	0.23	d	0/3	4.3	*DL*
Chromium	ND	117	ND	1/4	0/3	4.00-15	ND (20)	ND (20)	8	0/3	68	d	0/3	0.11	No
Copper	4.4	97.0	45.5	3/4	2/3	2-6.00	ND (6)	ND (6)	0.2	2/3	8.18	d	1/3	5.6	**Yes**
Lead	ND	ND	ND	0/4	0/3	2.00	ND (2.00)	ND (2.00)	1	0/3	2.24	d	0/3	0.45	No
Mercury	ND	ND	ND	0/4	0/3	0.2	ND (0.200)	ND (0.200)	0.01	0/3	0.77	d	0/3	0.13	No
Nickel	ND	169	ND	1/4	0/3	2.00-10	ND (10)	ND (10)	5	0/3	48	d	0/3	0.1	No
Selenium	14.7	13.1	14.7	2/4	1/3	5.00	23.1	10.4	0.4	1/3	5.0	d	1/3	2.9/1.4[5]	**Yes**
Silver	ND	ND	ND	0/4	0/3	0.5-2.00	ND (2.00)	ND (2.00)	0.05	0/3	NA	NA	NA	0.16	No
Thallium	ND	ND	ND	0/4	0/3	1.00	ND (1.00)	ND (1.00)	0.4	0/3	40	c	0/3	0.013	No
Vanadium	ND	ND	ND	0/2	0/2	20.0	ND (20.0)	ND (20.0)	NE	0/2	20	e	0/3	0.5	No
Zinc	ND	19	ND	2/4	0/3	7-50.0	ND (50.0)	ND (50.0)	20	0/3	108	d	0/3	0.23	No

Notes:
1 = For all samples.
2 = Background freshwater data: maximum detected concentration where >15% non-detects, or maximum detection limit if all NDs (ADEC, 2003c).
3 = Ecological values listed in Table 2-20:
a = ADEC (2007a) Environmental media-specific conservative screening values: freshwater.
b = Considered for those compounds exceeding ADEC ERBSCs, or where those benchmarks are NE:
c = Proposed AWQC (USEPA [1986] and/or NOAA [1999]).
d = ADEC (2003b, 2006a) AWQC: freshwater aquatic life chronic. using average site hardness in filtered samples of 90 µg/L where appropriate.
e = ORNL (1996, 1997a) secondary chronic value.
4 = DF and HQ based on dissolved data only: HQ=MDC/highest applicable benchmark; or ½ maximum DL/benchmark if MDC is ND.
5 = Second value is MDC/background where background > MDC.

AWQC = Ambient water quality criteria
CL = Confidence level
COEC = Chemical of potential ecological concern
DF = Detection frequency
DL = Detection limit
DL = ½ maximum DL>benchmark.
ERBSC = Ecological risk-based screening criteria
HQ = Hazard quotient
MCL = Maximum contaminant level
MDC = Maximum detected concentration
µg/L = Micrograms per liter
NA = Not applicable or not analyzed
ND = Not detected
NE = Not established
SRE = Streamlined Risk Evaluation

TABLE 2-38
ECOLOGICAL RISK SCREENING RESULTS FOR SALTWATER
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds	Minimum Detected Concentration[1] (µg/L)	Maximum Detected Concentration (µg/L)			Detection Frequency			Range of Detection Limits (µg/L)[1]	Background Concentration (µg/L)[2]		Ecological Benchmarks[3]							Hazard Quotient[4]		Retained as COEC for Further Evaluation in SRE?
											ADEC Marine Water ERBSCs[a]			Other Applicable Benchmarks[b]						
		Total Metals	Dissolved Metals		Total Metals	Dissolved Metals			Dissolved Metals		µg/L	Detection Frequency Above Benchmark and Background[4]		µg/L	Source	Detection Frequency Above Benchmark and Background[4]		Dissolved Metals		
			Non-RPPT Data	RPPT Data		Non-RPPT Data	RPPT Data		Non-RPPT Data	RPPT Data		Non-RPPT Data	RPPT Data			Non-RPPT Data	RPPT Data	Non-RPPT Data	RPPT Data	
Antimony	ND	ND	ND	NA	0/3	0/5	NA	1.00-5	NA	NA	500	0/5	NA	NA	NA	NA	NA	0.005	NA	No
Arsenic	0.23	64.3	61.3	4.2	3/3	4/5	4/7	0.4-5.11	15.2	1.07	50	1/5	1/5	36	c	2/5	1/7	1.2	0.084	No[5]
Beryllium	NA	ND	ND	NA	0/3	0/5	NA	1.00-1.02	NA	NA	NE	NA	NA	8.8	c	0/5	NA	0.057	NA	No
Cadmium	NA	ND	ND	NA	0/3	0/5	NA	0.2-2.05	NA	NA	9	0/5	NA	NA	NA	NA	NA	0.11	NA	No
Chromium	NA	ND	ND	NA	0/3	0/5	NA	4.00-15	NA	NA	100	0/5	NA	NA	NA	NA	NA	0.075	NA	No
Copper	1.58	74.9	565	596	3/3	6/6	7/7	2-2.05	1.68	0.851	3	5/6	3/7	3.1	c	5/6	3/7	180	190	Yes
Lead	NA	ND	ND	NA	0/3	0/5	NA	2-2.05	NA	NA	8	0/3	NA	NA	NA	NA	NA	0.13	NA	No
Mercury	0.0015	ND	ND	0.0881	0/3	0/5	7/7	0.00006-0.2	NA	0.0042	0.03	0/5	1/7	0.94	c	0/5	0/7	0.11	0.094	No
Nickel	0.15	13.5	14.4	0.16	1/3	1/6	2/7	2.0-10	3.69	0.39	8	1/3	0/6	8.2	c	1/3	0/7	1.8	0.020	No[5]
Selenium	0.2	233	229	0.5	3/3	3/5	5/7	0.2-5.11	NA	0.3	70	2/5	0/7	71	c	2/5	0/7	3.2	0.0070	No[5]
Silver	NA	ND	ND	NA	0/3	0/5	NA	0.5-2.05	NA	NA	0.4	0/5	NA	1.9	d	0/5	NA	0.53	NA	No
Thallium	NA	ND	1.25	NA	0/3	1/5	NA	1-1.02	NA	NA	20	0/5	NA	NA	NA	NA	NA	0.063	NA	No
Vanadium	ND	ND	ND	ND	0/3	0/4	0/7	4-20.5	2.22	ND (4)	NE	NA	NA	NE	NA	NA	NA	NA	NA	No
Zinc	NA	ND	ND	NA	0/3	0/5	NA	4-51.1	NA	NA	80	0/5	NA	NA	NA	NA	NA	0.33	NA	No
Petroleum Hydrocarbon Mixtures																				
DRO	ND	ND			0/1			498	NA		NE	NA		No Sheen	e	0/1		NA		No
PAHs																				
High Molecular Weight PAHs:																				
Benzo(a)anthracene	ND	ND			0/1			0.0995	NA		NE	NA		NE	NA	NA		NA		No
Benzo(a)pyrene	ND	ND			0/1			0.0995	NA		NE	NA		NE	NA	NA		NA		No
Benzo(b)fluoranthene	ND	ND			0/1			0.0995	NA		NE	NA		NE	NA	NA		NA		No
Benzo(k)fluoranthene	ND	ND			0/1			0.0995	NA		NE	NA		NE	NA	NA		NA		No
Benzo(g,h,i)perylene	ND	ND			0/1			0.0995	NA		NE	NA		NE	NA	NA		NA		No
Chrysene	ND	ND			0/1			0.0995	NA		0.5	0/1		NE	NA	NA		0.10		No
Dibenzo(a,h)anthracene	ND	ND			0/1			0.0995	NA		0.5	0/1		NE	NA	NA		0.10		No
Indeno(1,2,3-cd)pyrene	ND	ND			0/1			0.0995	NA		NE	NA		NE	NA	NA		NA		No
Pyrene	ND	ND			0/1			0.0995	NA		NE	NA		NE	NA	NA		NA		No
Low Molecular Weight PAHs:																				
Acenaphthene	ND	ND			0/1			0.0995	NA		10	0/1		NA	NA	NA		0.005		No
Acenaphthylene	ND	ND			0/1			0.0995	NA		NE	NA		NE	NA	NA		NA		No
Anthracene	ND	ND			0/1			0.0995	NA		NE	NA		NE	NA	NA		NA		No
Fluoranthene	ND	ND			0/1			0.0995	NA		2	0/1		NA	NA	NA		0.025		No
Fluorene	ND	ND			0/1			0.0995	NA		NE	NA		NE	NA	NA		NA		No
Naphthalene	ND	ND			0/1			0.0995	NA		20	0/1		NA	NA	NA		0.0025		No
Phenanthrene	ND	ND			0/1			0.0995	NA		8	0/1		NA	NA	NA		0.0063		No
Total PAHs	ND	ND (0.796)			0/1			NA	NA		NE	NA		15	e	0/1		0.053		No
PCBs																				
Arochlor 1016	ND	ND			0/1			0.101	NA		NE	NA		0.03	c	0/1		1.7		*DL*
Arochlor 1221	ND	ND			0/1			0.101	NA		NE	NA		0.03	c	0/1		1.7		*DL*
Arochlor 1232	ND	ND			0/1			0.101	NA		NE	NA		0.03	c	0/1		1.7		*DL*
Arochlor 1242	ND	ND			0/1			0.101	NA		NE	NA		0.03	c	0/1		1.7		*DL*
Arochlor 1248	ND	ND			0/1			0.101	NA		NE	NA		0.03	c	0/1		1.7		*DL*
Arochlor 1254	ND	ND			0/1			0.101	NA		NE	NA		0.03	c	0/1		1.7		*DL*
Arochlor 1260	ND	ND			0/1			0.101	NA		NE	NA		0.03	c	0/1		1.7		*DL*
Total PCBs	ND	ND (0.354)			0/1			NA	NA		0.03	0/1		0.03	c	0/1		12		*DL*

TABLE 2-38 (continued)
ECOLOGICAL RISK SCREENING RESULTS FOR SALTWATER
Salt Chuck Mine – Tongass National Forest, Alaska

Notes:
1 = For all samples.
2 = Background intertidal/saltwater data: maximum detected concentration where >15% non-detects, or maximum DL if all NDs (ADEC, 2003c).
3 = Ecological values listed in Table 2-20:
a = ADEC (2007a) Environmental media-specific screening values: marine water.
b = Considered for those compounds exceeding ADEC ERBSCs, or where these benchmarks are NE:
c = ADEC (2003b, 2006a)/USEPA (2002a) AWQC: saltwater aquatic life chronic.
d = ADEC (2003b, 2006a)/USEPA (2002a) AWQC: saltwater aquatic life acute.
e = ADEC (2006a) WQC for aquatic life and/or aquaculture supply.
4 = DF and HQ based on dissolved data only: HQ=MDC/highest applicable benchmark; or ½ maximum DL/benchmark if MDC is ND.
5 = Based on RPPT data < benchmark; non-RPPT HQ reflects saltwater interference.
AWQC = Ambient water quality criteria
CL = Confidence level
COEC = Chemical of potential ecological concern
DF = Detection frequency
DL = Detection limit
DL = ½ maximum DL>benchmark.
DRO = Diesel range organics
EABSC = Ecological risk-based screening criteria
HQ = Hazard quotient
MDC = Maximum detected concentration
µg/L = Micrograms per liter
NA = Not applicable
ND = Not detected
NE = Not established
PAHs = Polynuclear aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
RPPT = Reductive Precipitation: Sample preparation to separate certain metals from salt-rich matrix.
SRE = Streamlined Risk Evaluation
WQC = Water quality criteria
Bold = **Detected COEC with HQ>1.0**

TABLE 2-39
ECOLOGICAL RISK SCREENING RESULTS FOR TISSUE – FOR ANALYTES WITH BENCHMARKS
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds[1]	Maximum Detected Concentration (µg/g)[2,3]					Background Concentration (µg/g)[2,4]					NOAA Reference Bivalves (µg/g)[5]	RBSL	
	BC	BM	LN	SS	All Data	BC	BM	LN	SS	All Data	Mussels/ Oysters	µg/g	Source[7]
Wet Weight Data													
Mercury	0.009	0.0770	0.0112	0.0174	0.0770	0.0039	0.0117	0.0073	0.00322	0.00937	0.018-0.024	0.033/3	a/b
Selenium	0.290	0.660	0.41	0.410	0.660	NE (0.2)	NA	0.408	NA	0.408	0.46-0.66	1.0	c
Total PCBs	ND (0.0082)[6]	NA	ND (0.0059)[6]	ND (0.0060)[6]	ND (0.0060)[6]	NA	NA	ND (0.0074)[6]	NA	ND (0.0074)[6]	0.012-0.029	0.436	d
Dry Weight Data													
Copper	29.4	48.3	18.5	146	146	8.54	4.72	6.20	5.31	6.76	8.6-9.97	23.9/80.3	e

Target Compounds	Detection Frequency Above Benchmark and Background[2,8]					Hazard Quotient[2,10]									
	BC	BM	LN	SS	All Data	BC	Retained as COEC for Further Evaluation in SRE?	BM	Retained as COEC for Further Evaluation in SRE?	LN	Retained as COEC for Further Evaluation in SRE?	SS	Retained as COEC for Further Evaluation in SRE?	All Data	Retained as COEC for Further Evaluation in SRE?
Wet Weight Data															
Mercury	0/6	1/8	0/9	0/10	1/33[11]	0.27/0.003[12]	No	2.3/0.026[12]	Yes	0.34/0.0037[12]	No	0.53/0.0058[12]	No	2.3/0.026[12]	Yes
Selenium	0/6	0/3	0/7	0/8	0/24	0.29	No	0.66	No	0.41	No	0.41	No	0.66	No
Total PCBs[11]	0/3	NA	0/2	0/4	0/9	0.019	No	NA	NA	0.014	No	0.014	No	0.014	No
Dry Weight Data															
Copper	0/6[9]	0/8[9]	0/9[9]	2/10[9]	2/33[9]	0.34[9]	No	0.60[9]	No	0.23[9]	No	1.8[9]	Yes	1.8[9]	Yes

Notes: 1 = Includes only those analytes for which tissue screening values are available (Table 2-21).
2 = Species-specific data columns: BC = butter clams, BM = blue mussels; LN = littleneck clams; SS = softshell clams.
3 = See Table 2-30 for minimum detected concentrations, detection frequencies, and range of detection limits for tissue samples.
4 = Site-specific background tissue data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects or fewer than 4 samples (ADEC, 2003c).
5 = NOAA mussel water program (O'Connor, 1998): range of annual median concentrations from 274 sites nationwide. See Tables 2-17 and 2-18 for dry to wet weight conversions.
6 = Summation calculated using ½ DLs for ND results (of individual arochlors).
7 = Ecological screening values listed in Table 2-21:
a = CCME (1991a, 2006) methylmercury in fish/shellfish consumed by wildlife.
b = Berger et al. (1996) total Hg ECW for protection of fish.
c = CCME (1991b, 2006) total Se aquatic life (tissue) guideline.
d = NEHC (2005) bioaccumulation endpoint for saltwater invertebrate tissue.
e = Salazar and Salazar (2003) tissue levels indicating harm to invertebrates: NOEC/mean effects concentration.
8 = Background value for "all data" used where no species-specific background available.

TABLE 2-39 (continued)
ECOLOGICAL RISK SCREENING RESULTS FOR TISSUE – FOR ANALYTES WITH BENCHMARKS
Salt Chuck Mine – Tongass National Forest, Alaska

Notes: 9 = Represents comparison to mean effects benchmark.
10 = MDC/Benchmark; or sum of ½ DLs/Benchmark if MDC is ND.
11 = Exceeds methyl Hg benchmark only.
12 = HQs listed for methyl Hg/total Hg.
CL = Confidence level
COEC = Chemical of potential ecological concern
DL = Detection limit
ECW = Environmental contaminant in wildlife
Hg = mercury
HQ = Hazard quotient
MDC = Maximum detected concentration
µg/g = Micrograms per gram
NA = Not applicable or not analyzed
ND = Not detected
NOEC = No observed effects concentration
PCBs = Polychlorinated biphenyls
Se = Selenium
SRE = Streamlined Risk Evaluation
Bold = Detected COEC with HQ>1.0

TABLE 2-40
BACKGROUND SCREENING FOR TISSUE – FOR ANALYTES WITH NO ECOLOGICAL BENCHMARKS
Salt Chuck Mine – Tongass National Forest, Alaska

Target Compounds[1]	Maximum Detected Concentration (µg/g dry weight)[2]					Background Concentration (µg/g dry weight)[2,3]					NOAA Reference Bivalves (µg/g dry weight)[4]	MDC Exceeds Site-Specific Background and NOAA Reference Bivalves?				
	BC[5]	BM	LN	SS	All Data	BC	BM	LN	SS	All Data	Mussels/ Oysters	BC	BM	LN	SS	All Data
Antimony	0.014	ND	ND	0.166	0.166	0.012	NA	ND (0.063)	NA	0.012	NA	Yes	No	No	Yes	Yes
Arsenic, Total	32.7	10.9	47.6	13.5	47.6	14.6	NA	16.4	NA	16.4	8.22-10.14	Yes	No	Yes	No	Yes
Arsenic, Inorganic	0.265	NA	NA	5.19	5.19	0.162	NA	NA	NA	0.162	NA	Yes	NA	NA	Yes	Yes
Beryllium	0.016	ND	ND	ND	0.016	0.009	NA	ND (0.074)	NA	0.009	NA	Yes	No	No	No	Yes
Cadmium	0.888	3.16	2.07	1.57	0.888	0.546	NA	1.44	NA	1.44	2.15-3.20	No	No	No	No	No
Chromium	7.5	3.98	3.04	6.36	7.5	4.3	0.769	1.71	0.897	2.01	NA	Yes	Yes	Yes	Yes	Yes
Lead	0.21	0.368	0.269	1.01	1.01	0.175	0.187	1.96	0.124	0.218	1.55-2.32	No	No	No	No	No
Nickel	6.43	1.48	6.95	4.92	6.95	5.31	0.737	6.96	1.39	12.1	1.50-2.19	Yes	No	No	Yes	No
Silver	0.142	0.135	0.218	0.195	0.218	1.29	0.109	0.0310	0.437	0.622	NA	No	Yes	Yes	No	No
Thallium	0.009	ND	ND	0.012	0.012	0.008	NA	ND (0.05)	NA	0.008	NA	Yes	No	No	Yes	Yes
Vanadium	5.2	5.98	11.7	102	102	2.4	NA	1.96	NA	2.4	NA	Yes	Yes	Yes	Yes	Yes
Zinc	75.1	123	104	157	157	70.7	81.9	123.3	139	130	120-143	No	No	No	Yes	Yes

Notes:
1 = Metals for which ecological benchmarks for tissue are not available. See Table 2-39 for copper, mercury, selenium, and PCBs.
2 = Species-specific data columns: BC = butter clams, BM = blue mussels; LN = littleneck clams; SS = softshell clams.
3 = Site-specific background tissue data: % CL on the median where <15% non-detects; maximum concentration where >15% non-detects or fewer than 4 samples (ADEC, 2003c).
4 = NOAA mussel water program (O'Connor, 1998): range of annual median concentrations from 274 sites nationwide.
5 = No substantial difference between purged and unpurged butter clam data (1 sample location). MDC is for all data.
6 = Background value for "all data" used where no species-specific background available.
CL = Confidence level
MDC = Maximum detected concentration
µg/g = Micrograms per gram
NA = Not applicable or not analyzed
ND = Not detected

TABLE 3-1
TARGET REMEDIAL ACTION OBJECTIVES
Salt Chuck Mine – Tongass National Forest, Alaska

Receptor	Exposure Pathway	COC[1]	Target Remedial Goal	Basis	Location Where TRG Exceeded or Recommended Action
Surface Soils (mg/kg)					
Future Miner	Incidental soil ingestion, direct contact	Lead	400	ADEC residential value	**Building C4**: SCSS-1 and SCSS-2
		DRO	12,500	ADEC Method Three soil cleanup level	**AST Area:** SCSS-19
	Migration to groundwater, transport to surface water	DRO	12,500	ADEC Method Three soil cleanup level	**AST Area:** SCSS-19
Terrestrial Ecological Receptors	Ingestion	Copper	370	ORNL wildlife soil PRG	**Building C4**: SCSS-1, SCSS-2 and SCSS-27
		Lead	40.5	ORNL wildlife soil PRG	
		Zinc	100	ORNL soil microorganism benchmark	**Building C4**: SCSS-1 and SCSS-2
		Mercury	30	ORNL soil microorganism benchmark	**Building C4**: SCSS-2
		Selenium	0.93	ORNL mammalian wildlife soil PRG	**Building C4**: SCSS-2 and SCSS-27
Unsaturated Tailings/Sludge (mg/kg)					
Future Miner	Incidental soil/tailings ingestion	Benzo(a)pyrene	0.9	ADEC Method Two - Ingestion	**Mill Tailings:** SCUT-3 and SCUT-6
		Copper	42,000	EPA Region 6 RBSL -outdoor worker	**Mill Tailings:** SCUT-3 and SO03
		DRO	12,500	ADEC Method Three soil cleanup level	**Mill Floor/Tailings:** Sludge sample SO01
	Migration to groundwater, transport to surface water	DRO	12,500	ADEC Method Three soil cleanup level	**Mill Floor/Tailings:** Sludge sample SO01
Terrestrial Ecological Receptors	Incidental soil/sediment ingestion, dermal contact	Copper	370	ORNL wildlife soil PRG	**Mill Tailings and D14/15 Piles:** SCUT-1, SO04, SCUT-3, SCUT-4/5, SO03 and SCUT-6
		Lead	40.5	ORNL wildlife soil PRG	**Mill Tailings:** SCUT-3, SCUT-4/5, SO03 and SCUT-6
		Selenium	0.93	ORNL mammalian wildlife soil PRG	**Mill Tailings:** SCUT-3, SCUT-4/5, and SCUT-6
		Zinc	100	ORNL soil microorganism benchmark	**Mill Tailings:** SCUT-4/5, SO03, and SCUT-6
Stream Tailings (mg/kg)					
Aquatic Organisms	Incidental tailings/ sediment ingestion, dermal contact	Copper	500	Critical body residue[2]	**Between D14 and D15 piles:** SCST-1, S005

TABLE 3-1
TARGET REMEDIAL ACTION OBJECTIVES
Salt Chuck Mine – Tongass National Forest, Alaska

Receptor	Exposure Pathway	COC[1]	Target Remedial Goal	Basis	Location Where TRG Exceeded or Recommended Action
Intertidal Tailings (mg/kg)					
Aquatic Organisms	Incidental tailings/ sediment ingestion, dermal contact	Copper	500	Critical body residue[2]	**Zone A, B, and C Tailings Area:** all locations **Zone D Tailings:** between SCSD-9/10 and SCIT-7/8
		PCBs	0.18	NOAA ERM for benthics	**Zone B:** SCIT-5 **Zone D:** SCSD-9/10
Intertidal Saltwater (µg/L)					
Recreational Fisher	Ingestion of seafood	Arsenic	0.14	ADEC fish ingestion AWQC	**Zones A through C Tailings:** monitoring of SCSW-5/6, SCSW-1, SCSW-2 locations subsequent to action
Aquatic Organisms	Surface water ingestion dermal contact	Copper	3	ADEC screening value/ chronic saltwater AWQC	

Notes: 1 = TRGs not selected for all COECs where contamination co-located with listed constituents.
2 = Salazar and Salazar (2003) EC-tissue backcalculated to tailings/sediment concentration based on site-specific uptake rates.
ADEC = Alaska Department of Environmental Conservation
AST = Aboveground storage tank
AWQC = Ambient water quality criteria
COC = Constituent of concern
DRO = Diesel range organics
EC = Mean effects concentration
ERM = Effects range medium
mg/kg = Milligrams per kilogram
NA = Not applicable
ORNL = Oak Ridge National Laboratory
PCBs = Polychlorinated biphenyls
PRG = Preliminary remedial goal
RBSL = Risk-based screening level
TRG = Target Remediation Goal

Table 3-2
POTENTIAL FEDERAL AND STATE ARARS AND GUIDANCE TO BE CONSIDERED
Salt Chuck Mine – Tongass National Forest, Alaska

Citation	Description	Potential ARAR	To Be Considered	Rationale
	Chemical-Specific			
Alaska Solid Waste Regulations (18 AAC 60)	Regulations set forth standards for waste disposal facilities, including accumulation and storage limitations, land spreading restrictions, and requirements for special waste disposal. Permitting standards as well as monitoring and reporting requirements are also set forth in these regulations.	X		Solid waste regulations are applicable to the storage and disposal of solid waste such as soils and tailings materials.
Alaska Hazardous Waste Regulations (18 AAC 62 and 63)	Defines solid wastes that are hazardous waste; establishes standards for generators, transporters, and disposal facilities. Hazardous waste regulations may be applicable to the management and disposal of wastes at the site and wastes generated during the project. Alaska Hazardous Waste Management Regulations include the federal RCRA Subtitle C requirements with additional criteria and standards promulgated by the State of Alaska.	X		
Alaska Water Quality Standards (18 AAC 70)	Water quality standards identify desired uses for water in the State and establish in-stream criteria for inorganic constituents which are deemed necessary for the protection of the designated uses of that water body.	X		Water quality standards are applicable to surface water present onsite.
Alaska Oil and Other Hazardous Substance Pollution Control Regulations (18 AAC 75)	These regulations govern discharge of oil and hazardous substances, and related cleanup requirements. They also provide standards and guidance for site characterization, soil and groundwater cleanup levels, risk assessment, and the classification of groundwater as drinking water.	X		Soil and water cleanup levels in these regulations are applicable to onsite media.

Table 3-2 (continued)
POTENTIAL FEDERAL AND STATE ARARS AND GUIDANCE TO BE CONSIDERED
Salt Chuck Mine – Tongass National Forest, Alaska

Citation	Description	Potential ARAR	To Be Considered	Rationale
Chemical-Specific (continued)				
Alaska Drinking Water Standards (18 AAC 80)	Establishes drinking water standards for the state of Alaska.	X		All groundwater is considered drinking water unless specifically classified otherwise under 18 AAC 75.345.
Federal Water Quality Criteria (40 CFR Part 131)	Establishes regulatory levels for water quality parameters to protect propagation of fish, shellfish, and wildlife, and for recreation in and on the water. The standards include acute and chronic freshwater criteria and human health criteria. For selected metals, criteria are based on hardness and dissolved concentrations of metals.	X		Surface water is present on and near the site.
National Primary Drinking Water Standards (40 CFR Part 141)	Establishes standards for public water systems and specifies maximum contaminants levels (MCLs), also known as drinking water standards.	X		MCLs are valid because all groundwater in the state of Alaska is considered potential drinking water until proven otherwise. NCP regulations require that MCLs typically be ARARs for groundwater.
National Secondary Drinking Water Standards (40 CFR Part 143)	Establishes aesthetic standards for public water systems and specifies secondary maximum contaminants levels (SMCLs)		X	Relevant depending on type and concentration of contaminants detected. Some metals detected onsite (e.g., copper) are considered SMCLs.
Resource Conservation and Recovery Act (40 CFR Part 261)	The Federal regulations in 40 CFR Part 261 address the requirements for identification of hazardous wastes, which is critical during any remediation activity that may result in generation of hazardous wastes.	X		Onsite tailings materials may contain constituent concentrations exhibiting hazardous characteristics under RCRA.
Land Disposal Restrictions (40 CFR Part 268)	Requires treatment standards for certain wastes generated during remedial actions.	X		Not applicable to mine waste and tailings currently onsite (see Action-Specific ARARs below). Standards are potentially applicable to any treatment residuals.

Table 3-2 (continued)
POTENTIAL FEDERAL AND STATE ARARS AND GUIDANCE TO BE CONSIDERED
Salt Chuck Mine – Tongass National Forest, Alaska

Citation	Description	Potential ARAR	To Be Considered	Rationale
Chemical-Specific (continued)				
Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. OSWER Directive No. 9355.4-12 July 14, 1994	Describes methodology for developing site-specific preliminary remediation goals and media-specific cleanup standards for lead.		X	Potentially applicable, soils and tailings at the site contain elevated lead concentrations.
EPA Strategy for Reducing Lead Exposures EPA, February 21, 1991	Presents a strategy to reduce lead exposure, particularly for young children and reduce the amount of lead introduced into the environment.		X	Potentially applicable, soils and tailings at the site contain elevated lead concentrations and recreational use of the site has been reported.
EPA Region 6 Human Health Medium-Specific Screening Levels, December 2006	Provides risk-based concentrations for several human exposure scenarios; suggested for use by ADEC for compounds not included in 18 AAC 75.		X	Outdoor worker scenario values potentially applicable to site conditions.
ADEC Risk Assessment Procedures Manual, Draft, November 2005	Provides risk assessment guidance for use in preparing human health and ecological risk assessments under 18 AAC 75, including sources for ecological benchmarks for soil, sediment, and water.		X	Human and ecological receptors could be in contact with site media as detailed in SRE.
ADEC Ecoscoping Guidance, January 2007	Provides ERBSCs for identification of potential ecological risk.		X	Ecological receptors could be in contact with site media as detailed in SRE.
ADEC Additional Cleanup Values, Technical Memorandum 01-007, 2003	Provides cleanup levels for chemicals not listed in 18 AAC 75		X	Potentially applicable to chemicals in onsite media, e.g., copper.
ADEC Sediment Quality Guidelines, Technical Memorandum, March 2004	Provides recommendations for sediment screening levels based on Cormack (2001)		X	Potentially applicable to site sediment.
ADEC Guidance Document on Determining Background Concentrations in Soil, June 13, 2003	Provides guidance on the use of background concentrations at sites		X	In some cases, site-specific background concentrations (e.g., mercury) are above risk-based levels.

Table 3-2 (continued)
POTENTIAL FEDERAL AND STATE ARARS AND GUIDANCE TO BE CONSIDERED
Salt Chuck Mine – Tongass National Forest, Alaska

Citation	Description	Potential ARAR	To Be Considered	Rationale
Chemical-Specific (continued)				
NOAA Screening Quick Reference Tables, September 1999	Provides ecological benchmarks for freshwater and marine sediment		X	Potentially applicable to site media and receptors.
ORNL (1996, 1997a, 1997b, 1997c) technical documents	Provides ecological benchmarks and PRGs for a variety of media and receptors		X	Potentially applicable to site media and receptors.
CCME (1991a, 1991b, 2006) NEHC (2005), Netherlands Dept. of Soil Protection (2000), Salazar and Salazar (2003), and USEPA (2005c, 2005d, 2006c)	Various government agency and academic sources providing ecological benchmarks used in SRE.		X	Potentially applicable to site media and receptors.
Location-Specific				
Federal Coastal Zone Management Act (16 USC Sections 1451, 1456(c), and 307(c), 33 CFR Part 320)	Provides for the use, management, restoration, and enhancement of the coastal environment.			Salt Chuck Mine is not within the CZMA jurisdiction.
Alaska Coastal Management Regulations (6 AAC 80 and 85)	Provides for the regulated use of coastal areas and their resources.	X		These regulations are applicable if site activities such as barge landings affect the coastal environment. This regulation is most likely not appropriate to the potential actions.
Alaska Department of Fish and Game Requirements (Title 16.05.870 Anadromous Fish Stream Permit)	Permit required for actions in or affecting anadromous fish streams; including tidelands to mean low water at the mouth (MLW).	X		Actions are adjoining designated anadromous fish stream, Lake Ellen Creek.
U.S. Army Corps of Engineers Section 404 Permits	Required for any work within tidelands and wetlands involving dredge or fill activities.	X		Removal of contaminated tailings may alter current contours and extent of tidal influence. Material stockpiling may be in wetlands area.
Alaska Coastal Management Program Consistency Review Regulations (6 ACC 50)	Consistency review required for all activities within the coastal zone.	X		Cleanup activities initial work within active tidelands which necessitates a federal and several state permits.

Table 3-2 (continued)
POTENTIAL FEDERAL AND STATE ARARS AND GUIDANCE TO BE CONSIDERED
Salt Chuck Mine – Tongass National Forest, Alaska

Citation	Description	Potential ARAR	To Be Considered	Rationale
Location-Specific (continued)				
Alaska Department of Natural Resources Land Use Planning (AS 38.04.065)	Requires land use plans for management of state-owned lands and submerged lands underlying navigable waters. ADNR (1998) designates aquatic farming land use and critical habitat for certain fish and wildlife in Salt Chuck Bay and environs.	X		Site lies within area managed by Prince of Wales Island Area Plan (ADNR, 1998).
Essential Fish Habitat Consultation (Magnuson-Stevens Fisheries Conservation and Management Act: 50 CFR Part 600)	Consultation with National Marine Fisheries required for all activities in Essential Fish Habitat.		X	
Alaska Department of Natural Resources Tidelands Permit	DNR tideland permit or special use permit required for activities within state tidelands.	X		Proposed action will occur below mean high water on state tidelands.
Alaska Hazardous Waste Management Facilities Siting Regulations (18 AAC 63)	Restricts placement of hazardous waste management facilities in floodplains and other sensitive areas.	X		These regulations are applicable to alternatives incorporating the storage of tailings and/or soils onsite.
National Historic Preservation Act (32 CFR Part 229, 40 CFR § 6.301(b), 36 CFR Part 800)	Establishes a requirement for federal agencies to take into account the effect of any federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historical Places.	X		Applicable based on results of site archeological survey conducted in 2002. Archeological report (Bruder, 2002) indicates that the Sat Chuck Mine site is eligible for inclusion in the National Register.
Preservation of Historical and Archeological Data (40 CFR § 6.301(c))	Establishes procedures to provide for preservation of historical and archeological data which might be destroyed through alterations of terrain as a result of a federal construction project or a federally licensed activity or program.	X		Applicable to actions affecting potential archaeological data.
Alaska Historic Preservation Requirements (AS 41.35 and 11 AAC 16)	Provides for the protection of historic places on State lands and tidelands.		X	Not applicable to federal lands at the site. USFS typically takes lead on tidelands adjacent their sites.

Table 3-2 (continued)
POTENTIAL FEDERAL AND STATE ARARS AND GUIDANCE TO BE CONSIDERED
Salt Chuck Mine – Tongass National Forest, Alaska

Citation	Description	Potential ARAR	To Be Considered	Rationale
Location-Specific (continued)				
Fish and Wildlife Coordination Act (16 USC 1513-1543, 40 CFR 6.302(g))	Consultation with the Fish and Wildlife Service is required where modification or control of any stream is performed.	X		Applicable to any actions in streams or involving dredge or fill activities in streams or wetlands.
Endangered Species Act (16 USC 1531-1544 et. Seq. 16 USC 4201-4245, 50 CFR Parts, 17, 222, 227, and 402). AS 16/ 5 AAC 95	Provides for protection and conservation of various species of fish, wildlife, and plants. Establishes requirements for actions to conserve endangered species within critical habitats upon which endangered species depend.		X	Endangered species were not observed at the site during the 2006 site investigation; however, certain requirements may be appropriate, such as timing of remedial actions to avoid impacts to wildlife.
Management of Federal Lands (13 USC § 1700)	Establishes requirements concerning utilization of public lands, particularly rights-of-way regulation, land use planning and land acquisition and appropriation of waters on public lands.	X		May be relevant depending on land types and features present at the site.
Action-Specific				
Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257)	Establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment, and thereby prohibits open dumps.	X		Regulations apply to solid waste present at the site.
Identification and Listing of Hazardous Waste (40 CFR Part 261) (18 AAC 62)	Defines solid wastes that are subject to regulation as hazardous waste.	X		Not applicable to mine waste and tailings currently onsite. Mining waste disposed prior to 1989 are excluded from regulation as hazardous waste (Bevill Amendment). It is only the active management of mine waste which falls out of current exclusion, that is potentially regulated as hazardous waste. Standards are potentially applicable to any treatment residuals.

Table 3-2 (continued)
POTENTIAL FEDERAL AND STATE ARARS AND GUIDANCE TO BE CONSIDERED
Salt Chuck Mine – Tongass National Forest, Alaska

Citation	Description	Potential ARAR	To Be Considered	Rationale
Action-Specific (continued)				
Standards Applicable to Generators of Hazardous Waste (40 CFR Part 262) (18 AAC 62)	Establishes standards for Generators of Hazardous Waste	X		Not applicable to mine waste and tailings currently onsite. Mining waste disposed prior to 1989 are excluded from regulation as hazardous waste (Bevill Amendment). The tailings at the site were the beneficiation product of a mining practice, and therefore potentially applicable for exclusion under the Bevill Amendment regulations.
Land Disposal Restrictions Program (40 CFR Part 268)	Sets treatment standards for hazardous wastes based on the levels achievable by current technology; sets two-year national variances from the statutory effective dates due to insufficient treatment capacity.	X		Not applicable to mine waste and tailings currently onsite. Mining waste disposed prior to 1989 are excluded from regulation as hazardous waste (Bevill Amendment). The tailings at the site were the beneficiation product of a mining practice, and therefore potentially applicable for exclusion under the Bevill Amendment regulation.
Alaska Solid Waste Regulations (18 AAC 60)	Criteria and permitting requirements for landfills; define solid waste disposal requirements.	X		Solid waste generated during the removal needs to be managed in accordance with these regulations.
Clean Water Act (33 USC 1251 et. Seq. Section 404, 33 CFR Part 323, 40 CFR Part 230, 33 USC 1341, Sect. 401, 33 CFR Parts 320-330) AS 46.03/ 18 AAC 15, 18 AAC 70, 18 AAC 72	Prohibits discharge of dredged or fill material into wetlands without a permit. Requires Jurisdictional Determination for wetlands for proposed material stockpile locations. Obtain certification for any discharge into a waterway that may be considered a pollutant.	X		The CWA regulations that most likely apply are surface water quality standards, control of discharges of dredge and fill material into surface waters (including wetlands), and storm water management requirements.
Clean Water Act: NPDES Requirements (40 CFR Parts 122 – 125)	Establishes a program for controlling stormwater discharges from inactive mine sites.	X		Applicable to the inactive mine site, although permitting not required to execute removal actions.
Occupational Safety and Health Act of 1970 (29 CFR Part 1910)	Sets standards for safety and health in the work environment.		X	Health and Safety requirements are not ARARs per the NCP regulations.
Mine Safety and Health Act (30 CFR 57.20021)	Safety and health standards for underground mines		X	Health and Safety requirements are not ARARs per the NCP regulations.

Table 3-2 (continued)
POTENTIAL FEDERAL AND STATE ARARS AND GUIDANCE TO BE CONSIDERED
Salt Chuck Mine – Tongass National Forest, Alaska

Citation	Description	Potential ARAR	To Be Considered	Rationale
Action-Specific (continued)				
Alaska Mining Statutes (27 AAC 19 and 20)	Provides standards for reclamation and public safety at mining operations.		X	Requirements for operators to leave mine sites in stable condition, and to insure protection of public safety, may be applicable to the site.

Table 4-1
REMOVAL ALTERNATIVES SUMMARY
Salt Chuck Mine – Tongass National Forest, Alaska

Alternative Number	Alternative Name	Process Options Included
1	No Action	No removal action No institutional controls
2	Institutional Controls	Deed restrictions Physical access restrictions Long-term monitoring
3	Excavation, Consolidation in Onsite Repository and Capping	Deed restrictions Physical access restrictions Staging area for temporary stockpile(s) Excavation and grading Hand excavation at the millsite Onsite transportation Clear and prep repository area HDPE liner, cover Consolidation of materials Cover protection Clean fill Water quality control measures (silt fencing) Revegetation Long-Term Monitoring
4	Excavation and Offsite Disposal	Staging area for temporary stockpile(s) Excavation and grading Hand excavation at the millsite Onsite transportation Water quality control measures (silt fencing) Offsite transportation Offsite Disposal Revegetation Confirmatory sampling

Table 5-1
SUMMARY EVALUATION OF REMOVAL ALTERNATIVES FOR EFFECTIVENESS AND IMPLEMENTABILITY
Salt Chuck Mine – Tongass National Forest, Alaska

Evaluation Criterion	Alternative 1 No Action	Alternative 2 Institutional Controls	Alternative 3 Excavation, Consolidation in Onsite Repository, and Capping	Alternative 4 Excavation and Offsite Disposal
EFFECTIVENESS				
Protection of human health and the environment	Not protective of human or ecological receptors.	Limited protection of human health. Not protective of ecological receptors.	Protective; eliminates exposure pathways.	Protective; eliminates exposure pathways.
Long-term effectiveness and permanence	Not effective and permanent; short- and long-term risks remain onsite.	Effective and permanent of human receptors in the uplands areas. Not effective and permanent for ecological receptors. Not effective and permanent for human or ecological receptors in the intertidal zone.	Effective and permanent for human receptors, isolates impacted materials with cap. Depending on condition of the cap, this may not be permanent for terrestrial receptors in the case of burrowing animals.	Effective and permanent; impacted materials disposed of offsite in a permitted managed facility.
Reduction of toxicity, mobility, or volume through treatment	No reduction of toxicity, mobility, or volume would be achieved.	No reduction in toxicity, mobility or volume would be achieved.	No reduction in toxicity or volume onsite. Reduction in mobility by physical isolation of materials and COCs by means of a cap.	Reduction in constituent mobility and volume onsite through proper management at offsite disposal facility; no change in volume or toxicity of original material.
Level or degree of treatment	No treatment provided.	No treatment provided.	No treatment provided.	No treatment provided.
Timeliness with which alternative can mitigate threats	Not applicable.	Estimated to be within one construction season.	Estimated to be one construction season.	Estimated to be a minimum of two construction seasons.
Short-term effectiveness; protection of public health and workers during implementation	Not applicable.	Short-term impacts may include exposure to tailings and other impacted materials during fence installation. OSHA standards would be followed.	Short-term impacts may include dust-generated during area grading operations, excavation, transfer of materials, and cap construction. Potential for resuspension of materials in the intertidal zone. Potential risks could be managed with appropriate dust control and containment (silt fencing in the intertidal zone) measures. OSHA standards would be followed.	Short-term impacts may include dust-generated during excavation and potential for release of materials during transport. Potential risks could be managed with appropriate dust control and containment (silt fencing in the intertidal zone) measures. OSHA standards would be followed.

Table 5-1 (continued)
SUMMARY EVALUATION OF REMOVAL ALTERNATIVES FOR EFFECTIVENESS AND IMPLEMENTABILITY
Salt Chuck Mine – Tongass National Forest, Alaska

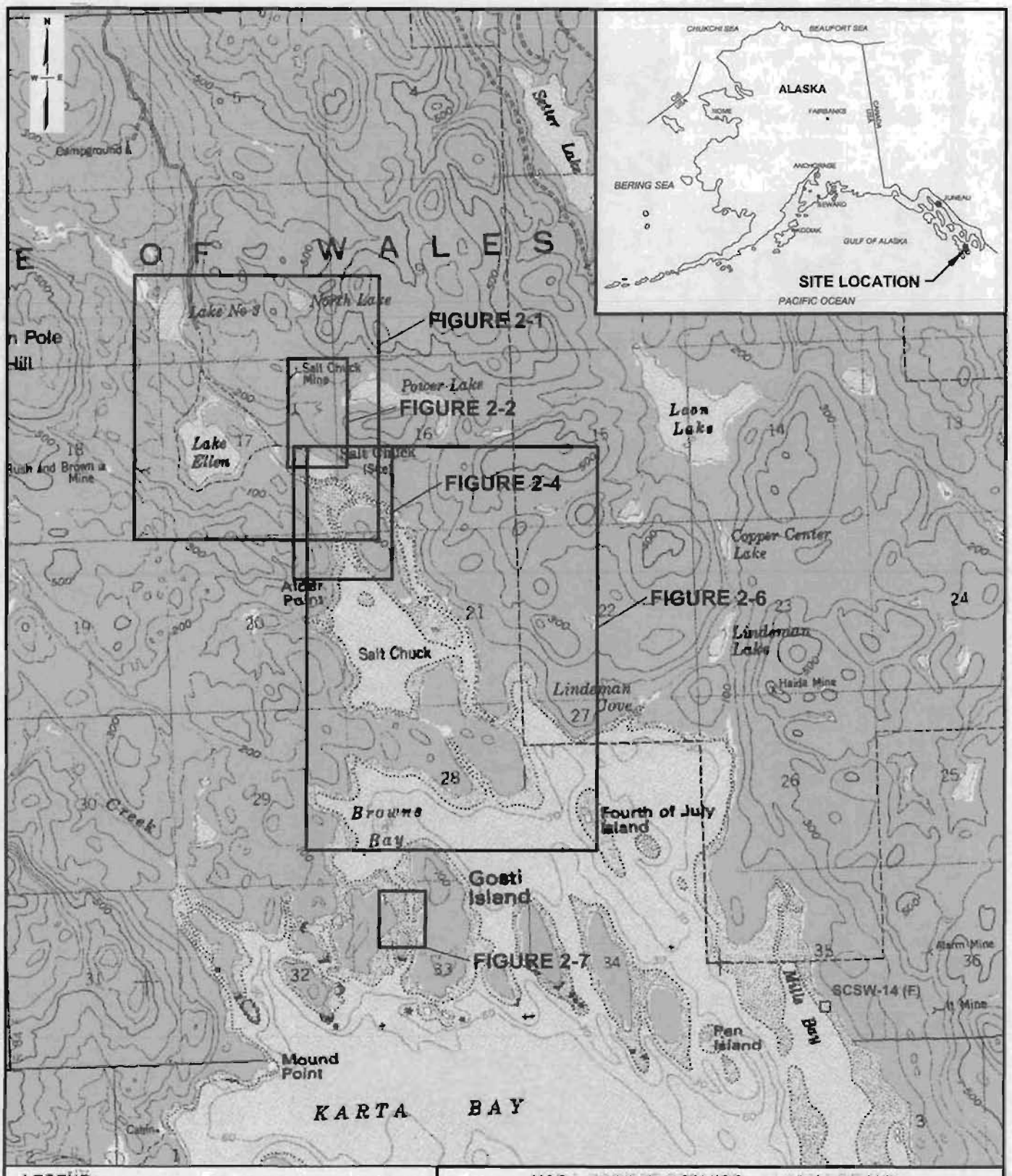
Evaluation Criterion	Alternative 1 No Action	Alternative 2 Institutional Controls	Alternative 3 Excavation, Consolidation in Onsite Repository, and Capping	Alternative 4 Excavation and Offsite Disposal
EFFECTIVENESS (continued)				
Ability to comply with ARARs	Would not comply with potential ARARs.	Would not comply with potential ARARs.	Would comply with potential ARARs. Water quality monitoring would be conducted in the intertidal zone to monitor compliance with AWQS. May require a Section 404 permit from the USACE.	Would comply with potential ARARs. Water quality monitoring would be conducted in the intertidal zone to monitor compliance with AWQS. May require a Section 404 permit from the USACE.
TECHNICAL IMPLEMENTABILITY				
Constructability	There are no construction aspects to this alternative.	All prescribed actions would be readily constructable.	All prescribed actions would be readily constructable. Intertidal excavation can only occur during low tide.	All prescribed actions would be readily constructable. Intertidal excavation can only occur during low tide.
O&M considerations	There are no O&M considerations associated with this alternative.	Routine inspections of access controls readily implementable. No safety concerns. On-going environmental monitoring.	Routine inspections of cap readily implementable. Difficult to inspect liner under cap. No safety concerns. On-going environmental monitoring.	No O&M required. No safety concerns.
Demonstrated performance/useful life	Not applicable.	Useful life of access controls indefinite with routine inspection and maintenance.	Useful life of access controls and cap indefinite with proper routine inspection and maintenance.	Material permanently removed from site. Useful life of offsite disposal facility indefinite with proper management of disposal facility.
Adaptability to environmental conditions	Not applicable.	Readily adaptable.	Concerns with working in the intertidal zones. Water quality monitoring. Working around tide schedule.	Concerns with working in the intertidal zones. Water quality monitoring. Working around tide schedule.
Reliability	Not applicable.	Security fencing is reliable.	Capping is a proven and reliable technology.	Offsite removal and disposal are reliable.
Availability of equipment, technologies, personnel, and services	Not applicable.	Readily available.	Readily available.	Readily available.

Table 5-1 (continued)
SUMMARY EVALUATION OF REMOVAL ALTERNATIVES FOR EFFECTIVENESS AND IMPLEMENTABILITY
Salt Chuck Mine – Tongass National Forest, Alaska

Evaluation Criterion	Alternative 1 No Action	Alternative 2 Institutional Controls	Alternative 3 Excavation, Consolidation in Onsite Repository, and Capping	Alternative 4 Excavation and Offsite Disposal
TECHNICAL IMPLEMENTABILITY (continued)				
Outside laboratory testing capacity	Not applicable.	Requires laboratory confirmatory testing for metals and organics; laboratory capacity readily available.	Requires laboratory confirmatory testing for metals and organics; laboratory capacity readily available.	Requires laboratory confirmatory testing for metals and organics; laboratory capacity readily available.
Offsite treatment and disposal capacity	Not applicable.	Not applicable.	Not applicable.	Permitted disposal facilities are located in Washington, Oregon and Idaho.
Availability of necessary post-removal site control	Not applicable.	Requires deed restrictions and use agreements for protection of materials left onsite and routine site inspections.	Requires deed restrictions and use agreements for protection of materials left onsite and routine site inspections.	Requires deed restrictions; other post-removal site control not required.
ADMINISTRATIVE IMPLEMENTABILITY				
Permitting requirements	No special permits required	No special permits required.	Jurisdictional Determination for wetlands required.	Jurisdictional Determination for wetlands required. U.S. and Canadian manifests required for transportation to Washington State.
Easements or rights-of-way	None required.	Easements may be necessary for access to private portions of the site for possible future development.	Easements may be necessary for access to private portions of the site for possible future development.	Easements may be necessary for access to private portions of the site for possible future development.
Ability to impose institutional controls	Not applicable.	Institutional controls readily implementable.	Institutional controls readily implementable.	Institutional controls would not be required following completion of removal action.
Potential impacts on adjacent properties	Not applicable.	Mitigation measures and contingency plans would be implemented to minimize impacts to surrounding USFS land.	Mitigation measures and contingency plans would be implemented to minimize impacts to surrounding USFS land.	Mitigation measures and contingency plans would be implemented to minimize impacts to surrounding USFS land.
Likelihood of public acceptance	Low.	Low.	High.	High.

FIGURES

FIGURE 1-0



LEGEND:

☐ SURFACE WATER SAMPLE (2006)
SCSW-14

(F) FILTERED

SOURCE: USGS TOPOGRAPHIC MAP SERIES, CRAIG (C-2) QUADRANGLE

0 2,000 4,000 8,000
SCALE IN FEET

USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS

SITE LOCATION MAP

SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA

URS

JOB NO: 26219785	DRAWN: ARN
DATE: MARCH 2007	FILE: 9785 REPORT (DRAFT).DWG

FIGURE 1-1

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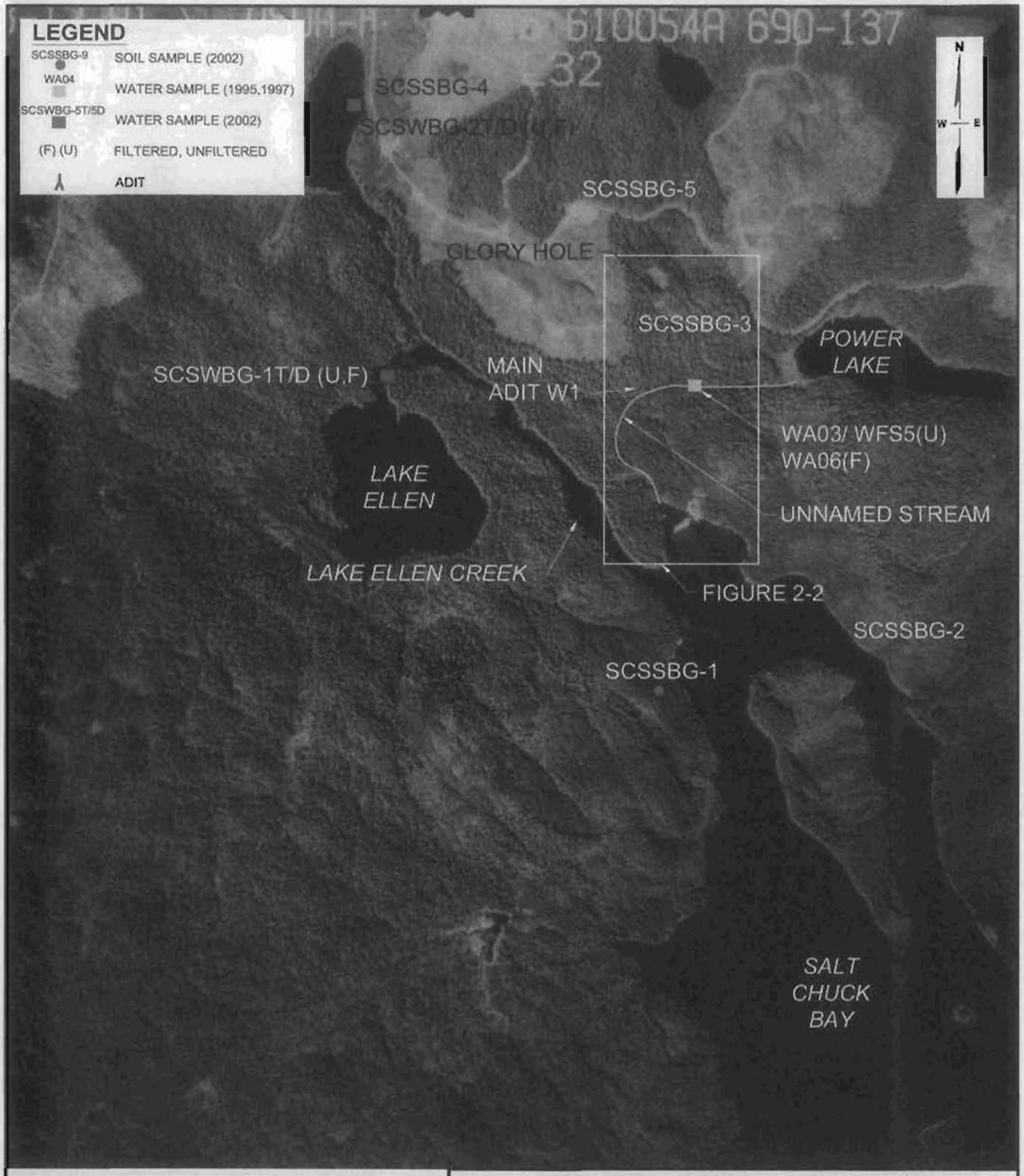

SOURCE:
US FOREST SERVICE (1991b), US BLM (1998), URS (2003)

0 750 1,500 3,000
APPROXIMATE SCALE IN FEET

USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS

BACKGROUND SOIL AND SURFACE WATER SAMPLE LOCATIONS

SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA

URS

JOB NO: 26219785	DRAWN: ARN
DATE: MARCH 2007	FILE: 9785 REPORT (DRAFT).DWG

FIGURE 2-1

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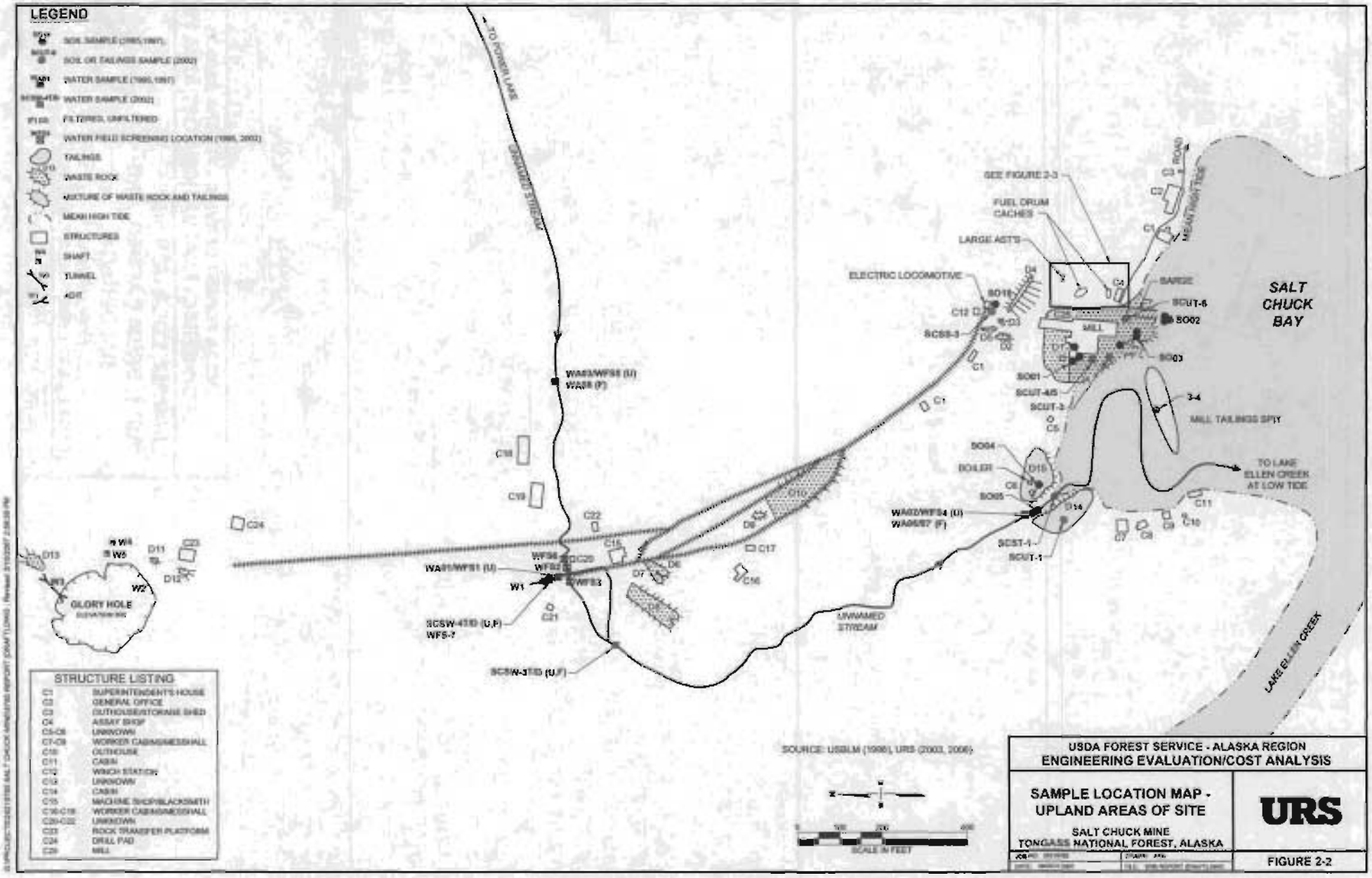
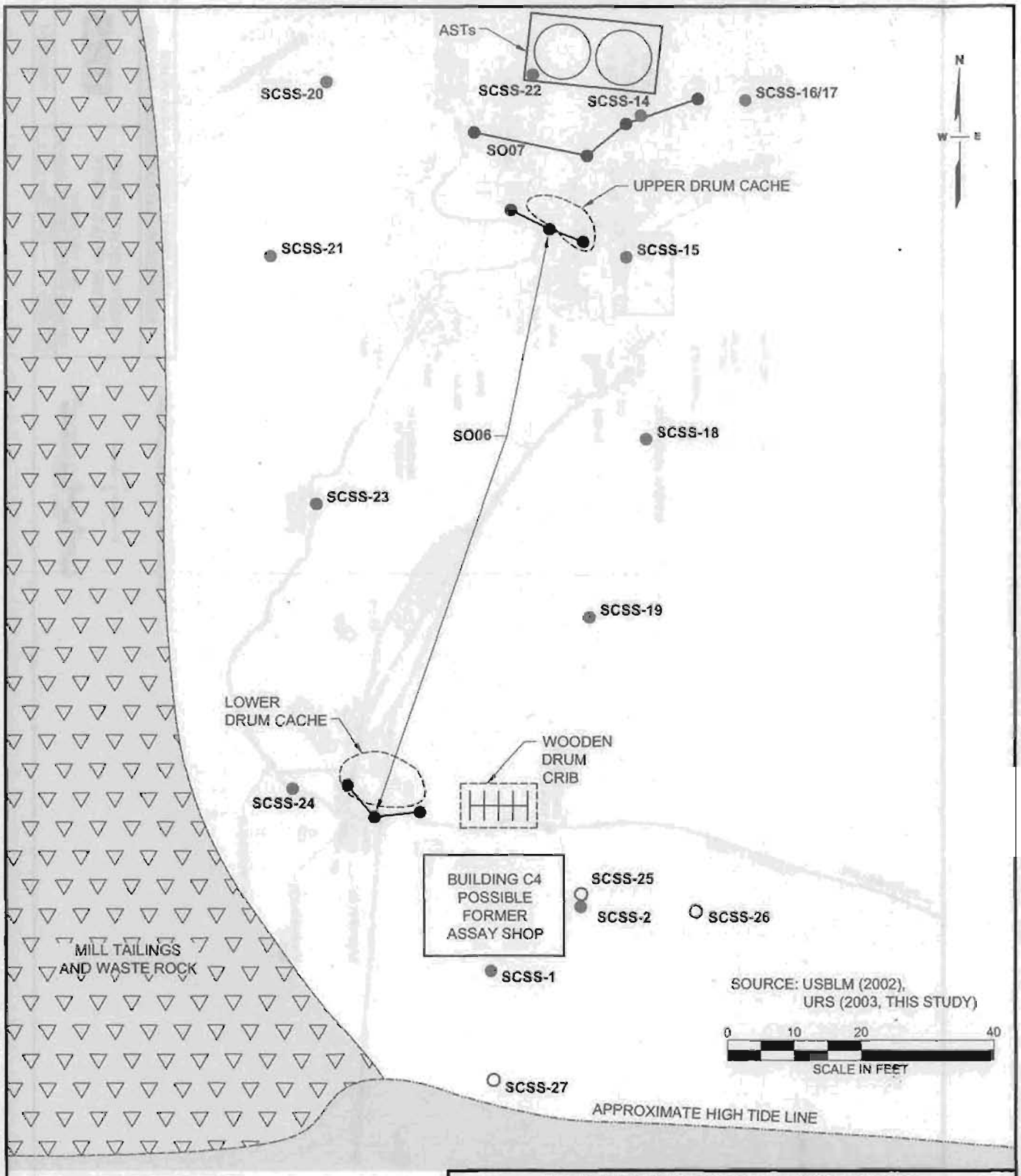

LEGEND
SOIL SAMPLE (1995,1997)
SOIL OR TAILINGS SAMPLE (2002)
WATER SAMPLE (1995,1997)
WATER SAMPLE (2002)
F1UN FILTERED, UNFILTERED
WATER FIELD SCREENING LOCATION (1995, 2002)
TAILINGS
WASTE ROCK
MIXTURE OF WASTE ROCK AND TAILINGS
MEAN HIGH TIDE
STRUCTURES
SHAFT
TUNNEL
ADIT
TO FOWLER LAKE
GRAVEL STREAM
SEE FIGURE 2-3
FUEL DRUM CACHES
LARGE ASTS
ELECTRIC LOCOMOTIVE
SCSS-3
WA03/WFS5 (U)
WA05 (F)
MILL
BARGE
SCUT-6
SO02
SO03
SO01
SCUT-4/5
SCUT-3
3-4
MILL TAILINGS SPIT
SO04
BOILER
SO05
WA02/WFS4 (U)
WA06/07 (F)
SCST-1
SCUT-1
TO LAKE ELLEN CREEK AT LOW TIDE
SALT CHUCK BAY
MEAN HIGH TIDE
ROAD
WA01/WFS1 (U)
W1
WFS6
WFS2
WFS3
SCSW-4TD (U,F)
WFS-7
SCSW-3TD (U,F)
GLORY HOLE
UNNAMED STREAM
LAKE ELLEN CREEK
STRUCTURE LISTING
C1 SUPERINTENDENT'S HOUSE
C2 GENERAL OFFICE
C3 OUTHOUSE/STORAGE SHED
C4 ASSAY SHOP
C5-C6 UNKNOWN
C7-C8 WORKER CABINS/MESS HALL
C9 OUTHOUSE
C11 CABIN
C12 WINCH STATION
C13 UNKNOWN
C14 CABIN
C15 MACHINE SHOP/BLACKSMITH
C16-C18 WORKER CABINS/MESS HALL
C20-C22 UNKNOWN
C23 ROCK TRANSFER PLATFORM
C24 DRILL PAD
C25 MILL
SOURCE: USGLM (1996), URS (2003, 2006)
SCALE IN FEET
USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS
SAMPLE LOCATION MAP - UPLAND AREAS OF SITE
SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA
URS
FIGURE 2-2



LEGEND

SO07 COMPOSITE SOIL SAMPLE (1997)

SCSS-24 SOIL SAMPLE (2002)

SCSS-27 SOIL SAMPLE (2006)

USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS

SAMPLE LOCATION MAP - ASTs, DRUM CACHES, AND BUILDING C4

SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA

URS

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FIGURE 2-3

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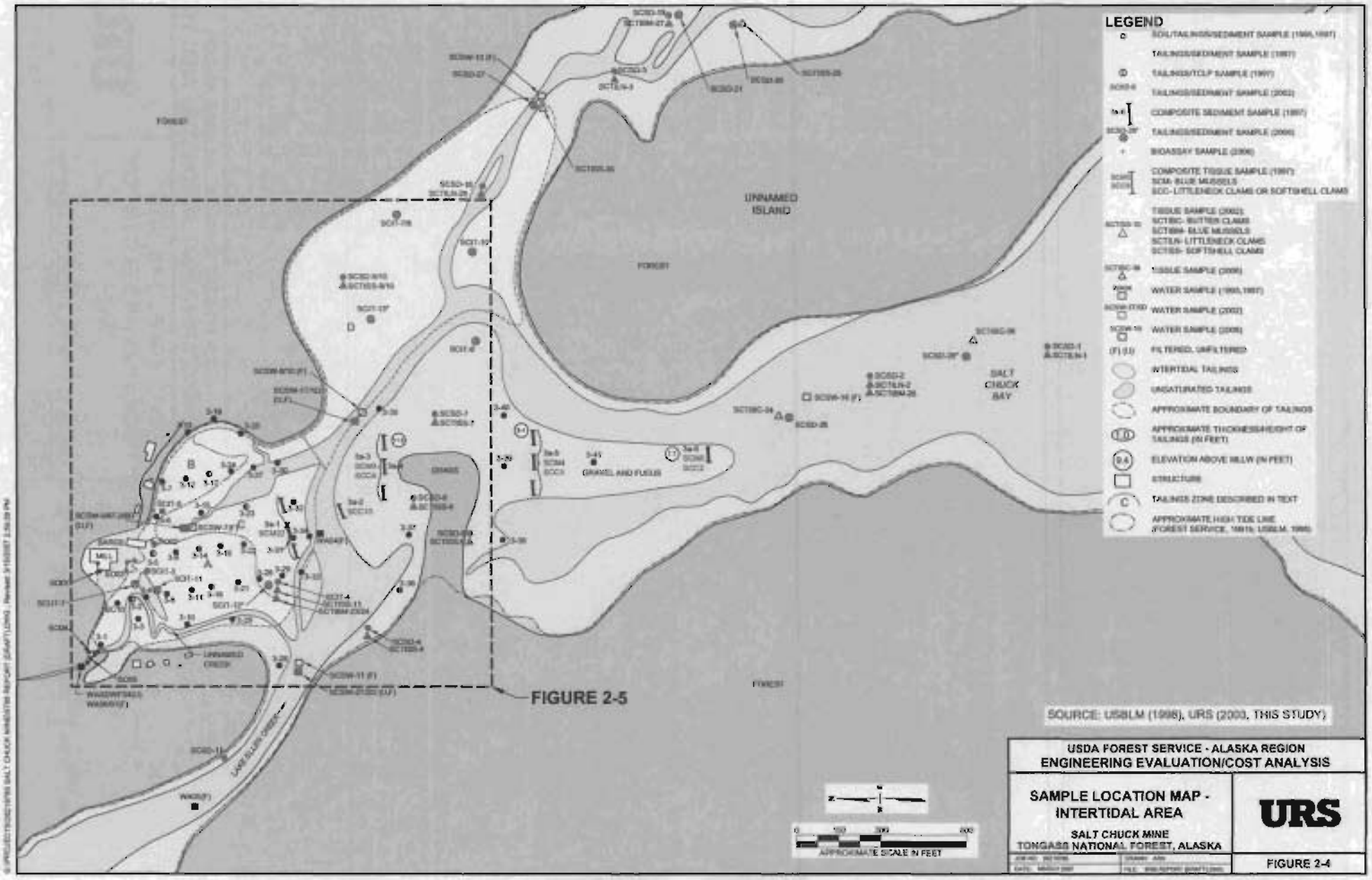
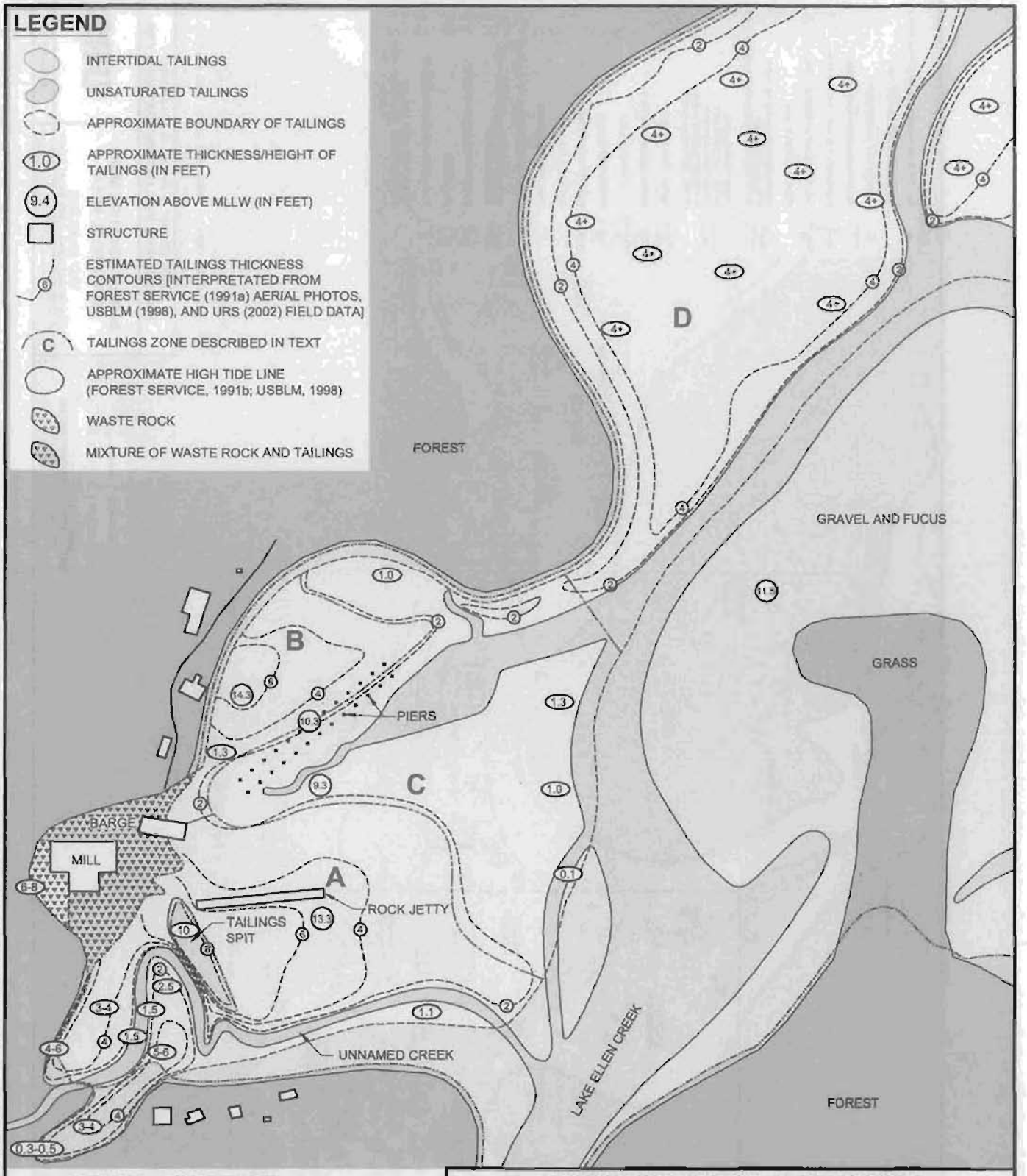

LEGEND
UNNAMED ISLAND
SALT CHUCK BAY
FOREST
GRAVEL AND FUSUS
FIGURE 2-5
SOURCE: USBLM (1998), URS (2003, THIS STUDY)
APPROXIMATE SCALE IN FEET
USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS
SAMPLE LOCATION MAP - INTERTIDAL AREA
SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA
URS
FIGURE 2-4



SOURCE: USBLM (1998), URS (2003, THIS STUDY)

N W E

0 100 200 400

SCALE IN FEET

USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS

INTERTIDAL TAILINGS THICKNESS AND ELEVATION DATA

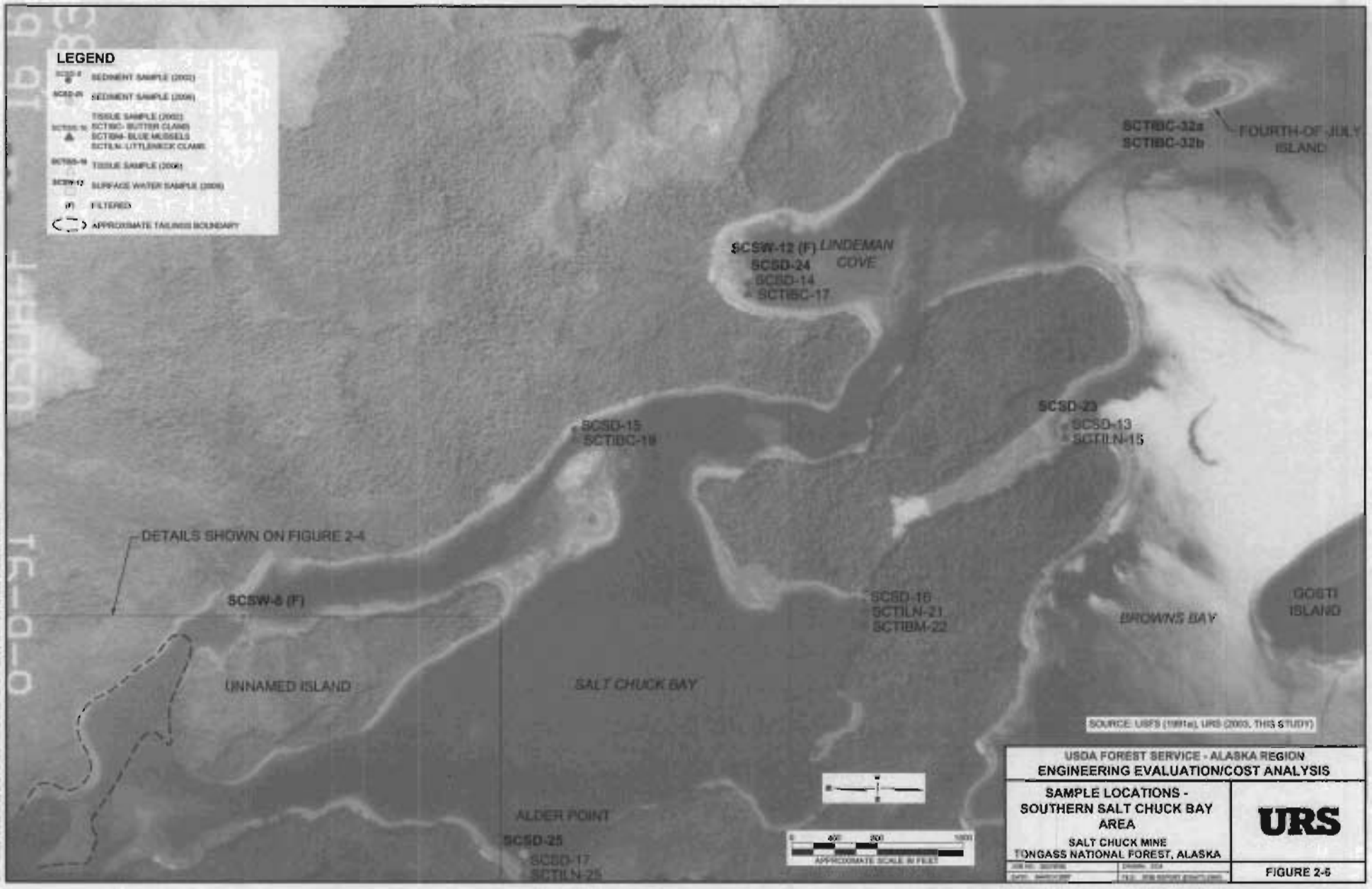
SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA

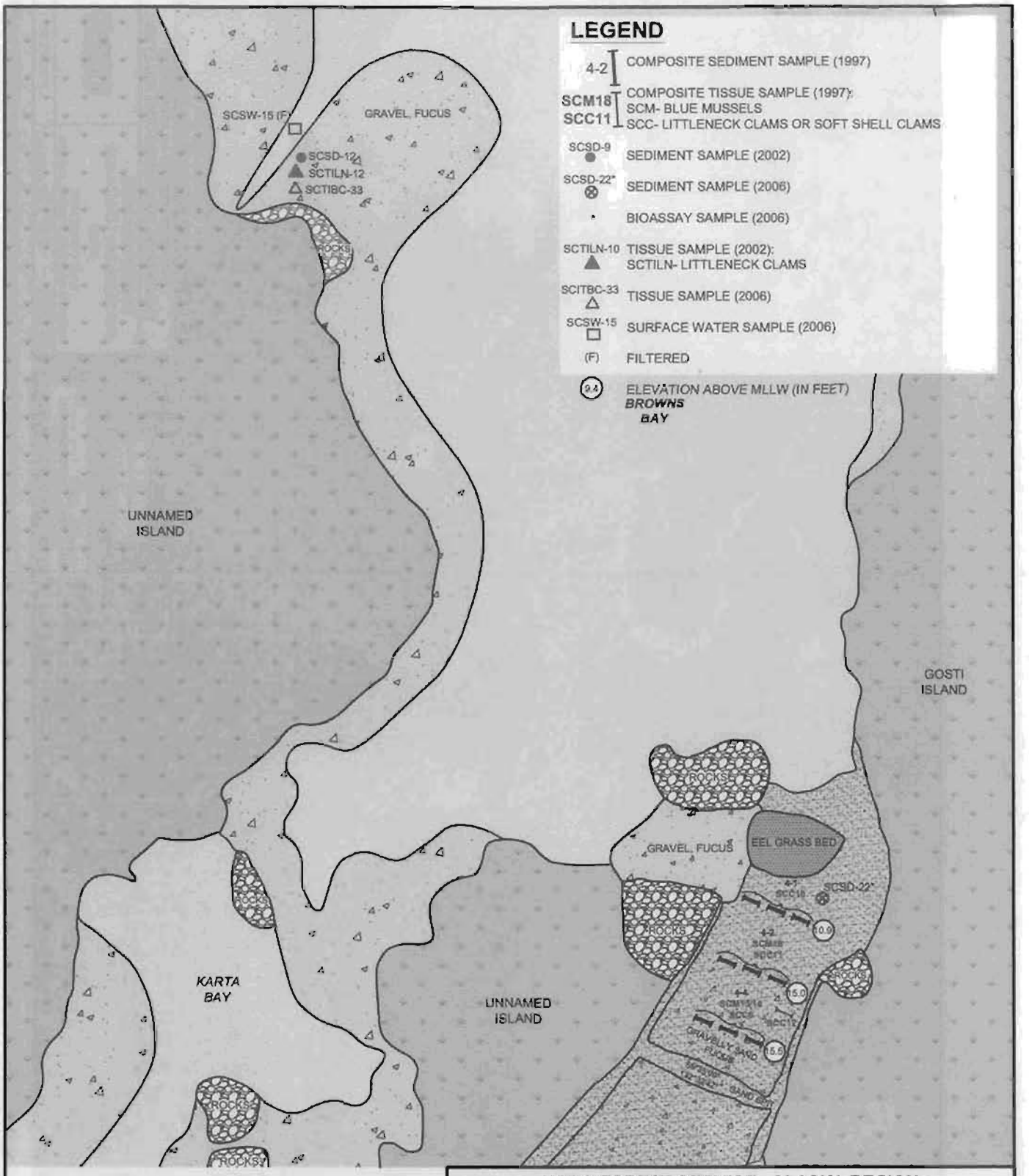
URS

JOB NO: 26219785	DRAWN: ARN
DATE: MARCH 2007	FILE: 9785 REPORT (DRAFT).DWG

FIGURE 2-5

G:\PROJECTS\26219785 SALT CHUCK MINE\9785 REPORT (DRAFT).DWG ; Revised 3/15/2007 2:59:39 PM


LEGEND
SEDIMENT SAMPLE (2002)
SEDIMENT SAMPLE (2006)
TISSUE SAMPLE (2002)
SCTIBC- BUTTER CLAMS
SCTIBM- BLUE MUSSELS
SCTILN- LITTLENECK CLAMS
TISSUE SAMPLE (2006)
SURFACE WATER SAMPLE (2006)
(F) FILTERED
APPROXIMATE TAILINGS BOUNDARY
SCTIBC-32a
SCTIBC-32b
FOURTH-OF-JULY ISLAND
SCSW-12 (F)
LINDEMAN COVE
SCSD-24
SCSD-14
SCTIBC-17
SCSD-23
SCSD-13
SCTILN-15
SCSD-15
SCTIBC-19
DETAILS SHOWN ON FIGURE 2-4
SCSW-8 (F)
SCSD-16
SCTILN-21
SCTIBM-22
BROWNS BAY
GOSTI ISLAND
UNNAMED ISLAND
SALT CHUCK BAY
SOURCE: USFS (1991a), URS (2003, THIS STUDY)
ALDER POINT
SCSD-25
SCSD-17
SCTILN-25
0 400 800 1600
APPROXIMATE SCALE IN FEET
USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS
SAMPLE LOCATIONS - SOUTHERN SALT CHUCK BAY AREA
SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA
URS
FIGURE 2-5



SOURCE: USBLM (1998),
URS (2003, THIS STUDY)

N
W E

0 100 200 400
APPROXIMATE SCALE IN FEET

USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS

BACKGROUND SEDIMENT AND TISSUE SAMPLE LOCATIONS - NEAR GOSTI ISLAND

SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA

URS

JOB NO: 26219785	DRAWN: ARN
DATE: MARCH 2007	FILE: 9785 REPORT (DRAFT).DWG

FIGURE 2-7

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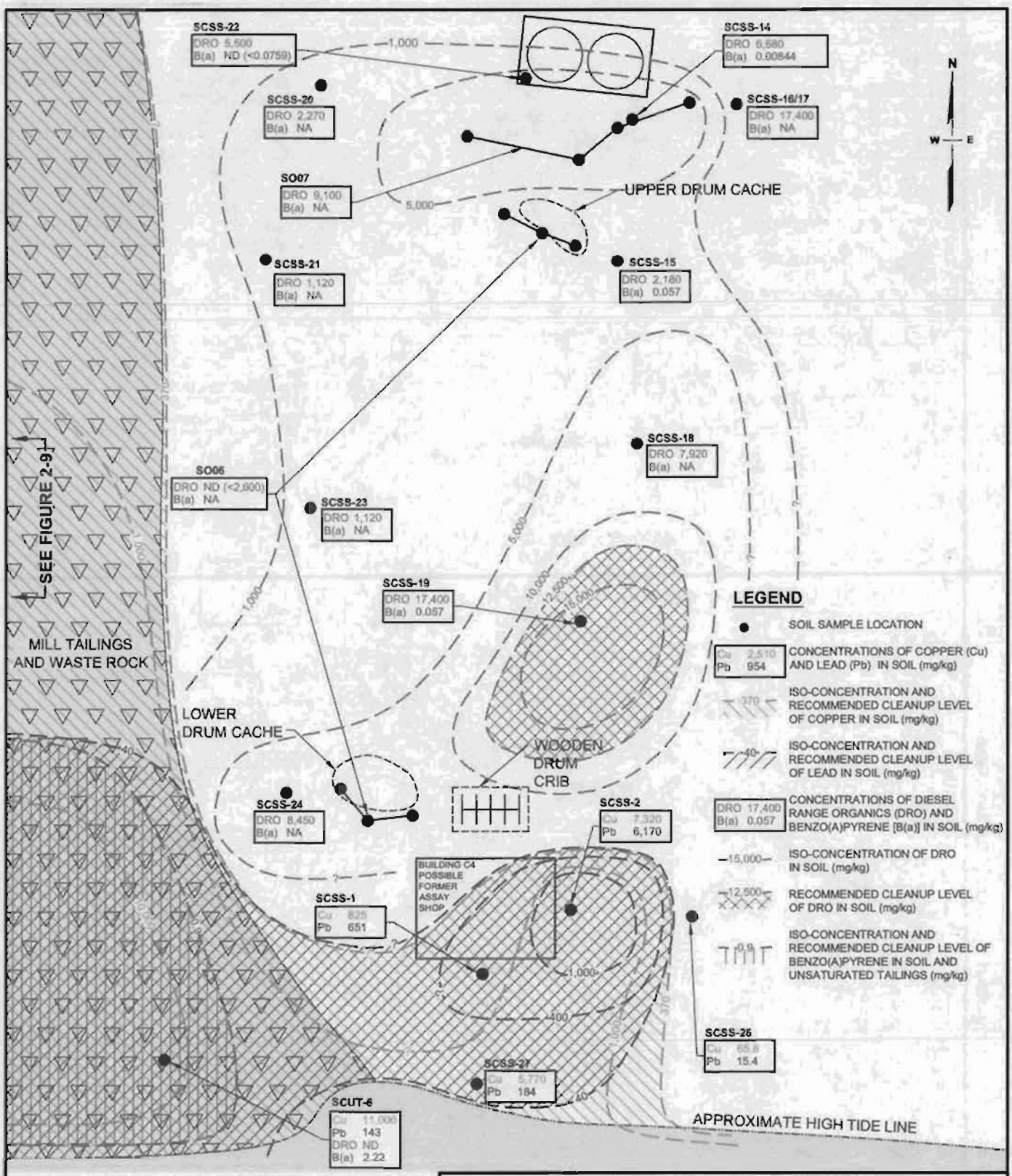

USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS

DISTRIBUTION OF SELECTED METALS AND ORGANICS IN SOIL - AST AND BUILDING C4 AREAS

SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA

URS

JOB NO: 26219785	DRAWN: ARN
DATE: APRIL 2007	FILE: 9785 REPORT (DRAFT).DWG

FIGURE 2-8

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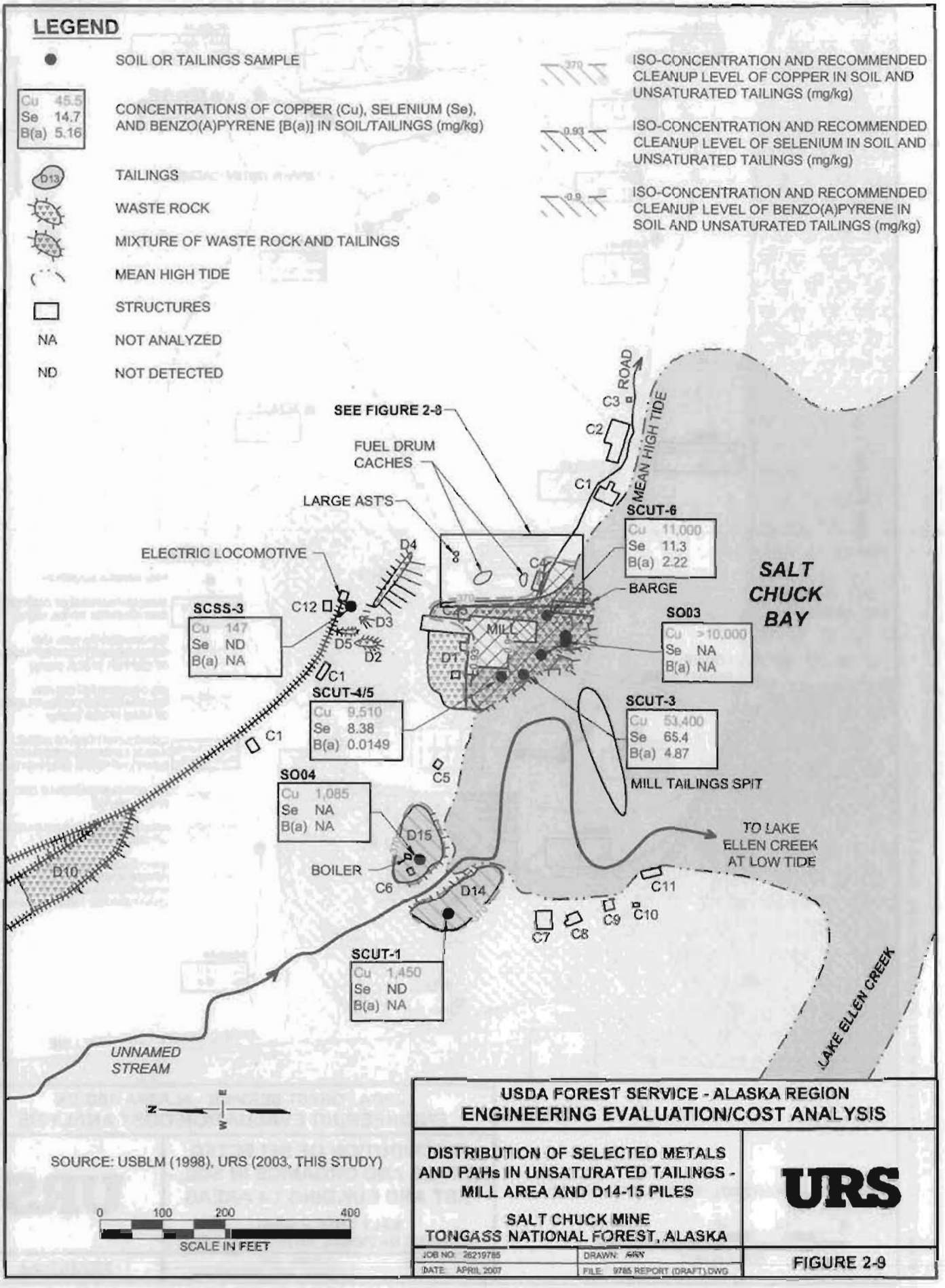
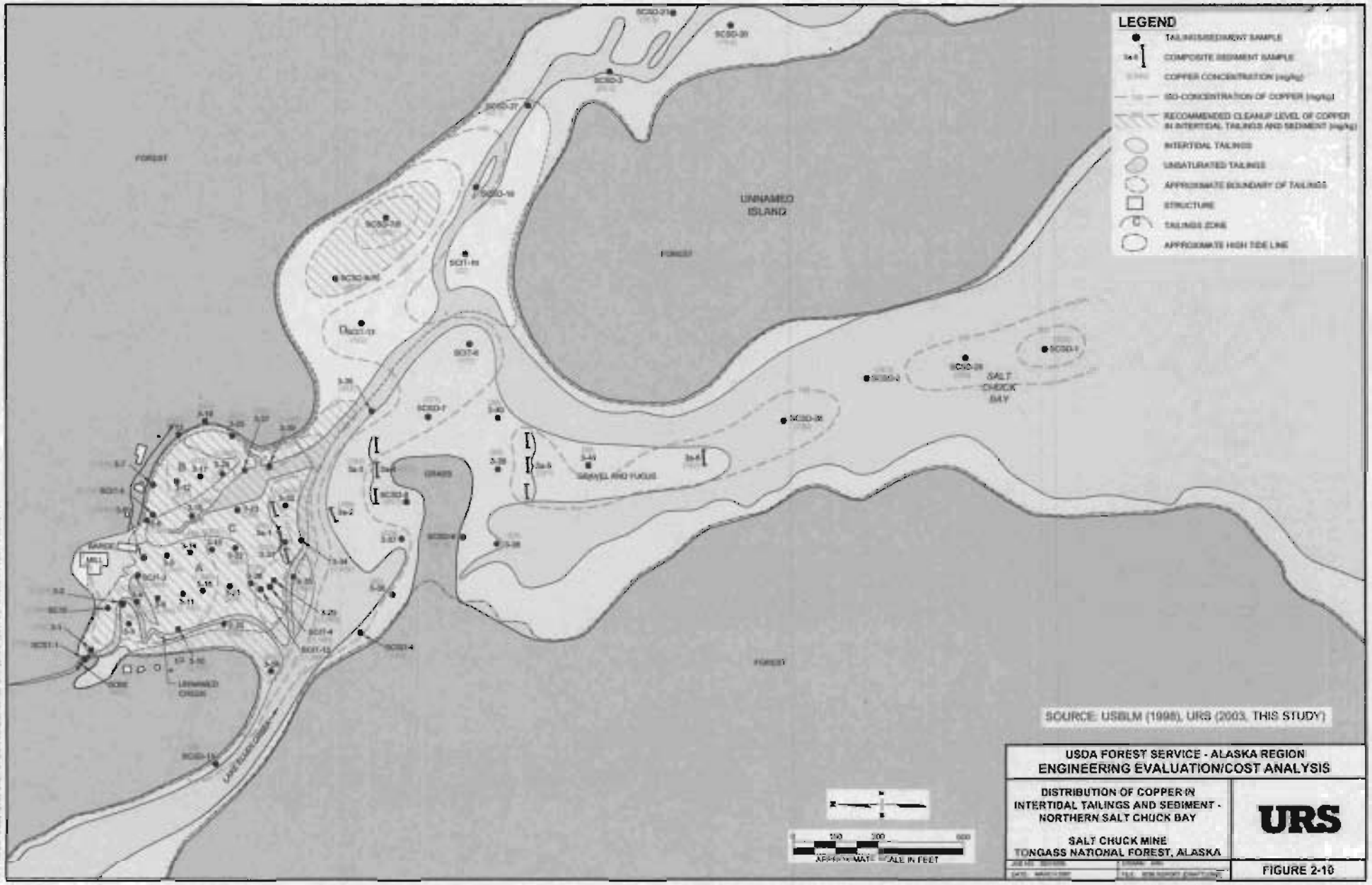
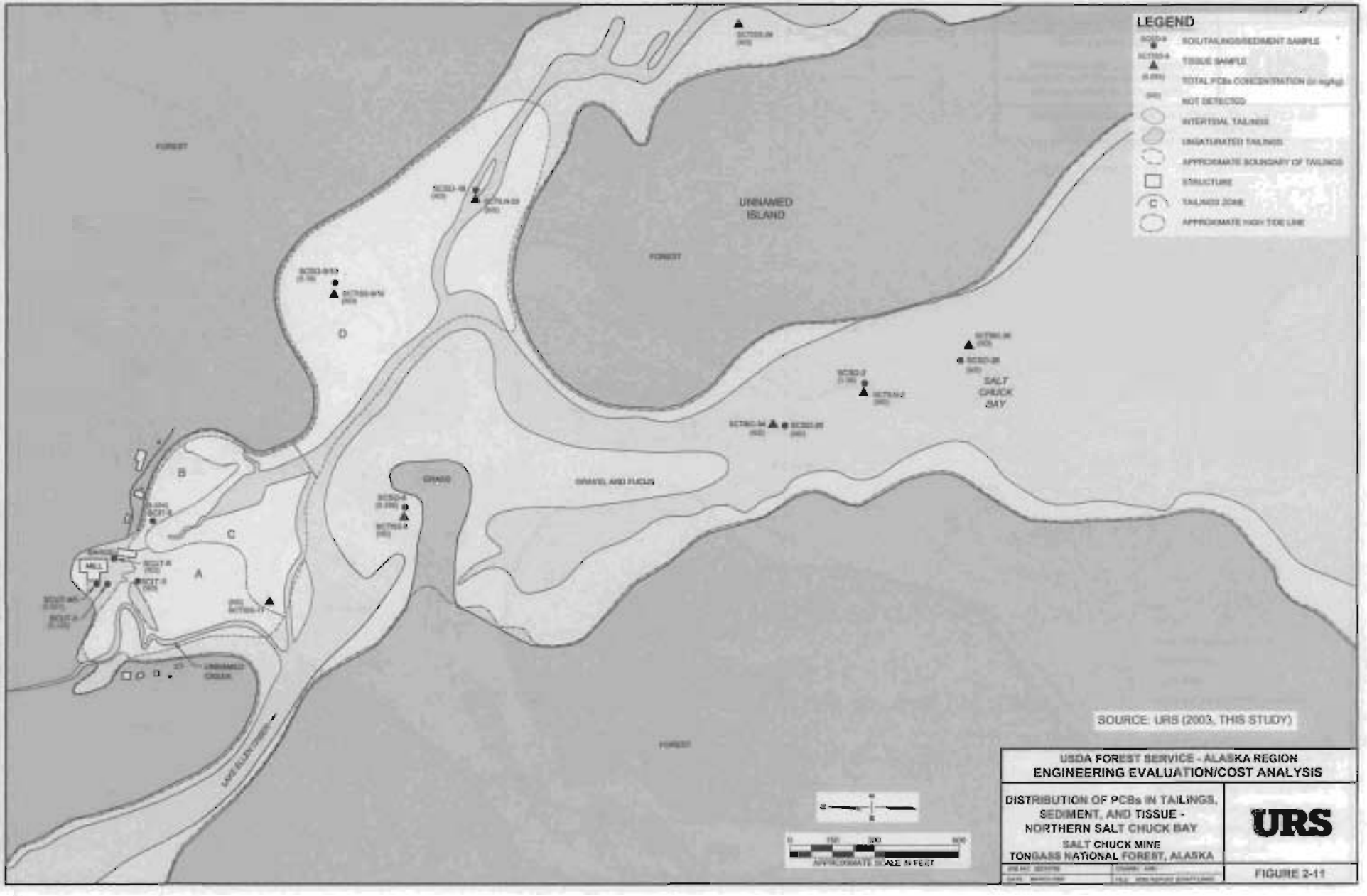
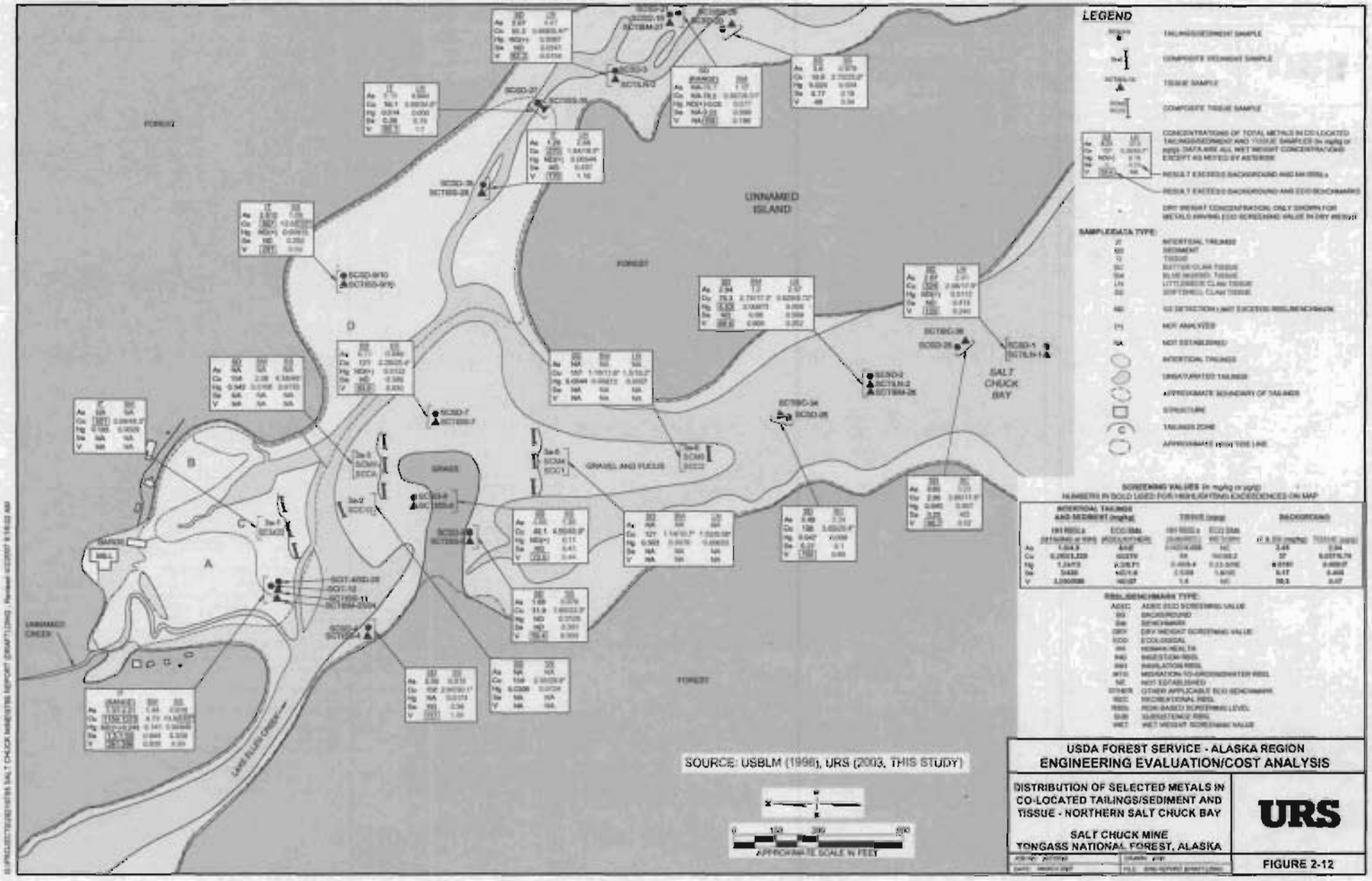
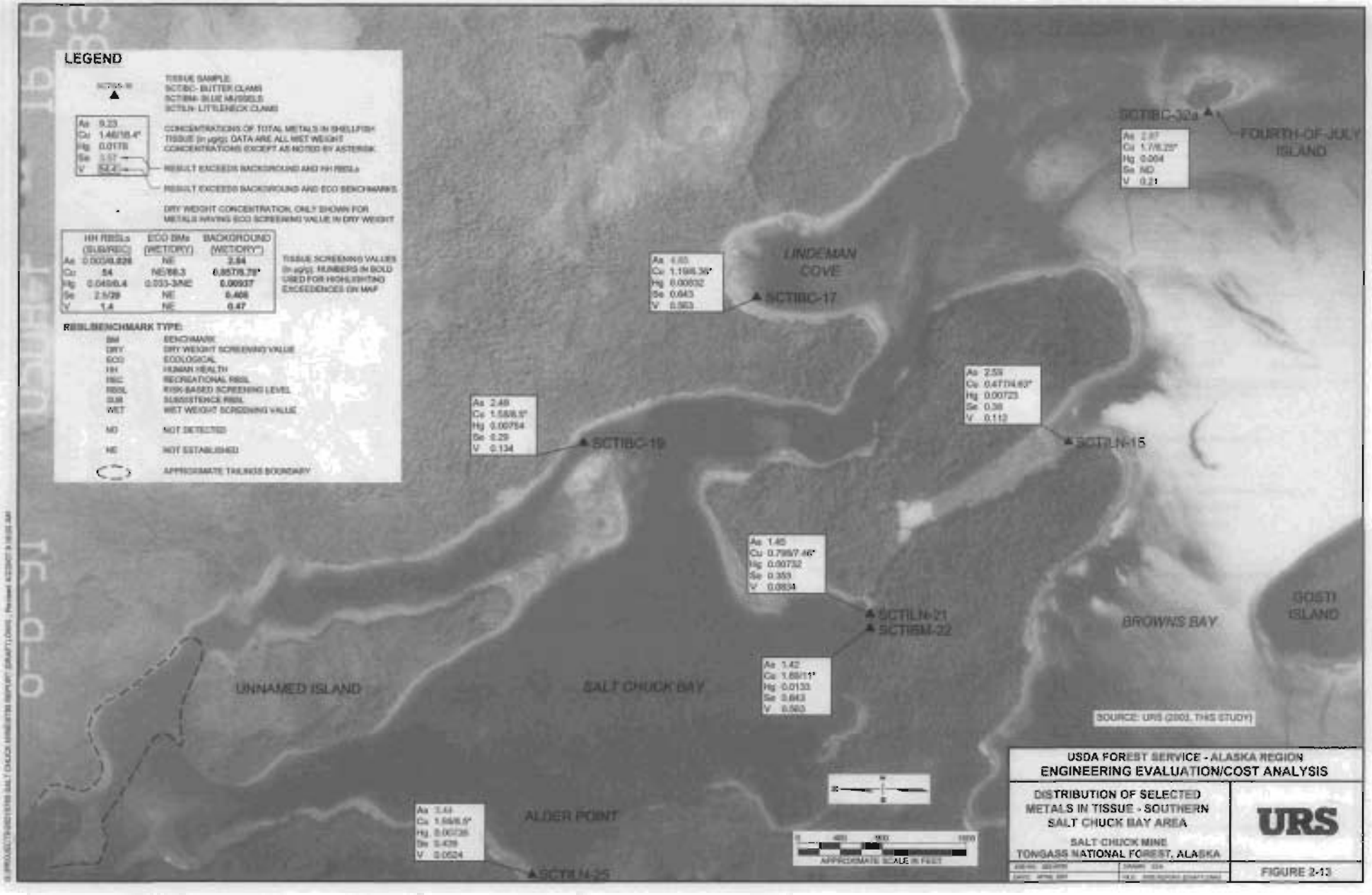
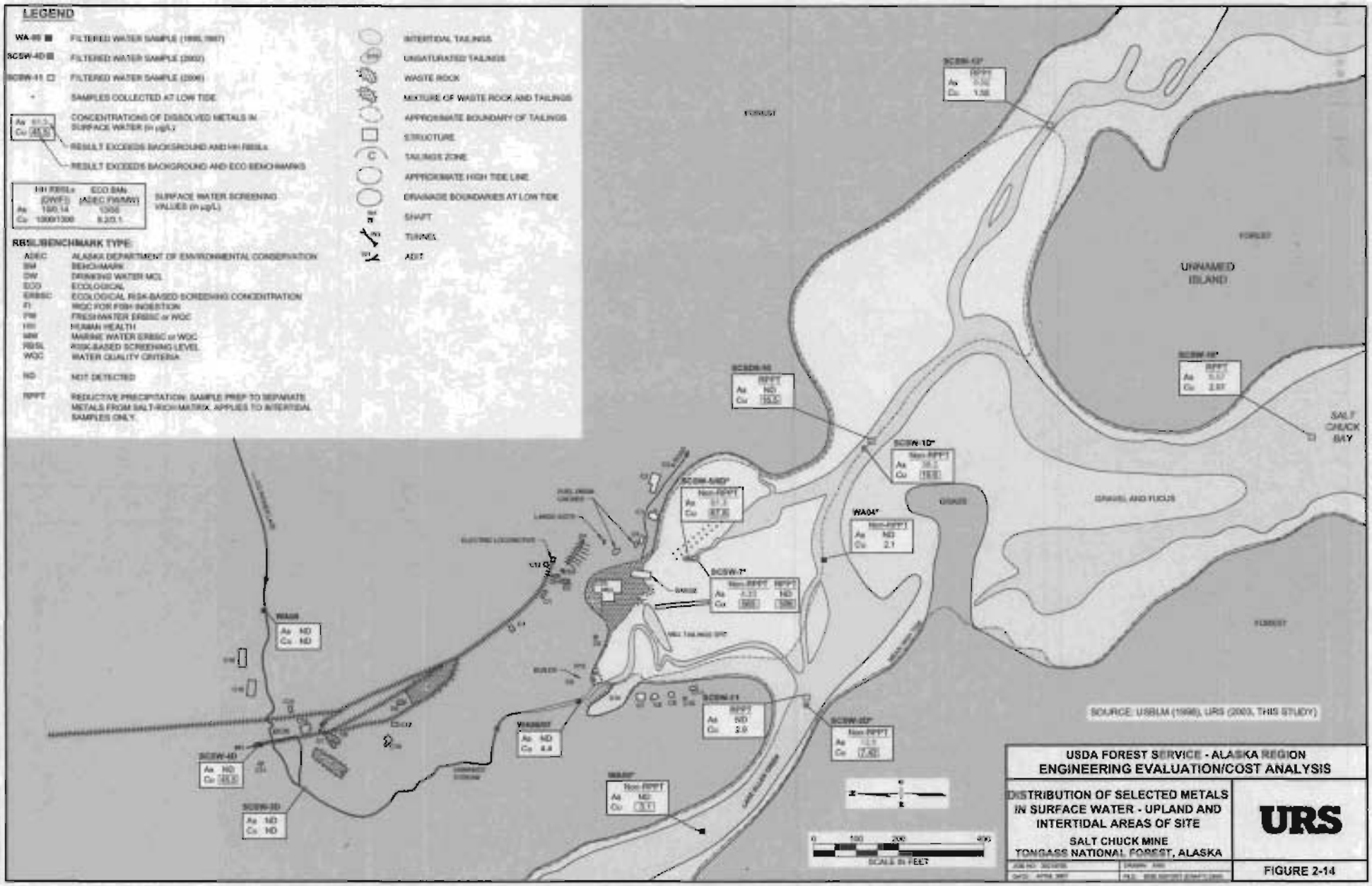

LEGEND
SOIL OR TAILINGS SAMPLE
Cu 45.5
Se 14.7
B(a) 5.16
CONCENTRATIONS OF COPPER (Cu), SELENIUM (Se), AND BENZO(A)PYRENE [B(a)] IN SOIL/TAILINGS (mg/kg)
D13
TAILINGS
WASTE ROCK
MIXTURE OF WASTE ROCK AND TAILINGS
MEAN HIGH TIDE
STRUCTURES
NA
NOT ANALYZED
ND
NOT DETECTED
370
ISO-CONCENTRATION AND RECOMMENDED CLEANUP LEVEL OF COPPER IN SOIL AND UNSATURATED TAILINGS (mg/kg)
0.93
ISO-CONCENTRATION AND RECOMMENDED CLEANUP LEVEL OF SELENIUM IN SOIL AND UNSATURATED TAILINGS (mg/kg)
0.9
ISO-CONCENTRATION AND RECOMMENDED CLEANUP LEVEL OF BENZO(A)PYRENE IN SOIL AND UNSATURATED TAILINGS (mg/kg)
SEE FIGURE 2-8
FUEL DRUM CACHES
LARGE AST'S
ELECTRIC LOCOMOTIVE
ROAD
MEAN HIGH TIDE
C3
C2
C1
SCUT-6
Cu 11,000
Se 11.3
B(a) 2.22
SALT CHUCK BAY
BARGE
D4
C4
SCSS-3
Cu 147
Se ND
B(a) NA
C12
D3
D5
D2
MILL
D1
SO03
Cu >10,000
Se NA
B(a) NA
C1
SCUT-4/5
Cu 9,510
Se 8.38
B(a) 0.0149
SCUT-3
Cu 53,400
Se 65.4
B(a) 4.87
C1
C5
MILL TAILINGS SPIT
SO04
Cu 1,085
Se NA
B(a) NA
D15
TO LAKE ELLEN CREEK AT LOW TIDE
D10
BOILER
C6
D14
C11
C9
C10
C7
C8
SCUT-1
Cu 1,450
Se ND
B(a) NA
LAKE ELLEN CREEK
UNNAMED STREAM
N
W
E
S
SOURCE: USBLM (1998), URS (2003, THIS STUDY)
0
100
200
400
SCALE IN FEET
USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS
DISTRIBUTION OF SELECTED METALS AND PAHs IN UNSATURATED TAILINGS - MILL AREA AND D14-15 PILES
SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA
URS
JOB NO: 26219785
DRAWN: ARN
DATE: APRIL 2007
FILE: 9785 REPORT (DRAFT).DWG
FIGURE 2-9
G:\PROJECTS\26219785 SALT CHUCK MINE\9785 REPORT (DRAFT).DWG ; Revised 4/2/2007 9:18:02 AM

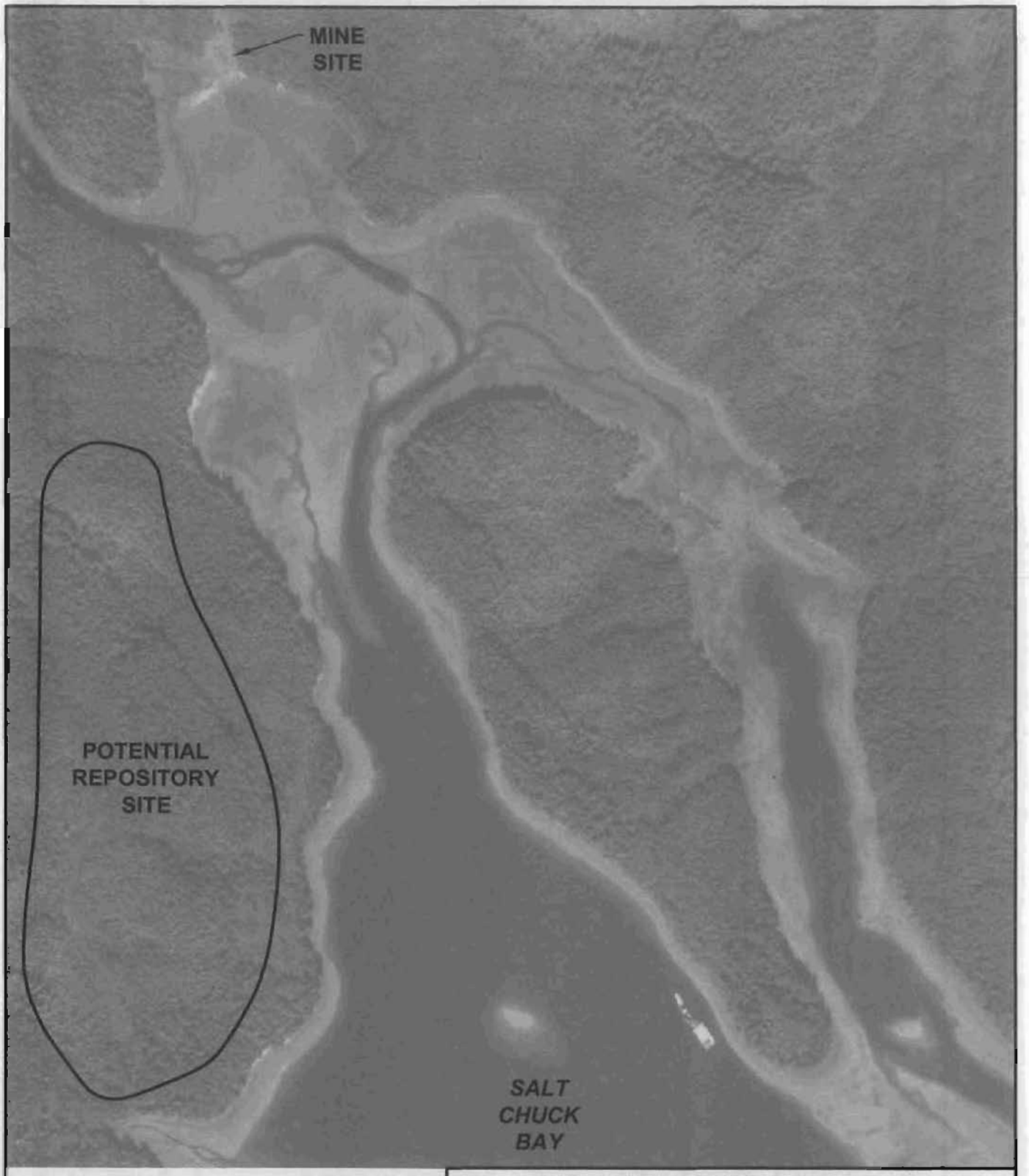

LEGEND
TAILINGS/SEDIMENT SAMPLE
COMPOSITE SEDIMENT SAMPLE
COPPER CONCENTRATION (mg/kg)
ISO-CONCENTRATION OF COPPER (mg/kg)
RECOMMENDED CLEANUP LEVEL OF COPPER IN INTERTIDAL TAILINGS AND SEDIMENT (mg/kg)
INTERTIDAL TAILINGS
UNSATURATED TAILINGS
APPROXIMATE BOUNDARY OF TAILINGS
STRUCTURE
TAILINGS ZONE
APPROXIMATE HIGH TIDE LINE
UNNAMED ISLAND
SALT CHUCK BAY
FOREST
GRASS
GRAVEL AND FUCUS
LEVEE
LEVEE
UNNAMED CREEK
LAKE ELLEN CREEK
SOURCE: USBLM (1998), URS (2003, THIS STUDY)
APPROXIMATE SCALE IN FEET
USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS
DISTRIBUTION OF COPPER IN INTERTIDAL TAILINGS AND SEDIMENT - NORTHERN SALT CHUCK BAY
SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA
URS
FIGURE 2-10


LEGEND
SOIL/TAILINGS/SEDIMENT SAMPLE
TISSUE SAMPLE
TOTAL PCBs CONCENTRATION (µg/kg)
NOT DETECTED
INTERTIDAL TAILINGS
UNSATURATED TAILINGS
APPROXIMATE BOUNDARY OF TAILINGS
STRUCTURE
TAILINGS ZONE
APPROXIMATE HIGH TIDE LINE
FOREST
UNNAMED ISLAND
SALT CHUCK BAY
GRAVEL AND FUCUS
GRASS
A
B
C
D
MILL
UNNAMED CREEK
LAKE ELLEN CREEK
APPROXIMATE SCALE IN FEET
SOURCE: URS (2003, THIS STUDY)
USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS
DISTRIBUTION OF PCBs IN TAILINGS, SEDIMENT, AND TISSUE - NORTHERN SALT CHUCK BAY
SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA
URS
FIGURE 2-11


LEGEND
UNNAMED ISLAND
SALT CHUCK BAY
FOREST
GRAVEL AND FUCUS
GRASS
MILL
UNNAMED CREEK
LAKE ELLEN CREEK
SOURCE: USBLM (1998), URS (2003, THIS STUDY)
APPROXIMATE SCALE IN FEET
USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS
DISTRIBUTION OF SELECTED METALS IN CO-LOCATED TAILINGS/SEDIMENT AND TISSUE - NORTHERN SALT CHUCK BAY
SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA
URS
FIGURE 2-12


LEGEND
TISSUE SAMPLE
SCTIBC- BUTTER CLAMS
SCTIBM- BLUE MUSSELS
SCTILN- LITTLENECK CLAMS
As 9.23
Cu 1.46/18.4*
Hg 0.0178
Se 3.57
V 52.2
CONCENTRATIONS OF TOTAL METALS IN SHELLFISH TISSUE (in µg/g). DATA ARE ALL WET WEIGHT CONCENTRATIONS EXCEPT AS NOTED BY ASTERISK
RESULT EXCEEDS BACKGROUND AND HH RBSLs
RESULT EXCEEDS BACKGROUND AND ECO BENCHMARKS
DRY WEIGHT CONCENTRATION, ONLY SHOWN FOR METALS HAVING ECO SCREENING VALUE IN DRY WEIGHT
HH RBSLs (SUB/REC) | ECO BMs (WET/DRY) | BACKGROUND (WET/DRY*)
As 0.003/0.028 | NE | 2.64
Cu 54 | NE/66.3 | 6.95/78.79*
Hg 0.045/0.4 | 0.033-3/NE | 0.00937
Se 2.5/29 | NE | 0.408
V 1.4 | NE | 0.47
TISSUE SCREENING VALUES (in µg/g). NUMBERS IN BOLD USED FOR HIGHLIGHTING EXCEEDENCES ON MAP
RBSL/BENCHMARK TYPE:
BM BENCHMARK
DRY DRY WEIGHT SCREENING VALUE
ECO ECOLOGICAL
HH HUMAN HEALTH
REC RECREATIONAL RBSL
RBSL RISK-BASED SCREENING LEVEL
SUB SUBSISTENCE RBSL
WET WET WEIGHT SCREENING VALUE
ND NOT DETECTED
NE NOT ESTABLISHED
APPROXIMATE TAILINGS BOUNDARY
SCTIBC-32a
As 2.87
Cu 1.7/8.25*
Hg 0.004
Se ND
V 0.21
FOURTH-OF-JULY ISLAND
LINDEMAN COVE
As 4.65
Cu 1.19/8.36*
Hg 0.00832
Se 0.643
V 0.563
SCTIBC-17
As 2.49
Cu 1.58/8.5*
Hg 0.00754
Se 0.29
V 0.134
SCTIBC-19
As 2.59
Cu 0.47/14.63*
Hg 0.00723
Se 0.38
V 0.112
SCTILN-15
As 1.40
Cu 0.79/7.46*
Hg 0.00732
Se 0.353
V 0.0834
SCTILN-21
SCTIBM-22
As 1.42
Cu 1.68/11*
Hg 0.0133
Se 0.643
V 0.563
BROWNS BAY
GOSTI ISLAND
UNNAMED ISLAND
SALT CHUCK BAY
ALDER POINT
As 3.44
Cu 1.64/8.5*
Hg 0.00236
Se 0.439
V 0.0524
SCTILN-25
SOURCE: URS (2003, THIS STUDY)
APPROXIMATE SCALE IN FEET
USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS
DISTRIBUTION OF SELECTED METALS IN TISSUE - SOUTHERN SALT CHUCK BAY AREA
SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA
URS
FIGURE 2-13


LEGEND
WA-05 FILTERED WATER SAMPLE (1995, 1997)
SCSW-4D FILTERED WATER SAMPLE (2003)
SCSW-11 FILTERED WATER SAMPLE (2006)
SAMPLES COLLECTED AT LOW TIDE
CONCENTRATIONS OF DISSOLVED METALS IN SURFACE WATER (in µg/L)
RESULT EXCEEDS BACKGROUND AND HH RBSLs
RESULT EXCEEDS BACKGROUND AND ECO BENCHMARKS
HH RBSLs (DWS) ECO BM (ADEC FW/MW)
As 190/14 1300
Cu 1300/1300 9.2/3.1
SURFACE WATER SCREENING VALUES (in µg/L)
RBSL/BENCHMARK TYPE
ADEC ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
BM BENCHMARK
DW DRINKING WATER MCL
ECO ECOLOGICAL
ERBSC ECOLOGICAL RISK-BASED SCREENING CONCENTRATION
FI WQC FOR FISH INGESTION
FW FRESHWATER ERBSC or WQC
HH HUMAN HEALTH
MW MARINE WATER ERBSC or WQC
RBSL RISK-BASED SCREENING LEVEL
WQC WATER QUALITY CRITERIA
ND NOT DETECTED
RPPT REDUCTIVE PRECIPITATION. SAMPLE PREP TO SEPARATE METALS FROM SALT-RICH MATRIX. APPLIES TO INTERTIDAL SAMPLES ONLY.
INTERTIDAL TAILINGS
UNSATURATED TAILINGS
WASTE ROCK
MIXTURE OF WASTE ROCK AND TAILINGS
APPROXIMATE BOUNDARY OF TAILINGS
STRUCTURE
TAILINGS ZONE
APPROXIMATE HIGH TIDE LINE
DRAINAGE BOUNDARIES AT LOW TIDE
SHAFT
TUNNEL
ADIT
FOREST
UNNAMED ISLAND
SALT CHUCK BAY
GRAVEL AND FUCUS
SCSW-12*
RPPT
As
Cu 1.58
SCSW-10*
Non-RPPT
As
Cu
WA04*
Non-RPPT
As ND
Cu 2.1
SCSW-7*
Non-RPPT RPPT
As ND
Cu
SCSW-11
RPPT
As ND
Cu 3.9
SCSW-9*
Non-RPPT
As
Cu
WA05
As ND
Cu ND
SCSW-4D
As ND
Cu
SCSW-3D
As ND
Cu ND
WA03
As ND
Cu 4.4
WA02*
Non-RPPT
As ND
Cu
SOURCE: USBLM (1996), URS (2003, THIS STUDY)
0 100 200 400
SCALE IN FEET
USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS
DISTRIBUTION OF SELECTED METALS IN SURFACE WATER - UPLAND AND INTERTIDAL AREAS OF SITE
SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA
URS
FIGURE 2-14



N
W E

0 300 600 1200
APPROXIMATE SCALE IN FEET

USDA FOREST SERVICE - ALASKA REGION
ENGINEERING EVALUATION/COST ANALYSIS

POTENTIAL REPOSITORY SITE

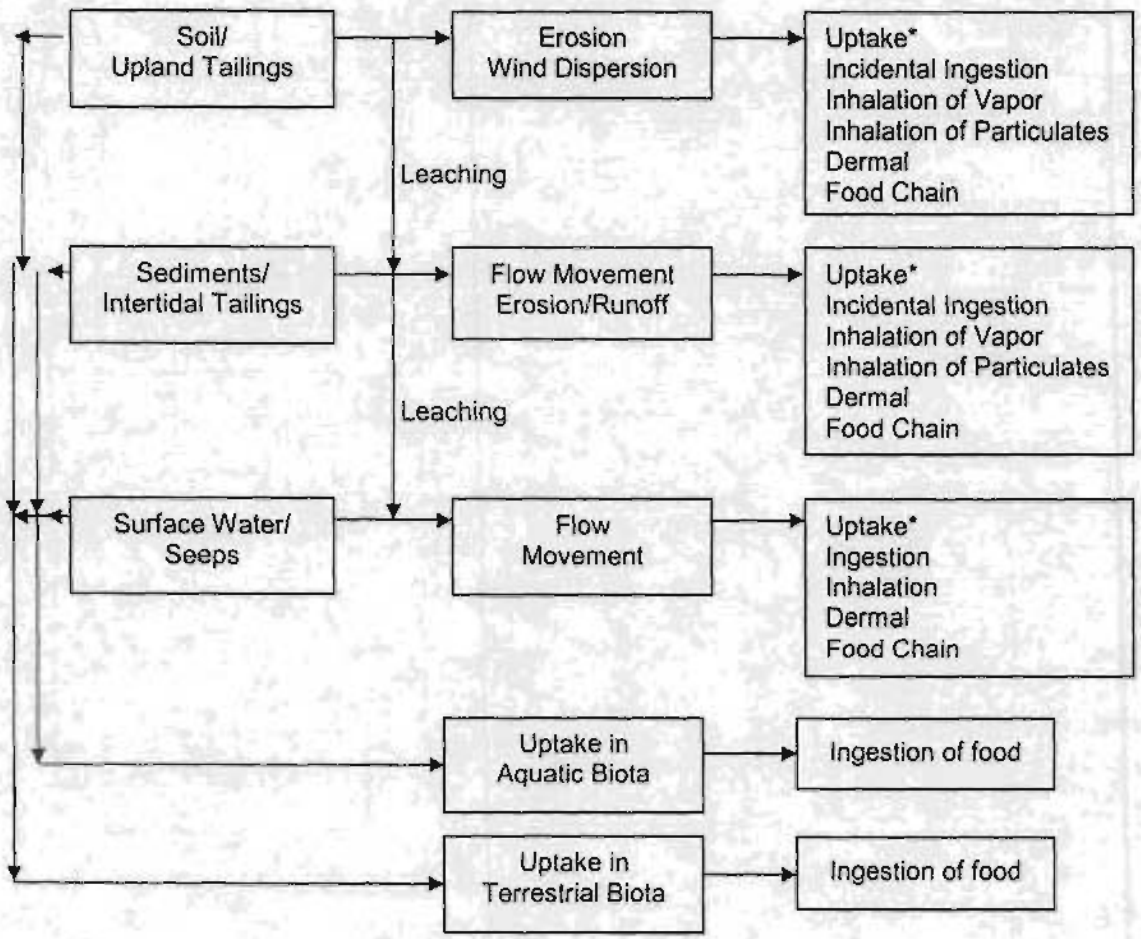
SALT CHUCK MINE
TONGASS NATIONAL FOREST, ALASKA

URS

JOB NO: 26219785	DRAWN: ELK
DATE: MARCH 2007	FILE: 9785 REPORT (DRAFT).DWG

FIGURE 4-1

G:\PROJECTS\26219785 SALT CHUCK MINE\9785 REPORT (DRAFT).DWG ; Revised 3/28/2007 10:42:34 AM



RECEPTORS			
TERRESTRIAL		AQUATIC	
Plants/ Invertebrates	Birds, Mammals	Aquatic Plants/ Organisms	Birds, Mammals
Complete	—	Complete	—
—	Insignificant	—	Complete
—	Insignificant	—	Insignificant
—	Insignificant	—	Insignificant
—	Insignificant	—	Insignificant
Complete	—	Complete	—
—	Insignificant	—	Insignificant
—	Insignificant	—	Insignificant
—	Insignificant	—	Insignificant
—	Insignificant	—	Insignificant
Complete	—	Complete	—
—	Insignificant	—	Complete
—	Insignificant	—	Insignificant
—	Insignificant	—	Insignificant
—	—	—	Complete
—	Complete	—	—

* Uptake is defined as chemical intake via dermal, ingestion, root or gill transfer and other unique mechanisms of exposure.
— Not applicable

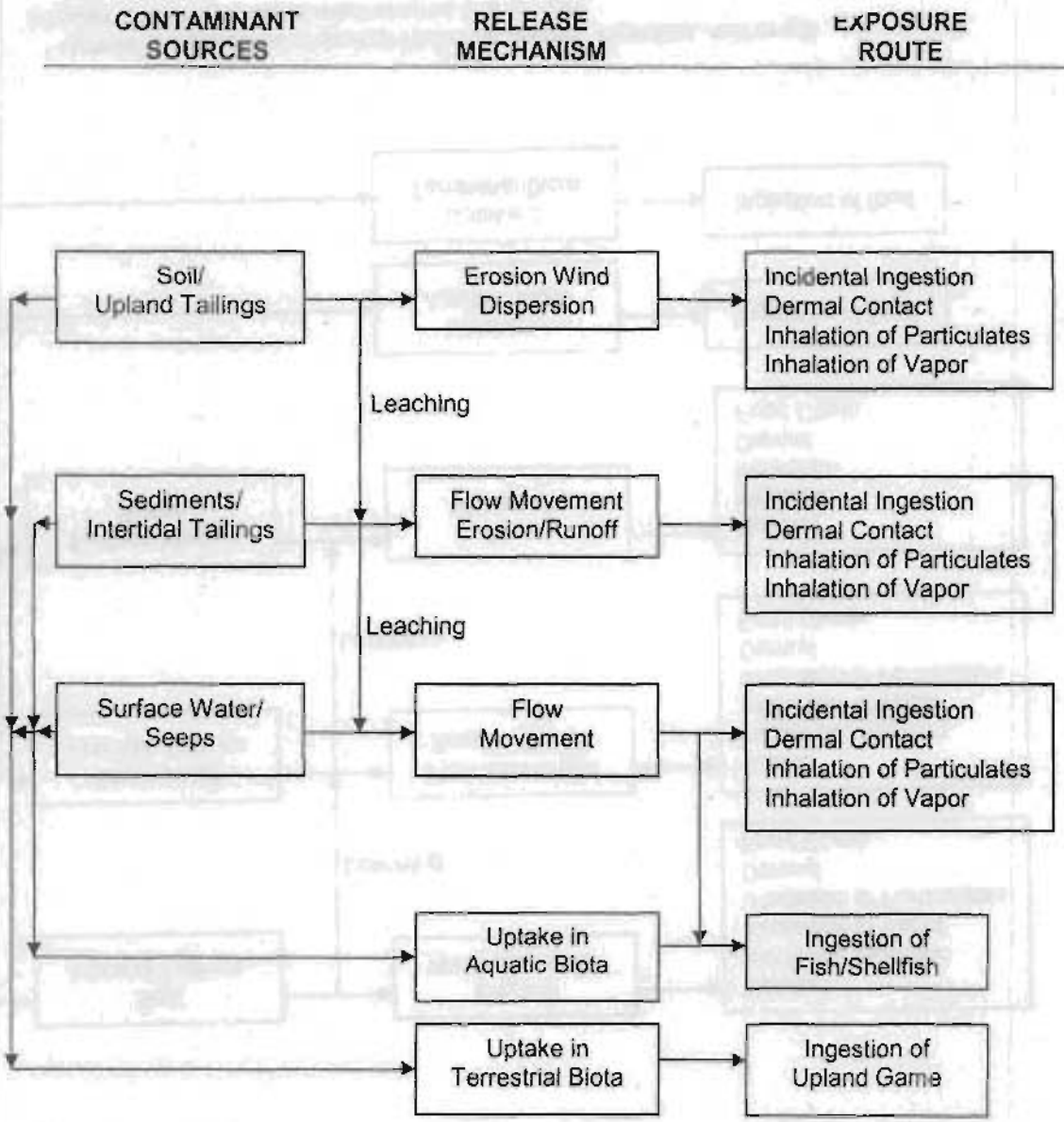
ECOLOGICAL CONCEPTUAL SITE MODEL

March 2007
26219785

EECA for Salt Chuck Mine
Tongass National Forest
Alaska

URS

Figure 2-16



RECEPTORS	CURRENT & FUTURE	FUTURE
	Recreational User	Mine Worker
Soil/ Upland Tailings	Potentially Complete Potentially Complete Potentially Complete Insignificant*	Complete Complete Complete Insignificant*
Sediments/ Intertidal Tailings	Potentially Complete Potentially Complete Insignificant Insignificant*	Insignificant Insignificant Insignificant Insignificant*
Surface Water/ Seeps	Complete Complete Insignificant Complete*	Complete Complete Insignificant Complete*
Uptake in Aquatic Biota / Ingestion of Fish/Shellfish	Complete	Potentially Complete
Uptake in Terrestrial Biota / Ingestion of Upland Game	Insignificant**	Insignificant**

*Possibly complete for mercury, all other inorganics nonvolatile.
**Game species are wide-ranging and unlikely to forage solely on the mine site such that chemical uptake is minimized.

HUMAN HEALTH CONCEPTUAL SITE MODEL

March 2007
26219785

EECA for Salt Chuck Mine
Tongass National Forest
Alaska

URS

Figure 2-15

PHOTOGRAPHS

Photograph 1. Mill site and associated waste rock and tailings.

Photograph 2. Zone A tailings and tailings spit looking southwest.

Photograph 3. Zone A tailings depth investigation. Tailings pile D14 visible in the background.

Photograph 4. Zone B and C tailings looking north.

Photograph 5. Zone D tailings at low tide looking northwest.

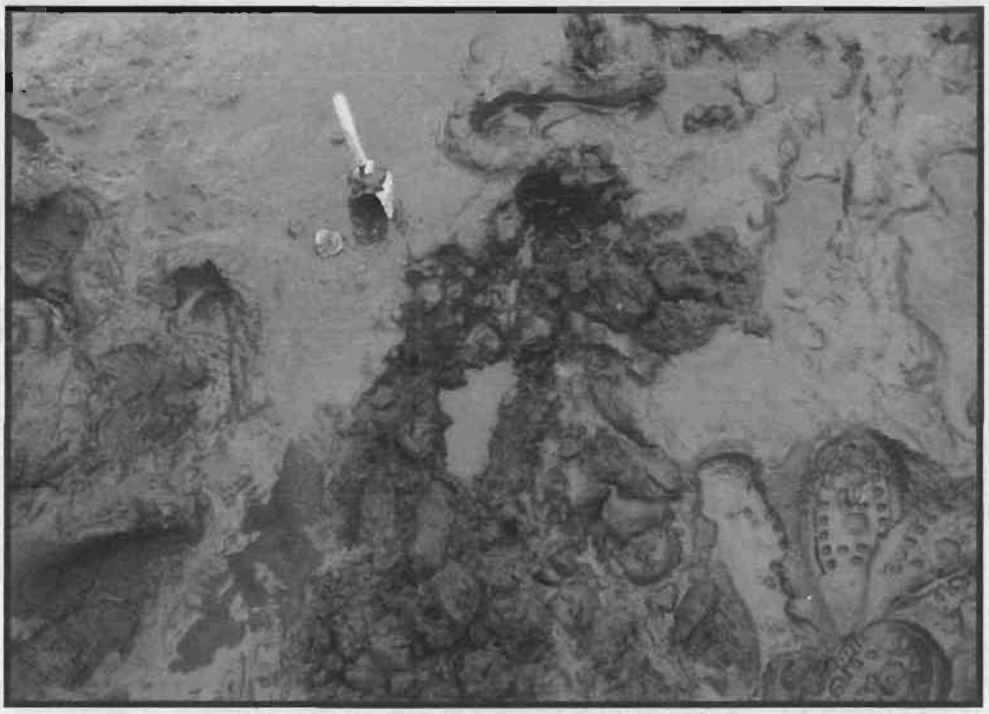
Photograph 6. Zone D tailings at high tide looking southeast.

Photograph 7. Electric locomotive.

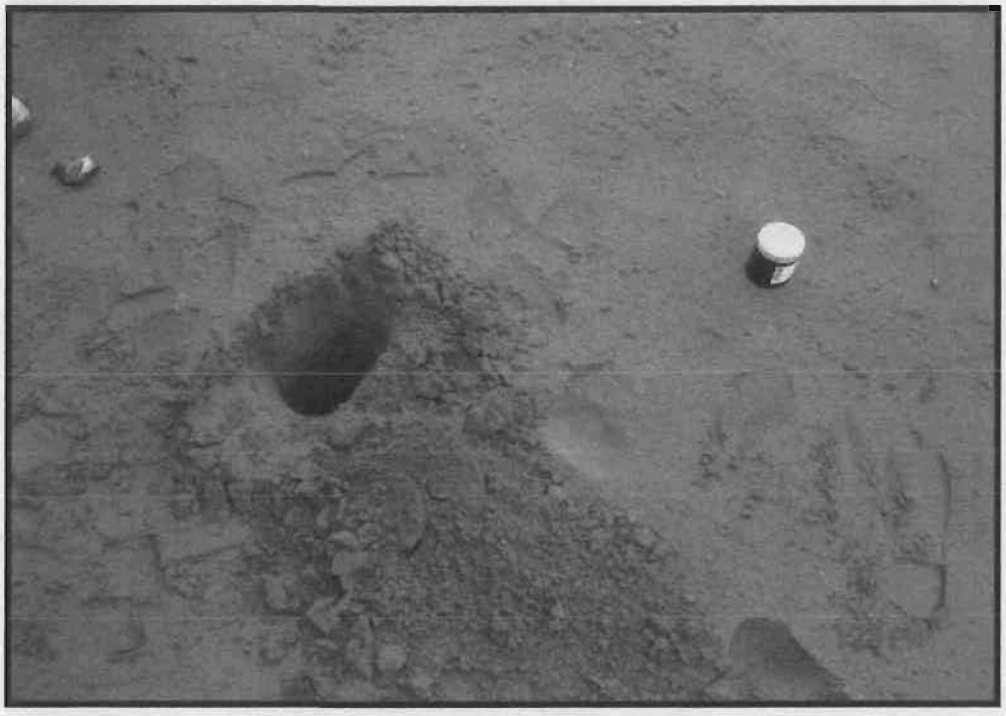
Photograph 8. One of several drum caches.

Photograph 9. Former location of Building C4.

Photograph 10. AST area near Mill site.

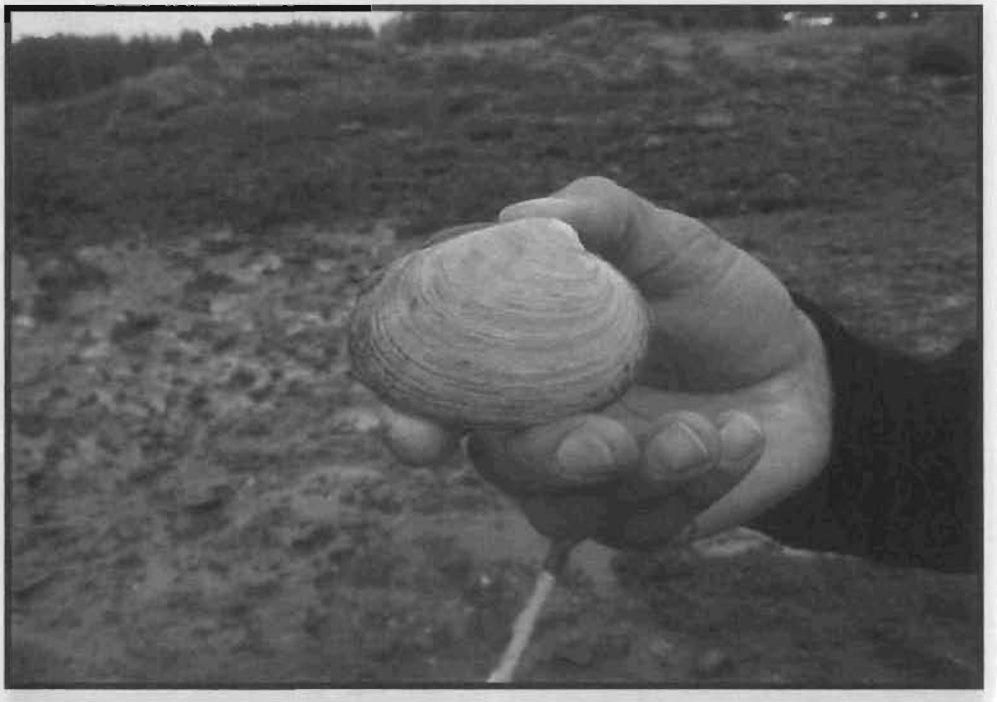


Photograph 11. Zone D sample site showing saturated consistency of inter-tidal tailings.



Photograph 12. Sample site SCUT-7 showing dryer consistency of unsaturated tailings.

Photograph 13. Fourth of July Island shellfish tissue sampling site.



Photograph 14. Typical size butter clam collected at Fourth of July Island.

Photograph 15. Digging for softshell clams at sample site SCTISS-29 east side of unnamed island.

Photograph 16. Typical softshell clams collected east side of unnamed island.

Photograph 17. Water sample site SCSW-7 collected from tailings seep.

Photograph 18. Logged area north of Zone D tailings – closest road access to the site.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WA 98101

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