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DRIFTWOOD BAY RRS
ALASKA

ADMINISTRATIVE RECORD
COVER SHEET

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UNITED STATES AIR FORCE
611TH AIR SUPPORT GROUP
611TH CIVIL ENGINEER SQUADRON

ELMENDORF AFB, ALASKA

RISK ASSESSMENT REPORT

DRIFTWOOD BAY RADIO RELAY STATION
DRIFTWOOD BAY, ALASKA

FINAL
SEPTEMBER 2009

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish & Game
ALM	Adult Lead Methodology
AUF	area use factor
BAF	bioaccumulation factor
BBA	Burned Battery Area
BCF	bioconcentration factor
BF	bioavailability factor
bgs	below ground surface
BLM	Bureau of Land Management
bw	body weight
cm^3/g	cubic centimeters per gram
COC	contaminant of concern
COPC	contaminant of potential concern
COPEC	constituent of potential ecological concern
CSM	conceptual site model
DEW	Distant Early Warning
DRO	diesel-range organics
EDA	Electronic Debris Area
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
FCM	food-chain multiplier
g/day	grams per day
HI	hazard index
HQ	hazard quotient
IEUBK	integrated exposure-uptake biokinetic
ILCR	incremental lifetime cancer risk
kg	kilogram
L	liter

ACRONYMS AND ABBREVIATIONS
(continued)

m^3/kg	cubic meters per kilogram
MDL	method detection limit
mg	milligrams
mg/g	milligrams per gram
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NA	not applicable
ND	nondetect
NOAA	National Oceanic and Atmospheric Administration
ORNL	Oak Ridge National Laboratory
PAH	polycyclic aromatic hydrocarbon
PbB	concentration of lead in blood (micrograms of lead/deciliter of blood)
PCB	polychlorinated biphenyl
POL	petroleum, oil, and lubricant
QAPP	Quality Assurance Project Plan
QC	quality control
RfD	reference dose
RI	remedial investigation
RRO	residual-range organics
RRS	Radio Relay Station
SCR	site characterization report
SF	slope factor
TRV	toxicity reference value
SLERA	Screening Level Ecological Risk Assessment
UCL	upper confidence limit
UCL_{95}	95-percent upper confidence limit
USAF	U.S. Air Force
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
VOC	volatile organic compound
°F	degrees Fahrenheit
µg/dL	micrograms per deciliters

1.0 INTRODUCTION

The purpose of the Driftwood Bay Radio Relay Station (RRS) risk assessment is to estimate and quantify potential risks that site contamination could pose to human health or the environment. The results of the risk assessment are intended to guide risk management decisions at the Driftwood Bay RRS. This document is in accordance with the Risk Assessment Work Plan, Driftwood Bay RRS, Alaska (U.S. Air Force [USAF] 2007b), and the Work Plan Addition and Comment Responses found in Appendix J.

The nature and extent of contamination at the facility are summarized in the Remedial Investigation (RI) Report (USAF 2009a) and the Site Characterization Report (SCR) (USAF 2009b). This risk assessment is based on data obtained from those reports. Table 1-1 summarizes the status of each site at the Driftwood Bay RRS and shows whether information for each site is presented in the RI or the SCR.

Table 1-1
Driftwood Bay Radio Relay Station Site Information Locations

Site	COPC	Location Reported
Antennae Arrays and Former USTs and Aboveground Storage Tanks (OT001)	DRO PAHs	SCR
Spill/Leak No. 1 at the Septic Tank (FL009)	No exceedances	SCR
POL Waste Pit (WP003)	DRO RRO PAHs 1,2,4-Trimethylbenzene	SCR
Old Disposal Site (LF006)	DRO RRO PAHs Lead Arsenic PCBs Carbon disulfide Beta-BHC	RI
Heavy Equipment Storage Area	DRO	SCR
Spill/Leak No. 4 at Drum Storage Area (SS004)	DRO	SCR

Table 1-1
Driftwood Bay Radio Relay Station Site Information Locations
(continued)

Site	Contaminants of Potential Concern	Location Reported
Spill/Leak No. 3 at Former Lighting Vault at Runway (SS011)	No exceedances	SCR
Spill/Leak No. 7 at POL Tank Farm (SS007)	DRO RRO PAHs Xylenes	SCR
Spill/Leak No. 8 at the POL Pipeline (SS008)	DRO	SCR
Spill/Leak No. 2 at the Former Water Supply Pump House (SS010)	DRO Benzo(a)pyrene	SCR
Quarry Area	No exceedances	SCR
Former Composite Building (OT001)	PCBs	RI
Burned Battery Area	Lead	RI
Electronic Debris Area	PCBs Aroclor 1260 Lead	RI

Note: For definitions, refer to the Acronyms and Abbreviations section.

1.1 REPORT ORGANIZATION

This report is composed of the following sections:

- Section 1.0: Introduction describing the history of the Driftwood Bay RRS and summarizing the physical characterization of the sites.
- Section 2.0: Identification of contaminants of potential concern (COPC) methods used for evaluating data, determination of background metals concentrations, and the derivation of exposure point concentrations (EPC).
- Section 3.0: Conceptual site models (CSM) present potential exposure pathways to contaminants at the site in relation to human and ecological receptors.
- Section 4.0: Human health risk assessment summarizes how human health risk was calculated and quantifies potential risk associated with each site.
- Section 5.0: Ecological risk assessment identifies the contamination sources, release mechanisms, and migration pathways at the site and evaluates potential hazardous exposures to ecological factors at the site.
- Section 6.0: References summarizes the materials cited in this document.

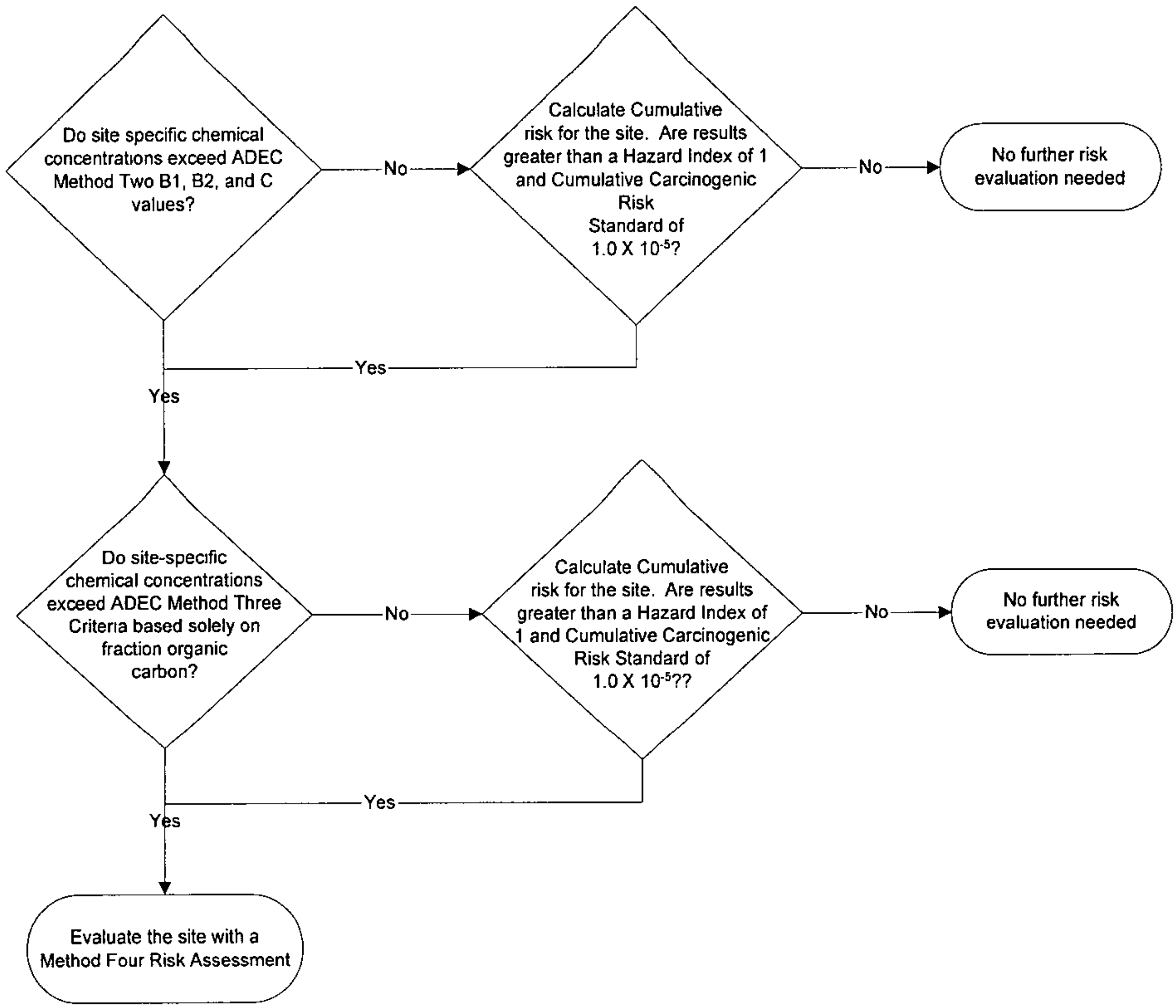
- Appendix A contains the Alaska Department of Environmental Conservation (ADEC) CSMs and ecological checklists.
- Appendix B summarizes the risk assessment scoping meeting.
- Appendix C contains the results of community surveys conducted by Jacobs Engineering Group Inc.
- Appendix D summarizes the ecological assessment endpoints and primary indicator species.
- Appendix E provides the available site data on CD.
- Appendix F presents the ProUCL calculations used to determine EPCs.
- Appendix G presents COPC determination and the human health risk assessment calculations.
- Appendix H presents the results of the Adult Lead Methodology (ALM).
- Appendix I presents the ecological risk assessment calculations.
- Appendix J presents Work Plan comments and responses.
- Appendix K presents ADEC's acceptance letter for the Driftwood Bay exposure assumptions.
- Appendix L presents preliminary draft report comments and responses.

1.2 SITES EVALUATED IN THE RISK ASSESSMENT

The data collected during the 2007 investigation was used to determine if a Method Four Risk Assessment was warranted for each site at the Driftwood Bay RRS. Method Four of the Alaska Administrative Code (AAC), Title 18, Chapter 75 provides for establishing site-specific alternative cleanup levels for the protection of human health based on the results of a risk assessment. This process includes sufficiently characterizing the contaminants, potential exposure routes, and potentially exposed human and ecological receptor populations to determine if unacceptable risks exist and development of an appropriate risk management approach.

The determination of the need for the Method Four Risk Assessment was based on the logic tree presented in Figure 1-1. Sites at the Driftwood Bay RRS to be included in this risk assessment were characterized by site-specific chemical concentrations that exceeded ADEC Method Two and/or Method Three criteria. Method Three criteria were developed based

Figure 1-1
Decision Logic Tree



Note: Method Three screening criteria do not change from Method Two for lead and PCBs solely on changing the fraction organic carbon in soil. If site-specific chemical concentrations exceeded the alternate cleanup levels determined by the web-based Method Three calculator, or if the cumulative risk standards were exceeded, a determination was made that a Method Four Risk Assessment was warranted.

The sites at Driftwood Bay that require a Method Four Risk Assessment in accordance with Figure 1-1 are detailed as follows:

- Former Composite Building (OT001) at Top Camp, where concentrations of polychlorinated biphenyls (PCBs) range up to 4.5 milligrams per kilogram (mg/kg).
- Antennae and underground storage tanks (UST) at the Former Composite Building (OT001) at Top Camp, where benzo(a)pyrene concentrations ranged up to 1.5 mg/kg.
- Burned Battery Area (BBA) at Top Camp, where concentrations of lead ranged up to 11,000 mg/kg.
- Petroleum, oil, and lubricant (POL) Waste Pit (WP003) at Top Camp, where diesel-range organics (DRO) was detected at concentrations up to 17,000 mg/kg.
- LF006 at Lower Camp, near a pond where lead detected at concentrations ranging up to 89,900 mg/kg was likely associated with debris (including batteries).
- Electronic Debris Area (EDA) at Lower Camp near LF006, where concentrations of lead ranged up to 72,200 mg/kg. The area was defined by a lack of vegetation and a number of lead-acid batteries.
- Spill/Leak No. 7 at POL Tank Farm (SS007) at the Beach Area, where DRO and benzo(a)pyrene were detected at concentrations of up to 3,400 and 0.61 mg/kg, respectively.
- Spill/Leak No. 2 at Former Water Supply Pump House (SS010) at Lower Camp, where concentrations of DRO range up to 5,300 mg/kg in surface soil near Snuffy Creek.

1.3 SITE HISTORY

Driftwood Bay RRS was initially one of 18 Distant Early Warning (DEW) Line stations constructed in Alaska between 1950 and 1959. Driftwood Bay RRS was made operational in 1961 to provide reliable communications for the DEW-Line station. Originally known as White Alice Communications Systems facilities, the Alaska Air Command redesignated these facilities as RRS in 1969. Driftwood Bay RRS was deactivated in 1977, and all facility buildings and structures were demolished or removed in 1991 (USAF 2007b). Figure 1-2 shows the location of the Driftwood Bay RRS, and Figure 1-3 shows the Top Camp, Lower Camp, and Beach areas.

Dutch Harbor, the closest community to Driftwood Bay RRS, is located approximately 13.5 air miles to the southeast.

A series of investigations and removal actions has been completed at Driftwood Bay since the site was deactivated in 1977. A summary of these investigations is presented in the Site Characterization Work Plan (USAF 2007b).

1.4 SITE DESCRIPTION

This section describes the surface features, soils, geology, hydrology, climate, and ecology of the sites covered in this Risk Assessment Report.

1.4.1 Surface Features

The Driftwood Bay RRS is located on the northwest portion of Unalaska Island and is divided into three distinct settings: Top Camp, Lower Camp, and the Beach Area. Top Camp is located approximately 3 miles west of Lower Camp at an elevation of approximately 1,400 feet, and is situated on a broad sloping flank of Makushin Volcano. The flank terminates to the west in an abrupt cliff edge that falls to the Bering Sea. Lower Camp is located in Driftwood Bay valley and is bounded by mountains on three sides with several waterfalls and streams flowing into the valley. The Beach Area is a flat flood plain between the ocean and Humpy Creek approximately 3,000 feet east of the north end of the runway (USAF 2009b).

1.4.2 Soil

The soils encountered in the area were comprised primarily of course gravels to fine sands composed of the breakdown products of basalts. The majority of the soil is a result of till deposition from glaciation, volcanism, and fluvial deposits in Driftwood Bay valley.

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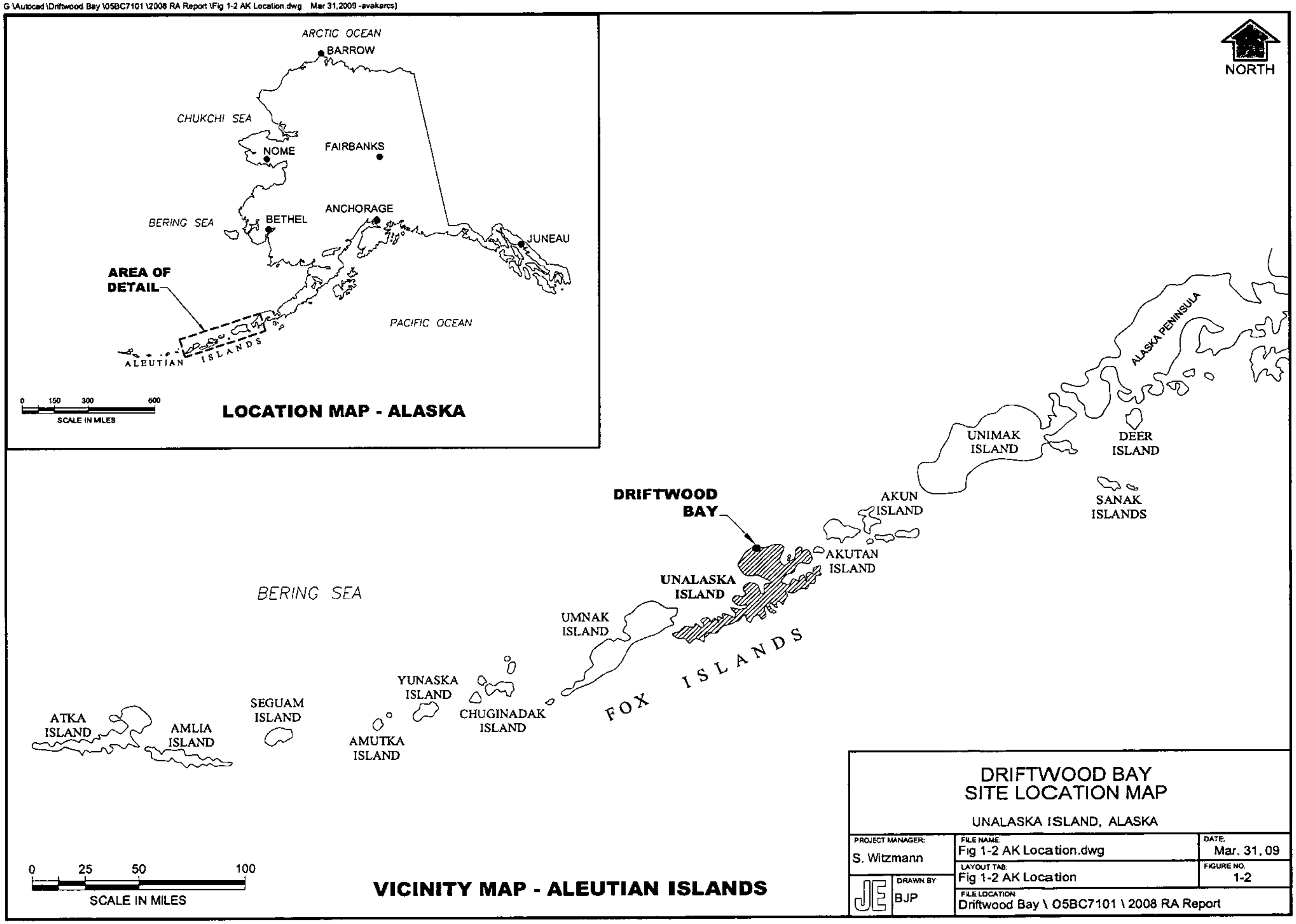

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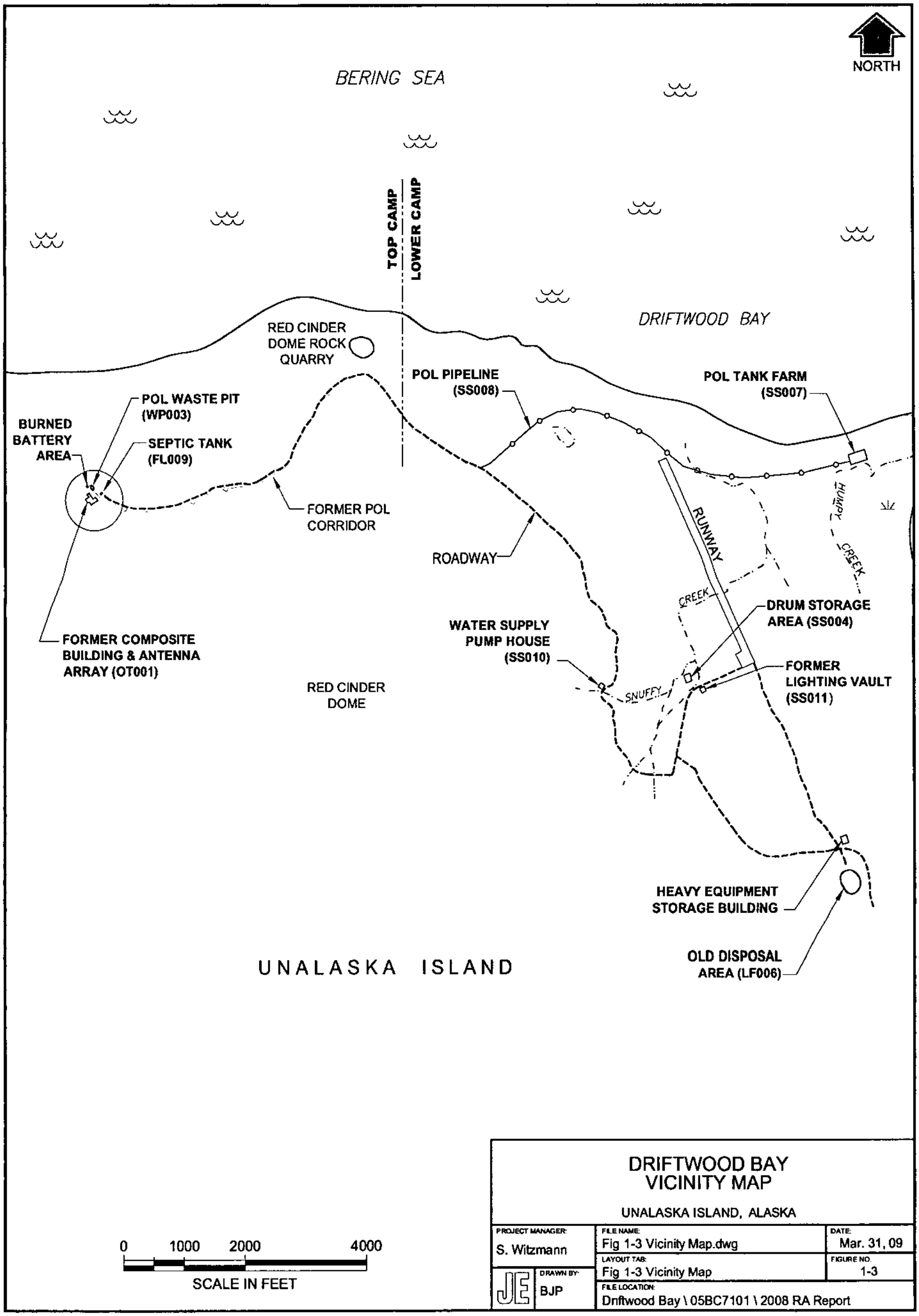

DRIFTWOOD BAY
VICINITY MAP

UNALASKA ISLAND, ALASKA

PROJECT MANAGER:	FILE NAME:	DATE:
S. Witzmann	Fig 1-3 Vicinity Map.dwg	Mar. 31, 09
DRAWN BY: BJP	LAYOUT TAB: Fig 1-3 Vicinity Map	FIGURE NO. 1-3
	FILE LOCATION: Driftwood Bay \ 05BC7101 \ 2008 RA Report	

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Chemical and mechanical weathering varies across the site with strong freeze-thaw cycles at Top Camp and dense vegetative cover at Lower Camp and the Beach Area.

Surface soils encountered at Top Camp had minimal organic content and consisted of sandy gravel that ranged from light gray to dark brown. Below approximately 6 feet below ground surface (bgs), the soils consisted of gravels with some sands that ranged from dark gray to dark reddish brown (USAF 2009b).

Surface soils encountered at Lower Camp were generally grayish brown to dark brown with organic clay in sands and gravels. An organic mat approximately 6 inches thick covered the surface soil at Lower Camp. Approximately 6 feet bgs, the soils consist primarily of sandy gravel to gravelly sand that range from light gray to dark reddish brown.

Surface soils encountered at Beach Area were generally grayish brown to dark brown with gravelly sands. An organic mat approximately 6 inches thick covered the surface soil at the Beach Area. Below approximately 5 feet bgs, cobbles were more prevalent and mixed with the gravelly sands that ranged from olive gray to brown gray.

1.4.3 Geology

Unalaska Island is composed mainly of volcanic rocks associated with the Makushin Volcano, located approximately 6.5 miles from Driftwood Bay RRS. Bedrock is predominantly basalt and andesitic lava overlain by volcanic till and ash layers. Bedrock outcrops exist at Top Camp and across Driftwood Bay RRS along valley edges and near the bay. Soil borings and test pits have shown till existing 5 to 20 feet deep in the vicinity of the RRS, underlain by bedrock. Large, rounded boulders of basalt and andesite line the beach area and were encountered approximately 30 feet from mean high tide lines. No permafrost was observed during soil borings or test pitting at the Driftwood Bay RRS in 2007 (USAF 2009b).

1.4.4 Hydrogeology

No surface water bodies or groundwater were observed at Top Camp in 2007. At Lower Camp groundwater was encountered during soil borings at approximately 3 feet bgs to 32 feet bgs. Variations in groundwater depth were a result of a shallow, leaky aquitard near the bay and surface water recharge in other areas of Lower Camp. At the Beach Area, groundwater was encountered at depths ranging between approximately 4 and 14 feet bgs; a perched aquifer was noted at a depth of between 7 and 8 feet bgs during the 2007 field effort and is assumed to be recharged by Humpy Creek. A lower aquifer was encountered at approximately 13 feet bgs and is believed to be influenced by the tides.

The Driftwood Bay valley is drained by permanent and intermittent streams that empty into Driftwood Bay. These include Humpy Creek, which runs along the east side of the Driftwood Bay valley, and Snuffy Creek, which runs along the west side of the runway and through culverts underneath the runway before emptying into Driftwood Bay. Several additional small unnamed drainages extend from the mountainous regions of the facility to the Driftwood Bay valley into these two dominant stream systems and into the Bering Sea (USAF 2009b).

1.4.5 Climate

Driftwood Bay RRS is located within a cold maritime climate with annual temperatures ranging from minus 8 to 80 degrees Fahrenheit (°F). The average summer temperature between June and August is 50 °F, and the average winter temperature between November and February is 34 °F. Average precipitation is 58 inches; snowfall can reach up to 50 inches in the winter months (USAF 2002). Overall snow accumulation rates are not abnormally high, but strong wind redeposition of snow into topographic lows can create snowpack greater than the 50-inch average. The winter of 2006-2007 deposited a deep snowpack that persisted at Top Camp throughout the 2007 summer season.

Top Camp, Lower Camp, and the Beach Area frequently have high winds, light rain and mist, and low cloud ceilings resulting from frequent cyclonic storms crossing from the Northern

Pacific and the Bering Sea. Top Camp has consistently cooler temperatures with cloud and fog cover. Lower Camp and the Beach Area have less frequent precipitation than Top Camp and seems to be protected by the surrounding mountains from the same frequency of storm events as occur at Top Camp (USAF 2009a).

1.4.6 Ecology

Several species of small mammals are indigenous to Unalaska Island, including the tundra vole, shrew, collared lemming, and red fox. Introduced species include arctic ground squirrel, blue phased arctic fox, and Norwegian rat (USAF 1996). Aquatic environments in the Driftwood Bay area include marine coastal waters of the Bering Sea and freshwater drainages of Humpy and Snuffy Creeks. Wildlife in and around the Bering Sea in the vicinity of Driftwood Bay include several salmon species, halibut, rockfish, Pacific herring, sea lions, sea otters, geese, ducks, several other sea bird populations, and bald eagles. Pink salmon are known to spawn in Humpy Creek (USAF 1996). Four known endangered species have ranges that span the vicinity of Unalaska Island: short-tailed albatross and humpback, right, and blue whales (USAF 2005). The sea otter, also found in the vicinity of Unalaska Island, is listed as a threatened species. Of the wildlife listed, the following were observed at the site during the 2007 field season: voles, shrews, fox, ground squirrel, salmon, halibut, sea lions, sea birds, bald eagles, and whales off shore. Due to the harsh environment at Top Camp, lack of surface water, and lack of vegetation, these species were not observed at Top Camp.

Aleutian tundra grasses, shrubs, and riparian vegetation were observed at Lower Camp. Top Camp lies in an alpine zone with minimal vegetative cover that consisted mainly of lichens, mosses, and some tundra grasses. The majority of the surface at Top Camp is sparsely vegetated mixed with gravels, sand, and some silts exposed in barren areas (USAF 2009a).

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2.0 IDENTIFICATION AND EVALUATION OF CONTAMINANTS OF POTENTIAL CONCERN

This section describes the methods for evaluating the data, determining background metal concentrations, identifying COPCs, and deriving the EPCs for the sites covered in this Risk Assessment.

2.1 DATA EVALUATION

Analytical data for each area of concern were selected based on the representativeness and quality of the data. In general, samples were collected from areas of concern based on results from previous investigations and historical use of the site. A portion of the data collected for volatile analytes during site characterization activities were impacted by poor surrogate recoveries. The associated results are flagged with "VX". These data were used to demonstrate that all objectives identified in the Site Characterization Work Plan (USAF 2007b) were met and that data gaps do not exist at any of the sites. These data were not used in risk assessment calculations because increased uncertainty could be introduced. All available analytical data of acceptable quality were included in the risk assessment.

2.1.1 Evaluation of Data Quality

A data quality assessment was performed to assess the overall quality and usability of data collected in support of the Driftwood Bay site characterization, RI, and the human health and ecological risk assessments. This evaluation consisted of a review of chain-of-custody and sample receipt records, laboratory case narratives, laboratory data including analytical methodology, sample holding times, method detection limits (MDL) and reporting limits, laboratory quality control (QC), sample recoveries, and precision. Analytical results were evaluated against data quality objectives listed in the Quality Assurance Project Plan (QAPP), Appendix D to the Site Characterization Work Plan (USAF 2007b).

In general, the review of the analytical results and associated QC samples found the overall quality of the project data to be acceptable and all data quality objectives specified in the project QAPP were considered met. Data quality is expressed by the assignment of qualifier codes during the analytical laboratory QC process or during data validation that reflects the level of confidence in the data. A "J" qualifier indicates that the analyte was positively identified, but that the result was greater than the MDL and less than the reporting limit. Qualified results are considered estimated and, whenever possible, are indicated as either biased high or low ("+" or "–"). Qualifiers applied to the analytical data set, as appropriate, are defined in the project QAPP (USAF 2007b).

Although the overall quality of the data is considered acceptable, several systematic issues were identified during the data review process. These include low volatile surrogate recoveries for soil samples, cooler temperature exceedances, improper spiking procedures for methods AK102 and AK103, laboratory reporting errors for method SW8260B, and field duplicate precision that did not meet project specified criteria. These issues and any potential impacts on data quality and usability are discussed in detail in Appendix C to the SCR (USAF 2009b) and in the RI Report (USAF 2009a).

2.1.2 Data Usability

All available analytical data of acceptable quality for relevant sites were included in the risk assessment. "J" qualified data were used in the risk assessment; "R", or rejected data, and "VX" qualified data were not. Data with other qualifiers were evaluated on a case-by-case basis. When confidence was reasonably high that the chemical was detected, but the actual concentration is somewhat in question, the data generally were used in the risk assessment. For most analytes, identification at concentrations above levels in the blanks (considering the 5x, 10x rule) was considered presumptive evidence of their presence. In general, there were no data for which the identity of the detected analyte was unclear and no data were excluded from further consideration based on low frequencies of detection.

Out of the analytical data collected during the site characterization, only one PCB result was rejected. During the analysis of groundwater sample DBLF006-SP04-WG, the surrogate recovery was unacceptable and the associated sample result was considered unusable. The result for this sample was not included in the SCR, the RI Report, or in the risk calculations for this risk assessment. Since there was an acceptable PCB result for the other groundwater sample at site LF006, no data gaps exist.

Of the volatile organic carbon (VOC) data collected at the Driftwood Bay RRS for samples analyzed by methods AK101 and SW8260B, approximately 10 percent was impacted by low surrogate recoveries. In response to this observation, randomly selected vials of methanol from the remaining supply were returned to the laboratory for analysis. The results of this study suggest that the low surrogate recoveries may be attributed to human error during the spiking of the vials of methanol with surrogate solution prior to shipment. It is likely that some vials were double-spiked and others were not spiked at all. Therefore, since the low surrogate recoveries are attributable to pre-spiked methanol provided by the laboratory, the associated sample results were qualified "VX" rather than rejected, and the results were considered usable for assessing the representativeness of the data. Despite the extensive data set and that the samples were collected from areas of likely contamination, VOCs were not detected above ADEC Method Two criteria in any samples. Data that were qualified "VX" were used to determine the representativeness of the site data and to identify any data gaps. However, the "VX" flagged data were not used to quantify risk.

In addition to the data quality assessment activities described in Section 2.1.1, the SW8260B and AK101 soil data were reviewed on a site-by-site basis to ensure that remedial decisions and risk assessment were supported by the available data. Table 2-1 includes the sites impacted by sample results with low surrogate recoveries as well as the ranges of surrogate recoveries found in the samples.

Table 2-1
Impacts of Low Volatile Surrogate Recoveries

Site	COCs Detected above Method Two or Three	Analysis Involved	Percent Recovery	Purpose of VOC Analysis	Potential Impact of Low Surrogate Recovery
OT001 - Composite Building, USTs, and Antennas	DRO, PAHs, PCBs	SW8260B	7 samples recovery <10%, 1 sample recovery = 81%	General investigation/ due diligence. COC was PCBs; however, VOC analysis was requested at the systematic planning meeting.	7 out of 9 doorway samples had less than 10% surrogate recovery. Doorway samples were planned to assess whether contaminants had discharged out the doors. The need for VOC analysis is unclear as the soil had been severely disturbed. At the time of sampling, both ADEC and USAF commented on the lack of need for this analysis. There were no visual or olfactory indications of contamination at the site. In response to the low surrogate recoveries, 10 randomly selected vials of methanol from the remaining supply were returned to the laboratory for analysis. Out of the 10 randomly selected vials of methanol, 2 vials had <10% recovery, 1 vial had 200% recovery and the others were within acceptable ranges. Low surrogate recoveries were likely due to human error during the spiking of the surrogate solution into the vials of methanol. In addition, the methanol provided by the laboratory to preserve the soil samples contained all surrogates used for analysis, which is not consistent with method SW8260B.
LF006 - Old Disposal Site	DRO, RRO, Arsenic, PAHs, Lead	AK101	1 sample recovery = 18%	General investigation/ due diligence. A full suite of analyses was performed due to the nature of the site. There were no previous detections of AK101 or SW8260 analytes.	Only the sediment sample had poor surrogate recoveries at this site. This sample had no visual or olfactory indications of fuel contamination. In addition to the methanol provided by the laboratory for preservation, the high organic content and high moisture content of the sample contributed to the low surrogate recoveries. These samples were also collected with the questionable surrogated methanol described for OT001.
		SW8260B	1 sample recovery <10%		
		SW8260B	1 sample recovery 76-80%		

Site	COCs Detected above Method Two or Three	Analysis Involved	Percent Recovery	Purpose of VOC Analysis	Potential Impact of Low Surrogate Recovery
SS007 - Tank Farm	DRO, PAHs	SW8260B (BTEX)	5 samples recovery 65-70%, 11 samples recovery > 70%	TAH for offsite migration of light-end hydrocarbons and Eco Risk. The site formerly housed two diesel tanks. AK101 and SW8260 are not likely COCs.	29 samples were analyzed for BTEX; 17 of those samples were impacted by low surrogate recoveries. Light-end distillates are not believed to have been stored at the SS007 tanks. The freshwater sediment sample from the creek was highly organic and saturated with water. The marine sediment sample from the ocean was composed of sandy material and also very wet. The moisture content of the samples at this site may have contributed to the low surrogate recoveries. A review of sample chromatograms demonstrates that contamination is associated with mid-range distillates. These samples were also collected with the questionable surrogated methanol described for OT001.
WP003 - Waste Pit	DRO, RRO, PAHs, 1,2,4-Trimethylbenzene	SW8260B	3 samples recovery <10%	Only DRO contamination (11,000 mg/kg range).	20 samples were collected, 3 of which had poor surrogate recoveries of <10%. The results for the remaining 17 samples were ND for VOC and had low detections of other fuel constituents. Therefore, volatile compounds were not anticipated to be detected in these three samples. These samples were also collected with the questionable surrogated methanol described for OT001.

Note: For definitions, see the Acronyms and Abbreviations section.

The site-by-site analysis approach included:

- Review of DRO chromatograms for the potential presence of low end hydrocarbons
- Review of field screening results
- Review of nearby samples from other media (i.e., review of water data associated with a sediment sample)
- Review of potential matrix interference based on matrix spike data
- Review of the purpose of the data (i.e., identification of contaminants of concern [COC] versus risk assessment)

After reviewing the data set for each site, it was determined that the data are representative of each site and that no data gaps remain. Out of the four sites that were impacted by low surrogate recoveries, sites OT001 Doorways and WP003 were included in the risk assessment. Although volatile sample results for 7 out of 9 samples collected from doorways of the composite building at OT001 were qualified "VX", the analysis of these samples for volatile analytes has been deemed unnecessary by all involved parties, as the soil in these locations was severely disturbed and volatile analytes were not likely to be present. At WP003, the data set included 20 samples, only three of which were impacted by low surrogate recoveries.

2.1.3 Frequency of Detection

As stated above, if confidence was high that a given analyte was present, the data generally were used in the risk assessment. Analytes that were reported infrequently (i.e., in less than 5 percent of the samples) may be artifacts in the data that do not reflect the presence of the chemical in question. However, no analytes were excluded from further consideration based on low frequencies of detection.

2.2 DETERMINATION OF BACKGROUND METALS CONCENTRATIONS

Results from previous investigations indicated that four metals were identified above ADEC Method Two criteria at the Driftwood Bay RRS site: arsenic, mercury, lead, and total chromium. These metals were addressed in the metals background study included as

Appendix F to the Site Characterization Work Plan (USAF 2007b). Analytical results for metals were compared to background levels. Lead was detected at levels greater than background concentrations at the BBA, EDA, and LF006. Lead detected at these sites is likely to be attributed to batteries present at these sites. No other metals were detected above calculated background concentrations for the sites included in this risk assessment.

2.3 PROCESS OF IDENTIFICATION OF CONTAMINANTS OF POTENTIAL CONCERN

COPCs are chemicals identified as site related and potentially capable of contributing significantly to risk. COPCs were identified based on the ADEC *Risk Assessment Procedure Manual, Draft* (ADEC 2005). All COPCs identified were carried forward to quantitative evaluation in the risk assessment. Potential exposure routes were used to evaluate which analytes were retained as COPCs for the risk assessment. All available analytical data of acceptable quality were used to identify COPCs. For field duplicates, the higher value of the two samples was used. The following paragraphs describe the identification process.

Detection limits for each analyte were obtained from the analytical laboratory. If a sample contained a detectable concentration of a given analyte, no detection limit is provided in text for that particular analyte. If a sample was nondetect (ND) for a given analyte, the reporting limit is bracketed next to the ND descriptor. All analytical data with associated qualifiers and detection limits are presented in Appendix E.

In accordance with the ADEC *Risk Assessment Procedures Manual, Draft* (ADEC 2005), for soils and groundwater, the maximum detected concentration of each analyte was compared to one-tenth of the more conservative of the ingestion and inhalation standards listed in 18 AAC 75 Tables B1 or B2, or to the standard provided in 18 AAC 75 Table C as appropriate. For surface water, freshwater sediment, and marine sediment, the maximum detected concentration was compared directly to the most conservative screening values from *Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances* (ADEC 2003), *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota* (Oak Ridge National Laboratory

[ORNL] 1997), *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Aquatic Biota* (ORNL 1996), *Screening Quick Reference Tables* (National Oceanic and Atmospheric Administration 2006), and *National Recommended Water Quality Criteria* (U.S. Environmental Protection Agency [EPA] 2002a), as applicable.

If an analyte was detected in any sample of each media from a site, all sample results for that analyte were evaluated against the screening criteria described above. One-half the MDL was the assumed screening value used for samples in which the analyte was not detected. In the case of xylenes and PCBs, where a total value is used for comparison to criteria, the following procedures for obtaining a screening value were used:

- All detections of xylenes (or PCBs) in each sample were summed to form a total value for screening.
- If the analyte was detected in any sample of the sample media from the site, but was ND for the given sample, half the MDL for each analyte with a ND result were added to the detected results for a total concentration and that value was used for screening.

Contaminants were excluded from consideration as COPCs if they were not detected in any sample, were detected only at concentrations less than the risk-based standard, or were detected only at concentrations below background levels discussed in Section 2.2.

Detections of inorganic or organic analytes at concentrations above applicable screening values indicate that the potential for unacceptable risk exists and that further study may be warranted. However, remedial or risk management decisions should not be made based solely on exceedances of screening values. The screening process identified the COPCs presented in Appendix G and summarized in Table 2-2. Results indicate that certain areas warrant further evaluation in this risk assessment.

Table 2-2
Contaminants of Potential Concern

Site	COPC (Soil)	COPC (Groundwater)	COPC (Sediment)	COPC (Surface Water)
Top Camp				
OT001 (Doorways)	Total PCBs Aroclor 1254 Aroclor 1260	NA	NA	NA
OT001 (USTs & Antennas)	DRO Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenzo(a,h)anthracene Indeno(1,2,3-c,d)pyrene Naphthalene	NA	NA	NA
BBA	Lead	NA	NA	NA
WP003	DRO RRO Benzo(a)pyrene Dibenzo(a,h)anthracene 1,2,4-Trimethylbenzene	NA	NA	NA
Lower Camp				
LF006	DRO RRO Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Dibenzo(a,h)anthracene Fluoranthene Indeno(1,2,3-cd)pyrene Naphthalene Pyrene Total PCBs Aroclor 1248 Aroclor 1254 Arsenic Lead	DRO RRO Lead Total PCBs Aroclor 1016 Aroclor 1221 Aroclor 1232 Aroclor 1242 Aroclor 1248 Aroclor 1254 Aroclor 1260	Benzo(a)anthracene Benzo(a)pyrene Chrysene Phenanthrene Pyrene Lead	Carbon disulfide Beta-BHC Lead
EDA	Total PCBs Aroclor 1248 Aroclor 1254 Aroclor 1260 Lead	NA	NA	NA

Table 2-2
Contaminants of Potential Concern
(continued)

Site	COPC (Soil)	COPC (Groundwater)	COPC (Sediment)	COPC (Surface Water)
SS007	DRO Benzo(a)pyrene Benzo(a)anthracene Benzo(b)fluoranthene Dibenzo(a,h)anthracene Ethylbenzene Xylenes	DRO RRO	NA	NA
SS010	DRO Benzo(a)pyrene	NA	NA	NA

Note: For definitions, see the Acronyms and Abbreviations section.

2.4 DERIVATION OF EXPOSURE POINT CONCENTRATIONS

The EPC is a conservative estimate of the average concentration of a COPC, statistically calculated from the analytical results of all samples for a particular environmental medium to which a receptor may be exposed over the duration of the exposure. An EPC may be based on media concentrations that have been directly measured, or it may be derived based on environmental medium-to-medium transport modeling. The EPCs of COPCs in soil, groundwater, surface water, and sediment are statistically derived values, based on analytical data collected in 2007.

Exposure to an environmental medium is generally assumed to be random, and the EPC should be the arithmetic average encountered over the exposure duration (EPA 1989). Therefore, the population mean concentration, if known, would be the ideal value selected as the EPC. The sample mean is an obvious estimate of the population mean. In accordance with EPA (U.S. Environmental Protection Agency) guidance, both the mean and the upper confidence limit (UCL) on the mean were estimated for each COPC in each medium of interest. Therefore, EPA (1989) has recommended the inclusion of the 95-percent UCL on the sample mean (UCL_{95}) for reasonable maximum exposure evaluation.

In general, unusually high values are included in the calculation of the UCL_{95} because high values seldom appear as statistical outliers in environmental data. Inclusion of outliers increases the overall conservatism of the risk estimate. The following paragraphs describe the general statistical approaches used to derive EPCs. The EPA statistical software package ProUCL Version 4 was used to compute estimated mean and UCL_{95} concentrations. The exposure point concentrations for the COPCs were calculated adhering the method described in Section 2.3, with the following exception: To calculate total PCBs or total xylenes when all values were ND, the highest individual MDL was used. If there were any detections, only those individual detections were summed to calculate the total. These values were then entered into ProUCL. The recommended output from ProUCL was used as the UCL on the mean for each COPC in each medium of interest. In the case where a recommended distribution was not selected, the maximum concentration was used to represent the UCL. Table 2-3 presents the value for used for each case.

Table 2-3
Exposure Point Concentration, 95-Percent Upper Confidence Limit, or Maximum Value

Site	Matrix	Analyte	UCL_{95} or Maximum Value (mg/kg)	Method	Sample with Maximum Concentration
SS007	Soil	DRO	3,080	UCL_{95}	
SS007	Soil	Benzo(a)pyrene	0.19	UCL_{95}	
SS007	Soil	Benzo(a)anthracene	0.217	UCL_{95}	
SS007	Soil	Benzo(b)fluoranthene	0.259	UCL_{95}	
SS007	Soil	Dibenzo(a,h)anthracene	0.0241	UCL_{95}	
SS007	Soil	Ethylbenzene	0.0824	UCL_{95}	
SS007	Soil	Xylene (Total)	0.304	UCL_{95}	
SS007	Groundwater	DRO	82	Max. value	DBSS007-MP03-WG
SS007	Groundwater	RRO	0.54	Max. value	DBSS007-MP02-WG
SS010	Soil	DRO	5,300	Max. value	DBSS010-SU08-SO-X
SS010	Soil	Benzo(a)pyrene	0.058	Max. value	DBSS010-SU08-SO
WP003	Soil	DRO	5,367	UCL_{95}	
WP003	Soil	RRO	5,745	UCL_{95}	
WP003	Soil	Benzo(a)pyrene	0.0791	UCL_{95}	
WP003	Soil	Dibenzo(a,h)anthracene	0.0252	UCL_{95}	
WP003	Soil	1,2,4-Trimethylbenzene	0.788	UCL_{95}	

Table 2-3
Exposure Point Concentration, 95 Percent Upper Confidence Limit, or Maximum Value
(continued)

Site	Matrix	Analyte	UCL_{95} or Maximum Value (mg/kg)	Method	Sample with Maximum Concentration
EDA	Soil	Total PCBs	0.167	Max. value	DBLF006-CAP02-SO
EDA	Soil	PCB-1248(Aroclor1248)	0.059	Max. value	DBLF006-CAP02-SO
EDA	Soil	PCB-1254(Aroclor1254)	0.071	Max. value	DBLF006-CAP02-SO
EDA	Soil	PCB-1260(Aroclor1260)	0.037	Max. value	DBLF006-CAP02-SO
EDA	Soil	Lead	62,275	UCL_{95}	
BBA	Soil	Lead	9,358	UCL_{95}	
LF006	Soil	DRO	2,100	Max. value	DBLF006-TP01A-SO
LF006	Soil	RRO	9,500	Max. value	DBLF006-TP01A-SO
LF006	Soil	Benzo(a)anthracene	120	Max. value	DBLF006-TP01C-SO
LF006	Soil	Benzo(a)pyrene	100	Max. value	DBLF006-TP01C-SO
LF006	Soil	Benzo(b)fluoranthene	77	Max. value	DBLF006-TP01C-SO
LF006	Soil	Benzo(k)fluoranthene	80	Max. value	DBLF006-TP01C-SO
LF006	Soil	Chrysene	130	Max. value	DBLF006-TP01C-SO
LF006	Soil	Dibenzo(a,h)anthracene	20	Max. value	DBLF006-TP01C-SO
LF006	Soil	Fluoranthene	240	Max. value	DBLF006-TP01C-SO
LF006	Soil	Indeno(1,2,3-c,d)pyrene	71	Max. value	DBLF006-TP01C-SO
LF006	Soil	Naphthalene	9	Max. value	DBLF006-TP01C-SO
LF006	Soil	Pyrene	220	Max. value	DBLF006-TP01C-SO
LF006	Soil	Total PCBs	1.52	Max. value	DBLF006-TP01C-SO
LF006	Soil	PCB-1248(Aroclor1248)	0.73	Max. value	DBLF006-TP01C-SO
LF006	Soil	PCB-1254(Aroclor1254)	0.79	Max. value	DBLF006-TP01C-SO
LF006	Soil	Arsenic	8.91	Max. value	DBLF006-TP01C-SO
LF006	Soil	Lead	89900	Max. value	DBLF006-BAT01-SO
LF006	Groundwater	DRO	0.36	Max. value	DBLF006-SP04-WG
LF006	Groundwater	RRO	0.99	Max. value	DBLF006-SP04-WG
LF006	Groundwater	Lead	0.0074	Max. value	DBLF006-SP04-WG
LF006	Groundwater	PCB-1016(Aroclor1016)	0.000135	Max. value	DBLF006-SP05-WG
LF006	Groundwater	PCB-1221(Aroclor1221)	0.00018	Max. value	DBLF006-SP05-WG
LF006	Groundwater	PCB-1232(Aroclor1232)	0.000065	Max. value	DBLF006-SP05-WG
LF006	Groundwater	PCB-1242(Aroclor1242)	0.0001	Max. value	DBLF006-SP05-WG
LF006	Groundwater	PCB-1248(Aroclor1248)	0.000055	Max. value	DBLF006-SP05-WG
LF006	Groundwater	PCB-1254(Aroclor1254)	0.00016	Max. value	DBLF006-SP05-WG
LF006	Groundwater	PCB-1260(Aroclor1260)	0.000125	Max. value	DBLF006-SP05-WG
LF006	Groundwater	Total PCBs	0.00082	Max. value	DBLF006-SP05-WG

Table 2-3
Exposure Point Concentration, 95 Percent Upper Confidence Limit, or Maximum Value
(continued)

Site	Matrix	Analyte	UCL_{95} or Maximum Value (mg/kg)	Method	Sample with Maximum Concentration
LF006	Sediment	Benzo(a)anthracene	0.0074	Max. value	DBLF006-SP01A-SEF-X
LF006	Sediment	Benzo(a)pyrene	0.0063	Max. value	DBLF006-SP01A-SEF-X
LF006	Sediment	Chrysene	0.0087	Max. value	DBLF006-SP01A-SEF-X
LF006	Sediment	Phenanthrene	0.0092	Max. value	DBLF006-SP01A-SEF-X
LF006	Sediment	Pyrene	0.013	Max. value	DBLF006-SP01A-SEF-X
LF006	Sediment	Lead	31	Max. value	DBLF006-SP01A-SEF-X
LF006	Surface Water	Carbon Disulfide	0.0004	Max. value	DBLF006-SU01A-WSF-X
LF006	Surface Water	beta-BHC	0.0000014	Max. value	DBLF006-SU01A-WSF
LF006	Surface Water	Lead	0.0029	Max. value	DBLF006-SU01A-WSF-X
OT001	Soil	PCB-1254(Aroclor1254)	1.301	UCL_{95}	
OT001	Soil	PCB-1260(Aroclor1260)	0.463	UCL_{95}	
OT001	Soil	Total PCBs	1.936	UCL_{95}	
OT001	Soil	Benzo(a)anthracene	0.927	UCL_{95}	
OT001	Soil	Benzo(a)pyrene	0.721	UCL_{95}	
OT001	Soil	Benzo(b)fluoranthene	0.585	UCL_{95}	
OT001	Soil	Dibenzo(a,h)anthracene	0.0686	UCL_{95}	
OT001	Soil	Indeno(1,2,3-cd)pyrene	0.345	UCL_{95}	
OT001	Soil	Naphthalene	0.74	UCL_{95}	
OT001	Soil	DRO	4192	UCL_{95}	

__Note:__ For definitions, see the Acronyms and Abbreviations section.

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3.0 CONCEPTUAL SITE MODELS

This section presents the current CSMs for Top Camp and Lower Camp and discusses potential exposure pathways and receptors. Appendix A presents ecological checklists that contain information pertaining to both ecological and human health exposure and risk. Both the original CSMs and ecological checklists were presented to ADEC at the Scoping Meeting; minutes from this meeting are presented in Appendix B. The CSMs were updated using both analytical data gathered during site characterization and the results of interviews with community members, pilots, USAF, USFWS, boat charters, Dutch Harbor outfitters, and Native corporations.

3.1 TOP CAMP

Top Camp is located approximately 3 miles west of Driftwood Bay, on a plateau about 1,400 feet above mean sea level. The Top Camp area consists of the Former Composite Building and fuel storage areas and White Alice Arrays (OT001); the POL Waste Pit (WP003); the Septic Tank (FL009) and outfall; an area where batteries had been previously burned (BBA); and portions of the POL Pipeline (SS008), which is discussed under the Lower Camp sites. Contamination at the Top Camp area is primarily the result of activities associated with the Former Composite Building.

Top camp is located on a very broad, gently sloping ridge. The weather at Top Camp is frequently harsher than the milder weather in the Driftwood Bay valley. Because of frequent high winds, fog, and rain, as well as late snowmelt, vegetation is light and consists mainly of low tundra plants. Portions of the surrounding area have been disturbed, and bare rocky soil is exposed in some of these disturbed areas.

Based on data collected during 2007 field activities, the CSM for potential current and future exposure pathways at the Driftwood Bay RRS for Top Camp has been updated (Figure 3-1). Appendix A contains the CSM scoping forms.

Initial activities at Top Camp focused on assessing the presence or absence of groundwater. Effort to assess the presence of groundwater at Top Camp focused on determining the top of the water table. Forty-seven soil borings were advanced to bedrock or refusal with no detection of groundwater. Three test pits were dug to bedrock and were also unable to detect the presence of groundwater at Top Camp. Multiple attempts were made to identify seeps at and downgradient of Top Camp from May through July, but none were identified.

Test pits and borings encountered no groundwater or seeps and encountered bedrock at depths from 5 to 20 feet bgs, thus eliminating groundwater as a potential transport mechanism at Top Camp. Figure 3-1 illustrates contaminant sources, release mechanisms, transport media, exposure routes, and receptors. Due to the lack of detectable groundwater, this CSM has been updated to indicate that groundwater is an incomplete pathway.

Windblown snow is the primary mechanism by which water is removed from the site. During the short period of time when temperatures are above freezing, surface snow melts, but underlying soil remains well below freezing. The water flows downward through the underlying snow and encounters the underlying soil, which causes the water to refreeze, forming a temporary impermeable layer. As additional snow melts, the water percolates downward through the snow until it encounters the impermeable layer. From there, the water collects and moves laterally until it collects in gullies, then flows downhill under the overlying snow layer. Generally, the sites at Top Camp are on a plateau area and contamination does not move through the gullies. As late as mid-July, this snow layer was determined to be 10 feet thick at the gully just east of the FL009 outfall. Thus, surface water is not present at the site. Surface water is also not a transport mechanism because it has generally not come into contact with the contamination.

Observations of surface soils at Top Camp showed signs of episodic surface runoff events beneath the snow layer. Sediment is traditionally described as particulate material redistributed by water or wind and deposited at the bottom of a body of water. The observations at Top Camp indicated no existing surface water bodies where sediment could be deposited; therefore, sediment is not considered present. Surface flow was observed in sheet

G:\Autocad\Driftwood Bay \05BC7101 \2008 RA Report \Fig 3-1 Top Camp CSM.dwg Mar 31,2009 -avakarcs)

Site: Driftwood Bay - Top Camp

Completed By: Jacobs Engineering

Date Completed: 02/11/2009

Follow the directions below. Do not consider engineering or land use controls when describing pathways.

(1) *Check the media that could be directly affected by the release.*

(2) *For each medium identified in (1), follow the top arrow and check possible transport mechanisms. Briefly list other mechanisms or reference the report for details.*

(3) *Check exposure media identified in (2).*

(4) *Check exposure pathways that are complete or need further evaluation. The pathways identified must agree with Sections 2 and 3 of the CSM Scoping Form.*

(5) *Identify the receptors potentially affected by each exposure pathway: Enter "C" for current receptors, "F" for future receptors, or "C/F" for both current and future receptors.*

Media	Transport Mechanisms
[✓] Surface Soil (0-2 ft bgs) *SEE NOTE 2	Direct release to surface soil → check soil
	[✓] Migration or leaching to subsurface → check soil
	[ ] Migration or leaching to groundwater → check groundwater
	[✓] Volatilization → check air
	[✓] Runoff or erosion → check surface water
	[✓] Uptake by plants or animals → check biota
	[ ] Other (list):
[✓] Subsurface Soil (2-15 ft bgs)	Direct release to subsurface soil → check soil
	[ ] Migration to groundwater → check groundwater
	[✓] Volatilization → check air
	[ ] Other (list):
[ ] Ground-water	Direct release to groundwater → check groundwater
	[ ] Volatilization → check air
	[ ] Flow to surface water body → check surface water
	[ ] Flow to sediment → check sediment
	[ ] Uptake by plants or animals → check biota
	[ ] Other (list):
[ ] Surface Water	Direct release to surface water → check surface water
	[ ] Volatilization → check air
	[ ] Sedimentation → check sediment
	[ ] Uptake by plants or animals → check biota
	[ ] Other (list):
[ ] Sediment	Direct release to sediment → check sediment
	[ ] Resuspension, runoff, or erosion → check surface water
	[ ] Uptake by plants or animals → check biota
	[ ] Other (list):

Current & Future Receptors

Exposure Media	Exposure Pathways	Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
[✓] soil *SEE NOTE 1	[✓] Incidental Soil Ingestion			C/F				C/F
	[✓] Dermal Absorption of Contaminants from Soil			C/F				C/F
[ ] groundwater	[ ] Ingestion of Groundwater							
	[ ] Dermal Absorption of Contaminants in Groundwater							
	[ ] Inhalation of Volatile Compounds in Tap Water							
[✓] air	[✓] Inhalation of Outdoor Air			C/F				C/F
	[ ] Inhalation of Indoor Air							
	[✓] Inhalation of Fugitive Dust			C/F				C/F
[ ] surface water	[ ] Ingestion of Surface Water							
	[ ] Dermal Absorption of Contaminants in Surface Water							
	[ ] Inhalation of Volatile Compounds in Tap Water							
[ ] sediment	[ ] Direct Contact with Sediment							
[ ] biota *SEE NOTE 1	[ ] Ingestion of Wild Foods							

***NOTES**

1. ALTHOUGH THERE IS POTENTIAL FOR A COMPLETE EXPOSURE PATHWAY FOR ECOLOGICAL RECEPTORS AT TOP CAMP, THIS AREA WAS ELIMINATED FROM CONSIDERATION BASED ON THE LACK OF HABITAT PRESENT AND THE LACK OF PRESENCE OF ANY POTENTIAL RECEPTORS IN THE AREA DURING FIELD EFFORT (REFER TO TEXT SECTION 3.2.1).
2. REFER TO TEXT SECTION 3.2.1 FOR FURTHER DISCUSSION REGARDING RUNOFF/EROSION AT TOP CAMP.

CONCEPTUAL SITE MODEL
TOP CAMP

UNALASKA ISLAND, ALASKA

PROJECT MANAGER: S. Witzmann	FILE NAME: Fig 3-1 Top Camp CSM.dwg	DATE: Mar. 31, 09
JE — DRAWN BY: BJP	LAYOUT TAB: Fig 3-1 Top Camp CSM	FIGURE NO.: 3-1
	FILE LOCATION: Driftwood Bay \ 05BC7101 \ 2008 RA Report	

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flow and rivulets during short warm periods but in insufficient volume for sampling and inaccessible for ingestion or dermal contact by potential receptors. Photo 1-2 shows small erosional traces from surface flow beneath the snow layer. Eroded material was present in the gullies near Top Camp but not in sufficient volume to be sampled. Due to the lack of surface water and sediment deposition locations, surface water and sediment have been eliminated as exposure media and are considered incomplete pathways at Top Camp.

Air was also identified as a potential exposure medium at Top Camp through fugitive dust emissions and volatilization of organic compounds from soil or water. However, observations at the site indicated that fugitive dust was rarely present under the climatic conditions observed during the 2007 field season because the surface soil was either snow covered, moistened from surface melt, or vegetated. The only potential for exposure observed at the site was due to human disturbance of the otherwise cohesive, lightly vegetated surface soil.

Possible secondary release and transport mechanisms at Top Camp include migration or leaching to subsurface, volatilization, and uptake by plants, all of which could result in contamination of potential contact media such as surface soil, air, and biota. Potential exposure routes include incidental soil ingestion, dermal absorption of contaminants from soil, inhalation of outdoor air, inhalation of fugitive dust, and ingestion of wild foods. However, the data indicate that contamination at Top Camp is not migrating from the site. Potential current and future receptors of these exposure routes include site visitors, trespassers, or recreational users, and unforeseen future user groups. Residential use is not anticipated because site access is limited to boat or plane as documented in surveys. Subsistence hunting or gathering is unlikely although harvesting of small game and vegetation (e.g., berries) may occur on a limited basis.

3.2 LOWER CAMP

Lower Camp is located in the wide, steep-sided Driftwood Bay valley. The rocky ridges to both the west and east of the valley provide significant protection from the typical harsh Aleutian weather. Vegetation in the valley is abundant and varied, due to snowmelt, shallow groundwater, and ample runoff flowing into the valley from surrounding slopes. The valley floor is generally flat and quickly becomes flooded during periods of high precipitation or snowmelt. Some disturbed areas are evident, but revegetation occurs quickly, and generally only the roads and airstrip remain obvious.

Based on data collected during 2007 field activities, the CSM for potential current and future exposure pathways at the Driftwood Bay RRS for Lower Camp has been updated (Figure 3-2). Appendix A contains the CSM scoping forms.

Surface flow was generally channelized, and surface flooding had distinct flow direction at Lower Camp. In general, surface water flows from the west and southwest to the east and northeast. Depth to the top of groundwater at Lower Camp ranged from approximately 3 to 32 feet bgs. In order to assess the direction of groundwater flow, measurement of perennial surface water elevations were collected using a Real Time Kinematic global positioning system, and depth to groundwater was measured in soil borings and SP16 points. Groundwater has the same general flow direction as surface water across the site, with some localized anomalies due to aquitards resulting from lithologic variations and groundwater mounding from surface water recharge.

Several areas at Lower Camp are potentially connected hydrologically. While all areas are considered to be Lower Camp, sufficient variation of the areas' characteristics warrants their individual discussion. Those sites included in the risk assessment are presented in the following sections. Individual discussions about each area at Lower Camp can be found in the SCR (USAF 2008b).

Possible secondary release and transport mechanisms at Lower Camp include migration or leaching to subsurface, migration or leaching to groundwater, volatilization, uptake by plants or animals, groundwater flow to surface water body, groundwater flow to sediment, sediment resuspension, runoff, or erosion, all of which could result in contamination of potential contact media such as soil, groundwater, air, surface water, sediment, and biota. Potential exposure routes include incidental soil ingestion, dermal absorption of contaminants from soil, ingestion of groundwater, dermal absorption of contaminants in groundwater, inhalation of outdoor air, G:\Autocad\Driftwood Bay \05BC7101 \2008 RA Report \Fig 3-2 Lower Camp CSM.dwg Mar 31,2009 -avakarcs)

Site: Driftwood Bay - Lower Camp

Completed By: Jacobs Engineering

Date Completed: 10-24-2007

Follow the directions below. Do not consider engineering or land use controls when describing pathways.

(1) *Check the media that could be directly affected by the release.*

(2) *For each medium identified in (1), follow the top arrow and check possible transport mechanisms. Briefly list other mechanisms or reference the report for details.*

(3) *Check exposure media identified in (2).*

(4) *Check exposure pathways that are complete or need further evaluation. The pathways identified must agree with Sections 2 and 3 of the CSM Scoping Form.*

(5) *Identify the receptors potentially affected by each exposure pathway: Enter "C" for current receptors, "F" for future receptors, or "C/F" for both current and future receptors.*

Media / Transport Mechanisms

Media	Transport Mechanisms	
✓ Surface Soil (0-2 ft bgs)	✓ Direct release to surface soil	check soil
	✓ Migration or leaching to subsurface	check soil
	✓ Migration or leaching to groundwater	check groundwater
	✓ Volatilization	check air
	✓ Runoff or erosion	check surface water
	✓ Uptake by plants or animals	check biota
	☐ Other (list):	
✓ Subsurface Soil (2-15 ft bgs)	✓ Direct release to subsurface soil	check soil
	✓ Migration to groundwater	check groundwater
	✓ Volatilization	check air
	☐ Other (list):	
✓ Ground-water	✓ Direct release to groundwater	check groundwater
	☐ Volatilization	check air
	✓ Flow to surface water body	check surface water
	✓ Flow to sediment	check sediment
	✓ Uptake by plants or animals	check biota
	☐ Other (list):	
✓ Surface Water	✓ Direct release to surface water	check surface water
	✓ Volatilization	check air
	✓ Sedimentation	check sediment
	✓ Uptake by plants or animals	check biota
	☐ Other (list):	
✓ Sediment	✓ Direct release to sediment	check sediment
	✓ Resuspension, runoff, or erosion	check surface water
	✓ Uptake by plants or animals	check biota
	☐ Other (list):	

Exposure Media / Exposure Pathways / Current & Future Receptors

Exposure Media	Exposure Pathways	Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
✓ soil	✓ Incidental Soil Ingestion			C/F				C/F
	✓ Dermal Absorption of Contaminants from Soil			C/F				C/F
✓ groundwater	✓ Ingestion of Groundwater			C/F				C/F
	✓ Dermal Absorption of Contaminants in Groundwater			C/F				C/F
	☐ Inhalation of Volatile Compounds in Tap Water							
✓ air	✓ Inhalation of Outdoor Air			C/F				C/F
	☐ Inhalation of Indoor Air							
	✓ Inhalation of Fugitive Dust			C/F				C/F
✓ surface water	✓ Ingestion of Surface Water			C/F				C/F
	✓ Dermal Absorption of Contaminants in Surface Water			C/F				C/F
	☐ Inhalation of Volatile Compounds in Tap Water							
✓ sediment	✓ Direct Contact with Sediment			C/F				C/F
✓ biota	✓ Ingestion of Wild Foods			C/F				C/F

*NOTE

GROUNDWATER IS NOT AN ANTICIPATED DRINKING WATER SOURCE AT SS007. PLEASE REFER TO THE GROUNDWATER USE DETERMINATION PROVIDED IN APPENDIX M.

CONCEPTUAL SITE MODEL LOWER CAMP

UNALASKA ISLAND, ALASKA

PROJECT MANAGER: S. Witzmann	FILE NAME: Fig 3-2 Lower Camp CSM.dwg	DATE: Mar. 31, 09
	LAYOUT TAB: Fig 3-2 Lower Camp CSM	FIGURE NO.: 3-2
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inhalation of fugitive dust, ingestion of surface water, dermal absorption of contaminants in surface water, direct contact with sediment, and ingestion of wild foods.

Potential current and future receptors include site visitors, trespassers, and recreational users. Residential use is not anticipated because site access is limited to boat or plane. Subsistence hunting or gathering is unlikely although harvesting of small game and vegetation (e.g., berries) may occur on a limited basis.

3.2.1 LF006 and Electronic Debris Area

Depth to groundwater at the HESA/LF006 area ranged from 5 to 14 feet bgs within the originally designated site boundaries. Variability of depth to the top of groundwater was consistent with changes in surface topography. Several attempts were made to advance SP16 borings on a bluff to the east of LF006, with refusal occurring on three occasions. Water was finally encountered for SP16 samples at roughly 32 feet bgs. For the duration of field activities, surface water was present at LF006 in a pond, the most likely source for a groundwater mound at LF006 that contributed to shallower groundwater depths relative to the eastern sample location. Groundwater flow direction at LF006 is east to northeast. The surface water pond may be seasonal. The EDA is adjacent to LF006. However, no surface water is present at the EDA. The data indicate that the contamination at site LF006 and the Electronic Debris Area is not migrating from the site.

3.2.2 SS007

Site SS007 is located along the bay to the north and is bordered by surface streams and ponds. Depth to groundwater ranged from approximately 4 to 14 feet bgs. Tidal influence is suspected as the reason for some of this variation. During soil boring and SP16 installation, a perched aquifer was observed at SS007, caused by a leaky aquitard around 7 to 8 feet bgs that was created by layers of clays, fine silts, and some organic clay. The perched aquifer is assumed to be recharged by Humpy Creek, which borders the site to the south. Deeper, investigative borings revealed a second and lower aquifer beginning roughly at 13 feet bgs. Conductivity measurements demonstrate that the lower aquifer is impacted by brackish water intrusion during high tides. Sediment was present in Humpy Creek to the south of SS007 and in Driftwood Bay to the north of the site. No sediment was present directly onsite. The data indicate that contamination at site SS007 is not migrating from the site.

3.2.3 SS010

Surface water and groundwater were both observed at site SS010, which is located on a steep slope. The topography of the site made sampling and advancing soil borings difficult. Proximity to an unstable slope, bedrock cliffs, and wind-deposited cornices made working conditions unsafe for site personnel; therefore, drilling did not occur at this site. However, during hand-digging activities, water was encountered where the soil was disturbed. Shallow groundwater at the site is due to shallow bedrock and high recharge levels from Snuffy Creek, adjacent to the site.

Sediment, groundwater, soil, and surface water pathways for SS010 are anticipated to be complete. The data indicate that contamination at site SS010 is not migrating from the site.

4.0 HUMAN HEALTH RISK ASSESSMENT

The human health risk assessment approach was developed in accordance with the ADEC *Risk Assessment Procedures Manual, Draft* (ADEC 2005) and includes exposure assessment, toxicity assessment, and risk characterization. Where additional clarification or guidance was required, EPA source documents were consulted, including:

- *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)*, 1989, Interim Final, Office of Emergency and Remedial Response, Washington, D.C., EPA/540/1-89/002
- Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors, 1991, Interim Final, Office of Solid Waste and Emergency Response, OSWER Directive 9285.6-03
- Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual Part B – Development of Risk-Based Preliminary Remediation Goals, 1991 (December), Interim, Office of Emergency and Remedial Response, Washington, D.C., EPA/540/R-92/003
- *Supplemental Guidance to RAGS: Calculating the Concentration Term*, 1992, Office of Solid Waste and Emergency Response, Washington, D.C., Publication 9285.7-081
- *Exposure Factors Handbook*, 1997 (August), Office of Research and Development, National Center for Environmental Assessment, Washington, D.C., EPA/600/P95/002F
- Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part E - Supplemental Guidance for Dermal Risk Assessment), 2004 (July), Final, Office of Superfund Remediation and Technology Innovation, Washington, D.C., EPA/540/R-99/005
- Soil Screening Guidance: User's Guide. Office of Research and Development, 1996 (July), 9355.4-23, PB96-963505, EPA/540/R-96/018
- *Soil Screening Guidance: Technical Background Document,* 1996 (May), Office of Solid Waste and Emergency Response, EPA/540/R-95/128, NTIS No. PB96-963502
- *Sediment Quality Guidelines: Technical Memorandum,* 2004 (March), Alaska Department of Environmental Conservation, Division of Spill Prevention and Response, Contaminated Sites Remediation Program

4.1 EXPOSURE ASSESSMENT

Exposure is the contact by a receptor with a chemical or physical agent. An exposure assessment estimates the type and magnitude of potential exposure of a receptor to COPCs found at or migrating from a site (EPA 1989). The following steps were followed to assess exposure:

- Characterization of the physical setting
- Identification of contaminant sources, release mechanisms, and migration pathways
- Identification of potentially exposed receptors
- Identification of potential exposure pathways
- Estimation of EPCs
- Estimation of chemical intakes or contact rates

This risk assessment characterized potential exposures to COPCs in soil, surface water, and sediment. No surface water COPCs were identified during COPC screening for Snuffy or Humpy Creeks. Surface water COPCs were identified for the LF006 pond, but this does not represent a significant aquatic habitat and does not contain fish. Therefore, the assessment of potential ingestion of biota (i.e., fish) was not evaluated.

All available site characterization data of acceptable quality were used to evaluate potential current and future exposures. As shown in Table 2-2, the COPCs at Top Camp are DRO, residual-range organics (RRO), benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a,h,)anthracene, indeno(1,2,3-c,d)pyrene, naphthalene, 1,2,4-trimethylbenzene, lead, and PCBs; COPCs at Lower Camp include DRO, RRO, ethylbenzene, xylenes, polycyclic aromatic hydrocarbons (PAH), metals, PCBs, carbon disulfide, and beta-BHC. These COPCs provided the basis for the exposure assessment and the development of CSMs. EPCs and potential intake values were calculated using the appropriate exposure models and analytical data. Risks from potential exposure to fuel related compounds were evaluated using measured concentrations of DRO, RRO, benzene, toluene, ethylbenzene, and xylenes, and PAHs, as appropriate. Evaluation of the potential for adverse effects from exposure to lead is discussed in Section 4.5.

Exposure assumptions were determined from the results of survey questionnaires from Ounalashka Corporation, local air and sea transport operators, Dutch Harbor outfitters, the USAF office that issues civil aircraft landing permits, and USFWS. Appendix C contains the completed questionnaires. Generally, the questionnaires confirmed that people do not visit Driftwood Bay because local resources such as fish and berries are more accessible from other parts of the island and rough seas on the Bering Sea often prevent boats from making it to Driftwood Bay. Additionally, the beach at Driftwood Bay is a very high energy beach and is often is difficult to land on.

Based upon the information collected from the community surveys, the only anticipated human receptors are recreational visitors. The only potential exposure pathways for visitors are through soil and surface water. Groundwater is an unlikely exposure pathway for recreational visitors since there is no access to it. Sediment is not an anticipated exposure medium for recreational visitors because the low ambient temperature at the site precludes wading in any of the surface water bodies at Lower Camp.

As agreed upon with ADEC, USAF is using a recreational exposure scenario of 1-day onsite exposure each week for 3 months (12 days exposure, averaged over 90 days) for Top Camp at the Driftwood Bay RRS (Appendix K). This scenario was developed to provide an exposure assumption consistent with potential recreational land use. Given the harsh climatic conditions of the area and the results of public surveys on the use of the site, this exposure scenario best meets the requirements of the ALM and provides a conservative estimate of potential exposure.

Table 4-1 summarizes the exposure parameters used in determining potential risks to human health.

4.2 QUANTIFICATION OF CHEMICAL INTAKES

This section describes the models used to quantify doses or intakes of the COPC for each exposure pathway. Models were taken or modified from EPA (1989) unless otherwise indicated. Intakes were calculated for both cancer and noncancer evaluations. Intake values were based on EPCs (Section 3.4) and the equations discussed below for the respective exposure pathways.

Table 4-1
Human Health Exposure Assumptions

Exposure Parameter	Values[1] – Top Camp	Values[1] – Lower Camp
THQ/target hazard quotient (unit less)	1	1
BW/body weight (kg)	70	70
AT/averaging time (days)	10,950 (noncancer) 25,500 (cancer)	10,950 (noncancer) 25,550 (cancer)
RfD_o/oral reference dose (mg/kg-d)	Chemical-specific[2]	Chemical-specific[2]
ED/exposure duration (year)	30	30
EF/exposure frequency (days per year)	12[3]	14[4]
IR/ water ingestion rate (L/day)	2	2
IR/soil ingestion rate (mg/d)	100	100
A/absorption factor (unit less)	1	1
Sf_o/oral slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific[2]	Chemical-specific[2]

Notes:

[1] Exposure parameters are based on a potential recreational exposure scenario. The receptor is assumed to be an adult who visits the site for two weeks each year (Lower Camp) and one day per week over 12 weeks (Top Camp).

[2] Chemical-specific values are obtained from ADEC Cleanup Levels Guidance (2004), Appendix C.

[3] Value is consistent with the conditions at Top Camp and consistent with the minimum requirements of the Adult Lead Methodology, exposure is assumed to be spread over 90 days.

[4] Default exposure frequency for residential scenario assumes that individuals are away from their residence for two weeks per year Those two weeks are assumed to be spent in recreational activities.

For definitions, see the Acronyms and Abbreviations section.

4.2.1 Inhalation of Contaminants of Potential Concern in Air

The recreational receptor would more likely be exposed to dust arising from wind erosion rather than from dust-raising activities on the site. EPA (1996) derived a model for estimating a dust particulate emission factor based on an "unlimited reservoir" model and the assumption that the source area is square:

$$PEF = \frac{Q}{C} \times \frac{3600}{0.036 \times (1-V) \times \left(\frac{U_m}{U_t}\right)^3 \times F(x)} \qquad \textbf{Eq. 4.1}$$

where:

PEF = particulate emission factor (m^3/kg, calculated)
Q/C = inverse of the mean concentration at center of square source (82.72 g/m^3second per kg/m^3, site-specific value from Exhibit 11 in EPA [1996] [Zone 1, Seattle, 0.5-acre site])
3600 = seconds/hour

V = fraction of surface covered with vegetation (0.8, unitless, assumed)
U_m = mean annual wind speed (default, 4.69 m/second)
U_t = equivalent threshold value of wind speed at 7 m (default, 11.32 m/second)
F(x) = function dependent on Um/Ut (default, 0.194)

The concentration of COPCs in air were calculated as follows:

$$C_a = \frac{C_{so}}{PEF} \qquad \textbf{Eq. 4.2}$$

where:

C_a = contaminant concentration in air (mg/m^3, calculated)
C_{so} = contaminant concentration in soil (mg/kg)
PEF = particulate emission factor (m3/kg)

Airborne concentrations of VOCs estimated by the wind erosion model were assumed to sufficiently estimate levels of VOCs that may arise from volatilization, because the wind erosion model treats the VOCs as if they were located at the ground surface.

The following equation was used to estimate the inhaled dose of COPCs in air:

$$I_a = \frac{(C_a)(FI_a)(IR_a)(ET_a)(EF)(ED)}{(BW)(AT)} \qquad \textbf{Eq. 4.3}$$

where:

I_a = inhaled dose of COPC (mg/kg-day, calculated)
C_a = concentration of COPC in air (mg/m^3)
FI_a = fraction of exposure attributed to site media (unitless)
IR_a = inhalation rate (m^3/hour)
ET_a = exposure time (hours/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

4.2.2 Incidental Ingestion of Contaminants of Potential Concern in Soil

The ingested dose of COPCs in soil was estimated from the following equation:

$$I_{so} = \frac{(C_{so})(FI_{so})(IR_{so})(EF)(ED)(CF_2)}{(BW)(AT)} \qquad \textbf{Eq. 4.4}$$

where:

I_{so} = ingested dose of COPC in soil (mg/kg-day, calculated)
C_{so} = concentration of COPC in soil (mg/kg)
FI_{so} = fraction of exposure attributed to site soil (unitless)
IR_{so} = ingestion rate of soil (mg/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
CF_2 = conversion factor (1E-6 kg/mg)
BW = body weight (kg)
AT = averaging time (days)

4.2.3 Dermal Contact with Contaminants of Potential Concern in Soil or Water

Unlike the methodologies for estimating inhaled or ingested doses of COPCs, which quantify the dose at the barrier membrane (the pulmonary or gastrointestinal mucosa), dermal dose is estimated as the dose that crosses the skin and is systemically absorbed. The absorbed dose of COPC was estimated from the following equation (EPA 1992):

$$DAD = \frac{(DA)(SA)(EF)(ED)}{(BW)(AT)} \qquad \textbf{Eq. 4.5}$$

where:

DAD = average dermal absorbed dose of COPC (mg/kg-day, calculated)
DA = dose absorbed from medium per unit body surface area per day: DA_s for soil, DA_w for water (mg/cm^2-day)
SA = surface area of the skin exposed to the medium: SA_{so} for soil, SA_w for water (cm^2)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)

AT = averaging time (days)

Dose absorbed was calculated differently for dermal uptake from soil and from water. Dermal uptake of constituents from soil assumes that exposure is a function of the fraction of a dermally applied constituent that is absorbed, as calculated from the following equation (EPA 1992):

$$DA_s = (C)(FI)(CF_2)(AF)(ABS) \qquad \textbf{Eq. 4.6}$$

where:

DA_s = dose absorbed per unit body surface area per day for soil (mg/cm^2-day, calculated)
C = concentration of COPC in medium (mg/kg)
FI = fraction of exposure attributed to site medium (unitless)
CF_2 = conversion factor (1E-6 kg/mg)
AF = soil-to-skin adherence factor (mg/cm^2-day)
ABS = absorption fraction (unitless, chemical-specific), is provided for each COPC.

Table 4-2 presents the recommended values for ABS from ADEC *Cleanup Levels Guidance* (ADEC 2008). Following ADEC guidance, assessment of risk from dermal absorption for all other constituents has been addressed qualitatively in the uncertainty analysis of the risk assessment report (ADEC 2008).

Table 4-2
Recommended Dermal Absorption Fraction from Soil

Analyte	ABS Dermal
Arsenic	0.030
Lead	0.000
DRO Aliphatic Portion	0.000
DRO Aromatic Portion	0.000
RRO Aliphatic Portion	0.000
RRO Aromatic Portion	0.000
Ethylbenzene	0.000
Toluene	0.000
Xylenes, total	0.000
Benzo[a]anthracene	0.130

Table 4-2
Recommended Dermal Absorption Fraction from Soil
(continued)

Analyte	ABS Dermal
Benzo[a]pyrene	0.130
Benzo[b]fluoranthene	0.130
Benzo[k]fluoranthene	0.130
Chrysene	0.130
Dibenzo[a,h]anthracene	0.130
Fluoranthene	0.130
Indeno[1,2,3-cd]pyrene	0.130
Naphthalene	0.130
Pyrene	0.130
1,2,4-Trimethylbenzene	0.000
Polychlorinated Biphenyls (high risk)	0.140

Notes:
Source: ADEC 2008
For definitions, see the Acronyms and Abbreviations section.

Quantification of dermal uptake of constituents from water depends on a permeability coefficient (K_p), which describes the rate of movement of the constituent from water across the dermal barrier to the systemic circulation system (EPA 1992). Separate calculation methods are applied to estimate the DA term for inorganic and organic chemicals in water. For inorganic chemicals, DA_w was calculated from the following equation:

$$DA_w = (C_w)(K_p)(ET_w)(CF) \quad \textbf{Eq. 4.7}$$

where:

DA_w = dose absorbed per unit body surface area per event for water (mg/cm^2-event, calculated)
C_w = concentration of COPC in water (mg/L)
K_p = permeability coefficient (cm/hour)
ET_w = time of exposure (hours/event)
CF = conversion factor (0.001 L/cm^3)

K_p values for organic chemicals vary by several orders of magnitude, largely dependent on lipophilicity, expressed as a function of the octanol/water partition coefficient (K_{ow}). Dermal

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exposure to groundwater and surface water is expected to generally be of relatively short duration (e.g., limited to bathing/showering time and/or intermittent hand and face washing). Therefore, it is assumed that steady state is not reached. Under these conditions, DA_w will be calculated using the spreadsheets for organic and inorganic constituents that accompany the *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (EPA 2004).

4.2.4 Ingestion of Contaminants of Potential Concern in Surface Water

The ingested dose of COPCs in surface water was estimated for Lower Camp sites only by the following equation:

$$I_w = \frac{(C_w)(IR_w)(EF)(ED)}{(BW)(AT)} \quad \textbf{Eq. 4.9}$$

where:

I_w = ingested dose of COPC in surface water (mg/kg-day, calculated)
C_w = concentration of COPC in surface water (mg/L)
IR_w = drinking water ingestion rate (L/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

4.3 TOXICITY ASSESSMENT

The potential for COPCs to produce adverse effects in humans was evaluated in the toxicity assessment. Risks were characterized by the type of adverse effect elicited in humans in response to an exposure to a contaminant and the concentration or dose associated with the effect. The toxicity assessment therefore includes hazard identification and an evaluation of the dose-response. Hazard identification is the process of evaluating adverse human health effects that may result from exposure to a contaminant. Hazards are classified as either carcinogenic or noncarcinogenic (systemic toxicity).

The dose-response refers to a quantitative relationship between the level of exposure and the occurrence of adverse health effects. This relationship is described by a cancer slope factor (SF) for carcinogens or a reference dose (RfD) for systemic toxicants. These values are collectively referred to as toxicity values. The hierarchy prescribed in ADEC's *Risk Assessment Procedures Manual, Draft* (ADEC 2005) was applied. The effects of subchronic exposures (two weeks to seven years) was evaluated as indicated in the ADEC's *Risk Assessment Procedures Manual, Draft* (ADEC 2005). Evaluation of potential subchronic exposure using available EPA-approved subchronic values was not performed because EPA-approved values were not available; therefore, chronic toxicity values were used. The effect of using chronic toxicity values to evaluate potential subchronic effects is addressed in the uncertainty analysis.

For the purpose of this risk assessment, potential carcinogenic effects from exposure to PCBs were evaluated using total PCB concentrations. All PCBs reported in the *RI Report* (USAF 2008b) were Aroclor 1254 and Aroclor 1260. All other Aroclors were ND. The high-risk PCB toxicity values were used to assess carcinogenic risk. Total PCB concentrations were not used to evaluate the potential for noncarcinogenic effects from exposure to PCBs. The RfD for Aroclor 1254 was used to evaluate the potential for non-carcinogenic effects from exposure to Aroclor 1254 as specified in the Integrated Risk Information System. An RfD is not available for Aroclor 1260 (EPA 2007).

Lead was detected above one-tenth screening level in BBA, LF006, and EDA soil. In accordance with ADEC guidance, lead contamination in soil or groundwater was not included in cumulative risk calculations. The potential for hazardous effects from exposure to lead were evaluated using EPA's ALM and is discussed in Section 4.5.

DRO and RRO data have been evaluated as described in *Guidance for Cleanup of Petroleum Contaminated Sites* (ADEC 2006). Because ADEC published physical/chemical parameters and toxicity information for these petroleum fractions are only available for their aliphatic and aromatic portions, DRO and RRO data for soils have been subdivided according to the default compositions shown in Table 4-3.

Table 4-3
Breakdown of Fuel Fractions in Soils

Carbon Range	Percent Aliphatic	Percent Aromatic	Total
DRO (C10-C25)	80%	40%	120%
RRO (C25-C36)	90%	30%	120%

Note: For definitions, see the Acronyms and Abbreviations section.

Because fuel compositions vary considerably, the sum of the default compositions for the aliphatic and aromatic fractions was set at 120 percent of the total concentrations, in accordance with ADEC guidance.

In contrast, it was assumed that all DRO and RRO in groundwater and surface water consist of aromatic constituents. This is because the aliphatic portions of these fuel fractions adsorb to soils far more strongly than the aromatic portions (Table 4-4). Thus, fuel contaminants present in groundwater and surface water are generally limited to aromatic components. This approach appears to be consistent with the method used by ADEC to develop Method Two groundwater cleanup levels (18 AAC 75, Table C). The POL tank area (LF006) is the only site at which surface water is a potential exposure media. Surface water contamination at the site appears to result from groundwater discharge.

Table 4-4
Organic Carbon Partition Coefficients for Fuels

Fuel Fraction	Koc Organic Carbon Partition Coefficient of Aliphatic Portion (cm^3/g)	Koc Organic Carbon Partition Coefficient of Aromatic Portion (cm^3/g)
DRO (C10-C25)	5.37×10^6	5.01×10^3
RRO (C25-C36)	Not available	2.24×10^5

Note: For definitions, see the Acronyms and Abbreviations section.

4.4 RISK CHARACTERIZATION

Risk characterization is the combination of the results of the exposure assessment and toxicity assessment to yield a quantitative expression of risk. Quantitative estimates are developed for individual chemicals, exposure pathways, and exposure media for each receptor. The risk characterization is used to guide risk management decisions.

Generally, the risk characterization follows the methodology prescribed by ADEC (2005) and the EPA (1989), as modified by more recent information and guidance. The methods are, appropriately, designed to be health-protective and tend to overestimate rather than underestimate risk. The risk results are generally conservative because risk characterization involves multiplication of the conservatisms built into the estimation of EPC, the exposure (intake) estimates, and the toxicity dose-response assessments.

Risk characterization is limited to those site-related chemicals selected as COPCs (Section 2.0).

Up to this point, the term "risk" has been used generically to mean the potential for the occurrence of adverse effects, either cancer or noncancer, to arise from exposure to chemicals. From this point forward, however, "risk" is used to describe the likelihood or probability of the occurrence of cancer. "Noncancer hazard" is used to describe the potential for the occurrence of noncancer effects.

4.4.1 Cancer Risk

The risk from exposure to potential chemical carcinogens is estimated as the probability of an individual developing cancer over a lifetime, and is called the incremental lifetime cancer risk (ILCR). In the low-dose range, which would be expected for most environmental exposures, cancer risk is estimated from the following linear equation (EPA 1989):

$$ILCR = (CDI)(SF) \qquad \textbf{Eq. 4.10}$$

where:

> $ILCR$ = incremental lifetime cancer risk, a unitless expression of the probability of developing cancer, adjusted for background incidence, calculated
> CDI = chronic daily intake, averaged over 70 years (mg/kg-day)
> SF = cancer slope factor (risk per mg/kg-day).

The use of Equation 4.1 assumes that chemical carcinogenesis does not exhibit a threshold and that the dose-response relationship is linear in the low-dose range. Because this equation could generate theoretical cancer risks greater than 1 for high-dose levels, it is considered to be inaccurate at cancer risks greater than 1 E-2. In these cases, cancer risk may be estimated by the one-hit model (EPA 1989):

$$ILCR = 1 - e^{[(CDI)(SF)]} \qquad \textbf{Eq. 4.11}$$

where:

$ILCR$ = incremental lifetime cancer risk, a unitless expression of the probability of developing cancer, adjusted for background incidence, calculated
$e^{[(CDI)(SF)]}$ = the exponential of the risk calculated using Equation 4.1

As a matter of policy, the EPA considers the carcinogenic risk of simultaneous exposure to low doses of different carcinogenic chemicals to be additive, regardless of the chemicals' mechanisms of toxicity or sites (organs of the body) of action (EPA 1986). For example, cancer risk arising from exposure to more than one chemical in a specific medium and pathway is estimated from the following equation:

$$ILCR_p = ILCR_{chem1} + ILCR_{chem2} + \ldots ILCR_i \qquad \textbf{Eq. 4.12}$$

where:

$ILCR_p$ = incremental lifetime cancer risk for more than one chemical in a specific medium and pathway, calculated
$ILCR_{chemi}$ = individual chemical cancer risk for that pathway and medium

Cancer risk for a given receptor across chemicals and across media is summed in the same manner. For risk management purposes, ADEC has established the ILCR goal of 1E-5. However, ILCR estimates between 1E-6 and 1E-4 may be considered acceptable consistent with 40 CFR 300.430. ILCR estimates above 1E-4 are considered to be unacceptable. The ADEC (2005) policy is consistent with the EPA (1990) policy of risk management.

4.4.2 Noncancer Hazards

The noncancer hazards associated with chemicals are evaluated by comparing an exposure level or intake with an RfD. The hazard quotient (HQ), defined as the ratio of intake to RfD, is estimated as (EPA 1989):

$$HQ = \frac{I}{RfD} \qquad \textbf{Eq. 4.13}$$

where:

> HQ = hazard quotient (unitless, calculated)
> I = intake of chemical averaged over subchronic or chronic exposure period (mg/kg-day)
> RfD = reference dose (mg/kg-day)

Chemical noncancer hazards were evaluated using chronic RfD values. This approach is different from the probabilistic approach used to evaluate cancer risks. An HQ of 0.01 does not imply a 1 in 100 chance of an adverse effect, but indicates that the estimated intake is 100 times lower than the RfD. An HQ of unity (1) indicates that the estimated intake equals the RfD. If the HQ is greater than one, there may be concern for potential adverse health effects.

In the case of simultaneous exposure of a receptor to multiple chemicals, or to a given chemical by multiple pathways, a hazard index (HI) is calculated as the sum of the HQs by:

$$HI = HQ_1 + HQ_2 + HQ_i \qquad \textbf{Eq. 4.14}$$

where:

> HI = hazard index (unitless, calculated)
> HQ_i = hazard quotient for the ith chemical, or for the ith pathway

An HI may be calculated across all exposure pathways for a given chemical, across all chemicals for a given exposure pathway, across all chemicals and exposure pathways for a given exposure medium, or across all chemicals, pathways and media to yield the total HI for a given receptor.

HQ or HI values below or equal to the threshold value of one are interpreted to mean that adverse noncancer effects are unlikely. HQ or HI values greater than one are interpreted to mean that there is a likelihood of adverse noncancer effects.

Calculating a total HI as the sum of HQ values is based on the assumption that the potential for noncancer effects is additive. EPA, however, acknowledges that the assumption of additivity is probably appropriate only for chemicals that induce adverse effects by the same mechanism (EPA 1989). Therefore, if the total HI for a receptor exceeds 1, individual HI values may be calculated for each target organ as follows:

$$Total\ HI_a = HI_{p1-a} + HI_{p2-a} + ...HI_{pi-a} \qquad \textbf{Eq. 4.15}$$

where:

$Total\ HI_a$ = total hazard index for target organ "a" (unitless, calculated)
HI_{pi-a} = hazard index for target organ "a" via pathway "i"

4.4.3 Risk Assessment for Lead

Toxicity values are not available for the evaluation of lead. Instead, two common exposure scenarios are evaluated for the risk assessment of lead.

The first scenario estimates the blood lead level (PbB) in children exposed to the environmental media at the site in question, and compares this estimate with the threshold level of 10 µg/dL (micrograms per deciliter). The EPA integrated exposure-uptake biokinetic (IEUBK) blood lead model for young children, developed for residential scenarios, is used to predict PbB for children hypothetically exposed at the site (EPA 1994). The IEUBK is a self-contained DOS-based computer program. Average lead concentrations in the various media are entered into the model; default values provided by the IEUBK are used when site-specific data are not available. Arithmetic mean values, rather than conservative estimates of average, are used because the IEUBK contains a statistical module that addresses individual variation in exposure and physiological parameters. The output is a probability density histogram of predicted PbB. The risk assessment is considered to "pass" if the IEUBK predicts that not more than 5 percent of young children exposed in this manner would experience a mean PbB above the 10 μg/dL threshold.

The second common exposure scenario which is evaluated in this risk assessment examines adult exposures to lead in soil in nonresidential exposure scenarios (EPA 1996). The method focuses on the estimation of PbB in fetuses carried by women exposed to average concentrations of lead in soil (EPA 1999). The method is based on a probability model for PbB in adult women exposed to lead in soil coupled with an estimated constant of proportionality between fetal and maternal PbBs, a geometric mean fetal PbB concentration and empirically determined geometric standard deviation (EPA 1999). The statistical terms used in the method permit an equation to be used to establish an average adult PbB such that a fetus has not more than a 5 percent probability of PbB exceeding 10 μg/dL (EPA 1996). The risk assessment is considered to pass if the average adult PbB does not predict an excess of 5-percent probability that fetal PbB exceed 10 μg/dL (EPA 1994, 1996).

4.5 RISK CHARACTERIZATION RESULTS AND DISCUSSION

ILCR and HQ estimates for each receptor, medium and COPC, including sums across exposure routes for each COPC, are compiled in tables in Appendix G.

Considerable uncertainty is associated with ILCR, HQ, and HI estimates; therefore, EPA recommends that they be rounded to one significant figure for presentation in an RA (EPA 1989). For example, an HI of 1.49E+0 is rounded to 1 and interpreted to mean that the HI does not exceed the threshold level of 1 and that occurrence of adverse noncancer effects is unlikely. An HI of 1.49E+1, for example, is rounded to 15.

COCs are defined as the chemicals that contribute significantly to an ILCR exceeding ADEC's risk goal of 1E-5 or an HI exceeding 1. For this discussion, an individual chemical is considered to contribute significantly to the cancer risk estimate if its ILCR summed across all exposure routes exceeds 1E-6. Similarly, an individual chemical is considered to contribute significantly to the noncancer hazard if its HI summed across all exposure routes exceeds 0.1.

As suggested by EPA, when total HI summed across chemicals and/or media exceeds the threshold limit of 1, consideration is given to possible benefit of segregating HI values by target organ (EPA 1989). Target organ-specific HIs were not developed for this risk assessment.

Total HI and ILCR estimates for each site at Top Camp and Lower Camp are summarized in Tables 4-5 and 4-6, respectively, and discussed below; detailed results are provided in Appendix G. The uncertainties associated with the HI and ILCR estimates are discussed in Section 4.6.

Table 4-5
Summary of Noncancer Hazards and Cancer Risks for Top Camp Sites

Type	Noncarcinogenic Effects	Carcinogenic Effects
WP003 Surface Soil		
Ingestion	8.6E-03	1.8E-08
Dermal	NA	2.1E-08
Inhalation	2.7E-07	2.8E-13
Total HI and ILCR	8E-03	4E-08
OT001 Surface Soil – Doorway Samples		
Ingestion	3.6E-03	1.5E-07
Dermal	2.7E-04	1.9E-07
Inhalation	1.7E-7	5.7E-12
Total HI and ILCR	4E-03	3E-07
OT001 Surface Soil UST and Antennae		
Ingestion	4.1E-03	1.7E-07
Dermal	1.8E-06	2.0E-07
Inhalation	1.1E-7	2.7E-12
Total HI and ILCR	4E-03	4E-07

<u>Note:</u> For definitions, see the Acronyms and Abbreviations section.

Table 4-6
Summary of Noncancer Hazards and Cancer Risks for Lower Camp Sites

Type	Noncarcinogenic Effects	Carcinogenic Effects
LF006 Surface Soil		
Ingestion	3.7E-03	2.6E-05
Dermal	4.4E-04	3.0E-05
Inhalation	1.5E-08	5.2E-10
Total HI and ILCR	4E-03	6E-05
LF006 Surface Water		
Ingestion	4.4E-06	1.2E-09
Dermal	4 0E-07	2.4E-10
Total HI and ILCR	5E-06	1E-09
LF006 Totals		
Cumulative HI and ILCR	4E-03	6E-05
Electronic Debris Area at LF006 Surface Soil		
Ingestion	1.9E-04	1.6E-08
Dermal	2.5E-04	2.0E-08
Inhalation	9.1E-09	5.9E-13
Total HI and ILCR	4E-08	4E-08
SS007 Surface Soil		
Ingestion	3.0E-03	4.5E-08
Dermal	4.1E-08	5.2E-08
Inhalation	7.7E-08	7.1E-13
Total HI and ILCR	3E-03	1E-07
SS010 Surface Soil		
Ingestion	5.2E-03	9.9E-09
Dermal	NA	1.2E-08
Inhalation	1.3E-07[7]	1.6E-13A
Total HI and ILCR	5E-03	2E-08

__Note:__ For definitions, see the Acronyms and Abbreviations section.

Risk to recreational receptors was evaluated for exposure only to surface soil at the Top Camp sites. The total HI estimate for the recreational receptor was less than 1 for all sites evaluated. The total ILCR estimates for the recreational receptor were 4E-8 for WP003 and 3E-07 for

OT001. Total ILCR estimates for the recreational receptor were below the threshold of 1E-5 and so there were no COCs for the ILCR. The HI is less than the threshold for noncancer effects and so there were no COCs for the HI.

The recreational receptor was evaluated for exposure to surface soil and surface water at the Lower Camp Sites. For sites LF006 and SS007, cancer risk and hazard estimates were not calculated for groundwater due to lack of a plausible exposure route for the recreational receptor. The Groundwater Use Determination for site SS007 can be found in Appendix M of the *Driftwood Bay Site Characterization Report* (USAF 2009b). DRO and RRO UCLs for LF006 are dominated by the results from DBLF006-SP04-WG (DRO 0.36 mg/L, RRO 0.99 mg/L). As evidenced by the chromatogram attached in Appendix L, the organics measured do not appear to be due to petroleum compounds. The total HI estimate for the recreational receptor was less than 1 for all sites evaluated. The total ILCR estimates for the recreational receptor were 6E-5 for LF006, 6E-08 for the EDA, and 6E-08 for SS007. There were no carcinogenic COPCs for SS010. The HI is less than the threshold for noncancer effects and there were no COCs for the HI. Total ILCR estimates for the recreational receptor were below 1E-5 for all sites except LF006. The carcinogenic COCs for LF006 were all PAHs from samples collected from a layer of ash.

The BBA at Top Camp and the EDA and LF006 at Lower Camp were contaminated with lead associated with batteries found at the sites. The ALM was used to evaluate the potential for noncancer effects, specifically an elevated PbB associated with an increase in neurological impairment. Predicted PbB for adult recreational receptors at the BBA, EDA, and LF006 were 2.3, 30.5, and 31.9 µg/dL, respectively. The results of the ALM suggest potential exposures to lead at the BBA do not pose an unacceptable hazard to adult recreational receptors, including pregnant women. However, potential exposure to lead at the EDA and LF006 may pose an unacceptable health hazard to adult recreational receptors including pregnant women. This assumes that 100 percent of exposure is confined to the 50-foot by 30-foot site. Uncertainties associated with the use of the ALM are addressed in Section 4.6.4.

4.6 UNCERTAINTY ANALYSIS

The primary objective of this risk assessment is to characterize and quantify potential human health risks; however, these risks are estimated using incomplete and imperfect information that introduces uncertainties at various stages of the risk assessment process. Uncertainties associated with earlier stages of the risk assessment become magnified when they are combined with other uncertainties in the latter stages of the assessment. Reliance on a simplified numerical presentation of dose rate and risk without consideration of uncertainties, limitations, and assumptions inherent in their derivation can be misleading. For example, the calculated ILCR for scenario "A" may be 5E-5 (within the risk management range) and that of scenario "B" may be 5E-4 (exceeding the risk management range). However, if the uncertainties associated with scenario "B" span, for instance, orders of magnitude and the ILCR is regarded as biased high, it is likely that scenario "A" actually presents a higher risk of developing cancer.

The chief goal of this analysis is to evaluate these uncertainties and present them in context of their potential impact on the interpretation of the risk assessment results and the types of environmental management decisions that may be based on these results. The uncertainty analysis does not exhaustively describe all potential uncertainties but presents those that have the largest implications for the interpretation of the risk assessment results. This analysis reviewed the types and, as applicable, the magnitude of the uncertainties at each stage of the risk assessment. Although the risk assessment includes generic uncertainties that are common to the state of human health risk assessment practice (e.g., additivity of health effects in the risk characterization), overall, the uncertainty analysis focused on a set of uncertainties unique to specific sites.

Various sources of uncertainty are inherent in the human risk assessment. Many of the uncertainties involved required the use of more conservative assumptions to estimate risks and hence are likely to result in an overestimation of potential risks. However, other uncertainties can result in the underestimation of risks. Key uncertainties include:

- Data uncertainties
- Uncertainty associated with toxicity values
- Uncertainty associated with future land use and institutional controls
- Uncertainty of human risk associated with lead ECO-BOND application
- DRO and RRO uncertainty

4.6.1 Data Uncertainty

A degree of uncertainty is inherent to all analytical sample data. Uncertainty may be related to such things as sampling methodology, laboratory analyses, or analytical results. For instance, data that did not meet all project data quality objectives were qualified using the flags defined in the project QAPP, Appendix D to the Site Characterization Work Plan (USAF 2007b). Since all data were retained for the COPC calculations in this risk assessment, data qualifiers may add varying degrees of uncertainty to the individual data. For example, "JTE" qualifiers indicate that the sample cooler was received with a temperature outside of the acceptable range, which is typically too warm. Therefore, a "JTE" flag on a benzene result may be associated with a greater degree of uncertainty than a "JTE" qualified PCB result.

As discussed in Section 3.1.2, sample results for volatile analyses that were impacted by low surrogate recoveries were qualified "VX". These results were used to evaluate the representativeness of the site data, but they were not used to calculate risks. Because the volatile results that were qualified "VX" did not have acceptable surrogate recoveries due to human error in the laboratory, the uncertainty associated with any individual result cannot be measured. Thus, by excluding the "VX" qualified data from consideration, the uncertainty associated with the volatile analytical data set was reduced.

For field duplicates, the higher of the two duplicate values was used in the risk calculations; this should result in an overestimation of risk. For instance, DRO was detected at 1,000 mg/kg in primary sample DBSS010-SU08-SO, but it was also detected at 5,300 mg/kg in the duplicate sample, and so this higher value was used in the risk calculations.

4.6.2 Uncertainty Associated with Toxicity Values

Considerable uncertainty is associated with the qualitative (hazard assessment) and quantitative (dose-response) evaluations of a toxicity assessment. Hazard assessment of carcinogenicity is evaluated as a weight-of-evidence determination (EPA 1986). Positive animal cancer test data suggest that humans also contain tissue(s) that may manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue response in humans. In the hazard assessment of noncancer effects, positive animal data suggest the nature of the effects (i.e., the target tissues and type of effects) anticipated in humans (EPA 1989).

There are many sources of uncertainty in the dose-response evaluation for cancer (i.e., computation of an SF or unit risk) and noncancer effects (i.e., computation of an RfD). First, there is uncertainty regarding interspecies (animal-to-human) extrapolation which, in the absence of quantitative pharmacokinetic, dosimetric, or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Second, there is uncertainty regarding intraspecies or individual variation. Most toxicity experiments are performed with animals that are very similar in age and genotype, so that intragroup biological variation is minimal, but the human population of concern may reflect wide heterogeneity including unusual sensitivity to the COPC. Even toxicity data from human occupational exposure reflect a bias because only those individuals sufficiently healthy to attend work regularly and those not unusually sensitive to the COPC are likely to be occupationally exposed. Third, uncertainty arises from expansion from short-term to lifetime exposure such as the construction worker and child on-site resident. Additional uncertainty arises from the potential for children to be more sensitive to the COPC than adults. Finally, the quality of the study from which the quantitative estimate is derived and gaps in the database can contribute to even more uncertainty. For cancer studies, the uncertainty associated with some quality factors (e.g., study group size) is expressed within the 95 percent upper-bound of the SF.

Another source of uncertainty regarding quantitative risk estimation for carcinogenicity is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in most quantitative estimates of human cancer risk from animal data (PAHs, PCBs), is based on a non-threshold assumption of carcinogenesis. An impressive body of evidence, however, suggests that epigenetic carcinogens as well as many genotoxic carcinogens, have a threshold below which they are noncarcinogenic (Gold et al. 1992); therefore, the use of the linearized multistage model is extremely conservative for chemicals that exhibit a threshold for carcinogenicity.

A further source of uncertainty for noncancer effects arises from use of an effect level in the estimation of an RfD or RfC, because this estimation is predicated on the assumption of a threshold below which adverse effects are not expected. Therefore, an additional uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises from estimating RfD values for chronic exposure from less-than-chronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the less-than-chronic study.

Uncertainty also arises from the presence of chemicals (e.g., lead) for which there are no EPA-approved toxicity values, and for which quantitative risk characterization is not possible. The effects of exposure to lead are well understood and PbB is recognized as a valid predictor of the potential for effects.

In summary, the EPA methodology for both cancer and noncancer toxicity evaluation is intentionally designed to be protective. However, the extent to which toxicity values may overestimate toxic potency is not clear, and it is possible that the toxicity values for some compounds may not be adequately protective.

4.6.3 Uncertainty Associated with Conservatism in Exposure Assumptions

The exposure scenario was determined based on community surveys performed in the area. Results from these surveys indicated that people rarely visit Driftwood Bay and if they do, very little time is spent at the site. An exposure scenario of 12 days intermittent for Top

Camp and 14 days continuous at Lower Camp was used to assess risk at Driftwood Bay. The assessment scenarios are more conservative than interviews with the general public suggest. Under the most reasonably anticipated future scenario, recreational use is the most likely use of the land if the land is utilized at all. Historically, the majority of recent activities have been in support of environmental investigations at the site. Due to the extreme weather, the high energy beach, the small runway, lack of road system, debris filled road to Top Camp, and rough seas to access Driftwood Bay; local people are more likely to visit other places on Unalaska Island for recreating. Additionally, the assessment of cancer risk and noncancer hazards have an inherent assumption that the receptor spends 100 percent of his or her time at the individual site. In reality, while a receptor may inadvertently set up a camp site on any given area, it most likely spends the majority of time away from its camp, in other areas of the valley (i.e., not always a continued site). A receptor's setting up camp on the same contaminated site year after year is highly unlikely. Therefore, for the sites evaluated in this risk assessment, the potential risks and hazards are likely to be overestimated.

4.6.4 Uncertainty Associated with Lead and ECO-BOND Application

Estimated risk associated with lead contamination at the BBA may be higher than actual risk due to the use of a remedial treatment technology at the site that is intended to reduce the leaching of metals from soil. During the 2007 field season, a proprietary technology called ECO-BOND was applied to soils at the BBA. This product is a phosphate-based chemical stabilizer typically applied to immobilize lead or other metals through the formation of insoluble metal-phosphate compounds, such as fluoropyromorphite ($Pb_5(PO_4)_3F$) and hydroxypyromorphite ($Pb_3(PO_4)_3OH$). Analytical results indicate that ECO-BOND is capable of rendering soil non-hazardous by the Resource Conservation and Recovery Act standards.

After the ECO-BOND was applied, it was determined that the quantity of contaminated soil on site was too great to conduct an interim removal action. Total lead results from 2007 samples were used to calculate risks at this site. Since lead-phosphate compounds tend to have low solubilities and have been shown to retain lead over a range of pH conditions, it is likely that the ECO-BOND left onsite has reduced the bioavailability of lead present at the site. As a result, the level of risk calculated for lead contamination at the BBA may be biased high.

The ALM is supported by a considerable body of empirical data, and is considered to be the best validated of the various models available for the evaluation of potential exposures to lead. However, as with the evaluation of cancer risks and noncancer hazards associated with all other COPCs, the model has the inherent assumption that the receptor spends 100 percent of his or her time on the site, which is not anticipated especially due to the small site size (less than 1/4 acre). Therefore, the potential for elevated blood lead levels is likely overestimated.

4.6.5 Diesel-Range Organics and Residual-Range Organics Uncertainty

Noncancer hazards associated with DRO and RRO were evaluated according to the *Guidance for Cleanup of Petroleum Contaminated Sites* (ADEC 2000), whereby toxicity values for each petroleum fraction were used. ADEC recognizes four petroleum fractions for DRO and RRO, two aliphatic and two aromatic fractions. Because fuel constituents often vary, the sum of the default composition of the aliphatic and aromatic fractions was set at 120 percent of the total concentration. This approach was used for evaluating soil and may overestimate noncancer hazards. Based on the very low solubility of the aliphatic fraction, DRO and RRO in surface water were assumed to be composed solely of aromatic constituents.

Because the compounds that makeup DRO and RRO degrade at differing rates, assessing risk based on these lump parameters introduces a variety of uncertainties. PAHs are risk drivers for DRO and RRO. PAHs are generally not volatile, are sparingly soluble in water, and can be resistant to biodegradation. Thus, the ratio of PAHs to DRO and RRO may tend to increase over time, and assessing noncancer hazards of DRO and RRO based on PAHs can underestimate risk.

4.6.6 Uncertainty of Cancer Risk Associated with Diesel-Range Organics and Residual-Range Organics

Cancer risks associated with DRO and RRO were not evaluated quantitatively because toxicity values are not available for these constituents. However DRO and RRO were evaluated qualitatively by considering exposure and toxicity of indicator constituents, known to be closely associated with the occurrence of DRO and RRO.

The indicator constituents selected for DRO and RRO include the PAHs. Of the PAHs that are human health COPCs, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3,c,d)pyrene are considered probable human carcinogens (B2). Qualitative assessment of the carcinogenic risks associated with DRO and RRO is presented below for each of the sites and focuses on these indicator contaminants.

- **SS010.** DRO and toluene are COPCs for the former Pump House. Although PAHs were detected in the soil sample with the highest DRO and RRO concentrations, the cancer risk associated with this sample did not exceed 1 in 100,000.
- **SS007.** PAHs were analyzed in conjunction with DRO and RRO at the former tank farm and benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, ethylbenzene, and xylene were retained as human health COPCs for the site. Although PAHs were detected in the soil sample with the highest DRO and RRO, the cancer risk associated with this sample did not exceed 1 in 100,000.
- **WP003.** PAHs were analyzed in conjunction with DRO and RRO at the waste outfall; benzo(a)pyrene, dibenzo(a,h)anthracene, and 1,2,4-trimethylbenzene were retained as human health COPCs for the site. Although PAHs were detected in the soil sample with the highest DRO and RRO concentrations at the waste outfall, the cancer risk associated with this sample did not exceed 1 in 100,000.
- **OT001 Antennas and USTs.** PAHs were analyzed in conjunction with DRO and RRO at the UST and Antennae; benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene and naphthalene were retained as human health COPCs for the site. Although PAHs were detected in the soil sample with the highest DRO and RRO concentrations at the waste outfall, the cancer risk associated with this sample did not exceed 1 in 100,000.
- **LF006.** PAHs were analyzed in conjunction with DRO and RRO. Several PAHs were retained as human health COPCs for the site. The highest concentrations of PAHs were associated with an ash sample (DBLF006-TP01C-SO). The available data indicate that these PAHs are not associated with the release of a hazardous substance but were produced by burning wood. The toxicity data used for PAHs assume that the PAHs are from petroleum hydrocarbons; thus, the calculated risk is believed to be biased high. The

highest concentrations of DRO and RRO detected in soil at LF006 were associated with sample DBLF006-TP01A-SO, which had significantly lower concentrations of PAHs. Thus, the sampling locations selected for PAHs introduced conservative bias.

4.6.7 Uncertainty of Cancer Risk at LF006 Associated with Ash Sample

Most of the PAHs found at site LF006 are associated with one ash sample (DBLF006-TP01C-SO). Excluding the ash sample results in a significant change in the carcinogenic effects at the site. Results for the single ash sample indicate elevated concentrations of PAHs. This sample was collected from 1 foot bgs and represents a de minimus amount of PAH-containing ash present within the body of the landfill. The ash does not extend to the ground surface; therefore, exposure is mitigated by the soil cover.

Table 4-7 presents calculated cancer risk both with and without inclusion of the results for the ash sample. As with the sampling strategy used at landfill sites across Alaska, waste within the LF006 landfill has not been fully characterized with regards to the potential risk associated with direct contact to the waste. The data presented in Table 4-7 can be interpreted as follows:

- Direct exposure to the waste within the landfill could cause risk at levels above ADEC's target level.
- Incidental exposure to the site (i.e., activities short of digging into the landfill) will not cause risk at levels above ADEC's target level.
- Contamination is not migrating from the landfill.

Without the ash sample all of the carcinogenic risk effects are below the ADEC cancer risk goal of 1.0E-05.

Table 4-7
Summary of Cancer Risks for Lower Camp Sites with and without Ash Sample

Type	Carcinogenic Effects without Ash Sample	Carcinogenic Effects with Ash Sample
LF006 Surface Soil		
Ingestion	3.9E-0.7	2.6E-05
Dermal	1.8E-0.7	3.0E-05
Inhalation	1.2E-10	5.2E-10
Total HI and ILCR	5.6E-07	6E-05
LF006 Surface Water		
Ingestion	4.4E-06	1.2E-09
Dermal	4.0E-07	2.4E-10
Total HI and ILCR	5E-06	1E-09
LF006 Totals		
Cumulative HI and ILCR	6E-06	6E-05

Note: For definitions, see the Acronyms and Abbreviations section.

the rationale for the elimination of all ecological receptors for the Top Camp sites based on the decision statements for Scoping Factor 3: Habitat (ADEC 2006).

Conditions at Top Camp are substantially different from Lower Camp. Temperatures throughout the year are substantially lower. High winds predominate. As a result, much of the area is barren talus slopes. At slightly higher elevations and in depressions, snow cover may last year round.

Remains of the Former Composite Building

Overall snow accumulation rates are not abnormally high, but strong wind redeposition of snow into topographic lows can create snowpack far greater than the 50-inch average. The winter of 2006-2007 deposited a deep snowpack that persisted at Top Camp throughout the 2007 summer season. Snow depth at a ravine just east of Top Camp measured approximately 10 feet deep in July.

Tundra vegetation typical of the Aleutian Islands is present at Lower Camp. Top Camp is an alpine zone with minimal vegetative cover that consists mainly of lichens, mosses, and some tundra grasses. The majority of the surface at Top Camp is sparsely vegetated mixed with exposed gravel, sand, and some silt in barren areas. The concrete slabs of several structures are still present at the site. No surface water, freshwater sediments, or marine sediments are present at Top Camp.

5.0 ECOLOGICAL RISK ASSESSMENT

This section identifies the potentially exposed ecological receptors at the Driftwood Bay RRS based on the *User's Guide for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions* (ADEC 1999). Preliminary problem formulation and method descriptions for the analyses for Top Camp, Lower Camp, and the Beach Area have been prepared in accordance with the *Risk Assessment Procedures Manual, Draft* (ADEC 2005).

5.1 PRELIMINARY PROBLEM FORMULATION AND ANALYSIS PHASE

The Risk Assessment Procedures Manual Ecological Scientific/Management Decision Points #1 and #2 (ADEC 2005) are addressed in the risk assessment. Sensitive environments were not identified, but potentially complete exposure pathways have been identified for all of the Driftwood Bay RRS sites. Therefore, progression with the ecological risk assessment proceeded according to the guidance in the *Risk Assessment Procedures Manual* (ADEC 2005).

5.1.1 Ecological Scoping Results for Elimination of Ecological Receptors at Lower Camp

At Lower Camp, annual temperatures generally range from 27 to 60 degrees Fahrenheit (°F). The average summer temperature between June and August is 50 °F, and the average winter temperature between November and February is 34 °F. Average precipitation is 58 inches; snowfall can reach up to 50 inches in the winter months (USAF 2002). Although soil temperatures remain too cold for the germination of tree seeds, this climate allows for a diverse vegetative community to flourish at Lower Camp.

5.1.2 Ecological Scoping Results for Elimination of Ecological Receptors at Top Camp

Although there is potential for a complete exposure pathway for ecological receptors at Top Camp, this area was eliminated from consideration based on the lack of habitat present and the absence of any potential receptors in the area during the field effort. This section presents

Site conditions at Top Camp (16 June 2007)

An evaluation of the Top Camp sites relative to the four decision statements for *Scoping Factor 3: Habitat* is as follows:

1. Valued Species - Does habitat that could be affected by the contamination support valued species (i.e., species that are regulated, used for subsistence, have ceremonial importance, have commercial value, or provide recreational opportunity)?

   No. There are no known regulated species at Top Camp. The majority of the surface at Top Camp is sparsely vegetated mixed with gravels, sand, and some silts exposed in barren areas. The concrete slabs of several structures are still present at the site. There is insufficient vegetation to provide cover or forage for terrestrial mammal receptors including the arctic ground squirrel, which are common at lower camp. The arctic ground squirrel is believed to be a human-introduced species on Unalaska Island.

2. Critical Habitats and Anadromous Streams - Is a critical habitat or anadromous stream in an area that could be affected by the contamination?

   No. There are no surface water, freshwater sediments, or marine sediments present at Top Camp.

3. Other Important Habitat – Is there any other habitat that is important to the region that could be affected by the contamination?

   No. The sparse vegetation at Top Camp does not provide a habitat for a diverse community of species nor is the available habitat distinct from the surrounding area.

Limited vegetation and exposed rocky surface

4. Parks, Preserves, and Wildlife Refuges – Is the contamination in a park, preserve, or wildlife refuge?

   No. Driftwood Bay is not within the boundaries of any state of national park, preserve, or wildlife refuge. The land is held by USAF under a Public Land Order. However, the surrounding land is part of the Alaska Martine National Wildlife Refuge. Contamination at Top Camp (primarily PCBs and lead) is generally immobile in the environment. Thus, available data indicate that contaminant migration to refuge lands will not occur. Review of the purposes of the refuge (http://alaska.fws.gov/nwr/akmar/whoweare/purposes.htm) indicates that the contamination will not adversely impact these purposes.

Based on the site conditions and the ecological scoping factors, ecological receptors may be eliminated from the Top Camp sites.

5.1.3 Identification of Potential Ecological Indicator Receptors

This section provides the rationale used to select indicator receptors for the lower camp sites. A variety of terrestrial, aquatic, and semiaquatic wildlife species are known or expected to live in the vicinity of the Low Camp areas of Driftwood Bay RRS. Evaluating risk for each and every wildlife species potentially present at a site is neither feasible nor necessary. Using EPA criteria, specific species were selected as "representative and protective" of other species within each trophic level. A trophic level is a functional classification of taxa within a community that is based on feeding relationships (EPA 1997).

As a first step in the selection process, default assessment endpoints and primary indicator species for the Aleutian Islands Ecoregion were identified for each trophic level (Appendix D). An effort was made to select a representative measurement receptor for each major habitat type (i.e., terrestrial and aquatic) as well as a measurement receptor that would be most protective for each trophic level.

The following criteria were considered in identifying the selected measurement receptors:

- Ecological relevance
- Exposure potential
- Sensitivity
- Social or economic importance
- Availability of natural history information

According to EPA, the most sensitive organisms should be selected as receptor species (EPA 1997). Such species include exclusively herbivorous species (e.g., arctic ground squirrel), omnivores that have relatively intense contact with soil, sediment, or surface water during feeding and include invertebrates in the diet (e.g., masked shrew and least sandpiper), and a carnivore that ingests soil, invertebrates, and small mammals in a limited home range (e.g., northern shrike).

Representative measurement receptors were selected for different trophic levels for both terrestrial, aquatic, and semiaquatic habitats.

Terrestrial Habitat

- Trophic Level 0 Terrestrial Plants – Generic. No specific measurement receptor selected. Terrestrial plants will be evaluated as a group.
- Trophic Level 1 Terrestrial Invertebrates – Generic. No individual measurement receptor selected. Terrestrial invertebrates will be evaluated as a group.
- Trophic Level 2 Terrestrial Herbivore – Arctic Ground Squirrel. Arctic ground squirrel was selected as the assessment endpoint for trophic level 2 terrestrial herbivores because of its high potential for exposure to soil, burrowing habit, and small home range compared to other trophic-level-2 terrestrial herbivores (i.e., willow ptarmigan). Consequently, the selection of the Arctic ground squirrel as an assessment measure is appropriate to evaluate other trophic-level-2 terrestrial receptors.
- Trophic Level 3 Terrestrial Insectivore – Masked Shrew. Masked shrew was selected as the assessment endpoint for trophic level 3 terrestrial omnivores because of its high potential for exposure to soil, burrowing habit, high metabolism relative to body weight, and small home range compared to other trophic-level-3 terrestrial omnivores (i.e., Lapland longspur). Consequently, the selection of the masked shrew as an assessment measure is appropriate to evaluate other trophic-level-3 terrestrial receptors.
- Trophic Level 4 Terrestrial Carnivore – Northern Shrike. Northern shrike was selected as the assessment endpoint for trophic-level-4 terrestrial carnivores because of its low body weight and relatively small home range compared to other trophic-level-4 terrestrial carnivores (i.e., arctic fox). Consequently, the use of the northern shrike as an assessment measure is considered protective of other trophic-level-4 terrestrial receptors.

Aquatic and Semiaquatic Habitat

- Trophic Level 1 Aquatic Invertebrates – Generic. No individual measurement receptor selected. Aquatic invertebrates will be evaluated as a group.
- Trophic Level 3 Semiaquatic Omnivore – Least Sandpiper. Least sandpiper was selected as the assessment endpoint for trophic-level-3 semiaquatic omnivores because it has a high potential for exposure, is common in both freshwater and marine habitats, and has relatively small body size compared to other trophic-level-3 semiaquatic omnivores (i.e., American dipper, common snipe). Consequently, the least sandpiper is protective of other trophic-level-3 semiaquatic receptors.
- Trophic Level 3 Aquatic Omnivore – Salmon Species. Salmon were selected as the assessment endpoint for trophic-level-3 aquatic omnivores because they have a high potential for exposure and a life-cycle that spans both freshwater and marine habitats. The critical life-stages for this assessment are eggs and fry, which may be found in the creeks in Driftwood Bay Valley (Johnson and Weiss 2006).

- Trophic Level 4 Aquatic Carnivore – Sea Otter. The Sea Otter was selected as the assessment endpoint for trophic level 4 aquatic carnivore because it is listed as a threatened species in Alaska by USFWS.

The feeding guilds (herbivores, omnivores, and carnivores) and representative species listed above were selected for the following reasons:

- They are or may be present in the study area.
- They represent herbivorous, omnivorous, and carnivorous feeding habits representative of other species in these types of habitat.
- They are among those recommended as default assessment endpoints and indicator species for the Aleutian Islands Ecoregion (ADEC 1999).

5.1.4 Selection of Assessment and Measurement Endpoints

The following assessment endpoints for this ecological risk assessment will be any adverse effects on ecological receptors (plant and animal populations and communities, habitats, and sensitive environments). Adverse effects on populations can be inferred from measures related to impaired reproduction, growth, and survival. Adverse effects on communities can be inferred from changes in community structure and function. Adverse effects on habitats can be inferred from changes in composition and characteristics that reduce a habitat's ability to support plant and animal populations and communities.

- Assessment Endpoint 1: Protection of populations of terrestrial plants (trophic level 0) and soil invertebrates (trophic level 1)
- Measurement Endpoint 1: Comparison of soil concentrations with soil benchmarks for terrestrial plants and soil invertebrates
- Assessment Endpoint 2: Protection of populations of freshwater aquatic invertebrates (trophic level 1)
- Measurement Endpoint 2: Comparison of surface water and sediment concentrations with surface water and sediment benchmarks for the aquatic invertebrates
- Assessment Endpoint 3: Protection of populations of terrestrial herbivorous mammals (trophic level 2), represented by the arctic ground squirrel
- Measurement Endpoint 3: Comparison of estimated exposure dose (due to ingestion of soil, surface water, and food) with a toxicity reference value (TRV), using data for the arctic ground squirrel to represent herbivorous mammals

- Assessment Endpoint 4: Protection of populations of terrestrial insectivorous mammals (trophic level 3), represented by the masked shrew
- Measurement Endpoint 4: Comparison of estimated exposure dose (due to ingestion of soil, surface water, and food) with a TRV, using data for the masked shrew to represent insectivorous mammals
- Assessment Endpoint 5: Protection of populations of terrestrial carnivorous birds (trophic level 4), represented by the northern shrike
- Measurement Endpoint 5: Comparison of estimated exposure dose (due to ingestion of soil, surface water, and food) with a TRV, using data for the northern shrike to represent terrestrial carnivorous birds
- Assessment Endpoint 6: Protection of populations of semiaquatic omnivorous birds (trophic level 3), represented by the least sandpiper
- Measurement Endpoint 6: Comparison of estimated exposure dose (due to ingestion of sediment, surface water, and food) with a TRV, using data for the least sandpiper to represent semiaquatic omnivorous birds
- Assessment Endpoint 7: Protection of aquatic omnivorous fish (trophic level 3), represented by the salmon.
- Measurement Endpoint 7: Comparison of surface water concentrations with surface water benchmarks. Special emphasis will be placed on benchmarks derived from studies on the fathead minnow (*Pimephales promelas*).
- Assessment Endpoint 8: Protection of populations of aquatic carnivores (trophic level 4), represented by the sea otter.
- Measurement Endpoint 8: Comparison of estimated exposure dose (due to ingestion of sediment, surface water, and food) with a TRV, using data for the sea otter to represent aquatic carnivores.

5.1.5 Indicator Species

Arctic Ground Squirrel (*Citellus parryi*)

The arctic ground squirrel is described as having a red, furry face and sides, with white fur around its eyes. It has strong front paws that are well adapted for digging and burrowing. Its range includes Alaska, Yukon Territory, northern British Columbia, and the mainland of Northwest Territory. Its habitat includes alpine and arctic tundra in bushy meadows, riverbanks, lakeshores, and sandbanks. In the summer, arctic ground squirrels begin to store leaves, seeds, and grasses in their burrows, then hibernate during the winter (for up to eight months, generally from September through April), and use this store of food until spring foliation. Arctic ground squirrels mate in May; the female will have between 5 and 10 babies, which are born blind and hairless in late June. The babies begin to grow hair after about 8 days, and their eyes open after about 20 days. They begin to leave the burrow after their eyes open and are fully weaned by September, when they leave their mother to find or make a burrow of their own. Arctic ground squirrels live in colonies of hundreds. An arctic ground squirrel colony is made up of burrows that are dug about 3 feet bgs. These burrows are connected with a series of tunnels where, in general, they will stay on rainy and cloudy days. Arctic ground squirrels are usually active in the evenings. On rainy and cloudy days, they will stay in their burrows (Yukon Department of Renewable Resources 2003).

The arctic ground squirrel is primarily herbivorous. Seeds, leaves, flowers, and berries make up the greatest proportion of its diet. Mushrooms and freshly killed animals (including other ground squirrels) are also occasionally consumed; however, these foods are expected to compose less than 5 percent of the arctic ground squirrel's diet. For purposes of this evaluation, 100 percent of the arctic ground squirrel's diet was assumed to consist of plant material. Although non-seed plant material provides a significant proportion of daily water requirements, the arctic ground squirrel is assumed to ingest water. Due to its habit of burrowing, this species will also be assumed to have incidental ingestion of soil. The exposure dose to the arctic ground squirrel was estimated from the following equation:

$$HD_T = [(PC \times IR) + (SC \times IR_S) + (WC \times IR_W)] \times AUF / BW$$

Where:

HD_T	=	estimated dose to terrestrial herbivores via the food chain (mg/kg-day)
PC	=	concentration of COPEC in plant material (mg/g)
P_{plant}	=	proportion of ingestion composed of plants (unitless)
IR	=	daily ingestion rate of food item (g/day)
SC	=	concentration of COPEC in soil (mg/g)
IR_S	=	ingestion rate of soil (g/day)
WC	=	concentration of COPEC in water (mg/L)
IR_W	=	ingestion rate of water (L/day)
AUF	=	area use factor (unitless ratio of exposure area to home range)
BW	=	body weight (kg)

Masked Shrew (*Sorex cinereus*)

The masked shrew is primarily insectivorous. Analysis of stomach contents indicate that insects, earthworms, slugs, and snails make up most of the shrew's diet (Hamilton 1941, Martin et al. 1951, Whitaker and Ferraro 1963). Plants, fungi, millipedes, centipedes, arachnids, and small mammals are also consumed; however, these foods are expected to compose less than 5 percent of the shrew's diet. For purposes of this evaluation, 100 percent of the masked shrew's diet was assumed to consist of invertebrates. The shrew must consume additional water outside of its diet to compensate for its high evaporative water loss. Due to its habit of living in direct contact with soils during foraging, resting, nesting, and movement, this species was assumed to have incidental ingestion of soil (Alaska Department of Fish & Game [ADFG] 1994a). The exposure dose for the shrew was estimated from the following equation:

$$ID_T = [(IC \times IR) + (SC \times IR_S) + (WC \times IR_W)] \times AUF / BW$$

Where:

ID_T = estimated dose for terrestrial insectivores via the food chain (mg/kg/day)
IC = concentration of COPEC in invertebrates (mg/g)
P_{inv} = proportion of ingestion composed invertebrates (unitless)
IR = ingestion rate of food item (g/day)
SC = concentration of COPEC in soil (mg/g)
IR_S = ingestion rate of soil (g/day)
WC = concentration of COPEC in water (mg/L)
IR_W = ingestion rate of water (L/day)
AUF = area use factor (unitless ratio of exposure area to home range)
BW = body weight (kg)

Northern Shrike (*Lanius excubitor*)

The northern shrike is a robin-sized bird with a pale gray backside, white underside, and bold black mask ending at its bill. Faint barring is present on its underparts. Its tail is black with white edges, and it possesses a stout, hooked bill. The immature bird is browner in coloration than the adult. Its habitat includes open woodlands and brushy swamps in summer and open grasslands with short vegetation in winter. The northern shrike breeds in Alaska, across northern Canada to Labrador, and south to northern British Columbia (Degen, A. A. et al

1992). It winters irregularly across northern tier of states south to northern California, Kansas, and Pennsylvania (Atkinson, E. C. 1993). It's clutch usually includes four to six pale gray eggs, with dark gray and brown spots. Its nest consists of a large mass of twigs, lichens, moss, and feathers, usually in a dense conifer.

Shrikes feed almost exclusively on animal life (both vertebrate and invertebrate) (Martin et al. 1951). Especially prominent in their diet are large insects such as grasshoppers, beetles, caterpillars, and wasps; small rodents and birds are also consumed. Therefore, 50 percent of the northern shrike's diet was assumed to be from vertebrates and 50 percent from invertebrates (Martin et al. 1951). It attacks prey from an elevated perch by hawking or hovering, then diving and pouncing. Due to its feeding habits, the northern shrike was assumed to have incidental ingestion of soil; the shrike was assumed to consume water to meet its daily requirements (Beyer, W. N. et al 1994). The exposure dose to the northern shrike was estimated from the following equation:

$$CD_T = [(IC \times P_{inv} \times IR) + (VC \times P_{vert} \times IR) + (SC \times IR_S) + (WC \times IR_W)] \times AUF / BW$$

Where:

CD_T	=	estimated dose to terrestrial carnivores via the food chain (mg/kg/day)
IC	=	concentration of COPEC in invertebrates (mg/g)
P_{inv}	=	proportion of ingestion composed of invertebrates (unitless)
IR	=	ingestion rate of food item (g/day)
VC	=	concentration of COPEC in vertebrates (mg/g)
P_{vert}	=	proportion of ingestion composed of food item (vert = vertebrate)
SC	=	concentration of COPEC in soil (mg/g)
IR_S	=	ingestion rate of soil (g/day)
WC	=	concentration of COPEC in water (mg/L)
IR_W	=	ingestion rate of water (L/day)
AUF	=	area use factor (unitless ratio of exposure area to home range)
BW	=	body weight (kg)

Least Sandpiper (*Calidris minutilla*)

The least sandpiper is primarily insectivorous. It feeds on subterranean and aquatic fly larvae (especially crane flies and midges) and a variety of arthropods. Sandpipers may also feed on small clams, crustaceans, and other marine invertebrates (ADFG 1994b). For purposes of this evaluation, 100 percent of the least sandpiper's diet was assumed to be aquatic invertebrate material with an assumed incidental ingestion of sediment. In addition, the least sandpiper was assumed to consume water to meet its daily requirements. The exposure dose for the least sandpiper was estimated from the following equation:

$$ID_A = [(IC \times IR) + (SedC \times IR_{Sed}) + (WC \times IR_W)] \times AUF / BW$$

Where:

ID_A	=	estimated dose to aquatic insectivores via the food chain (mg/kg/day)
IC	=	concentration of COPEC in invertebrates (mg/g)
P_{inv}	=	proportion of ingestion composed of invertebrates (unitless)
IR	=	ingestion rate of food item (g/day)
SedC	=	concentration of COPEC in sediment (mg/g)
IR_{Sed}	=	ingestion rate of sediment (g/day)
WC	=	concentration of COPEC in water (mg/L)
IR_W	=	ingestion rate of water (L/day)
AUF	=	area use factor (unitless ratio of exposure area to home range)
BW	=	body weight (kg)

<u>Sea Otter (*Enhydra lutris*)</u>

The sea otter (*Enhydra lutris*) inhabits kelp beds and rocky shores from the Aleutian Islands to California. Its diet includes fish, abalones, sea urchins, and other marine animals (EPA 1993). For purposes of this evaluation, it was assumed that 100 percent of the diet is composed of aquatic invertebrate material. Since the sea otter spends a portion of its time on land, incidental ingestion of soil during grooming was assumed. Sea otters obtain most of their water from food items, and therefore, it was assumed that significant amounts water are not consumed in order to meet daily requirements.

The exposure dose for the sea otter will be estimated from the following equation:

$$CD_A = [(IC_{inv} \times IR) + (SC \times IR_S) \times AUF / BW$$

Where:

CD_A	=	estimated dose to aquatic carnivores via the food chain (mg/kg/day)
IC	=	concentration of COPEC in invertebrates (mg/g)
P_{inv}	=	proportion of ingestion composed of invertebrates (unitless)
IR	=	ingestion rate of food item (g/day)
SC	=	concentration of COPEC in soil (mg/g)
IR_S	=	ingestion rate of soil (g/day)

AUF = area use factor (unitless ratio of exposure area to home range)
BW = body weight (kg)

Table 5-1 presents exposure factors for each of the measurement receptors.

Table 5-1
Species-Specific Exposure Parameters for Terrestrial Receptors in Driftwood Bay Study Area

Receptor	COC	HQ
SS007		
Arctic Ground Squirrel	None	0.03
Masked Shrew	Naphthalene	30
	Phenanthrene	300
	Pyrene	500
Least Sandpiper	None	NA
Northern Shrike	None	NA
Sea Otter	Phenanthrene	30
	Pyrene	50
LF006		
Arctic Ground Squirrel	Phenanthrene	3
	Pyrene	1
	Lead	200
Masked Shrew	Anthracene	50,000
	Benzo(a)anthracene	30
	Benzo(a)pyrene	30
	Benzo(b)fluoranthene	20
	Benzo(k)fluoranthene	30
	Chrysene	40
	Dibenzo(a,h)anthracene	6
	Fluorene	10,000
	Indeno(1,2,3-c,d)pyrene	20
	Naphthalene	500
	Phenanthrene	200,000
	Pyrene	400,000

Table 5-1
Species-Specific Exposure Parameters for Terrestrial Receptors in Driftwood Bay Study Area
(continued)

Receptor	COC	HQ
Masked Shrew (continued)	Arsenic	3
	Barium	10
	Cadmium	2
	Selenium	2
	Lead	7,000
Least Sandpiper	Arsenic	50
	Barium	70
	Cadmium	8
	Selenium	20
	Lead	700,000
Northern Shrike	Lead	3,000
Electronic Debris Area		
Arctic Ground Squirrel	Lead	50
Masked Shrew	Lead	2,000
Least Sandpiper	Lead	200,000[3]
Northern Shrike	Lead	800

__Notes:__
[1] COC are contaminants with an HQ greater than or equal to 1
[2] HQs are presented for each COC, if no COCs are identified; the value is the HI for the receptor.
NA = Not applicable. HQs were not calculated because toxicity values were not available.
[3] The Least Sandpiper represents any avian receptor with the same feeding habit (e.g., insectivorous).
For additional definitions, see the Acronyms and Abbreviations section.

5.1.6 Estimation of Exposure to Indicator Species

Terrestrial wildlife may be exposed to contaminants via three potential pathways: oral, dermal, and inhalation. Oral exposure occurs through the consumption of contaminated food, water, or soil. Dermal exposure occurs when contaminants are absorbed directly through the skin. Inhalation exposure occurs when volatile compounds or fine particulates are respired into the lungs. Total possible exposure is the sum of exposures from all three pathways:

$$E_{total} = E_{oral} + E_{dermal} + E_{inhalation}$$

Where:

E_{total} = total exposure from all pathways
E_{oral} = oral exposure
E_{dermal} = dermal exposure
$E_{inhalation}$ = inhalation exposure

Dermal exposure is considered to be negligible for birds and mammals at most contaminated sites. Methods to assess human dermal exposure to contaminants lack data for wildlife (EPA 1993; Sample et al. 1997). The likelihood of significant dermal exposures is further limited by feathers and fur of birds and mammals.

Inhalation of contaminants was also assumed negligible given the lack of fine particulates at most sites and that the contaminated soil is covered by vegetation. VOCs are the constituents most likely to pose an inhalation risk but their rapid volatilization from soil dilutes and disperses them. VOCs are generally lost from soil before significant exposure can occur (Sample et al. 1997).

PAHs, on the other hand, adsorb readily to particulates that may be ingested in soil and were considered a constituent of potential ecological concern (COPEC), given their tendency to bioaccumulate.

Consequently, oral exposure was considered to be the primary exposure pathway, and indicator species were assumed to be exposed to COPECs in surface soil primarily through ingestion of soil and dietary intake (e.g., plants, seeds, soil invertebrates), depending on the species. While absorption and inhalation exposure routes are possible, little information is available for quantifying these exposure routes in wildlife, and their risk was considered minimal in comparison to ingestion. Table 5-1 presents the exposure factors for each of the measurement receptors.

Oral Exposure

Wildlife may be exposed orally to contaminants from multiple sources. Consumption of contaminated food (plant or animal), water, or soil may pose an oral exposure risk. Soil ingestion may be incidental due to foraging or grooming activities. Alternatively, it may be intentional to meet nutritional needs. Therefore, the total oral exposure experienced by an individual was calculated as the sum of the exposures from each source and is described as follows:

$$E_{oral} = E_{food} + E_{water} + E_{soil}$$

Where:

E_{oral} = oral exposure
E_{food} = exposure from food
E_{water} = exposure from water
E_{soil} = exposure from soil

Diet Composition

Most wildlife diets consist of more than one food type to meet nutritional needs for growth, maintenance, and reproduction. Not all food types consumed are likely to contain equivalent contaminant concentrations; therefore, the composition of the diet is one of the most important exposure modifying factors. To account for the differences in contaminant concentrations of different food types, exposure estimates were assessed by the relative proportions of daily food intake of each food type and the contaminant concentration in each food type. Assumptions of dietary composition were specific to the receptor species evaluated. Table 5-1 presents information on diet composition for each of the selected measurement receptors.

Spatial/Area Use Factors

The movement of wildlife is the most important spatial consideration. Animals travel various distances on a daily to seasonal basis for food, water, and shelter. The area encompassed by these travels is defined as the home range. A variety of factors may influence home range (i.e., habitat quality, food/prey abundance, population density).

The area use factor (AUF) is defined as the ratio of home range, or feeding/foraging range, to the area of the affected property. For purposes of this evaluation, AUF was assumed to be

100 percent (i.e., the home range of each measurement receptor will be assumed to be smaller than the site). However, for purposes of the uncertainty analysis, AUFs less than 100 percent were applied as appropriate to provide a more reasonable evaluation. Table 5-1 presents home range data for the selected measurement receptors.

Body Weight

Assumptions of body weights were specific to the receptor species evaluated (Table 5-1). The values selected were minimum body weights from the range of data reported in the available literature.

Estimation of Food Consumption

Field observations of food consumption rates are the best data to use to estimate exposure; however, these data are usually not available for the wildlife measurement receptors. In the absence of experimental data, food consumption values have been estimated from allometric regression models based on metabolic rate. Nagy (1987) derived equations to estimate food consumption for various groups of birds and mammals:

For passerine birds (northern shrike): $FI = 0.398\ Wt^{0.850}$

For placental mammals: $FI = 0.235\ Wt^{0.822}$

For rodents (arctic squirrel): $FI = 0.621\ Wt^{0.564}$

Where:

FI = food ingestion rate (g/day)
Wt = body weight (g)

An uncertainty factor of 2 was applied to the calculated value for each species to account for variability within the group.

Estimation of Soil Ingestion

In addition to food consumption, many wildlife consume soil inadvertently while foraging and grooming. Wildlife may also deliberately ingest soil to meet dietary nutrient requirements as well. Many bird species consume grit to either supplement their dietary calcium or for its abrasive properties instrumental in food grinding.

Assumptions of soil, sediment, and water ingestion are specific to the receptor species evaluated (Table 5-1). Information on soil/sediment ingestion was obtained from *Wildlife Exposure Factors Handbook* (EPA 1993).

Estimation of Water Ingestion

Water ingestion rates (L/day) were estimated from allometric regression models based on body weight (Calder and Braun 1983) using the following equations:

$$W = 0.099\ (BW)^{0.90} \quad \text{(for mammals)}$$
$$W = 0.059\ (BW)^{0.67} \quad \text{(for birds)}$$

Where:

W = water ingestion rate (L/day)
BW = body weight (kg)

Therefore, the calculated estimation of water consumption for the northern shrike and arctic ground squirrel are 0.009 and 0.072 L/day, respectively.

Estimating Contaminant Concentrations in Wildlife Foods

The oral exposure for wildlife is equivalent to the contaminant concentration consumed or ingested in soil and water, assuming that the contaminant concentration in the food or water can be predicted from available soil and water data. The bioaccumulation factor (BAF) relates to the concentration of the contaminant in the food type to the contaminant concentration in the soil. Exposures to COPECs were quantified for each of the selected measurement receptors. Equations to estimate exposure doses are specific for exclusive herbivores, carnivores or omnivores (Table 5-1). Section 5.2.3 contains equations for estimating contaminant concentrations in wildlife foods.

Toxicity Reference Values

Literature such as the *User's Guide for the Selection and Application of Default Endpoints and Indicator Species in Alaskan Ecoregions* (ADEC 1999) and relevant EPA guidance were used to select TRVs for the indicator species. As a conservative approach, TRVs were based on no observed adverse effects levels for initial screening purposes.

In general, the TRVs were selected to protect the population of a species, not the individual response. Consequently, the endpoints that ecological risk assessments need to address include reproduction, growth, maintenance, and critical developmental processes. TRVs were obtained from EPA's *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (EPA 1999).

Bioavailability

Bioavailability is defined as the potential for a contaminant to enter into ecological or human receptors. It is specific to the receptor, route of entry, time of exposure, and the environmental matrix (Anderson et al. 1999); therefore, a contaminant may have different levels of bioavailability from soil, water, food, etc. Bioavailability is the ratio of a COPEC that reaches a site of toxic action in an organism to the total load of the COPEC in the environment. Uptake and elimination rates of the bioavailable form are important since the combined effect of these factors determines whether the material is accumulated or eliminated. A COPEC may have different levels of bioavailability from soil, water, food, etc. Parameters important in the consideration of contaminant bioavailability are chemical dependent; for instance, the lipophicity and persistence of organic contaminants affect their bioavailability as they tend to sorb to soil and persist in soil, from which they can be taken up into the food chain. Sorption by soil is primarily related to their hydrophobicity and the amount of organic matter present in the soil. The more affinity a contaminant has for organic matter, the larger the organic carbon partitioning coefficient. A soil with more organic matter has a higher propensity to sorb nonionic organic compounds. Higher hydrophobicity reflects higher lipophicity, which in turn means a greater potential exists for the contaminant to bioaccumulate in the lipid fractions of biota.

For purposes of this evaluation, the bioavailability factor (BF) for each media was assumed to be 100 percent; however, for purposes of the uncertainty analysis, BFs less than 100 percent was applied as appropriate to provide a more reasonable evaluation. The rationale for any BFs less than 100 percent was fully documented from the literature.

Bioconcentration and Bioaccumulation

Bioconcentration is the process by which net accumulation of a constituent occurs directly from an exposure medium into an organism. The bioconcentration factor (BCF) is the ratio of the concentration of a constituent in an organism to the concentration in the ambient environment at steady state. The BAF is the BCF when the organism can take in the constituent through ingestion of food as well as direct contact.

Uptake in Aquatic and Terrestrial Plants. Soil-to-plant and sediment-to-plant BCFs for the COPECs were obtained from the *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (EPA 1999). If a plant BCF for an organic COPEC was not available in this reference, the BCF was calculated from the following regression equation (Travis and Arms 1988):

$$\text{Log BCF} = 1.588 - 0.578 \times \text{Log } K_{ow}$$

If a BCF for an inorganic COPEC was not available from EPA 1999, the BCF was obtained from Baes et al. (1984).

Uptake in Small Mammals. Concentrations of COPECs in small mammals were estimated using an equation specific to each feeding guild (herbivores, omnivores, and carnivores), based on plant and animal food items and media ingested. COPEC concentrations were estimated using BCFs for small mammals from the available literature. General equations for estimating COPEC concentrations in small mammals in each guild are described in EPA's *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (EPA 1999) and include BCFs and a trophic-level-specific food-chain multiplier (FCM) for small mammals.

The COPEC concentration in herbivorous mammals is calculated by summing the contributions of ingestion of contaminated plant food items and media. The general equation for computing COPEC concentrations in herbivores is as follows:

$$C_H = \sum (C_{TP} \times BCF_{TP\text{-}H} \times P_{TP} \times F_{TP}) + (C_s \times BCF_{S\text{-}H} \times P_S) + (C_{wctot} \times BCF_{W\text{-}H} \times P_W)$$

Where:

C_H	=	COPEC concentration in herbivore (mg/kg)
C_{TP}	=	COPC concentration in terrestrial plant food item (mg/kg)
$BCF_{TP\text{-}H}$	=	bioconcentration factor for terrestrial plant-to-herbivore (unitless)
P_{TP}	=	proportion of terrestrial plant food in diet that is contaminated (unitless)
F_{TP}	=	fraction of diet consisting of terrestrial plant food (unitless)
C_s	=	COPC concentration in soil (mg/kg)
$BCF_{S\text{-}H}$	=	bioconcentration factor for soil-to-herbivore (unitless)
P_S	=	proportion of soil in diet that is contaminated (unitless)
C_{wctot}	=	total COPC concentration in water column (mg/L)
$BCF_{W\text{-}H}$	=	bioconcentration factor for water-to-herbivore (L/kg)
P_W	=	proportion of water in diet that is contaminated (unitless)

In general, the COPEC concentration in omnivores depends on the COPEC concentration in each food item ingested and the trophic level of each food item, as follows:

$$C_{OM} = \sum (C_{Ai} \times (FCM_{TL3}/FCM_{TLn\text{-}Ai}) \times P_{Ai} \times F_{Ai}) + \sum (C_{TP} \times BCF_{TP\text{-}OM} \times P_{TP} \times F_{TP}) + (C_s \times BCF_{S\text{-}OM} \times P_S) + (C_{wctot} \times BCF_{W\text{-}OM} \times P_W)$$

Where:

C_{OM}	=	COPEC concentration in omnivore (mg/kg)
C_{Ai}	=	COPEC concentration in animal food item (mg/kg)
FCM_{TL3}	=	food-chain multiplier for trophic level 3 (unitless)
$FCM_{TLn\text{-}Ai}$	=	food-chain multiplier for trophic level of animal food item (unitless)
P_{Ai}	=	proportion of animal food item in diet that is contaminated (unitless)
F_{Ai}	=	fraction of diet consisting of animal food item (unitless)
C_{TP}	=	COPC concentration in terrestrial plant food item (mg/kg)
$BCF_{TP\text{-}OM}$	=	bioconcentration factor for terrestrial plant-to-omnivore (unitless)
P_{TP}	=	proportion of terrestrial plant food in diet that is contaminated (unitless)
F_{TP}	=	fraction of diet consisting of terrestrial plant food (unitless)
C_s	=	COPC concentration in soil (mg/kg)

$BCF_{S\text{-}OM}$	=	bioconcentration factor for soil-to-omnivore (unitless)
P_S	=	proportion of soil in diet that is contaminated (unitless)
C_{wctot}	=	total COPC concentration in water column (mg/L)
$BCF_{W\text{-}OM}$	=	bioconcentration factor for water-to-omnivore (L/kg)
P_W	=	proportion of water in diet that is contaminated (unitless)

Media-to-herbivore and media-to-omnivore BCF values are COPEC- and receptor-specific. FCMs are chemical specific (based on Log K_{ow}). Each of these values plus terrestrial-plant-to-herbivore and terrestrial-plant-to-omnivore BCF values was obtained from EPA (1999).

If the necessary media-to-receptor and terrestrial-plant-to-receptor BCFs were available, they were determined from appropriate biotransfer factors. BCF values for measurement receptors ingesting small mammals were calculated using the following COPEC-specific biotransfer factor:

$$BCF_{F\text{-}A} = Ba_A \times IR_F$$

Where:

$BCF_{F\text{-}A}$	=	bioconcentration factor for food item (small mammal)-to-animal (measurement receptor)
Ba_A	=	COPC-specific biotransfer factor applicable for the animal
IR_F	=	measurement receptor food item ingestion rate

For organics, the following correlation equation from Travis and Arms (1988) was used to derive Ba_{mammal} values on a fresh weight basis:

$$\text{Log } Ba_{mammal} = -7.6 + \text{Log } K_{ow}$$

For inorganics, biotransfer factor (Ba) values on a fresh weight basis was obtained from Baes et al. (1984).

The use of an FCM ratio to estimate biomagnification between trophic levels is consistent with EPA (1999).

5.2 RISK CHARACTERIZATION

Risk characterization integrates information from problem formulation and the exposure and ecological effects characterization to estimate the nature and extent of ecological risk or threat. Ecological risk characterization is based on a weight-of-evidence approach, in which multiple lines of evidence are presented and evaluated. In determining ecological risks, the HQ was calculated. The HQ was obtained by dividing the dose by an ecological TRV.

A tiered approach to the risk characterization is as follows:

- Screen constituent concentrations against media benchmarks for assessment endpoints.
- Calculate HQs based on conservative default exposure assumptions.
- Calculate HQs based on site-specific and species-specific (less conservative) exposure assumptions.
- Perform uncertainty analysis, considering a refinement of constituents, species, and pathways as well as development of risk questions for HQs greater than 1.

Qualitative and semiquantitative approaches were taken to estimate the likelihood of adverse effects occurring as a result of potential exposure of the assessment receptors to COPECs. Potential adverse affects to terrestrial plants were qualitatively assessed by comparing plant toxicity benchmarks with COPEC concentrations. Potential adverse impacts to aquatic biota were qualitatively assessed by comparing surface water and sediment quality criteria for the protection of aquatic life to surface water and sediment COPEC concentrations.

For the semiquantitative predictive assessment, TRVs and estimated exposure rates were used to calculate HQ as:

$$HQ = Dose / TRV$$

Where:

Dose	=	estimated daily dose for the measurement receptor through a specific exposure route (mg/kg bw/day)
TRV	=	toxicity reference value for the measurement receptor through the same exposure route (mg/kg bw/day)

If the calculated HQ exceeds unity (HQ>1), then the species of concern may be at risk from an adverse effect from that COPEC through that exposure route. Because TRVs incorporate a number of extrapolation factors, exceedance of a TRV (i.e., the HQ exceeds unity) does not necessarily indicate that an adverse effect will occur.

If the HQ exceeds unity, consideration of uncertainty will be discussed. This uncertainty assessment considered the effect of less conservative exposure and toxicity assessment assumptions such as less-than-100-percent AUFs and BFs, average EPCs, average body weights and ingestion rates, and lowest observed adverse effect level-based TRVs. If specific constituents, species, and pathways are still a concern after consideration of less conservative site-specific and species-specific assumptions (i.e., can not be eliminated based on uncertainty issues such as overly conservative assumptions), then a recommendation for further evaluation will be made to determine what course of action is appropriate for the site.

5.3 TERRESTRIAL PLANT IMPACT ASSESSMENT

To assess the potential impact of COPEC concentrations in surface soil on terrestrial plant species, the EPCs from each site were compared with available benchmark concentrations developed for the protection of terrestrial plants. As shown in Table 2-1, benchmarks were exceeded by the COPEC EPC for multiple constituents. Additionally, benchmarks were not available for some of the COPECs retained for the SLERA (Screening Level Ecological Risk Assessment). However, based on site reconnaissance performed, no signs of vegetative stress were noted (Section 2.1.4).

5.4 AQUATIC BIOTA IMPACT ASSESSMENT

To assess the potential impact of COPEC concentrations in surface water and sediment on aquatic biota, the EPCs for surface water and sediment were compared with available benchmark concentrations developed for the protection of aquatic life. As shown in Table 2-2, no surface water COPEC concentrations from Snuffy or Humpy Creeks exceeded the available benchmarks for the protection of aquatic life. Benchmarks were exceeded for constituents in the LF006 pond (carbon disulfide, beta-BHC, and lead); however, this water body does not represent significant habitat for aquatic biota. The available evidence suggests that the pond is the result of construction activities.

As shown in Table 2-2, no sediment COPEC concentrations from Snuffy or Humpy Creeks exceeded the available benchmarks for the protection of aquatic life. Six constituents detected in the sediment of the LF006 pond were retained as COPECs for sediment, of these, only one had concentrations exceeding the benchmark. The remaining constituents were retained because benchmarks were not available for comparison. Low frequency of detection for organic compounds reported in sediment samples collected at the Driftwood Bay RRS resulted in the maximum measured concentration being used as the EPC (Table 2-2). It is important to note that the LF006 pond does not represent a significant aquatic habitat.

5.5 PREDICTIVE RISK ESTIMATION FOR TERRESTRIAL AND AQUATIC WILDLIFE

Estimates of potential for risks associated with exposure to environmental media were evaluated (Appendix I) through a series of quantitative HQ calculations that compared receptor-specific exposure values with TRVs. It should also be noted that HQs are not measures of risk, are not population-based statistics, or linearly scaled statistics. Accordingly, an HQ above 1, even exceedingly so, does not necessarily mean that there is even one individual expressing the toxicological effect associated with a given chemical to which it was exposed (Tannenbaum 2001; Bartell 1996).

Table 5-2 summarizes the COCs and HQ estimates for Lower Camp sites.

Table 5-2
Hazard Quotients and Contaminants of Concern for Indicator Receptor at Lower Camp

Receptor	COC	HQ
SS007		
Arctic Ground Squirrel	None	0.03
Masked Shrew	Naphthalene	30
	Phenanthrene	300
	Pyrene	500
Least Sandpiper	None	NA
Northern Shrike	None	NA
Sea Otter	Phenanthrene	30
	Pyrene	50
LF006		
Arctic Ground Squirrel	Phenanthrene	3
	Pyrene	1
	Lead	200
Masked Shrew	Anthracene	50,000
	Benzo(a)anthracene	30
	Benzo(a)pyrene	30
	Benzo(b)fluoranthene	20
	Benzo(k)fluoranthene	30
	Chrysene	40
	Dibenzo(a,h)anthracene	6
	Fluorene	10,000
	Indeno(1,2,3-c,d)pyrene	20
	Naphthalene	500
	Phenanthrene	200,000
Masked Shrew	Pyrene	400,000
	Arsenic	3
	Barium	10
	Cadmium	2
	Selenium	2
	Lead	7,000
Least Sandpiper	Arsenic	50
	Barium	70
	Cadmium	8
	Selenium	20
	Lead	700,000

Table 5-2
Hazard Quotients and Contaminants of Concern for Indicator Receptor at Lower Camp
(continued)

Receptor	COC	HQ
Northern Shrike	Lead	3,000
Electronic Debris Area		
Arctic Ground Squirrel	Lead	50
Masked Shrew	Lead	2,000
Least Sandpiper	Lead	200,000[3]
Northern Shrike	Lead	800

Notes:
[1] COC are contaminants with an HQ greater than or equal to 1
[2] HQs are presented for each COC, if no COCs are identified; the value is the HI for the receptor.
NA = Not applicable. HQs were not calculated because toxicity values were not available
[3] The Least Sandpiper represents any avian receptor with the same feeding habit (e.g , insectivorous).
For definitions, see the Acronyms and Abbreviations section.

5.6 UNCERTAINTY ANALYSIS

The results of the SLERA are influenced to some degree by variability and uncertainty. In theory, investigators might reduce variability by increasing sample size of the media or species sampled. Alternatively, uncertainty within the risk analysis can be reduced by using species-specific and site-specific data to better quantify contamination of media, vegetation, and prey through direct field measurements, toxicity testing of site-specific media, and field studies using site-specific receptor species. Detailed media, prey, and receptor field studies are costly; therefore, the preliminary predictive analyses of risk was conducted to limit the potential use of these resource-intensive techniques to only those COPECs that continue to show a relatively high potential for ecological risk. Since assessment criteria were developed based on conservative assumptions, the results of the screening and predictive assessments are on the side of conservatism.

A number of factors contribute to the overall variability and uncertainty inherent in ecological risk assessments. Variability is due primarily to measurement error. Laboratory media analyses and receptor study design are the major sources of this kind of error. Uncertainty, on the other hand, is associated primarily with deficiency or irrelevancy of effects, exposure, or habitat data to actual ecological conditions at the site. Species physiology, feeding patterns, and nesting behavior are poorly predictable; therefore, all toxicity information derived from toxicity testing, field studies, or observation will have uncertainties associated with them. Laboratory studies conducted to obtain site-specific, measured information often suffer from poor relevance to the actual exposure and uptake conditions on site (i.e., bioavailability, exposure, assimilation, etc., are generally greater under laboratory conditions as compared to field conditions). Calculating an estimated value based on a large number of assumptions is often the only alternative to the accurate (but costly) method of direct field or laboratory observation, measurement, or testing. Finally, habitat- or site-specific species may be misidentified if, for example, the observational assessment results are based on only one brief site reconnaissance.

The uncertainty analysis lists some of the major assumptions made for the SLERA; the direction of bias caused by each assumption, i.e., whether the uncertainty results in an overestimate or underestimate of risk; the likely magnitude of impact as high, medium, low, or unknown; and, where possible, a description of recommendations for minimizing the identified uncertainties if the SLERA progresses to higher level assessment phases (EPA 1992). The uncertainty analysis identifies and, where possible, quantifies the uncertainty in the individual preliminary scoping assessment, problem formulation, exposure and effects assessment, and risk characterization of this SLERA. The most important uncertainties associated with this SLERA are as follows:

- **Assumptions of bioavailability.** Assuming that COPECs are 100 percent bioavailable likely overestimates the potential for adverse effects. The duration since the contaminant release affects bioavailability as the contaminant becomes sequestrated or transformed within the environmental media. Sequestration, transformation, and bioavailability are influenced by medium characteristics including pH, temperature, and organic carbon content.
- **Use of laboratory-derived or empirically-estimated partitioning and transfer factors.** The use of laboratory-derived or empirically-estimated partitioning and transfer factors to predict COPEC concentrations in plants, invertebrates, prey species, and sediment pore water likely overestimates potential risks. As discussed above, the incorporation of COPECs into the food chain is influenced by the characteristics of the exposure medium which likely differs from that used in the laboratory to derive partitioning and transfer factors.

- **Use of laboratory-derived TRVs.** The use of laboratory-derived TRVs may over- or under-estimate the potential for adverse effects. The method of administration of the contaminant in the laboratory is significantly different that that experienced in the wild by the receptors.
- **Use of the HQ method to estimate risks to populations or communities.** Many of the HQs presented in this SLERA are unrealistically high and toxicologically impossible. Estimated HQs greater than 1000 should be considered suspect.

5.6.1 Sampling and Analytical Limitations

It is not possible to completely characterize the nature and extent of contamination on any site. Uncertainties arise from limits on the number of locations that can be sampled. The sampling protocol used at the Driftwood Bay RRS, however, was designed to optimize efficiency of the sampling effort and reduce uncertainty by focusing on areas around former process buildings, storage structures, and potential transfer piping. The sampling appears to be sufficient to show that the contamination is largely limited to the soil.

A sample collected from LF006 may present a conservative bias toward the risk assessment. HQs were calculated for receptors exposed to contaminants at LF006 with results from the ash sample removed from the data, as was done for the human health risk assessment. Total ILCR estimates for the recreational receptor exceeded the threshold of 1E-5. Carcinogenic COCs for LF006 were all PAHs from samples collected from a layer of ash. When data from the ash layer were excluded from the risk calculations, the HI dropped to 6E-07 and the ILCR dropped to 1E-09.

5.6.2 Selection and Quantification of Chemicals of Potential Ecological Concern

Uncertainty associated with the processes used to identify COPECs and estimate EPCs arises from the following:

- Identifying background chemicals. Metals are judged to be present at concentrations comparable to background if the MDC does not exceed the BSC, or if statistical testing demonstrates that the site data and background data are drawn from the same population. Statistical testing of site data versus background was not performed for this SLERA.
- Estimated EPCs are uncertain. For statistical purposes, if a constituent is positively identified at a site and has at least a single positive hit, all the samples with NDs were

assumed to have a value equal to half the reporting limit and were included in the data set. This process may introduce a conservative bias into the risk assessment. Computed UCL_{95} values are only estimates of the actual UCLs associated with each data set. Examples of factors affecting the uncertainty of these estimates include the number of samples, proportion of NDs, conformance with an assumed mathematical distribution, imprecision of laboratory data, elevated detection limits (from dilutions, matrix interference, etc.), and statistical methodology.

- A limited number of samples may not completely characterize a site because they provide less information about the population from which they are drawn than do larger sample sets. Accordingly, small sets tend to have a greater variability, which results in the calculation of wide confidence intervals on the mean concentration and high EPCs. In some cases, the UCL_{95} was greater than the maximum value or there were an insufficient number of samples to calculate the UCL_{95} for the SLERA; thus, the maximum value was chosen as the EPC. High confidence limits may introduce a conservative bias into the risk assessment.
- Laboratory analytical techniques have a degree of uncertainty associated with them. These uncertainties are documented by using data qualifiers to reflect the degree of certainty of measurement. For example, some data were estimated (e.g., J-qualified), while other data were rejected (i.e., R-qualified). The direction of bias is unclear.

Consistent with EPA guidance (1992), the UCL_{95} was used for the EPC. Therefore, the exposure assessment is likely to underestimate the EPCs in 5 percent of the cases and overestimate exposures in 95 percent of cases, imparting an overall conservative bias to the risk assessment. Also, there are significant uncertainties associated with estimating COPEC concentrations in macroinvertebrates.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The baseline risk assessment describes potential risks to human and ecological receptors associated with exposures to contaminants at the following sites at the Driftwood Bay RRS:

- Former Composite Building (OT001) Doorways at Top Camp
- Former Composite Building (OT001) Antennas and USTs at Top Camp
- BBA at Top Camp
- POL Waste Pit (WP003) at Top Camp
- LF006 at Lower Camp
- EDA at Lower Camp near LF006
- Spill/Leak No. 7 at POL Tank Farm (SS007)
- Spill/Leak No. 2 at Former Water Supply Pump House (SS010) at Lower Camp

Analytical data for each site were selected based on representativeness and quality of the data. In general, samples were collected from areas of concern based on results from previous investigations and historical use of the site. COPCs are chemicals identified as site related and potentially capable of contributing significantly to risk. COPCs were identified based on the ADEC Risk Assessment Procedures Manual (ADEC 2005). Potential exposure routes were used to evaluate which analytes were retained as COPCs for the risk assessment. All COPCs identified were carried forward for quantitative evaluation in the risk assessment. All available analytical data of acceptable quality were used to identify COPCs. The ecological risk assessment included comparison of contaminant concentrations to a variety of media-specific ecological screening benchmarks.

All available site characterization data of acceptable quality were used to evaluate potential current and anticipated exposures. The COPCs at Top Camp include DRO, RRO, PAHs, 1,2,4-trimethylbenzene, lead, and PCBs; COPCs at Lower Camp include DRO, RRO, ethylbenzene, xylenes, PAH, metals, PCBs, carbon disulfide, and beta-BHC. EPCs and potential intake values were calculated using the appropriate exposure models and analytical data. Risks from potential exposure to fuel-related compounds were evaluated using measured concentrations of DRO; RRO; benzene, toluene, ethylbenzene, and xylenes; and PAHs, as appropriate.

6.1 HUMAN HEALTH RISK ASSESMENT

Based upon the information collected from community surveys, the only anticipated human receptors were recreational visitors. The risk assessment characterized potential human exposures to COPCs in soil and surface water. Groundwater is an unlikely exposure pathway for recreational visitors because there is no access to it. Sediment is not an anticipated exposure medium for recreational visitors because the low ambient temperature at the site precludes wading in any of the surface water bodies at Lower Camp. No surface water COPCs were identified during COPC screening of Snuffy and Humpy Creeks. Surface water COPCs were identified for the LF006 pond, but this does not represent a significant aquatic habitat and does not contain fish. Therefore, the assessment of potential ingestion of biota (i.e., fish) was not evaluated at LF006. Risk to recreational receptors was evaluated for exposure only to surface soil at the Top Camp sites. The recreational receptor was evaluated for exposure to surface soil and surface water at the Lower Camp Sites.

The BBA at Top Camp and the EDA and LF006 at Lower Camp are contaminated with lead associated with batteries disposed of at the sites. Toxicity values are not available for the evaluation of lead. The ALM was used to evaluate the potential for noncancer effects, specifically an elevated concentration of lead in blood associated with an increase in neurological impairment.

ILCR and HQ estimates for each receptor, medium and COPC, including sums across exposure routes, were derived for each COPC at each site. COCs are defined as chemicals that contribute significantly to an ILCR exceeding ADEC's risk goal of 1E-5 or an HI exceeding 1. For this discussion, an individual chemical was considered to contribute significantly to the cancer risk estimate if its ILCR summed across all exposure routes exceeded 1E-6. Similarly, an individual chemical was considered to contribute significantly to the noncancer hazard if its HI summed across all exposure routes exceeded 0.1. Results of the risk characterization for each site are summarized in the following paragraphs.

6.1.1 Top Camp

Risk to recreational receptors was evaluated for exposure only to surface soil at the Top Camp sites. Total HI and ILCR estimates for the recreational receptor at each site are summarized as follows:

- **OT001 (UST and Antennae)** – The HI calculated for recreational exposure to contaminants at the UST and antennae location at OT001 was 4E-03 (UST and antennae) for a total HI of 8E-03 (across OT001). The HI is less than the threshold for noncancer effects, so there were no COCs for the HI. The ILCR calculated for recreational exposure at the doorway and UST and antennae locations at OT001 was 4E-08, for a total ILCR of 4E-07 (across OT001). Total ILCR estimates for the recreational receptor were below the threshold of 1E-5, so there were no COCs for the ILCR.
- **OT001 (Doorway)** – The HI calculated for recreational exposure to contaminants at the doorway location at OT001 was 4E-03, for a total HI of 8E-03 (across OT001). The HI is less than the threshold for noncancer effects, so there were no COCs for the HI. The ILCR calculated for recreational exposure at the doorway location at OT001 was 3E-07, for a total ILCR of 4E-07 (across OT001). Total ILCR estimates for the recreational receptor were below the threshold of 1E-5, so there were no COCs for the ILCR.
- **WP003** – The HI calculated for recreational exposure at WP003 was 8E-03. The HI is less than the threshold for noncancer effects, so there were no COCs for the HI. The ILCR for recreational exposure at WP003 was 4E-08. Total ILCR estimates for the recreational receptor were below the threshold of 1E-5, so there were no COCs for the ILCR.
- **BBA** – The BBA at Top Camp was contaminated with lead associated with batteries found at the site. The ALM was used to evaluate the potential for noncancer effects, specifically an elevated PbB associated with an increase in neurological impairment. Predicted PbB for adult recreational receptors at the BBA was 2.3 μg/dL. The results of the ALM suggest that potential exposure to lead at the BBA, including that for pregnant women, does not pose an unacceptable hazard to adult recreational receptors under current and anticipated land use,.

6.1.2 Lower Camp

The recreational receptor was evaluated for exposure to surface soil and surface water at the Lower Camp sites. Total HI and ILCR estimates for the recreational receptor at each site are summarized as follows:

- **LF006** – HIs calculated for recreational exposure to soil and surface water at LF006 were 4E-03 and 5E-6, respectively. The cumulative HI for LF006 was 4E-03. The HI is less than the threshold for noncancer effects, so there were no COCs for the HI. ILCRs for recreational exposure to soil and surface water at LF006 was 6E-05 and 1E-09, respectively. The cumulative ILCR for LF006 was 6E-05. Total ILCR estimates for the recreational receptor exceeded the threshold of 1E-5. The carcinogenic COCs for LF006 were all PAHs from samples collected from a layer of ash. When data from the ash layer are excluded from risk calculations, the HI drops to 6E-07 and the ILCR drops to 1E-09. Lead contamination was detected at LF006 associated with batteries found at the site. The ALM was used to evaluate the potential for noncancer effects, specifically an elevated PbB associated with an increase in neurological impairment. Predicted PbB for adult recreational receptors at the LF006 was 31.9 µg/dL. The results of the ALM suggest that potential exposures to lead at the LF006 may pose an unacceptable hazard to adult recreational receptors, including pregnant women. Appendix H summarizes PRGs for lead developed for this site.
- **EDA** – The HI calculated for recreational exposure to soil at EDA was 4E-08. The HI is less than the threshold for noncancer effects, so there were no COCs for the HI. The ILCR for recreational exposure to soil at EDA was 4E-08. Total ILCR estimates for the recreational receptor were below the threshold of 1E-5, so there were no COCs for the ILCR. Lead contamination was also detected at the EDA, associated with batteries found at the site. The ALM was used to evaluate the potential for noncancer effects, specifically an elevated PbB associated with an increase in neurological impairment. Predicted PbB for adult recreational receptors at the EDA was 30.5 µg/dL. The results of the ALM suggest that potential exposures to lead at the EDA may pose an unacceptable hazard to adult recreational receptors, including pregnant women. Appendix H summarizes PRGs for lead developed for this site.
- **SS007** – The HI calculated for recreational exposure at SS007 was 3E-05. The HI is less than the threshold for noncancer effects, so there were no COCs for the HI. The ILCR for recreational exposure at SS007 was 1E-07. Total ILCR estimates for the recreational receptor were below the threshold of 1E-5, so there were no COCs for the ILCR.
- **SS010** – The HI calculated for recreational exposure at SS010 was 5E-03. The HI is less than the threshold for noncancer effects, so there were no COCs for the HI. The ILCR for recreational exposure at SS010 was 2E-08. Total ILCR estimates for the recreational receptor were below the threshold of 1E-5, so there were no COCs for the ILCR.

6.2 ECOLOGICAL RISK ASSESSMENT

COPECs are those constituents with concentrations exceeding their respective ecological benchmark values. Ecological risks were estimated for five receptor species, representing a variety of trophic levels potentially exposed to site COPECs:

- Arctic ground squirrel representing terrestrial herbivores
- Masked shrew representing terrestrial omnivores
- Northern shrike representing terrestrial carnivores
- Least sandpiper representing aquatic omnivores
- Sea otter representing aquatic carnivores

Based on the lack of habitat and absence of potential receptors in the area during the field effort, no potential exposure to contamination is anticipated for ecological receptors, and this area was eliminated from consideration. Therefore, the ecological risk assessment only evaluated the potential for adverse effects to ecological receptors exposed to contaminants at the Lower Camp sites.

Ecological risk characterization is based on a weight-of-evidence approach, in which multiple lines of evidence are presented and evaluated. Qualitative and semiquantitative approaches were taken to estimate the likelihood of adverse effects occurring as a result of potential exposure of the assessment receptors to COPECs. Potential adverse affects to terrestrial plants were qualitatively assessed by comparing plant toxicity benchmarks with COPEC concentrations. Potential adverse impacts to aquatic biota were qualitatively assessed by comparing surface water and sediment quality criteria for the protection of aquatic life to surface water and sediment COPEC concentrations. For the semiquantitative predictive assessment, TRVs and estimated exposure rates were used to calculate HQs. The HQ was obtained by dividing the dose by an ecological TRV.

To assess the potential impact of COPEC concentrations in surface soil on terrestrial plant species, the EPCs from each site were compared with available benchmark concentrations developed for the protection of terrestrial plants. Benchmarks were exceeded by the COPEC EPC for multiple constituents. However, based on site reconnaissance performed, no signs of vegetative stress were noted.

To assess the potential impact of COPEC concentrations in surface water and sediment on aquatic biota, the EPCs for surface water and sediment were compared with available benchmark concentrations developed for the protection of aquatic life. No surface water COPEC concentrations from Snuffy or Humpy Creek exceeded the available benchmark for the protection of aquatic life. Benchmarks were exceeded for constituents in the LF006 pond (carbon disulfide, beta-BHC, and lead). The LF006 pond does not represent a significant aquatic habitat, and available evidence suggests that the pond is the result of construction activities and was never intended to contain aquatic life.

No sediment COPEC concentrations from Snuffy or Humpy Creek exceeded available benchmarks for the protection of aquatic life. Six constituents detected in the sediment of the LF006 pond were retained as COPECs for sediment; only one of these had concentrations exceeding the benchmark. The remaining constituents were retained because benchmarks were not available for comparison. Low frequency of detection for organic compounds reported in sediment samples collected at the Driftwood Bay RRS resulted in the maximum measured concentration being used as the EPC.

Estimates of potential for risks associated with exposure to environmental media were evaluated through a series of quantitative HQ calculations that compared receptor-specific exposure values with TRVs (Appendix I). HQs are not measures of risk, population-based statistics, or linearly scaled statistics. Accordingly, an HQ above 1, even exceedingly so, does not necessarily mean that there is even one individual expressing the toxicological effect associated with a given chemical to which it was exposed (Tannenbaum 2001; Bartell 1996).

COPECs from soil, rather than surface water, were risk drivers for all of the evaluated terrestrial receptors. Important routes of exposure were invertebrate and plant intake. HQs exceeding 1 were calculated for all receptors at all sites, with the exception of the arctic ground squirrel, least sandpiper, and northern shrike at SS007. Receptors, COCs, and HQs are as follows:

- SS007
  - Masked shrew
    - Naphthalene – 30
    - Phenanthrene – 300

- Pyrene – 500

- Sea otter
  - Phenanthrene – 30
  - Pyrene – 50

- LF006
  - Arctic ground squirrel
    - Phenanthrene – 3
    - Pyrene – 1
    - Lead – 200
  - Masked shrew
    - Anthracene – 50,000
    - Benzo(a)anthracene – 30
    - Benzo(a)pyrene – 30
    - Benzo(b)fluoranthene – 20
    - Benzo(k)fluoranthene – 30
    - Chrysene – 40
    - Dibenzo(a,h)anthracene – 6
    - Fluorene – 10,000
    - Indeno(1,2,3-c,d)pyrene – 20
    - Naphthalene – 500
    - Phenanthrene – 200,000
    - Pyrene – 400,000
    - Arsenic – 3
    - Barium – 10
    - Cadmium – 2
    - Selenium – 2
    - Lead – 7,000
  - Northern shrike
    - Lead – 3,000
  - Least sandpiper
    - Arsenic – 50
    - Barium – 70
    - Cadmium – 8
    - Selenium – 20
    - Lead – 700,000

- EDA
  - Arctic ground squirrel
    - Lead – 50

  - Masked shrew
    - Lead – 2,000
  - Northern shrike
    - Lead – 800
  - Least sandpiper
    - Lead – 200,000

HQs were also calculated for receptors exposed to contaminants at LF006 with results from the ash sample removed from the data. Receptors, COCs, and HQs for LF006 without data from the ash sample are as follows:

- Arctic ground squirrel
  - Lead – 200
- Masked shrew
  - Anthracene – 1,000
  - Benzo(a)anthracene – 2
  - Benzo(a)pyrene – 2
  - Benzo(b)fluoranthene – 2
  - Chrysene – 2
  - Fluorene – 4,000
  - Indeno(1,2,3-c,d)pyrene – 1
  - Naphthalene – 50
  - Phenanthrene – 5,000
  - Pyrene – 20,000
  - Lead – 7,000
- Northern shrike
  - Lead – 3,000
- Least sandpiper
  - Lead – 700,000

6.3 SUMMARY

Uncertainties associated with the human health and ecological risk assessments, particularly those related to contaminant contact rates such as exposure frequency and duration, contaminant bioavailability, and exposure point concentrations for COPECs, suggest that the results are overestimated (Sections 4.6 and 5.6). Results of the human health risk assessment indicate that cancer risk and noncancer hazard estimates for human receptors are below EPA and ADEC target levels, with the possible exception of potential exposure to lead. Ecological receptors may be adversely impacted by potential exposure to PAHs and lead in soil.

The risk assessment is based on current and anticipated land-use assumptions. To ensure that assumptions and results of the risk assessment remain valid, institutional controls (18 AAC 75.375[a][2]) may be appropriate for select sites.

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APPENDIX A

Alaska Department of Environmental Conservation Ecological Checklists and Human Health Conceptual Site Model Scoping Forms

A-1 Top Camp
A-2 Lower Camp

A-1 Top Camp

ECOLOGICAL CHECKLIST #1: GENERAL

1. Site Name: Driftwood Bay (Top Camp)

   - OT001- Former Composite Building and Antenna Arrays
   - FL009- Spill/Leak No. 1 at Septic Tank
   - WP003- POL Waste Pit at Composite Building
   - Burned Battery Area

2. Location: Unalaska Island, Alaska, 13.5 miles northwest of Dutch Harbor

3. Latitude: 52.93444° North Latitude

4. Longitude: 168.73469° West Longitude

5. Approximate site area: 17 acres

6. Dates of site visits: 1985 SI, 1991 building demolition and soil excavation, 1995 PA/SI, 2000 sample collection and site inspection, 2005 completed a PA/SI which consisted of data collection at known source areas and road maintenance

7. Land use on the site:

7a. Historic land use: An archaeological survey of Driftwood Bay conducted in 1986 found evidence of potential archaeological sites along coast. There were no potential archaeological sites identified inland from the beach (Holmes 1986; University of Alaska Anchorage 2003).

Driftwood Bay RRS was one of 18 Distant Early Warning (DEW) Line stations constructed in Alaska between 1950 and 1959. Driftwood Bay RRS was made operational in 1961 to provide reliable communications for the DEW-Line station. Originally known as White Alice Communications Systems facilities, the Alaska Air Command redesignated these facilities as RRSs in 1969. Driftwood Bay RRS was deactivated in 1977, and all facility buildings and structures were demolished or removed in 1991 (USAF 1998).

The Top Camp area consists of the composite building and fuel storage areas, four antennas, a septic tank and outfall, a waste pit, and an area where batteries had been burned previously.

7b. Current land use: Dutch Harbor, the closest community to Driftwood Bay RRS, is located approximately 13.5 air miles to the southeast. There are no residents within 4 miles of the former facility. USAF currently owns most of the land under a Public

Land Order. A variety of land transfer options are possible. A portion of the land is right-of-way held by Notice of Record and could be transferred through Bureau of Land Management (BLM) to U.S. Fish and Wildlife Service (USFWS). Additional withdrawn land may also be transferred to USFWS by Public Land Order. Unalaska Corporation has filed interest on portions of the land and has selected, prioritized, and has existing entitlement on these tracts. Unalaska Corporation could select and receive portions through BLM. In addition, the Regional Aleut Corporation has filed interest, but the priority of selection is unknown, and the corporation has over-selected.

Interviews indicate that there is no current local use of the area The structures have been removed from the site; however, concrete pads from the building as well as the fuel storage tank and pipeline remain. Currently, land surrounding the facility is part of the Alaska Maritime National Wildlife Refuge and managed by USFWS (USAF 2005).

7c. Expected future land use: Subsequent land use will depend on the ultimate disposition of the land. If the land remains in Air Force possession, the land is likely to remain vacant, and the land use will likely be restricted to recreational and subsistence use. If the land is turned over to the local community (through the Bureau of Land Management), construction of residential property could occur although it isn't likely as access is limited. The only access to the site is by plane or boat (USAF 2005). Interviews from community members, pilots, U.S. Air Force, USFWS, boat charters, Dutch Harbor Outfitters, and Native corporations will be conducted to characterize the most likely future use scenario.

8. Land use surrounding the site: Current land use surrounding the site is limited to recreational and subsistence activities.

9. Describe movement of soil on the site: Historically, there has been significant movement of soils at the site. This includes initial construction of the site and site demolition. There is no agricultural use of the site. Soil erosion appears to be minimal. Heavy equipment operation is limited to work associated with investigation and potential cleanup of the site.

10. Identify sensitive environments: Unalaska Island is not a state designated critical habitat. The unnamed drainages near Driftwood Bay top camp are not perennial and are not listed as waters important for anadromous fishes (Johnson and Weiss 2006). This area has been classified as alpine tundra (USAF 1996). No known wetlands are in the vicinity of Top Camp.

The entire coastline of Unalaska Island is part of the Alaska Maritime National Wildlife Refuge. Measurable concentrations of contaminants are not expected to migrate from the site or to impact the Alaska Maritime National Wildlife Refuge.

No threatened or endangered species are known to inhabit the site area. Four known endangered species have ranges that span the vicinity of Unalaska Island: short-tailed albatross; humpback, right, and blue whales (USAF 2005). Additionally, in 2005 the southwest Alaska Distinct Population Segment of the northern sea otters was listed as federally threatened under the Endangered Species Act. It is not known if sea otters inhabit the coastal areas adjacent to the Driftwood Bay top camp.

11. Potential routes of offsite migration: A conceptual site model for the Top Camp area has been developed in accordance with ADEC guidelines. Migration routes for contaminants at the site include desorption from soils, volatilization, excavation, fugitive dust, and biouptake. Current data is not available to determine if groundwater is present at the Top Camp.

12. Depth of water table: Unknown for the top camp sites. Bedrock was encountered at approximately three feet below ground surface in two test pits excavated near the former composite building during the 2005 investigation.

13. Identify water bodies in the vicinity of the site: The unnamed freshwater drainages near Driftwood Bay top camp are not perennial and are not listed as waters important for anadromous fishes (Johnson and Weiss 2006). The Bering Sea (Driftwood Bay) lies approximately 3 miles east of the former composite building at the Top Camp site.

14. Incidence of flooding: None. Soils appear to be well drained and there is no evidence of flooding.

ECOLOGICAL CHECKLIST #2: TERRESTRIAL

A. Wooded Areas

1. Are there wooded areas at the site: No

2. Percentage of site wooded: None

3. Dominant type of vegetation: Not applicable

4. Dominant tree size by diameter: Not applicable

B. Shrub/Scrub

1. Is there shrub/scrub vegetation present at the site: Yes. Tundra vegetation is present immediately surrounding the site.

2. Percentage of site covered with shrub/scrub: Unknown.

3. Dominant type of vegetation: Vegetation in the top camp area is typical of the tundra vegetation found in the Aleutian Islands. There are no known species lists of documented plants for this site.

4. Dominant height of shrub/scrub vegetation: Unknown.

5. Shrub/scrub density: In areas where surface soils have not been disturbed, the tundra vegetation is generally dense.

C. Open Areas

1. Are there open (bare, barren) field areas present at the site: Yes. Vegetation has not reestablished itself in areas where soil was previously disturbed during remedial actions.

2. Percentage of site open field: Approximately 1.2 acres

3. Dominant type of plant: None

4. Dominant height of dominant plant: Not applicable

5. Shrub/scrub density: Sparse

ECOLOGICAL CHECKLIST #3: AQUATIC-FLOWING SYSTEMS

There are intermittent unnamed drainages near Driftwood Bay top camp. Substrate and bank heights are unknown. There is not a regular known discharge from the site to the water body or discharge from the water body to the site. No aquatic vegetation is expected to be present. The presence of other aquatic organisms has not been verified.

ECOLOGICAL CHECKLIST #4: AQUATIC NON-FLOWING SYSTEMS

Not applicable

ECOLOGICAL CHECKLIST #5: WETLANDS

Not applicable

Human Health Conceptual Site Model
Scoping Form

Site Name: Driftwood Bay - Top Camp (Alpine Zone)

File Number: ____________________

Completed by: Jacobs Engineering

Introduction

The form should be used to reach agreement with the Alaska Department of Environmental Conservation (DEC) about which exposure pathways should be further investigated during site characterization. From this information, a CSM graphic and text must be submitted with the site characterization work plan.

***General Instructions:* Follow the italicized instructions in each section below.**

1. *General Information:*

Sources *(check potential sources at the site)*

- [x] USTs
- [x] ASTs
- [x] Dispensers/fuel loading racks
- [x] Drums
- [ ] Vehicles
- [x] Landfills
- [x] Transformers
- [x] Other: Burned batteries; septic outfall

Release Mechanisms *(check potential release mechanisms at the site)*

- [x] Spills
- [x] Leaks
- [x] Direct discharge
- [x] Burning
- [ ] Other: ____________________

Impacted Media *(check potentially-impacted media at the site)*

- [x] Surface soil (0-2 feet bgs*)
- [x] Subsurface Soil (>2 feet bgs)
- [x] Air
- [ ] Groundwater
- [x] Surface water
- [ ] Other: ____________________

Receptors *(check receptors that could be affected by contamination at the site)*

- [ ] Residents (adult or child)
- [ ] Commercial or industrial worker
- [ ] Construction worker
- [ ] Subsistence harvester (i.e., gathers wild foods)
- [ ] Subsistence consumer (i.e., eats wild foods)
- [x] Site visitor
- [x] Trespasser
- [x] Recreational user
- [ ] Farmer
- [x] Other: Unforseen future land users

* bgs – below ground surface

2. **Exposure Pathways:** *(The answers to the following questions will identify complete exposure pathways at the site. Check each box where the answer to the question is "yes".)*

a) **Direct Contact –**

1 Incidental Soil Ingestion

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

If both boxes are checked, label this pathway complete: complete

2 Dermal Absorption of Contaminants from Soil

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

Can the soil contaminants permeate the skin? (Contaminants listed below, or within the groups listed below, should be evaluated for dermal absorption). ☑

Arsenic	Lindane
Cadmium	PAHs
Chlordane	Pentachlorophenol
2,4-dichlorophenoxyacetic acid	PCBs
Dioxins	SVOCs
DDT	

If all of the boxes are checked, label this pathway complete: complete

b) **Ingestion –**

1 Ingestion of Groundwater

Have contaminants been detected or are they expected to be detected in the groundwater, OR are contaminants expected to migrate to groundwater in the future? ☑

Could the potentially affected groundwater be used as a current or future drinking water source? *Please note, only leave the box unchecked if ADEC has determined the groundwater is not a currently or reasonably expected future source of drinking water according to 18 AAC 75.350.* ☐

If both the boxes are checked, label this pathway complete: __________

2 **Ingestion of Surface Water**

Have contaminants been detected or are they expected to be detected in surface water OR are contaminants expected to migrate to surface water in the future? ☑

Could potentially affected surface water bodies be used, currently or in the future, as a drinking water source? *Consider both public water systems and private use (i.e., during residential, recreational or subsistence activities).* ☐

If both boxes are checked, label this pathway complete: ____________

3 **Ingestion of Wild Foods**

Is the site in an area that is used or reasonably could be used for hunting, fishing, or harvesting of wild food? ☑

Do the site contaminants have the potential to bioaccumulate (*see* Appendix A)? ☑

Are site contaminants located where they would have the potential to be taken up into biota? (i.e. the top 6 feet of soil, in groundwater that could be connected to surface water, etc.) ☑

If all of the boxes are checked, label this pathway complete: complete

c) Inhalation

1 **Inhalation of Outdoor Air**

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

Are the contaminants in soil volatile (*See Appendix B*)? ☑

If all of the boxes are checked, label this pathway complete: complete

2 **Inhalation of Indoor Air**

Are occupied buildings on the site or reasonably expected to be placed on the site in an area that could be affected by contaminant vapors? (i.e., within 100 feet, horizontally or vertically, of the contaminated soil or groundwater, or subject to "preferential pathways" that promote easy airflow, like utility conduits or rock fractures) ☐

Are volatile compounds present in soil or groundwater (*See Appendix C*)? ☐

If both boxes are checked, label this pathway complete: ____________

3. *Additional Exposure Pathways:* *(Although there are no definitive questions provided in this section, these exposure pathways should also be considered at each site. Use the guidelines provided below to determine if further evaluation of each pathway is warranted.)*

Dermal Exposure to Contaminants in Groundwater and Surface Water

Exposure from this pathway may need to be assessed only in cases where DEC water-quality or drinking-water standards are not being applied as cleanup levels. Examples of conditions that may warrant further investigation include:

- Climate permits recreational use of waters for swimming,
- Climate permits exposure to groundwater during activities, such as construction, without protective clothing, or
- Groundwater or surface water is used for household purposes.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Inhalation of Volatile Compounds in Household Water

Exposure from this pathway may need to be assessed only in cases where DEC water-quality or drinking-water standards are not being applied as cleanup levels. Examples of conditions that may warrant further investigation include:

- The contaminated water is used for household purposes such as showering, laundering, and dish washing, <u>and</u>
- The contaminants of concern are volatile (common volatile contaminants are listed in Appendix B)

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Inhalation of Fugitive Dust

Generally DEC soil ingestion cleanup levels in Table B1 of 18 AAC 75 are protective of this pathway, although this is not true in the case of chromium. Examples of conditions that may warrant further investigation include:

- Nonvolatile compounds are found in the top 2 centimeters of soil. The top 2 centimeters of soil are likely to be dispersed in the wind as dust particles.
- Dust particles are less than 10 micrometers. This size can be inhaled and would be of concern for determining if this pathway is complete.

Check the box if further evaluation of this pathway is needed: ☑

Comments:

There did not appear to be a dust problem on the site due to snow and vegetation cover. Disturbance of the surface may create a dust concern.

Direct Contact with Sediment

This pathway involves people's hands being exposed to sediment, such as during recreational or some types of subsistence activities. People then incidentally **ingest** sediment from normal hand-to-mouth activities. In addition, **dermal absorption of contaminants** may be of concern if people come in contact with sediment and the contaminants are able to permeate the skin (see dermal exposure to soil section). This type of exposure is rare but it should be investigated if:

- Climate permits recreational activities around sediment, and/or
- Community has identified subsistence or recreational activities that would result in exposure to the sediment, such as clam digging.

ADEC soil ingestion cleanup levels are protective of direct contact with sediment. If they are determined to be over-protective for sediment exposure at a particular site, other screening levels could be adopted or developed.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Sediment, being particulate material redistributed by water or wind and deposited at the bottom of the body of water, was not found at the site. There is no permanent or long term water bodies at Top Camp

4. Other Comments *(Provide other comments as necessary to support the information provided in this form.)*

APPENDIX A

BIOACCUMULATIVE COMPOUNDS

Table A-1: List of Compounds of Potential Concern for Bioaccumulation

Organic compounds are identified as bioaccumulative if they have a BCF equal to or greater than 1.000 or a log K_{ow} greater than 3.5. Inorganic compounds are identified as bioaccumulative if they are listed as such by EPA (2000). Those compounds in Table X of 18 AAC 75.345 that are bioaccumulative, based on the definition above, are listed below.

Aldrin	DDT	Lead
Arsenic	Dibenzo(a,h)anthracene	Mercury
Benzo(a)anthracene	Dieldrin	Methoxychlor
Benzo(a)pyrene	Dioxin	Nickel
Benzo(b)fluoranthene	Endrin	PCBs
Benzo(k)fluoranthene	Fluoranthene	
Cadmium	Heptachlor	Pyrene
Chlordane	Heptachlor epoxide	Selenium
Chrysene	Hexachlorobenzene	Silver
Copper	Hexachlorocyclopentadiene	Toxaphene
DDD	Indeno(1,2,3-c,d)pyrene	Zinc
DDE		

Because BCF values can relatively easily be measured or estimated, the BCF is frequently used to determine the potential for a chemical to bioaccumulate. A compound with a BCF greater than 1,000 is considered to bioaccumulate in tissue (EPA 2004b).

For inorganic compounds, the BCF approach has not been shown to be effective in estimating the compound's ability to bioaccumulate. Information available, either through scientific literature or site-specific data, regarding the bioaccumulative potential of an inorganic site contaminant should be used to determine if the pathway is complete.

The list was developed by including organic compounds that either have a BCF equal to or greater than 1,000 or a log K_{ow} greater than 3.5 and inorganic compounds that are listed by the United States Environmental Protection Agency (EPA) as being bioaccumulative (EPA 2000). The BCF can also be estimated from a chemical's physical and chemical properties. A chemical's octanol-water partitioning coefficient (K_{ow}) along with defined regression equations can be used to estimate the BCF. EPA's Persistent, Bioaccumulative, and Toxic (PBT) Profiler (EPA 2004) can be used to estimate the BCF using the K_{ow} and linear regressions presented by Meylan et al. (1996). The PBT Profiler is located at http://www.pbtprofiler.net/. For compounds not found in the PBT Profiler, DEC recommends using a log K_{ow} greater than 3.5 to determine if a compound is bioaccumulative.

APPENDIX B

VOLATILE COMPOUNDS

Table B-1: List of Volatile Compounds of Potential Concern
Common volatile contaminants of concern at contaminated sites. A chemical is defined as volatile if the Henry's Law constant is 1×10^{-5} atm-m^3/mol or greater and the molecular weight less than 200 g/mole (g/mole; EPA 2004a). Those compounds in Table X of 18 AAC 75.345 that are volatile, based on the definition above, are listed below.

Acenaphthene	1,4-dichlorobenzene	Pyrene
Acetone	1,1-dichloroethane	Styrene
Anthracene	1,2-dichloroethane	1,1,2,2-tetrachloroethane
Benzene	1,1-dichloroethylene	Tetrachloroethylene
Bis(2-chlorethyl)ether	Cis-1,2-dichloroethylene	Toluene
Bromodichloromethane	Trans-1,2-dichloroethylene	1,2,4-trichlorobenzene
Carbon disulfide	1,2-dichloropropane	1,1,1-trichloroethane
Carbon tetrachloride	1,3-dichloropropane	1,1,2-trichloroethane
Chlorobenzene	Ethylbenzene	Trichloroethylene
Chlorodibromomethane	Fluorene	Vinyl acetate
Chloroform	Methyl bromide	Vinyl chloride
2-chlorophenol	Methylene chloride	Xylenes
Cyanide	Naphthalene	GRO
1,2-dichlorobenzene	Nitrobenzene	DRO

APPENDIX C

COMPOUNDS OF CONCERN FOR VAPOR MIGRATION

Table C-1: List of Compounds of Potential Concern for the Vapor Migration

A chemical is considered sufficiently toxic if the vapor concentration of the pure component poses an incremental lifetime cancer risk greater than 10-6 or a non-cancer hazard index greater than 1. A chemical is considered sufficiently volatile if it's Henry's Law constant is 1×10^{-5} atm-m^3/mol or greater.

Acenaphthene	Dibenzofuran	Hexachlorobenzene
Acetaldehyde	1,2-Dibromo-3-chloropropane	Hexachlorocyclopentadiene
Acetone	1,2-Dibromoethane (EDB)	Hexachloroethane
Acetonitrile	1,3-Dichlorobenzene	Hexane
Acetophenone	1,2-Dichlorobenzene	Hydrogen cyanide
Acrolein	1,4-Dichlorobenzene	Isobutanol
Acrylonitrile	2-Nitropropane	Mercury (elemental)
Aldrin	N-Nitroso-di-n-butylamine	Methacrylonitrile
alpha-HCH (alpha-BHC)	n-Propylbenzene	Methoxychlor
Benzaldehyde	o-Nitrotoluene	Methyl acetate
Benzene	o-Xylene	Methyl acrylate
Benzo(b)fluoranthene	p-Xylene	Methyl bromide
Benzylchloride	Pyrene	Methyl chloride chloromethane)
beta-Chloronaphthalene	sec-Butylbenzene	Methylcyclohexane
Biphenyl	Styrene	Methylene bromide
Bis(2-chloroethyl)ether	tert-Butylbenzene	Methylene chloride
Bis(2-chloroisopropyl)ether	1,1,1,2-Tetrachloroethane	Methylethylketone (2-butanone)
Bis(chloromethyl)ether	1,1,2,2-Tetrachloroethane	Methylisobutylketone
Bromodichloromethane	Tetrachloroethylene	Methylmethacrylate
Bromoform	Dichlorodifluoromethane	2-Methylnaphthalene
1,3-Butadiene	1,1-Dichloroethane	MTBE
Carbon disulfide	1,2-Dichloroethane	m-Xylene
Carbon tetrachloride	1,1-Dichloroethylene	Naphthalene
Chlordane	1,2-Dichloropropane	n-Butylbenzene
2-Chloro-1,3-butadiene (chloroprene)	1,3-Dichloropropene	Nitrobenzene
Chlorobenzene	Dieldrin	Toluene
1-Chlorobutane	Endosulfan	trans-1,2-Dichloroethylene
Chlorodibromomethane	Epichlorohydrin	1,1,2-Trichloro-1,2,2-trifluoroethane
Chlorodifluoromethane	Ethyl ether	1,2,4-Trichlorobenzene
Chloroethane (ethyl chloride)	Ethylacetate	1,1,2-Trichloroethane
Chloroform	Ethylbenzene	1,1,1-Trichloroethane
2-Chlorophenol	Ethylene oxide	Trichloroethylene
2-Chloropropane	Ethylmethacrylate	Trichlorofluoromethane
Chrysene	Fluorene	1,2,3-Trichloropropane
cis-1,2-Dichloroethylene	Furan	1,2,4-Trimethylbenzene
Crotonaldehyde (2-butenal)	Gamma-HCH (Lindane)	1,3,5-Trimethylbenzene
Cumene	Heptachlor	Vinyl acetate
DDE	Hexachloro-1,3-butadiene	Vinyl chloride (chloroethene)

Source: EPA 2002.

A-2 Lower Camp

Human Health Conceptual Site Model
Scoping Form

Site Name: Driftwood Bay - Lower Camp

File Number: ____________________

Completed by: Jacobs Engineering

Introduction

The form should be used to reach agreement with the Alaska Department of Environmental Conservation (DEC) about which exposure pathways should be further investigated during site characterization. From this information, a CSM graphic and text must be submitted with the site characterization work plan.

General Instructions: Follow the italicized instructions in each section below.

1. *General Information:*

Sources *(check potential sources at the site)*

- [x] USTs
- [x] ASTs
- [x] Dispensers/fuel loading racks
- [x] Drums
- [x] Vehicles
- [x] Landfills
- [x] Transformers
- [x] Other: Batteries

Release Mechanisms *(check potential release mechanisms at the site)*

- [x] Spills
- [x] Leaks
- [x] Direct discharge
- [x] Burning
- [ ] Other: ____________

Impacted Media *(check potentially-impacted media at the site)*

- [x] Surface soil (0-2 feet bgs*)
- [x] Subsurface Soil (>2 feet bgs)
- [x] Air
- [x] Groundwater
- [x] Surface water
- [ ] Other: ____________

Receptors (*check receptors that could be affected by contamination at the site)*

- [ ] Residents (adult or child)
- [ ] Commercial or industrial worker
- [ ] Construction worker
- [ ] Subsistence harvester (i.e., gathers wild foods)
- [ ] Subsistence consumer (i.e., eats wild foods)
- [x] Site visitor
- [x] Trespasser
- [x] Recreational user
- [ ] Farmer
- [x] Other: Unforseen future land users

* bgs – below ground surface

2. **Exposure Pathways:** *(The answers to the following questions will identify complete exposure pathways at the site. Check each box where the answer to the question is "yes".)*

a) **Direct Contact –**

1 Incidental Soil Ingestion

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

If both boxes are checked, label this pathway complete: complete

2 Dermal Absorption of Contaminants from Soil

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

Can the soil contaminants permeate the skin? (Contaminants listed below, or within the groups listed below, should be evaluated for dermal absorption). ☑

Arsenic	Lindane
Cadmium	PAHs
Chlordane	Pentachlorophenol
2,4-dichlorophenoxyacetic acid	PCBs
Dioxins	SVOCs
DDT	

If all of the boxes are checked, label this pathway complete: complete

b) **Ingestion –**

1 Ingestion of Groundwater

Have contaminants been detected or are they expected to be detected in the groundwater, OR are contaminants expected to migrate to groundwater in the future? ☑

Could the potentially affected groundwater be used as a current or future drinking water source? *Please note, only leave the box unchecked if ADEC has determined the groundwater is not a currently or reasonably expected future source of drinking water according to 18 AAC 75.350.* ☐

If both the boxes are checked, label this pathway complete: ____________

Note- A Groundwater Use Determination under Section 350 has been completed.

2 Ingestion of Surface Water

Have contaminants been detected or are they expected to be detected in surface water OR are contaminants expected to migrate to surface water in the future? ☐

Could potentially affected surface water bodies be used, currently or in the future, as a drinking water source? *Consider both public water systems and private use (i.e., during residential, recreational or subsistence activities).* ☑

If both boxes are checked, label this pathway complete: ________________

3 Ingestion of Wild Foods

Is the site in an area that is used or reasonably could be used for hunting, fishing, or harvesting of wild food? ☑

Do the site contaminants have the potential to bioaccumulate (*see* Appendix A)? ☑

Are site contaminants located where they would have the potential to be taken up into biota? (i.e. the top 6 feet of soil, in groundwater that **could be** connected to surface water, etc.) ☑

If all of the boxes are checked, label this pathway complete: complete

c) Inhalation

1 Inhalation of Outdoor Air

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

Are the contaminants in soil volatile (*See Appendix B*)? ☐

If all of the boxes are checked, label this pathway complete: ________________

2 Inhalation of Indoor Air

Are occupied buildings on the site or reasonably expected to be placed on the site in an area that could be affected by contaminant vapors? (i.e., within 100 feet, horizontally or vertically, of the contaminated soil or groundwater, <u>or</u> subject to "preferential pathways" that promote easy airflow, like utility conduits or rock fractures) ☐

Are volatile compounds present in soil or groundwater (*See Appendix C*)? ☑

If both boxes are checked, label this pathway complete: ________________

3. Additional Exposure Pathways: *(Although there are no definitive questions provided in this section, these exposure pathways should also be considered at each site. Use the guidelines provided below to determine if further evaluation of each pathway is warranted.)*

Dermal Exposure to Contaminants in Groundwater and Surface Water

Exposure from this pathway may need to be assessed only in cases where DEC water-quality or drinking-water standards are not being applied as cleanup levels. Examples of conditions that may warrant further investigation include:

- o Climate permits recreational use of waters for swimming,
- o Climate permits exposure to groundwater during activities, such as construction, without protective clothing, or
- o Groundwater or surface water is used for household purposes.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Inhalation of Volatile Compounds in Household Water

Exposure from this pathway may need to be assessed only in cases where DEC water-quality or drinking-water standards are not being applied as cleanup levels. Examples of conditions that may warrant further investigation include:

- o The contaminated water is used for household purposes such as showering, laundering, and dish washing, <u>and</u>
- o The contaminants of concern are volatile (common volatile contaminants are listed in Appendix B)

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Inhalation of Fugitive Dust

Generally DEC soil ingestion cleanup levels in Table B1 of 18 AAC 75 are protective of this pathway, although this is not true in the case of chromium. Examples of conditions that may warrant further investigation include:

- Nonvolatile compounds are found in the top 2 centimeters of soil. The top 2 centimeters of soil are likely to be dispersed in the wind as dust particles.
- Dust particles are less than 10 micrometers. This size can be inhaled and would be of concern for determining if this pathway is complete.

Check the box if further evaluation of this pathway is needed: ☐

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Comments:

Sampling for speciated Chromium was conducted throughout the site without any readings exceeding any method two criteria.

Direct Contact with Sediment

This pathway involves people's hands being exposed to sediment, such as during recreational or some types of subsistence activities. People then incidentally **ingest** sediment from normal hand-to-mouth activities. In addition, **dermal absorption of contaminants** may be of concern if people come in contact with sediment and the contaminants are able to permeate the skin (see dermal exposure to soil section). This type of exposure is rare but it should be investigated if:

- Climate permits recreational activities around sediment, and/or
- Community has identified subsistence or recreational activities that would result in exposure to the sediment, such as clam digging.

ADEC soil ingestion cleanup levels are protective of direct contact with sediment. If they are determined to be over-protective for sediment exposure at a particular site, other screening levels could be adopted or developed.

Check the box if further evaluation of this pathway is needed: ☑

Comments:

Fishing for halibut and salmon occurs in Driftwood Bay and could present an activity that would present a potential exposure to sediment through contact with the hands.

4. Other Comments *(Provide other comments as necessary to support the information provided in this form.)*

APPENDIX A

BIOACCUMULATIVE COMPOUNDS

Table A-1: List of Compounds of Potential Concern for Bioaccumulation

Organic compounds are identified as bioaccumulative if they have a BCF equal to or greater than 1,000 or a log K_{ow} greater than 3.5. Inorganic compounds are identified as bioaccumulative if they are listed as such by EPA (2000). Those compounds in Table X of 18 AAC 75.345 that are bioaccumulative, based on the definition above, are listed below.

Aldrin	DDT	Lead
Arsenic	Dibenzo(a,h)anthracene	Mercury
Benzo(a)anthracene	Dieldrin	Methoxychlor
Benzo(a)pyrene	Dioxin	Nickel
Benzo(b)fluoranthene	Endrin	PCBs
Benzo(k)fluoranthene	Fluoranthene	
Cadmium	Heptachlor	Pyrene
Chlordane	Heptachlor epoxide	Selenium
Chrysene	Hexachlorobenzene	Silver
Copper	Hexachlorocyclopentadiene	Toxaphene
DDD	Indeno(1,2,3-c,d)pyrene	Zinc
DDE		

Because BCF values can relatively easily be measured or estimated, the BCF is frequently used to determine the potential for a chemical to bioaccumulate. A compound with a BCF greater than 1,000 is considered to bioaccumulate in tissue (EPA 2004b).

For inorganic compounds, the BCF approach has not been shown to be effective in estimating the compound's ability to bioaccumulate. Information available, either through scientific literature or site-specific data, regarding the bioaccumulative potential of an inorganic site contaminant should be used to determine if the pathway is complete.

The list was developed by including organic compounds that either have a BCF equal to or greater than 1,000 or a log K_{ow} greater than 3.5 and inorganic compounds that are listed by the United States Environmental Protection Agency (EPA) as being bioaccumulative (EPA 2000). The BCF can also be estimated from a chemical's physical and chemical properties. A chemical's octanol-water partitioning coefficient (K_{ow}) along with defined regression equations can be used to estimate the BCF. EPA's Persistent, Bioaccumulative, and Toxic (PBT) Profiler (EPA 2004) can be used to estimate the BCF using the K_{ow} and linear regressions presented by Meylan et al. (1996). The PBT Profiler is located at http://www.pbtprofiler.net/. For compounds not found in the PBT Profiler, DEC recommends using a log K_{ow} greater than 3.5 to determine if a compound is bioaccumulative.

APPENDIX B

VOLATILE COMPOUNDS

Table B-1: List of Volatile Compounds of Potential Concern

Common volatile contaminants of concern at contaminated sites. A chemical is defined as volatile if the Henry's Law constant is 1 x 10^{-5} atm-m^3/mol or greater and the molecular weight less than 200 g/mole (g/mole; EPA 2004a). Those compounds in Table X of 18 AAC 75.345 that are volatile, based on the definition above, are listed below.

Acenaphthene	1,4-dichlorobenzene	Pyrene
Acetone	1,1-dichloroethane	Styrene
Anthracene	1,2-dichloroethane	1,1,2,2-tetrachloroethane
Benzene	1,1-dichloroethylene	Tetrachloroethylene
Bis(2-chlorethyl)ether	Cis-1,2-dichloroethylene	Toluene
Bromodichloromethane	Trans-1,2-dichloroethylene	1,2,4-trichlorobenzene
Carbon disulfide	1,2-dichloropropane	1,1,1-trichloroethane
Carbon tetrachloride	1,3-dichloropropane	1,1,2-trichloroethane
Chlorobenzene	Ethylbenzene	Trichloroethylene
Chlorodibromomethane	Fluorene	Vinyl acetate
Chloroform	Methyl bromide	Vinyl chloride
2-chlorophenol	Methylene chloride	Xylenes
Cyanide	Naphthalene	GRO
1,2-dichlorobenzene	Nitrobenzene	DRO

APPENDIX C

COMPOUNDS OF CONCERN FOR VAPOR MIGRATION

Table C-1: List of Compounds of Potential Concern for the Vapor Migration

A chemical is considered sufficiently toxic if the vapor concentration of the pure component poses an incremental lifetime cancer risk greater than 10-6 or a non-cancer hazard index greater than 1. A chemical is considered sufficiently volatile if it's Henry's Law constant is 1 x 10^{-5} atm-m^3/mol or greater.

Acenaphthene	Dibenzofuran	Hexachlorobenzene
Acetaldehyde	1,2-Dibromo-3-chloropropane	Hexachlorocyclopentadiene
Acetone	1,2-Dibromoethane (EDB)	Hexachloroethane
Acetonitrile	1,3-Dichlorobenzene	Hexane
Acetophenone	1,2-Dichlorobenzene	Hydrogen cyanide
Acrolein	1,4-Dichlorobenzene	Isobutanol
Acrylonitrile	2-Nitropropane	Mercury (elemental)
Aldrin	N-Nitroso-di-n-butylamine	Methacrylonitrile
alpha-HCH (alpha-BHC)	n-Propylbenzene	Methoxychlor
Benzaldehyde	o-Nitrotoluene	Methyl acetate
Benzene	o-Xylene	Methyl acrylate
Benzo(b)fluoranthene	p-Xylene	Methyl bromide
Benzylchloride	Pyrene	Methyl chloride chloromethane)
beta-Chloronaphthalene	sec-Butylbenzene	Methylcyclohexane
Biphenyl	Styrene	Methylene bromide
Bis(2-chloroethyl)ether	tert-Butylbenzene	Methylene chloride
Bis(2-chloroisopropyl)ether	1,1,1,2-Tetrachloroethane	Methylethylketone (2-butanone)
Bis(chloromethyl)ether	1,1,2,2-Tetrachloroethane	Methylisobutylketone
Bromodichloromethane	Tetrachloroethylene	Methylmethacrylate
Bromoform	Dichlorodifluoromethane	2-Methylnaphthalene
1,3-Butadiene	1,1-Dichloroethane	MTBE
Carbon disulfide	1,2-Dichloroethane	m-Xylene
Carbon tetrachloride	1,1-Dichloroethylene	Naphthalene
Chlordane	1,2-Dichloropropane	n-Butylbenzene
2-Chloro-1,3-butadiene (chloroprene)	1,3-Dichloropropene	Nitrobenzene
Chlorobenzene	Dieldrin	Toluene
1-Chlorobutane	Endosulfan	trans-1,2-Dichloroethylene
Chlorodibromomethane	Epichlorohydrin	1,1,2-Trichloro-1,2,2-trifluoroethane
Chlorodifluoromethane	Ethyl ether	1,2,4-Trichlorobenzene
Chloroethane (ethyl chloride)	Ethylacetate	1,1,2-Trichloroethane
Chloroform	Ethylbenzene	1,1,1-Trichloroethane
2-Chlorophenol	Ethylene oxide	Trichloroethylene
2-Chloropropane	Ethylmethacrylate	Trichlorofluoromethane
Chrysene	Fluorene	1,2,3-Trichloropropane
cis-1,2-Dichloroethylene	Furan	1,2,4-Trimethylbenzene
Crotonaldehyde (2-butenal)	Gamma-HCH (Lindane)	1,3,5-Trimethylbenzene
Cumene	Heptachlor	Vinyl acetate
DDE	Hexachloro-1,3-butadiene	Vinyl chloride (chloroethene)

Source: EPA 2002.

APPENDIX B

Driftwood Bay Risk Assessment Scoping Meeting Project Notes

Driftwood Bay Risk Assessment
SCOPING MEETING CHECKLIST/MEETING MINUTES

✔ **Discussion Points**

- **GENERAL SITE INFORMATION**
  - History of use (See Attached)
  - Current land use (See Attached)
  - Map of site
  - Currently available relevant documents (See Attached)
- **PURPOSE OF ASSESSMENT**
  - The purpose of the Driftwood Bay Radio Relay Station (RRS) risk assessment will be to estimate and quantify any potential risks that site contamination could pose to human health or the environment. The results of the risk assessment are intended to guide risk management decisions at the Driftwood Bay RRS.
  - Develop ACLs based on reasonably expected future use.
  - Develop preliminary remediation goals based on reasonably expected future use.
  - Human Health Management Goals: Cumulative carcinogenic risk goal = $1X\ 10^{-5}$
    HI goal = 1.0
  - Ecological Goals: No adverse effects to sensitive species or habitat.
- **USE OF DETERMINISTIC VS. PROBABILISTIC RA TECHNIQUES**
  The human health risk assessment will use only deterministic techniques. No Monte Carlo analysis will be performed.
- **USE OF MULTI-INCREMENTAL SAMPLING**
- **STUDY AREA**
  - Boundary of study area
  - Use of operable units will be adjusted based on RI findings. Currently, we will look at the Lower Camp and the Upper Camp. As data is collected the operable units will be refined.
- **PRELIMINARY CSM**
  - Human health (Appendix A and Figures 2-1 and 2-3)
  - Ecological (Appendix A) Also need to take a look at salmon species using the streams (surface water and sediment samples) and comparing these results to benchmark values. Additionally, there is a potential of adding the sea otter to the indicator species based on F&W data. (ADEC to provide Fish and Wildlife study on salmon and sea otters)
  - Sensitive populations or environments
    Five known endangered or threatened species have ranges that span the vicinity of Unalaska Island: short-tailed albatross: humpback whales, right whales, sea otters, and blue whales (USAF 2005). ADEC suggests looking at Fish and Wildlife Sea Otter Surveys. During field work habitat for and presence of Sea Otters will be determined (This may necessitate the need for a biologist to certify Sea Otter habitat). Both moist tundra and wet tundra have been identified at the lower camp. Due to the presence of streams in the area, wet lands are suspected to exist.

- **Exposure Assessment**
  - Current use will be based on community survey results
  - Following the community survey, Jacobs will provide a table listing planned exposure assumptions based on current land use and recreational default values (from EPA).
  - Sediment and surface water samples from the stream will be collected to assess potential ecological impacts.
- **COPCs**
  - Preliminary identification of COPCs
    COPCs are GRO, DRO, RRO, BTEX, PAH, VOC, metals and PCBs
  - ARARs (See Attached)
  - Screening criteria reference for each media of concern **(Will be developed per RA Procedures Manual)**
- **DATA GAPS**
  - Quality and quantity of available data **(This data is summarized in the PA/SI)**
  - Additional sampling needs **(Per Systematic Meetings and Site Characterization Work Plan)**
  - Upcoming sampling and analysis plans **(Reference Site Characterization WP)**
- **DEVIATIONS FROM DEC GUIDANCE OR EPA PROTOCOL**
  No deviations from DEC Guidance or EPA protocol are anticipated.
- **LINES OF COMMUNICATION**
  - DEC/RP roles and responsibilities
  - Procedural issues to be resolved between Jacobs and ADEC (such as sources of screening values).
- **PUBLIC INVOLVEMENT**
  - Meetings needed and schedule (Will call the Native Corporations and inquire as to whether they are interested in attending a public meeting or not. Historically, attendance at public meetings in Dutch Harbor has been limited.)
  - Wendy Svarny-Hawthorne, CEO Unalaska Corp, will be contacted to see if they are interested in attending a public meeting.
  - Public meeting tentatively scheduled for April 2nd
  - Community Survey (Both Aleut and Unalaska Corps will be included in the survey)
- **SCHEDULE**
  - Document deliverable schedule (3/20/07) The site characterization work plan is also planned to be submitted during the week of March 19^{th}.
  - DEC review (3/20/07-4/20/07)
  - Fieldwork (6/1/07-8/3/07)
- **Misc.**
  - Data will be collected in order to calculate landfill volume estimates.

History of use: Driftwood Bay RRS was initially one of 18 Distant Early Warning (DEW) Line stations constructed in Alaska between 1950 and 1959. Driftwood Bay RRS was made operational in 1961 to provide reliable communications for the DEW-Line station. Originally known as White Alice Communications Systems facilities, the Alaska Air Command redesignated these facilities as RRSs in 1969. Driftwood Bay RRS was deactivated in 1977, and all facility buildings and structures were demolished or removed in 1991 (USAF 1998). All facility buildings and structures were demolished or removed, and oiled sand was excavated from the aboveground storage tank (AST) foundations in 1991 (USAF 1996). The buildings and structures were landfilled at Top Camp in 1991.

Current land use: Dutch Harbor, the closest community to Driftwood Bay RRS, is located approximately 13.5 air miles to the southeast. There are no residents within 4 miles of the former facility. USAF currently owns most of the land under a Public Land Order. A variety of land transfer options are possible. Currently, land surrounding the facility is part of the Alaska Maritime National Wildlife Refuge and managed by USF&WS (USAF 2005).

Map of site:

Currently available relevant documents: A series of investigations and removal actions have been completed at Driftwood Bay since the site was deactivated in 1977. Currently available relevant documents are:

University of Alaska Anchorage. 2003. *Driftwood Bay LRRS, Archaeological Survey, June 12-14, 2003: Cultural Heritage Studies—ENRI, University of Alaska Anchorage, for the US Air Force 611 ASG, Elmendorf AFB, MIPR02040156.*

United States Air Force (USAF). 2005. *Preliminary Assessment/Site Investigation, Driftwood Bay RRS, Alaska.* December.

USAF. 2002. *Management Action Plan, Driftwood Bay Radio Relay Station,* September.

USAF. 1996. *Final Preliminary Assessment/Site Investigation, Radio Relay Station, Driftwood Bay, Unalaska Island, Alaska.* January.

USAF. 2001. *Preliminary Site Inspection for Closed Solid Waste Landfills at Various Remote Air Force Installations in Alaska.* Draft Report. April.

STUDY AREA

OPERABLE UNITS

For investigation purposes, the Driftwood Bay RRS has been divided into 12 sites and two areas of concern:

Top Camp

- OT001- Former Composite Building and Antenna Arrays
- FL009- Spill/Leak No. 1 at septic tank
- WP003- POL Waste Pit at composite building
- Burned Battery Area

Lower Camp

- LF006- old disposal site
- SS04- spill/leak No.4 at drum storage area
- SS007- spill/leak No.7 at POL tank farm
- SS08- spill/leak N0.8 at POL pipeline
- SS010- spill/leak N0.2 at former water supply pump house
- SS011- spill/leak No.3 at former lighting vault at runway
- Heavy Equipment Storage
- Quarry Area

APPENDIX C

Survey Questionnaires Conducted by Jacobs Engineering Group Inc.

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Community Input Survey for Driftwood Bay Radio Relay Station
611 CES Civilian Landing Permit Section

The U.S. Air Force is asking for community input regarding current and future use at the former Driftwood Bay Radio Relay Station on Unalaska Island. Your answers to the following questions will help us plan for the future of the facility.

Person surveyed: Nick Lemay

Date: 17 April 2007

1. How often do you issue landing permits for Driftwood Bay?

A civilian landing permit issued by USAF is required to legally land on the Driftwood Bay landing strip. However, based on experience at other closed sites, others may use the runway without permission. Such use constitutes trespass.

Prior to 2007, the last civilian landing permit issued for the Driftwood Bay landing strip was issued in 2005 for the runway repair and to support clean sweep operations. This permit was for a helicopter. A 2007 permit was issued for field work in support of site characterization.

Runway use also requires a PRP number (prior permission required). This provision requires runway users to contact 611 CES 24 hours prior to use to obtain permission and the PRP number. This allows 611 CES to de-conflict use and ensure that users are aware of other activities in the area.

2. Is there a particular time of year when landing permits are issued?

Mostly in summer. The runway is not maintained in winter.

3. When was the last time you issued a landing permit for Driftwood Bay, other than for the 2005 runway repair and the 2007 remedial investigation?

None known.

4. What did the permittees do there (hunting, fishing, berry picking, hiking, camping, etc.)?

The primary purpose has been to support Clean Sweep operations.

611 ASG also has a policy letter that allows landing for hunting, fishing, berry picking, hiking, camping, and similar purposes. However, no permits have been requested for such use.

5. How long did they stay?

Varies by project.

6. How often do they return to Driftwood Bay?

Varies.

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Community Input Survey for Driftwood Bay Radio Relay Station
Dutch Harbor Outfitters

The U.S. Air Force is asking for community input regarding current and future use at the former Driftwood Bay Radio Relay Station on Unalaska Island. Your answers to the following questions will help us plan for the future of the facility.

Person surveyed: Dean DeCuir of North Port Rental

Date: 17 April 2007

1. When was the last time you equipped someone to go to Driftwood Bay?

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2. How often do you equip groups or individuals for trips to Driftwood Bay?

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3. Is there a particular time of year when people travel to Driftwood Bay?

Summer

4. Are there particular areas at Driftwood Bay where your guests prefer to go?

Popular for halibut fishing; however, they don't tend to land. Salmon fishing is a possibility. Greg Hawthorn at Ace is really the fishing expert.

5. What did they go there to do (hunting, fishing, berry picking, hiking, camping, etc.?

Fishing only. No hunting, but fox trapping is a possibility --- fox trapping hasn't been popular for years. Trappers would only use the fox pelts.

6. How long did they stay?

Mostly day trips.

7. How often do individuals or groups return to Driftwood Bay?

Mostly locals. Tourists come only for bird watching and fishing. They tend to stay closer by town and roads systems.

8. What is the typical age of the people who take trips to Driftwood Bay?

Wide range, from 18-60 years old.

9. Do you equip both men and women or mostly men or women for Driftwood Bay?

Mostly local folks use the area, mostly men but some women. Most of the people in Dutch Harbor are men.

10. What areas on Unalaska Island are popular with visitors?

Accessible portions of the island, mostly closer bays.

11. Is there anything you would like to add?

Community Input Survey for Driftwood Bay Radio Relay Station
Dutch Harbor Outfitters

The U.S. Air Force is asking for community input regarding current and future use at the former Driftwood Bay Radio Relay Station on Unalaska Island. Your answers to the following questions will help us plan for the future of the facility.

Person surveyed: Greg Hawthorn of ACE

Date: 17 April 2007

1. When was the last time you equipped someone to go to Driftwood Bay?

Greg ran a fishing camp one harbor beyond Driftwood Bay. Prior to the Selindang Au oil spill, he traveled frequently over the summer season between Dutch Harbor, past Driftwood Bay, to the fishing camp. The camp attracted a steady business with a strong clientele that returned each year. The oil spill pretty much ended the business.

2. How often do you equip groups or individuals for trips to Driftwood Bay?

No one lands at Driftwood Bay. Landing at the beach is very tricky. The area at the mouth of the creek provides the best landing, but changes with every storm.

3. Is there a particular time of year when people travel to Driftwood Bay?

Summer

4. Are there particular areas at Driftwood Bay where your guests prefer to go?

Fishing for halibut in the bay.

5. What did they go there to do (hunting, fishing, berry picking, hiking, camping, etc.?

Halibut fishing in the bay. There is some pink and silver salmon fishing. No body goes on the land for berry picking, etc.

6. How long did they stay?

Day trips only – no one lands in Driftwood Bay.

7. How often do individuals or groups return to Driftwood Bay?

---

8. What is the typical age of the people who take trips to Driftwood Bay?

---

9. Do you equip both men and women or mostly men or women for Driftwood Bay?

---

10. What areas on Unalaska Island are popular with visitors?

---

11. Is there anything you would like to add?

The beach landing at Driftwood Bay is really hard.

A larger boat is required to get from Dutch Harbor to Driftwood Bay. Using a small skiff would be very dangerous. Good captains include Christine and Dan Graves and Scott Kerr. Even when the water in Dutch Harbor is flat calm, but head lands between Dutch Harbor and Driftwood Bay can have high surf. In addition to storms, the tides and water flowing through the passes between the Bering Sea and the Pacific Ocean have a large impact on the ability of boats to make the trip. It is best to plan to travel during the neap tides.

The bugs are really bad, especially the white socks.

Community Input Survey for Driftwood Bay Radio Relay Station Transporters (PenAir, Boat Charter Operators)

The U.S. Air Force is asking for community input regarding current and future use at the former Driftwood Bay Radio Relay Station on Unalaska Island. Your answers to the following questions will help us plan for the future of the facility.

Name: Jeff Hancock of Aleutian Adventure Sports

Date: 23 April 2007

1. How often do you transport passengers to Driftwood Bay?

This varies by year. None last year. However, Aleutian Adventure Sports did rent kayaks to four people who paddled from Unalaska to Makushin Bay and back (passing Driftwood Bay each way).

In 2005 Aleutian Adventure Sports dropped on person at Driftwood Bay who climbed Makushin Volcano and who returned via Broad Bay (not Driftwood Bay).

Kayakers traveling on the north side of Unalaska may use Driftwood Bay for camping.

2. Is there a particular time of year when you transport passengers to Driftwood Bay?

Summer time

3. When was the last time you transported someone to or from Driftwood Bay?

2005

4. What did they do there (hunting, fishing, berry picking, hiking, camping, etc.?

Kayak camping

Others use the area to access Makushin Volcano or to hike to Broad Bay (near Dutch Harbor)

5. How long did they stay?

Generally over night. They may stay longer if they get weathered in.

6. How often do they return to Driftwood Bay?

Most visitors only come once due to the costs of getting the Dutch Harbor. One of Aleutian Adventure Sports' clients is a pair of Japanese guests that return to the Aleutians year after year.

7. What is the typical age of the people who you transport to Driftwood Bay?

Generally 30 to 50 years old

8. Do you transport both men and women or mostly men or women?

Mostly male, some couples

9. Is there anything you would like to add?

Community Input Survey for Driftwood Bay Radio Relay Station Transporters (PenAir, Boat Charter Operators)

The U.S. Air Force is asking for community input regarding current and future use at the former Driftwood Bay Radio Relay Station on Unalaska Island. Your answers to the following questions will help us plan for the future of the facility.

Person surveyed: Dan Magone of Magone Marine Inc.

Date: 17 April 2007

1. How often do you transport passengers to Driftwood Bay?

Almost never since the White Alice site stopped operating.

Over the past 20 years, Dan has been to Driftwood Bay by boat and airplane.

2. Is there a particular time of year when you transport passengers to Driftwood Bay?

Summer.

3. When was the last time you transported someone to or from Driftwood Bay?

Dan was on site to bid on demolition of the radar facility. However, Magone Marine did not win the work.

Magone Marine last transported personnel to Driftwood Bay in 2005 in support of the runway repair operation.

4. What did they do there (hunting, fishing, berry picking, hiking, camping, etc.?

Other than supporting military projects, people going to Driftwood Bay are generally involved in Halibut fishing. Generally, they do not land. Landing at the beach is very difficult and can be dangerous.

5. How long did they stay?

While supporting projects, Magone Marine's stay would be very short. Drop off and pick up only.

6. How often do they return to Driftwood Bay?

Magone Marine drops people off in Driftwood Bay to support projects approximately once every two years.

7. What is the typical age of the people who you transport to Driftwood Bay?

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8. Do you transport both men and women or mostly men or women?

---

9. Is there anything you would like to add?

No locally owned small aircraft land at Driftwood Bay.

Community Input Survey for Driftwood Bay Radio Relay Station Transporters (PenAir, Boat Charter Operators)

The U.S. Air Force is asking for community input regarding current and future use at the former Driftwood Bay Radio Relay Station on Unalaska Island. Your answers to the following questions will help us plan for the future of the facility.

Person surveyed: Echo Burgess and Mercy of PenAir

Date: 17 April 2007

1. How often do you transport passengers to Driftwood Bay?

Mercy indicated that 3 or 4 trips had been made to Driftwood Bay over the last 9 months that she had been working at PenAir. However, she emphasized that she was not sure and that she only works there two days per week. She suggested that we ask Mercy.

Mercy indicated that they fly to Driftwood Bay once or twice per year.

2. Is there a particular time of year when you transport passengers to Driftwood Bay?

Summer

3. When was the last time you transported someone to or from Driftwood Bay?

Last summer.

4. What did they do there (hunting, fishing, berry picking, hiking, camping, etc.?

Unknown.

5. How long did they stay?

Estimated to be 2 or 3 days.

6. How often do they return to Driftwood Bay?

---

7. What is the typical age of the people who you transport to Driftwood Bay?

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8. Do you transport both men and women or mostly men or women?

---

9. Is there anything you would like to add?

Community Input Survey for Driftwood Bay Radio Relay Station
Transporters (PenAir, Boat Charter Operators)

The U.S. Air Force is asking for community input regarding current and future use at the former Driftwood Bay Radio Relay Station on Unalaska Island. Your answers to the following questions will help us plan for the future of the facility.

Person surveyed: Jimmer of Mac Enterprise

Date: 18 April 2007

1. How often do you transport passengers to Driftwood Bay?

Once for a charter and twice personally

2. Is there a particular time of year when you transport passengers to Driftwood Bay?

Summer time. Even then the conditions have to be ideal, the coastline is very exposed.

3. When was the last time you transported someone to or from Driftwood Bay?

2 years ago

4. What did they do there (hunting, fishing, berry picking, hiking, camping, etc.?

Charter: Construction and Air Force Personnel conducting runway repair activities.

Personal: Hiked around with cousin one time. Came back once alone and hiked around for a couple of hours.

5. How long did they stay?

Charter: No more than 8 hours

Personal: 2-3 hours on both personal trips to the area.

6. How often do they return to Driftwood Bay?

---

7. What is the typical age of the people who you transport to Driftwood Bay?

Charter: Mean age was about 35 years old.

Personal: Approximately 55 years old.

8. Do you transport both men and women or mostly men or women?

Only men have gone over so far.

9. Is there anything you would like to add?

People once talked about going over to try and bring back some fuel oil that was left at the old facility; however, the landing is very difficult.

Community Input Survey for Driftwood Bay Radio Relay Station
Ounalashka Corporation

The U.S. Air Force is asking for community input regarding current and future use at the former Driftwood Bay Radio Relay Station on Unalaska Island. Your answers to the following questions will help us plan for the future of the facility.

Person surveyed: Wendy Svarny-Hawthorne CEO of Ounalashka Corp.

Date: 17 April 2007

1. How often do your members travel to Driftwood Bay?

It is unknown how often shareholders in the corporation travel to Driftwood Bay. Travel off of the road system requires a larger boat.

OC does not monitor travel off of the road system.

Travel to McLease Lake, which is closer than Driftwood Bay, is much more common. Travel to Driftwood Bay exposes the boat to heavy surf.

2. Is there a particular time of year when they travel to Driftwood Bay?

Mostly summer.

3. Are there particular areas at Driftwood Bay where your members prefer to go?

None known.

4. What do they go there to do (hunting, fishing, berry picking, hiking, camping, etc.?

Not to Driftwood Bay. McLease Lake/Reese Bay is much more popular. Pink Salmon are available in Dutch Harbor, so no one would travel to Driftwood Bay to fish for Pink Salmon. There is a run of red salmon in McLease Lake/Reese Bay.

5. How long do they stay?

Mostly day trips

6. How often do they return to Driftwood Bay?

Not known

7. What is the typical age of your members who travel to Driftwood Bay?

Substance activities are conducted by all age groups within the native community. Only older members were eligible to become OC shareholders.

8. Do both men and women or mostly men or women go to Driftwood Bay?

Evenly split between men and women.

9. What areas on Unalaska Island do your members prefer for outdoor activities?

Areas close to Dutch Harbor.

10. Is there anything you would like to add?

OC Corporation has selected Driftwood Bay as part of their allotment.

OC Corporation is concerned about the landfill at lower camp.

Future use: OC Corporation's primary interest in the Driftwood Bay facility is associated with the nearby Makushin Volcano. The corporation is considering a geothermal power generation project that would use geothermal heat from the volcano. Electricity costs in Dutch Harbor are very high, running up to $1,000 per month for a household. If the geothermal power project at Makushin Volcano is executed, it would possibly make use of the landing strip at Driftwood Bay, which is the nearest one to the volcano. Other land options may be considered for a geothermal project other than the runway. Nearby bays or less lengthy options may be more appropriate. Other, closer, lower temperature geothermal heat sources are also being considered.

Tourism: The development of tourism on Unalaska is limited by the high prices charged for air fare by Alaska Airlines and PenAir. OC Corporation does not have any current plans to develop Driftwood Bay for tourism, but tourism development is possible. If it were to be developed for tourism, the primary draw would be the landing strip.

Community Input Survey for Driftwood Bay Radio Relay Station
U.S. Fish and Wildlife Service

The U.S. Air Force is asking for community input regarding current and future use at the former Driftwood Bay Radio Relay Station on Unalaska Island. Your answers to the following questions will help us plan for the future of the facility.

People surveyed: Greg Siekaniec, Refuge Manager and Kent Sundseth, Refuge Operations Specialist – Aleutians

Date: 7 May 2007

1. Is there a particular time of year when people travel to Driftwood Bay?

Local folks would generally know better.

2. Are there particular areas at Driftwood Bay where people prefer to go?

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3. What do they do there (hunting, fishing, berry picking, hiking, camping, etc.)?

Potentially there would be some resource gathering, things like berry picking. However, other areas are easier to visit. There is no big game in the area, so hunting would not be important.

4. How long do they stay?

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5. How often do individuals or groups return to Driftwood Bay?

USF&WS has not heard of any people specifically using Driftwood Bay.

6. What is the typical age of the people who go to Driftwood Bay?

--

7. Do both men and women or mostly men or women go to Driftwood Bay?

--

8. How often do employees of USFWS go to Driftwood Bay?

USF&WS personnel were flying over the area during the response to the Selendang Ayu wreck. However, USF&WS personnel would only have very short visits to the area, if any.

9. How long do they stay there?

Short periods, if any.

10. Are there particular areas they go to?

Little visitation to Driftwood Bay, if any. Site visits generally focus on areas of high bird or marine mammal density. For instance, if USF&WS had a Dutch Harbor office, it would focus efforts on monitoring sea bird colonies.

11. What do they do while they are there?

--

12. Are there any threatened or endangered plants or animals or species that require special protection or management at Driftwood Bay?

In the general area, but not necessarily in Driftwood Bay. Species of potential concern include:

Uplands: song sparrow, winter wrens, rosey finch
Beach area: oyster catchers
Wetlands: migrating water fowl
Marine: Stellar eiders, emperor geese, sea otters, bald eagle

13. Is there anything you would like to add?

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APPENDIX D

Summary of Proposed Ecological Assessment Endpoints and Primary Indicator Species

Summary of Proposed Ecological Assessment Endpoints and Primary Indicator Species

Default Assessment Endpoints	Aleutian Islands	Risk Assessment Area: Top Camp	Risk Assessment Area: Driftwood Bay Valley	Typical Tier I Assessment Method	Primary (bold) & Other Exposure Media
Primary Producers (Trophic Level 0)					
The potential for significant adverse effects on terrestrial soil plant species abundance, diversity, and primary production	All plants that obtain nutrients primarily from soil	X	X	Compare media concentration with lowest available phytotoxicity benchmarks for any plant species	**Surface soil**
The potential for significant adverse effects on terrestrial air plant species abundance, diversity, and primary production	All plants that obtain nutrients primarily from the air			Not evaluated under normal circumstances	**Air**
The potential for significant adverse effects on marine plant species abundance, diversity, and primary production	All plants that obtain nutrients primarily from marine water			Compare media concentrations with available, adjusted water quality criteria (preference for marine and chronic values)	**Marine Water**
The potential for significant adverse effects on marine semi-aquatic plant species abundance, diversity, and primary production	All plants that obtain nutrients primarily from marine sediment		X	Compare media concentrations with available, adjusted sediment quality criteria (preference for marine and chronic values); site-specific TOC adjustment when appropriate	**Marine Sediment** Marine Water
The potential for significant adverse effects on freshwater plant species abundance, diversity, and primary production	All plants that obtain nutrients primarily from fresh water		X	Compare media concentrations with available, adjusted water quality criteria (preference for freshwater and chronic values)	**Fresh Water**
The potential for significant adverse effects on freshwater semiaquatic plant species abundance, diversity, and primary production	All plants that obtain nutrients primarily from freshwater sediment		X	Compare media concentrations with available, adjusted sediment quality criteria (preference for freshwater and chronic values); site-specific TOC adjustment when appropriate	**Freshwater Sediment** Fresh Water
Herbivores and Detrivores (Trophic Levels 1 and 2)					
The potential for significant adverse effects on marine aquatic invertebrate community abundance and diversity	All marine aquatic invertebrates			Compare media concentrations with available, adjusted water quality criteria (preference for marine and chronic values)	**Marine Water**
The potential for significant adverse effects on marine benthic invertebrate community abundance and diversity	All marine benthic invertebrates		X	Compare media concentrations with available adjusted sediment quality criteria (Preference for marine and chronic values), site-specific TOC adjustments when appropriate	**Marine Sediment** Marine Water
The potential for significant adverse effects on freshwater aquatic invertebrate community abundance and diversity	All freshwater aquatic invertebrates		X	Compare media concentrations with available adjusted water quality criteria (preference for freshwater and chronic values)	**Fresh Water**
The potential for significant adverse effects on freshwater benthic invertebrate community abundance and diversity	All freshwater benthic invertebrates		X	Compare media concentrations with available adjusted sediment quality criteria (Preference for freshwater and chronic values), site-specific TOC adjustment when appropriate	**Freshwater Sediment** Fresh Water
The potential for significant adverse effects on soil invertebrate community abundance and diversity	All terrestrial invertebrates	X	X	Compare media concentrations with lowest available toxicity benchmarks for earthworms or other soil invertebrate species	**Surface Soil**

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Summary of Proposed Ecological Assessment Endpoints and Primary Indicator Species

Default Assessment Endpoints	Aleutian Islands	Risk Assessment Area: Top Camp	Risk Assessment Area: Driftwood Bay Valley	Typical Tier I Assessment Method	Primary (bold) & Other Exposure Media
The potential for significant adverse effects on marine fish detritivore abundance and diversity	All marine fish			Compare media concentrations with available adjusted water quality criteria (Preference for marine and chronic values)	**Marine Water**
The potential for significant adverse effects on freshwater fish detritivore abundance and diversity	All freshwater fish		X	Compare media concentrations with available adjusted water quality criteria (Preference for freshwater and chronic values)	**Fresh Water**
The potential for significant adverse effects on freshwater semi-aquatic avian herbivore abundance and diversity	Green-winged teal		X	Model dose from ingestion of water, sediment, and sediment-associated plants; compare with appropriate toxicity reference value	**Freshwater Sediment** Fresh Water
The potential for significant adverse effects on marine semi-aquatic avian herbivore abundance and diversity.	NA			Model dose from ingestion of marine sediment and marine-sediment-associated plants and compare with appropriate toxicity reference value	**Marine Sediment** Marine Water
The potential for significant adverse effects on terrestrial avian herbivore abundance and diversity	Willow Ptarmigan	X	X	Model dose associated with soil ingestion, surface water ingestion, and ingestion of soil-associated plants	**Surface Soil** Fresh Water
The potential for significant adverse effects on freshwater semi-aquatic mammalian herbivore abundance and diversity	NA			Model dose associated with sediment ingestion, surface water ingestion, and ingestion of sediment-associated plants and compare with applicable toxicity reference value	**Freshwater Sediment** Fresh Water
The potential for significant adverse effects on terrestrial mammalian herbivore abundance and diversity	Arctic ground squirrel	X	X	Model dose associated with soil ingestion, surface water ingestion, and ingestion of soil-associated plants and compare with applicable toxicity reference value	**Surface Soil** Fresh Water
Secondary Consumers (Trophic Level 3)					
The potential for significant adverse effects on marine avian invertevore abundance and diversity	Least auklet			Model dose associated with sediment ingestion and ingestion of marine aquatic invertebrates and compare with applicable toxicity reference value	**Marine Water**
The potential for significant adverse effects on freshwater avian invertevore abundance and diversity	American dipper		X	Model dose associated with sediment ingestion and ingestion of freshwater aquatic invertebrates and compare with applicable toxicity reference value	**Fresh Water**
The potential for significant adverse effects on marine semi-aquatic avian invertevore abundance and diversity	Least sandpiper		X	Model dose associated with sediment ingestion and ingestion of marine benthic invertebrates and compare with applicable toxicity reference value	**Marine Sediment**
The potential for significant adverse effects on freshwater semi-aquatic avian invertevore abundance and diversity	Common snipe		X	Model dose associated with sediment ingestion and ingestion of freshwater benthic invertebrates and compare with applicable toxicity reference value	**Freshwater Sediment**

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Summary of Proposed Ecological Assessment Endpoints and Primary Indicator Species

Default Assessment Endpoints	Aleutian Islands	Risk Assessment Area		Typical Tier I Assessment Method	Primary (bold) & Other Exposure Media
		Top Camp	Driftwood Bay Valley		
The potential for significant adverse effects on terrestrial avian interevore abundance and diversity	Lapland longspur	X	X	Model dose associated with soil ingestion and ingestion of soil invertebrates and compare with applicable toxicity reference value	**Surface Soil**
The potential for significant adverse effects on freshwater fish interevore abundance and diversity	NA			Compare media concentrations with available adjusted water quality criteria (preference for freshwater and chronic value)	**Fresh Water**
The potential for significant adverse effects on marine fish invertevore abundance and diversity	NA			compare media concentrations with available adjusted water quality criteria (preference for marine and chronic values)	**Marine Water**
All terrestrial invertebrates*	**All Terrestrial invertebrates***	X	X	Compare media concentrations with lowest available toxicity benchmarks for earthworms or other soil invertebrate species	**Surface Soil**
The potential for significant adverse effects on freshwater amphibian invertevore abundance and diversity	NA			Compare media concentrations with available adjusted water quality criteria or model dose associated with ingestion of freshwater aquatic invertebrates and sediment and compare with applicable toxicity reference value.	**Fresh Water** Sediment
Terrestrial amphibian invertevore abundance and physical health	NA			Model dose associated with soil ingestion and ingestion of soil invertebrates and compare with applicable toxicity reference value	**Surface Soil**
The potential for significant adverse effects on marine mammalian invertevore abundance and diversity	Sea otter			Model dose associated with sediment ingestion of marine aquatic invertebrates and compare with applicable toxicity reference value	**Marine Water** Sediment
The potential for significant adverse effects on terrestrial mammalian invertevore abundance and diversity	Shrews	X	X	Model dose associated with soil ingestion and ingestion of soil invertebrates and compare with applicable toxicity reference value	**Surface Soil** Fresh Water
Tertiary Consumers (Trophic Level 4)					
The potential for significant adverse effects on marine avian piscivore abundance and diversity	Pigeon guillemot			Model dose associated with fish ingestion and compare with applicable toxicity reference value	**Marine Water**
The potential for significant adverse effects on freshwater avian piscivore abundance and diversity	Belted kingfisher		X	Model dose associated with fresh water and fish ingestion and compare with applicable toxicity reference value	**Fresh Water**
The potential for significant adverse effects on terrestrial avian carnivore abundance and diversity	Northern shrike	X	X	Model dose associated with soil ingestion and ingestion of prey and compare with applicable toxicity reference value	**Surface Soil**
The potential for significant adverse effects on terrestrial mammalian carnivore abundance and diversity	NA			Model dose associated with soil ingestion and ingestion of prey and compare with applicable toxicity reference value	**Surface Soil**

Summary of Proposed Ecological Assessment Endpoints and Primary Indicator Species

Default Assessment Endpoints	Aleutian Islands	Risk Assessment Area: Top Camp	Risk Assessment Area: Driftwood Bay Valley	Typical Tier I Assessment Method	Primary (bold) & Other Exposure Media
The potential for significant adverse effects on freshwater semi-aquatic mammalian carnivore abundance and diversity	NA			Model dose associated with fresh water, freshwater sediment, and fish ingestion and compare with applicable toxicity reference value	**Fresh Water** Sediment Surface Soil
The potential for significant adverse effects on freshwater mammalian piscivore abundance and diversity	NA			Model dose associated with fresh water and fish ingestion and compare with applicable toxicity reference value	**Fresh Water**
The potential for significant adverse effects on marine mammalian piscivore abundance and diversity	Harbor seal			Model dose associated with fish ingestion and compare with applicable toxicity reference value	**Marine Water**
The potential for significant adverse effects on marine mammalian carnivore abundance and diversity	Arctic fox			Model dose associated with marine bird or marine mammal ingestion and compare with applicable toxicity reference value	**Marine Water**
The potential for significant adverse effects on freshwater fish piscivore abundance and diversity	All freshwater fish*		X	Compare media concentrations with available adjusted water quality criteria (Preference for freshwater and chronic values)	**Fresh Water**
The potential for significant adverse effects on marine fish piscivore abundance and diversity	All marine fish*			Compare media concentrations with available adjusted water quality criteria (Preference for marine and chronic values)	**Marine Water**

* Toxicity data currently available for use in Tier I risk assessments do not allow consideration of individual species within each of these functional groups.

NA = not applicable

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APPENDIX E

Analytical Data

(on CD)

APPENDIX F

ProUCL Calculations

SS007 DRO Soil

1700
2
820
350
270
1600
390
1400
870
1.4
2700
6.3
950
580
2100
940
3400
2900
1400
3400
370
2000
1 1
890
310
1200
680
2500
310

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_g.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	29	Number of Distinct Observations	26
Raw Statistics		Log-transformed Statistics	
Minimum	1.1	Minimum of Log Data	0.0953
Maximum	3400	Maximum of Log Data	8.132
Mean	1174	Mean of log Data	6.077
Median	890	SD of log Data	2.311
SD	1032		
Coefficient of Variation	0.879		
Skewness	0.846		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.894	Shapiro Wilk Test Statistic	0 723
Shapiro Wilk Critical Value	0 926	Shapiro Wilk Critical Value	0.926
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	1500	95% H-UCL	42112
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	16925
95% Adjusted-CLT UCL	1521	97.5% Chebyshev (MVUE) UCL	22181
95% Modified-t UCL	1505	99% Chebyshev (MVUE) UCL	32505
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.579	Data do not follow a Discernable Distribution (0.05)	
Theta Star	2026		
nu star	33 6		
Approximate Chi Square Value (.05)	21.34	Nonparametric Statistics	
Adjusted Level of Significance	0.0407	95% CLT UCL	1489
Adjusted Chi Square Value	20.76	95% Jackknife UCL	1500
		95% Standard Bootstrap UCL	1479
Anderson-Darling Test Statistic	1.301	95% Bootstrap-t UCL	1548
Anderson-Darling 5% Critical Value	0 798	95% Hall's Bootstrap UCL	1531
Kolmogorov-Smirnov Test Statistic	0.178	95% Percentile Bootstrap UCL	1486
Kolmogorov-Smirnov 5% Critical Value	0 171	95% BCA Bootstrap UCL	1527
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	2009
		97.5% Chebyshev(Mean, Sd) UCL	2370
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3080
95% Approximate Gamma UCL	1848		
95% Adjusted Gamma UCL	1900		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	3080

0.033
0.0036
0.0034
0.006
0.072
0.006
0.00495
0.61
0.3
0.11
0.25
0.02
0.13
0.047
0.019
0.016
0 045
0.029
0 006
0.024
0 0077
0.006
0 0057
0.14
0.065
0.0095
0.33
0.0041
0.009

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_h.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	29	Number of Distinct Observations	26
Raw Statistics		Log-transformed Statistics	
Minimum	0.0034	Minimum of Log Data	-5.684
Maximum	0.61	Maximum of Log Data	-0.494
Mean	0.0797	Mean of log Data	-3.676
Median	0.02	SD of log Data	1.544
SD	0.136		
Coefficient of Variation	1.702		
Skewness	2 685		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.618	Shapiro Wilk Test Statistic	0.924
Shapiro Wilk Critical Value	0.926	Shapiro Wilk Critical Value	0.926
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.123	95% H-UCL	0 211
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0 198
95% Adjusted-CLT UCL	0.135	97.5% Chebyshev (MVUE) UCL	0.251
95% Modified-t UCL	0.125	99% Chebyshev (MVUE) UCL	0 354
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.513	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	0 155		
nu star	29.75		
Approximate Chi Square Value (.05)	18 29	Nonparametric Statistics	
Adjusted Level of Significance	0.0407	95% CLT UCL	0.121
Adjusted Chi Square Value	17.76	95% Jackknife UCL	0.123
		95% Standard Bootstrap UCL	0.121
Anderson-Darling Test Statistic	1 411	95% Bootstrap-t UCL	0.15
Anderson-Darling 5% Critical Value	0.806	95% Hall's Bootstrap UCL	0.145
Kolmogorov-Smirnov Test Statistic	0.167	95% Percentile Bootstrap UCL	0.126
Kolmogorov-Smirnov 5% Critical Value	0.172	95% BCA Bootstrap UCL	0.136
Data follow Appr Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0 19
		97.5% Chebyshev(Mean, Sd) UCL	0 237
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.33
95% Approximate Gamma UCL	0.13		
95% Adjusted Gamma UCL	0.134		
Potential UCL to Use		Use 95% Approximate Gamma UCL	0.13

0.00135
0.000135
0.0016
0.0029
0.014
0 0028
0 0023
0 13
0 055
0.00255
0.035
0.0048
0.03
0.01
0 0031
0 0035
0.0031
0.00245
0.00285
0.0032
0.0013
0.00285
0.0011
0 032
0 016
0 00455
0 074
0 0019
0.0005

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_i wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	29	Number of Distinct Observations	27
Raw Statistics		Log-transformed Statistics	
Minimum	1.35E-04	Minimum of Log Data	-8.91
Maximum	0 13	Maximum of Log Data	-2.04
Mean	0 0153	Mean of log Data	-5 356
Median	0 0031	SD of log Data	1.546
SD	0.0283		
Coefficient of Vanation	1.845		
Skewness	2.95		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.57	Shapiro Wilk Test Statistic	0.941
Shapiro Wilk Critical Value	0 926	Shapiro Wilk Critical Value	0.926
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0243	95% H-UCL	0.0394
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.0371
95% Adjusted-CLT UCL	0.0271	97.5% Chebyshev (MVUE) UCL	0 047
95% Modified-t UCL	0.0248	99% Chebyshev (MVUE) UCL	0.0663
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.501	Data appear Lognormal at 5% Significance Level	
Theta Star	0 0306		
nu star	29.08		
Approximate Chi Square Value (.05)	17 77	Nonparametric Statistics	
Adjusted Level of Significance	0.0407	95% CLT UCL	0.024
Adjusted Chi Square Value	17 24	95% Jackknife UCL	0 0243
		95% Standard Bootstrap UCL	0 0237
Anderson-Darling Test Statistic	2.061	95% Bootstrap-t UCL	0.0325
Anderson-Darling 5% Critical Value	0 808	95% Hall's Bootstrap UCL	0 0414
Kolmogorov-Smirnov Test Statistic	0.28	95% Percentile Bootstrap UCL	0 0242
Kolmogorov-Smirnov 5% Critical Value	0.172	95% BCA Bootstrap UCL	0.0277
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0382
		97.5% Chebyshev(Mean, Sd) UCL	0.0482
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0 0676
95% Approximate Gamma UCL	0.0251		
95% Adjusted Gamma UCL	0 0259		
Potential UCL to Use		Use 95% Chebyshev (MVUE) UCL	0.0371

0.044
0.005
0.00475
0.005
0.0037
0.004
0.00345
0.005
0 00345
0.0046
0.0034
0.00495
0.0039
0 0041
0.029
0 0055
0.14
0.092
0.063
0.51
0.01
0.21
0 00275
0.016
0.0028
0 007
0.0032
0 0027
0.0042

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_j.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	29	Number of Distinct Observations	26
Raw Statistics		Log-transformed Statistics	
Minimum	0 0027	Minimum of Log Data	-5.915
Maximum	0.51	Maximum of Log Data	-0.673
Mean	0 0413	Mean of log Data	-4.653
Median	0 00495	SD of log Data	1 477
SD	0.102		
Coefficient of Variation	2 466		
Skewness	3 917		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0 437	Shapiro Wilk Test Statistic	0.765
Shapiro Wilk Critical Value	0.926	Shapiro Wilk Critical Value	0 926
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0735	95% H-UCL	0.0669
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0 0659
95% Adjusted-CLT UCL	0 0871	97 5% Chebyshev (MVUE) UCL	0.083
95% Modified-t UCL	0 0757	99% Chebyshev (MVUE) UCL	0.117
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.419	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0985		
nu star	24.3		
Approximate Chi Square Value (05)	14 08	Nonparametric Statistics	
Adjusted Level of Significance	0 0407	95% CLT UCL	0 0724
Adjusted Chi Square Value	13.61	95% Jackknife UCL	0 0735
		95% Standard Bootstrap UCL	0.0723
Anderson-Darling Test Statistic	4.207	95% Bootstrap-t UCL	0 127
Anderson-Darling 5% Critical Value	0 825	95% Hall's Bootstrap UCL	0 179
Kolmogorov-Smirnov Test Statistic	0.338	95% Percentile Bootstrap UCL	0.0739
Kolmogorov-Smirnov 5% Critical Value	0.173	95% BCA Bootstrap UCL	0.0917
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0 124
		97 5% Chebyshev(Mean, Sd) UCL	0 159
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0 229
95% Approximate Gamma UCL	0 0713		
95% Adjusted Gamma UCL	0.0737		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	0.229

0.206
0 00785
0.00735
0 0081
0.0057
0.008
0 0053
0.00795
0 0053
0 00705
0.0053
0 00765
0.013
0.00635
0.24
0 0087
0.67
0.476
0 1
2.11
0 0155
0.774
0 0042
0 048
0.0043
0.011
0.0049
0 00415
0.0065

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_k wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	29	Number of Distinct Observations	27
Raw Statistics		Log-transformed Statistics	
Minimum	0.00415	Minimum of Log Data	-5.485
Maximum	2.11	Maximum of Log Data	0.747
Mean	0 165	Mean of log Data	-3.915
Median	0 00795	SD of log Data	1.879
SD	0 425		
Coefficient of Variation	2.578		
Skewness	3 834		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.443	Shapiro Wilk Test Statistic	0.752
Shapiro Wilk Critical Value	0 926	Shapiro Wilk Critical Value	0.926
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0 299	95% H-UCL	0.429
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.303
95% Adjusted-CLT UCL	0.355	97.5% Chebyshev (MVUE) UCL	0.39
95% Modified-t UCL	0 308	99% Chebyshev (MVUE) UCL	0 561
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.312	Data do not follow a Discernable Distribution (0 05)	
Theta Star	0.528		
nu star	18.11		
Approximate Chi Square Value (.05)	9.472	Nonparametric Statistics	
Adjusted Level of Significance	0.0407	95% CLT UCL	0 295
Adjusted Chi Square Value	9.099	95% Jackknife UCL	0.299
		95% Standard Bootstrap UCL	0 294
Anderson-Darling Test Statistic	4.347	95% Bootstrap-t UCL	0.484
Anderson-Darling 5% Critical Value	0.851	95% Hall's Bootstrap UCL	0 693
Kolmogorov-Smirnov Test Statistic	0.365	95% Percentile Bootstrap UCL	0 31
Kolmogorov-Smirnov 5% Critical Value	0.176	95% BCA Bootstrap UCL	0.384
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0 509
		97.5% Chebyshev(Mean, Sd) UCL	0.657
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0 95
95% Approximate Gamma UCL	0.315		
95% Adjusted Gamma UCL	0 328		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	0.95

7.9
15
82
2 3
2
0.73

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_I.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	6	Number of Distinct Observations	6
Raw Statistics		Log-transformed Statistics	
Minimum	0.73	Minimum of Log Data	-0.315
Maximum	82	Maximum of Log Data	4.407
Mean	18 32	Mean of log Data	1.732
Median	5.1	SD of log Data	1.691
SD	31 65		
Coefficient of Variation	1 727		
Skewness	2 302		

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0 635	Shapiro Wilk Test Statistic	0.963
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	44 35	95% H-UCL	3395
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	60.14
95% Adjusted-CLT UCL	52.54	97 5% Chebyshev (MVUE) UCL	79.25
95% Modified-t UCL	46 38	99% Chebyshev (MVUE) UCL	116 8
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.378	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	48.42		
nu star	4.541		
Approximate Chi Square Value (.05)	0 946	Nonparametric Statistics	
Adjusted Level of Significance	0.0122	95% CLT UCL	39 57
Adjusted Chi Square Value	0.488	95% Jackknife UCL	44.35
		95% Standard Bootstrap UCL	37.43
Anderson-Darling Test Statistic	0 438	95% Bootstrap-t UCL	170.1
Anderson-Darling 5% Critical Value	0 734	95% Hall's Bootstrap UCL	184.3
Kolmogorov-Smirnov Test Statistic	0.24	95% Percentile Bootstrap UCL	42.05
Kolmogorov-Smirnov 5% Critical Value	0.348	95% BCA Bootstrap UCL	46.38
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	74 63
		97.5% Chebyshev(Mean, Sd) UCL	99
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	146 9
95% Approximate Gamma UCL	87.91		
95% Adjusted Gamma UCL	170 6		
Potential UCL to Use		Use 95% Approximate Gamma UCL	87 91
Recommended UCL exceeds the maximum observation			

0.42
0.54
4.2
0.42
0.21
0.096

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_m.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	6	Number of Distinct Observations	5
Raw Statistics		Log-transformed Statistics	
Minimum	0.096	Minimum of Log Data	-2.343
Maximum	4 2	Maximum of Log Data	1.435
Mean	0.981	Mean of log Data	-0.803
Median	0.42	SD of log Data	1.265
SD	1.585		
Coefficient of Variation	1.616		
Skewness	2.393		

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.594	Shapiro Wilk Test Statistic	0.908
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	2.285	95% H-UCL	17.26
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2.622
95% Adjusted-CLT UCL	2.721	97.5% Chebyshev (MVUE) UCL	3.399
95% Modified-t UCL	2.39	99% Chebyshev (MVUE) UCL	4.925
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.492	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	1.994		
nu star	5.904		
Approximate Chi Square Value (.05)	1.591	Nonparametric Statistics	
Adjusted Level of Significance	0.0122	95% CLT UCL	2 045
Adjusted Chi Square Value	0.916	95% Jackknife UCL	2.285
		95% Standard Bootstrap UCL	1.971
Anderson-Darling Test Statistic	0.706	95% Bootstrap-t UCL	9.521
Anderson-Darling 5% Critical Value	0.721	95% Hall's Bootstrap UCL	9.96
Kolmogorov-Smirnov Test Statistic	0.363	95% Percentile Bootstrap UCL	2.241
Kolmogorov-Smirnov 5% Critical Value	0.343	95% BCA Bootstrap UCL	2.33
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	3.802
		97.5% Chebyshev(Mean, Sd) UCL	5 022
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	7.42
95% Approximate Gamma UCL	3.64		
95% Adjusted Gamma UCL	6.323		
Potential UCL to Use		Use 95% Approximate Gamma UCL	3.64

490
27
140
5300

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_e.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	4	Number of Distinct Observations	4

Warning: This data set only has 4 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

17000
19
10
3600
7400
240
610
7900
20
5 9
3000
9.2
11000
9 8
1.3
2.9
0.89
25
12000

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	19	Number of Distinct Observations	19
Raw Statistics		Log-transformed Statistics	
Minimum	0.89	Minimum of Log Data	-0 117
Maximum	17000	Maximum of Log Data	9 741
Mean	3308	Mean of log Data	4.914
Median	25	SD of log Data	3.504
SD	5194		
Coefficient of Variation	1.57		
Skewness	1.523		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.703	Shapiro Wilk Test Statistic	0.881
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	5374	95% H-UCL	20844848
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	77003
95% Adjusted-CLT UCL	5713	97.5% Chebyshev (MVUE) UCL	103401
95% Modified-t UCL	5444	99% Chebyshev (MVUE) UCL	155256
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.226	Data do not follow a Discernable Distribution (0 05)	
Theta Star	14664		
nu star	8 573		
Approximate Chi Square Value (05)	3 071	Nonparametric Statistics	
Adjusted Level of Significance	0 0369	95% CLT UCL	5268
Adjusted Chi Square Value	2.789	95% Jackknife UCL	5374
		95% Standard Bootstrap UCL	5191
Anderson-Darling Test Statistic	1 157	95% Bootstrap-t UCL	5998
Anderson-Darling 5% Critical Value	0 876	95% Hall's Bootstrap UCL	5367
Kolmogorov-Smirnov Test Statistic	0 267	95% Percentile Bootstrap UCL	5383
Kolmogorov-Smirnov 5% Critical Value	0.219	95% BCA Bootstrap UCL	5753
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	8502
		97.5% Chebyshev(Mean, Sd) UCL	10750
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	15165
95% Approximate Gamma UCL	9235		
95% Adjusted Gamma UCL	10166		
Potential UCL to Use		Use 95% Hall's Bootstrap UCL	5367

In Case Bootstrap t and/or Hall's Bootstrap yields an unreasonably large UCL value, use 97 5% or 99% Chebyshev (Mean, Sd) UCL

6600
13
40
410
2400
680
270
1400
46
39
1800
120
1700
0 95
43
13
16
32
17000

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	19	Number of Distinct Observations	18
Raw Statistics		Log-transformed Statistics	
Minimum	0.95	Minimum of Log Data	-0.0513
Maximum	17000	Maximum of Log Data	9.741
Mean	1717	Mean of log Data	5.141
Median	120	SD of log Data	2.542
SD	4022		
Coefficient of Variation	2.342		
Skewness	3.468		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.48	Shapiro Wilk Test Statistic	0.965
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	3317	95% H-UCL	99244
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	10443
95% Adjusted-CLT UCL	4019	97.5% Chebyshev (MVUE) UCL	13850
95% Modified-t UCL	3439	99% Chebyshev (MVUE) UCL	20541
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.287	Data Follow Appr Gamma Distribution at 5% Significance Level	
Theta Star	5985		
nu star	10.9		
Approximate Chi Square Value (.05)	4.513	Nonparametric Statistics	
Adjusted Level of Significance	0.0369	95% CLT UCL	3235
Adjusted Chi Square Value	4.159	95% Jackknife UCL	3317
		95% Standard Bootstrap UCL	3202
Anderson-Darling Test Statistic	0.848	95% Bootstrap-t UCL	8383
Anderson-Darling 5% Critical Value	0.843	95% Hall's Bootstrap UCL	9385
Kolmogorov-Smirnov Test Statistic	0.211	95% Percentile Bootstrap UCL	3362
Kolmogorov-Smirnov 5% Critical Value	0.215	95% BCA Bootstrap UCL	4309
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	5739
		97.5% Chebyshev(Mean, Sd) UCL	7479
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	10897
95% Approximate Gamma UCL	4148		
95% Adjusted Gamma UCL	4501		
Potential UCL to Use		Use 95% Adjusted Gamma UCL	4501

0.14
0.0007
0.000325
0.0055
0.027
0.23
0.19
0.0094
0.11
0.000295
0.032
0.037
0.0065
0.0014
0.000345
0.0027
0.00024
0 057

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_a.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	18	Number of Distinct Observations	18
Raw Statistics		Log-transformed Statistics	
Minimum	2.40E-04	Minimum of Log Data	-8.335
Maximum	0.23	Maximum of Log Data	-1.47
Mean	0.0472	Mean of log Data	-4.869
Median	0.00795	SD of log Data	2.421
SD	0.0716		
Coefficient of Variation	1.515		
Skewness	1.653		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0 71	Shapiro Wilk Test Statistic	0.917
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0766	95% H-UCL	2.855
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.358
95% Adjusted-CLT UCL	0.082	97.5% Chebyshev (MVUE) UCL	0.473
95% Modified-t UCL	0.0777	99% Chebyshev (MVUE) UCL	0.701
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.343	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.138		
nu star	12.35		
Approximate Chi Square Value (.05)	5.459	Nonparametric Statistics	
Adjusted Level of Significance	0.0357	95% CLT UCL	0.075
Adjusted Chi Square Value	5.025	95% Jackknife UCL	0 0766
		95% Standard Bootstrap UCL	0.0742
Anderson-Darling Test Statistic	0.509	95% Bootstrap-t UCL	0.0932
Anderson-Darling 5% Critical Value	0.828	95% Hall's Bootstrap UCL	0.0794
Kolmogorov-Smirnov Test Statistic	0.134	95% Percentile Bootstrap UCL	0.0766
Kolmogorov-Smirnov 5% Critical Value	0.219	95% BCA Bootstrap UCL	0.0816
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.121
		97.5% Chebyshev(Mean, Sd) UCL	0 153
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.215
95% Approximate Gamma UCL	0.107		
95% Adjusted Gamma UCL	0.116		
Potential UCL to Use		Use 95% Adjusted Gamma UCL	0.116

0.00295
0.0024
3
0.44
0.0025
0.00355
0.0032
0.0027
0.00235
0.00295
0.0042
0.00345
0.00355
0.0034
0.00345
0.0042

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_b.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	16	Number of Distinct Observations	12
Raw Statistics		Log-transformed Statistics	
Minimum	0.00235	Minimum of Log Data	-6.053
Maximum	3	Maximum of Log Data	1.099
Mean	0.218	Mean of log Data	-5.023
Median	0.00343	SD of log Data	2.053
SD	0.75		
Coefficient of Variation	3 443		
Skewness	3.868		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.327	Shapiro Wilk Test Statistic	0.496
Shapiro Wilk Critical Value	0.887	Shapiro Wilk Critical Value	0.887
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.546	95% H-UCL	0.61
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.143
95% Adjusted-CLT UCL	0.72	97.5% Chebyshev (MVUE) UCL	0.188
95% Modified-t UCL	0.577	99% Chebyshev (MVUE) UCL	0.276
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.211	Data do not follow a Discernable Distribution (0.05)	
Theta Star	1.03		
nu star	6.765		
Approximate Chi Square Value (.05)	2.043	Nonparametric Statistics	
Adjusted Level of Significance	0.0335	95% CLT UCL	0.526
Adjusted Chi Square Value	1.761	95% Jackknife UCL	0.546
		95% Standard Bootstrap UCL	0.507
Anderson-Darling Test Statistic	4 577	95% Bootstrap-t UCL	286.8
Anderson-Darling 5% Critical Value	0.875	95% Hall's Bootstrap UCL	50.26
Kolmogorov-Smirnov Test Statistic	0.53	95% Percentile Bootstrap UCL	0.565
Kolmogorov-Smirnov 5% Critical Value	0.237	95% BCA Bootstrap UCL	0.752
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1.035
		97.5% Chebyshev(Mean, Sd) UCL	1.389
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2.083
95% Approximate Gamma UCL	0.721		
95% Adjusted Gamma UCL	0.837		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	2.083

0.0555
0.0135
0.031
0.167

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	4	Number of Distinct Observations	4

Warning: This data set only has 4 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

6470
376
148
27.6
4.77
14500
3.78
43700
14400
24.4
3880
72200

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_d.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	12	Number of Distinct Observations	12
Raw Statistics		Log-transformed Statistics	
Minimum	3.78	Minimum of Log Data	1.33
Maximum	72200	Maximum of Log Data	11.19
Mean	12978	Mean of log Data	6.533
Median	2128	SD of log Data	3.586
SD	22515		
Coefficient of Variation	1.735		
Skewness	2.13		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.655	Shapiro Wilk Test Statistic	0.909
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	24650	95% H-UCL	4.28E+09
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	300408
95% Adjusted-CLT UCL	27939	97.5% Chebyshev (MVUE) UCL	404234
95% Modified-t UCL	25316	99% Chebyshev (MVUE) UCL	608179
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.238	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	54590		
nu star	5.706		
Approximate Chi Square Value (.05)	1.491	Nonparametric Statistics	
Adjusted Level of Significance	0.029	95% CLT UCL	23669
Adjusted Chi Square Value	1.189	95% Jackknife UCL	24650
		95% Standard Bootstrap UCL	23569
Anderson-Darling Test Statistic	0.39	95% Bootstrap-t UCL	51960
Anderson-Darling 5% Critical Value	0.848	95% Hall's Bootstrap UCL	73989
Kolmogorov-Smirnov Test Statistic	0.17	95% Percentile Bootstrap UCL	24262
Kolmogorov-Smirnov 5% Critical Value	0.269	95% BCA Bootstrap UCL	27130
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	41308
		97.5% Chebyshev(Mean, Sd) UCL	53567
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	77647
95% Approximate Gamma UCL	49652		
95% Adjusted Gamma UCL	62275		
Potential UCL to Use		Use 95% Adjusted Gamma UCL	62275

1300
610
360
54
6000
130
110
100
27
42
530
43
31
35
11000

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_c.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	15	Number of Distinct Observations	15
Raw Statistics		Log-transformed Statistics	
Minimum	27	Minimum of Log Data	3.296
Maximum	11000	Maximum of Log Data	9.306
Mean	1358	Mean of log Data	5.313
Median	110	SD of log Data	1.922
SD	3069		
Coefficient of Variation	2.26		
Skewness	2.78		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.503	Shapiro Wilk Test Statistic	0.883
Shapiro Wilk Critical Value	0.881	Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	2754	95% H-UCL	12418
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	3420
95% Adjusted-CLT UCL	3269	97.5% Chebyshev (MVUE) UCL	4476
95% Modified-t UCL	2849	99% Chebyshev (MVUE) UCL	6550
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.327	Data appear Lognormal at 5% Significance Level	
Theta Star	4153		
nu star	9.81		
Approximate Chi Square Value (.05)	3.824	Nonparametric Statistics	
Adjusted Level of Significance	0 0324	95% CLT UCL	2661
Adjusted Chi Square Value	3.376	95% Jackknife UCL	2754
		95% Standard Bootstrap UCL	2584
Anderson-Darling Test Statistic	1.476	95% Bootstrap-t UCL	11289
Anderson-Darling 5% Critical Value	0.824	95% Hall's Bootstrap UCL	10182
Kolmogorov-Smirnov Test Statistic	0.264	95% Percentile Bootstrap UCL	2789
Kolmogorov-Smirnov 5% Critical Value	0.238	95% BCA Bootstrap UCL	3430
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	4812
		97.5% Chebyshev(Mean, Sd) UCL	6307
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	9242
95% Approximate Gamma UCL	3485		
95% Adjusted Gamma UCL	3947		
Potential UCL to Use		Use 99% Chebyshev (MVUE) UCL	6550

2100
0.37

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_n.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	2	Number of Distinct Observations	2

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

9500
7.7

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_o.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	2	Number of Distinct Observations	2

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

6.1
120
0.0005

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_p.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	3	Number of Distinct Observations	3

Warning: This data set only has 3 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

5.6
100
0.00023

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_q.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	3	Number of Distinct Observations	3

Warning: This data set only has 3 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

7.3
77
0.0008

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_r.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	3	Number of Distinct Observations	3

Warning: This data set only has 3 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

2.6
80
0.00017

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_s.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	3	Number of Distinct Observations	3

Warning: This data set only has 3 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

7.2
130
0.0005

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_t.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	3	Number of Distinct Observations	3

Warning: This data set only has 3 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

0.95
20
0.000105

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_u.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	3	Number of Distinct Observations	3

Warning: This data set only has 3 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

3.2
71
0.00017

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_v.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	3	Number of Distinct Observations	3

Warning: This data set only has 3 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

1.52
0.02

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_w.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	2	Number of Distinct Observations	2

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable C0 was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

8.91

Only one sample

69.3
26
2.34
89900
2080
3000
90 4

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_x.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	7	Number of Distinct Observations	7
Raw Statistics		Log-transformed Statistics	
Minimum	2 34	Minimum of Log Data	0 85
Maximum	89900	Maximum of Log Data	11.41
Mean	13595	Mean of log Data	5.701
Median	90.4	SD of log Data	3.528
SD	33669		
Coefficient of Variation	2 476		
Skewness	2.639		

Warning: A sample size of 'n' = 7 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 7 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0 481	Shapiro Wilk Test Statistic	0.966
Shapiro Wilk Critical Value	0 803	Shapiro Wilk Critical Value	0 803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	38324	95% H-UCL	2.94E+12
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	61810
95% Adjusted-CLT UCL	48088	97.5% Chebyshev (MVUE) UCL	83251
95% Modified-t UCL	40439	99% Chebyshev (MVUE) UCL	125367
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0 206	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	66011		
nu star	2 883		
Approximate Chi Square Value (.05)	0.339	Nonparametric Statistics	
Adjusted Level of Significance	0 0158	95% CLT UCL	34527
Adjusted Chi Square Value	0.174	95% Jackknife UCL	38324
		95% Standard Bootstrap UCL	32674
Anderson-Darling Test Statistic	0 609	95% Bootstrap-t UCL	589561
Anderson-Darling 5% Critical Value	0.824	95% Hall's Bootstrap UCL	589840
Kolmogorov-Smirnov Test Statistic	0.272	95% Percentile Bootstrap UCL	38858
Kolmogorov-Smirnov 5% Critical Value	0 342	95% BCA Bootstrap UCL	39687
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	69065
		97 5% Chebyshev(Mean, Sd) UCL	93067
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	140213
95% Approximate Gamma UCL	115730		
95% Adjusted Gamma UCL	225036		
Potential UCL to Use		Use 95% Adjusted Gamma UCL	225036
Recommended UCL exceeds the maximum observation			

0.023
0.035
0.04
0.008
0.36
0.061

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_y.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	6	Number of Distinct Observations	6
Raw Statistics		Log-transformed Statistics	
Minimum	0.008	Minimum of Log Data	-4.828
Maximum	0.36	Maximum of Log Data	-1.022
Mean	0 0878	Mean of log Data	-3.165
Median	0.0375	SD of log Data	1.257
SD	0.134		
Coefficient of Variation	1.531		
Skewness	2.355		

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results

Warning: There are only 6 Values in this data
Note It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.623	Shapiro Wilk Test Statistic	0 945
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0 788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.198	95% H-UCL	1.561
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.245
95% Adjusted-CLT UCL	0.235	97 5% Chebyshev (MVUE) UCL	0 317
95% Modified-t UCL	0.207	99% Chebyshev (MVUE) UCL	0.459
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.516	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0 17		
nu star	6.186		
Approximate Chi Square Value (.05)	1.736	Nonparametric Statistics	
Adjusted Level of Significance	0.0122	95% CLT UCL	0.178
Adjusted Chi Square Value	1.018	95% Jackknife UCL	0.198
		95% Standard Bootstrap UCL	0 172
Anderson-Darling Test Statistic	0 568	95% Bootstrap-t UCL	0.712
Anderson-Darling 5% Critical Value	0.72	95% Hall's Bootstrap UCL	0.709
Kolmogorov-Smirnov Test Statistic	0.304	95% Percentile Bootstrap UCL	0.192
Kolmogorov-Smirnov 5% Critical Value	0 343	95% BCA Bootstrap UCL	0 203
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.327
		97.5% Chebyshev(Mean, Sd) UCL	0.431
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0 634
95% Approximate Gamma UCL	0 313		
95% Adjusted Gamma UCL	0.534		
Potential UCL to Use		Use 95% Approximate Gamma UCL	0.313

0.094
0.093
0.13
0.087
0.99
0.15

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_z.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	6	Number of Distinct Observations	6
Raw Statistics		Log-transformed Statistics	
Minimum	0.087	Minimum of Log Data	-2.442
Maximum	0.99	Maximum of Log Data	-0.0101
Mean	0.257	Mean of log Data	-1.855
Median	0.112	SD of log Data	0.929
SD	0.36		
Coefficient of Variation	1.398		
Skewness	2.424		

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.556	Shapiro Wilk Test Statistic	0.691
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.553	95% H-UCL	1.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.58
95% Adjusted-CLT UCL	0.654	97.5% Chebyshev (MVUE) UCL	0.736
95% Modified-t UCL	0.578	99% Chebyshev (MVUE) UCL	1.042
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.683	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.377		
nu star	8.192		
Approximate Chi Square Value (.05)	2 846	Nonparametric Statistics	
Adjusted Level of Significance	0.0122	95% CLT UCL	0.499
Adjusted Chi Square Value	1.839	95% Jackknife UCL	0.553
		95% Standard Bootstrap UCL	0.479
Anderson-Darling Test Statistic	1 178	95% Bootstrap-t UCL	3.045
Anderson-Darling 5% Critical Value	0.713	95% Hall's Bootstrap UCL	2.909
Kolmogorov-Smirnov Test Statistic	0.414	95% Percentile Bootstrap UCL	0.542
Kolmogorov-Smirnov 5% Critical Value	0.34	95% BCA Bootstrap UCL	0.57
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.898
		97.5% Chebyshev(Mean, Sd) UCL	1.175
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1.719
95% Approximate Gamma UCL	0.741		
95% Adjusted Gamma UCL	1.146		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	0.898

0.0003
0.0003
0.0007
0.0003
0.0074
0.0015

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	6	Number of Distinct Observations	4
Raw Statistics		Log-transformed Statistics	
Minimum	3 00E-04	Minimum of Log Data	-8 112
Maximum	0 0074	Maximum of Log Data	-4 906
Mean	0.00175	Mean of log Data	-7.168
Median	5.00E-04	SD of log Data	1.284
SD	0 00281		
Coefficient of Variation	1.604		
Skewness	2.307		

Warning· There are only 4 Distinct Values in this data
There are insufficient Distinct Values to perform some GOF tests and bootstrap methods.
Those methods will return a 'N/A' value on your output displayl

It is necessary to have 4 or more Distinct Values to compute bootstrap methods.
It is recommended to have 10-15 or more observations for accurate and meaningful bootstrap results.

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.619	Shapiro Wilk Test Statistic	0.812
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.00406	95% H-UCL	0.033
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.00463
95% Adjusted-CLT UCL	0.00479	97 5% Chebyshev (MVUE) UCL	0.00601
95% Modified-t UCL	0 00424	99% Chebyshev (MVUE) UCL	0.00872
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0 477	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	0.00367		
nu star	5 728		
Approximate Chi Square Value (.05)	1 503	Nonparametric Statistics	
Adjusted Level of Significance	0.0122	95% CLT UCL	0 00363
Adjusted Chi Square Value	0 855	95% Jackknife UCL	0 00406
		95% Standard Bootstrap UCL	0 00347
Anderson-Darling Test Statistic	0.765	95% Bootstrap-t UCL	0.0196
Anderson-Darling 5% Critical Value	0.722	95% Hall's Bootstrap UCL	0 0113
Kolmogorov-Smirnov Test Statistic	0.273	95% Percentile Bootstrap UCL	0.00392
Kolmogorov-Smirnov 5% Critical Value	0.344	95% BCA Bootstrap UCL	0.00503
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0 00675
		97.5% Chebyshev(Mean, Sd) UCL	0 00891
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.0132
95% Approximate Gamma UCL	0.00667		
95% Adjusted Gamma UCL	0 0117		
Potential UCL to Use		Use 95% Approximate Gamma UCL	0.00667

1.6
0.1
2.5
0 67
0 98
0.43
0.33
0.061
0.11
1.9
0.86
0.66
1.6
0 37
1 1
0.38
0 28
0.15
2.9
1.1
1.5
0.36

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	22	Number of Distinct Observations	20
Raw Statistics		Log-transformed Statistics	
Minimum	0.061	Minimum of Log Data	-2 797
Maximum	2.9	Maximum of Log Data	1.065
Mean	0.906	Mean of log Data	-0.556
Median	0 665	SD of log Data	1.084
SD	0.799		
Coefficient of Variation	0.881		
Skewness	1.103		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.88	Shapiro Wilk Test Statistic	0.957
Shapiro Wilk Critical Value	0 911	Shapiro Wilk Critical Value	0.911
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	1.199	95% H-UCL	1 935
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2.133
95% Adjusted-CLT UCL	1.229	97.5% Chebyshev (MVUE) UCL	2.627
95% Modified-t UCL	1.206	99% Chebyshev (MVUE) UCL	3.597
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1 094	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0 829		
nu star	48 12		
Approximate Chi Square Value (.05)	33.2	Nonparametric Statistics	
Adjusted Level of Significance	0.0386	95% CLT UCL	1.187
Adjusted Chi Square Value	32.28	95% Jackknife UCL	1.199
		95% Standard Bootstrap UCL	1.179
Anderson-Darling Test Statistic	0 237	95% Bootstrap-t UCL	1.252
Anderson-Darling 5% Critical Value	0.765	95% Hall's Bootstrap UCL	1.26
Kolmogorov-Smirnov Test Statistic	0.117	95% Percentile Bootstrap UCL	1.21
Kolmogorov-Smirnov 5% Critical Value	0 19	95% BCA Bootstrap UCL	1.217
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1 649
		97 5% Chebyshev(Mean, Sd) UCL	1.97
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2.601
95% Approximate Gamma UCL	1 314		
95% Adjusted Gamma UCL	1.351		
Potential UCL to Use		Use 95% Approximate Gamma UCL	1.314

0.63
0.05
2
0.35
0.63
0.23
0.16
0.038
0 07
0 83
0.38
0.34
0.7
0.21
0.36
0.21
0.13
0.12
0.97
0.45
0 56
0 2

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_a wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	22	Number of Distinct Observations	20
Raw Statistics		Log-transformed Statistics	
Minimum	0.038	Minimum of Log Data	-3.27
Maximum	2	Maximum of Log Data	0.693
Mean	0.437	Mean of log Data	-1.246
Median	0.345	SD of log Data	0.988
SD	0.436		
Coefficient of Variation	0.996		
Skewness	2.385		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.763	Shapiro Wilk Test Statistic	0 98
Shapiro Wilk Critical Value	0.911	Shapiro Wilk Critical Value	0.911
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0 597	95% H-UCL	0 808
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.923
95% Adjusted-CLT UCL	0 64	97.5% Chebyshev (MVUE) UCL	1.126
95% Modified-t UCL	0.605	99% Chebyshev (MVUE) UCL	1.524
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.184	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.369		
nu star	52.09		
Approximate Chi Square Value (.05)	36.51	Nonparametric Statistics	
Adjusted Level of Significance	0.0386	95% CLT UCL	0.59
Adjusted Chi Square Value	35.54	95% Jackknife UCL	0 597
		95% Standard Bootstrap UCL	0.588
Anderson-Darling Test Statistic	0.193	95% Bootstrap-t UCL	0.698
Anderson-Darling 5% Critical Value	0.763	95% Hall's Bootstrap UCL	1.24
Kolmogorov-Smirnov Test Statistic	0 0978	95% Percentile Bootstrap UCL	0 599
Kolmogorov-Smirnov 5% Critical Value	0.189	95% BCA Bootstrap UCL	0.655
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.842
		97 5% Chebyshev(Mean, Sd) UCL	1 017
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1.361
95% Approximate Gamma UCL	0.624		
95% Adjusted Gamma UCL	0.641		
Potential UCL to Use		Use 95% Approximate Gamma UCL	0.624

2.23
0.15
4.5
1.02
1.61
0 66
0 49
0.099
0.18
2.73
1.24
1
2.3
0.58
1.46
0 59
0.41
0.27
3.87
1.55
2.06
0.56

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet_b.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics			
Number of Valid Observations	22	Number of Distinct Observations	22
Raw Statistics		Log-transformed Statistics	
Minimum	0 099	Minimum of Log Data	-2.313
Maximum	4.5	Maximum of Log Data	1.504
Mean	1.344	Mean of log Data	-0.144
Median	1 01	SD of log Data	1.049
SD	1.198		
Coefficient of Variation	0.892		
Skewness	1.296		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0 866	Shapiro Wilk Test Statistic	0 967
Shapiro Wilk Critical Value	0 911	Shapiro Wilk Critical Value	0.911
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	1.783	95% H-UCL	2 73
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	3.051
95% Adjusted-CLT UCL	1.839	97.5% Chebyshev (MVUE) UCL	3 745
95% Modified-t UCL	1 795	99% Chebyshev (MVUE) UCL	5 108
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.136	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	1.183		
nu star	49.98		
Approximate Chi Square Value (.05)	34.74	Nonparametric Statistics	
Adjusted Level of Significance	0.0386	95% CLT UCL	1.764
Adjusted Chi Square Value	33.8	95% Jackknife UCL	1.783
		95% Standard Bootstrap UCL	1.758
Anderson-Darling Test Statistic	0.179	95% Bootstrap-t UCL	1.885
Anderson-Darling 5% Critical Value	0 764	95% Hall's Bootstrap UCL	1 92
Kolmogorov-Smirnov Test Statistic	0 113	95% Percentile Bootstrap UCL	1.78
Kolmogorov-Smirnov 5% Critical Value	0.19	95% BCA Bootstrap UCL	1.841
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	2.457
		97 5% Chebyshev(Mean, Sd) UCL	2.939
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3.886
95% Approximate Gamma UCL	1.933		
95% Adjusted Gamma UCL	1.987		
Potential UCL to Use		Use 95% Approximate Gamma UCL	1 933

APPENDIX G

Contaminants of Potential Concern Identification and Human Health Risk Assessment Calculations

(on CD)

APPENDIX H

Results of the Adult Lead Methodology

Table 1. Evaluation of Blood Lead Concentrations (PbBs) for Recreational Exposures at the Driftwood Bay Burned Battery Area Site. (assuming 12 days of exposure over 3 months)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee
Version date 05/19/05

Exposure Variable	Description of Exposure Variable	Units	Region OR Ethnic GSDi and PbBo Data from NHANES III Analysis West/All
PbS	Soil lead concentration	ug/g or ppm	1430
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	2.1
PbB_0	Baseline PbB	ug/dL	1.4
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S,D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	12
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	90
PbB_{adult}	**PbB of adult, geometric mean**	**ug/dL**	**2.3**
$PbB_{fetal,\ 0\ 95}$	95th percentile PbB among fetuses of adult	ug/dL	7.1
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	10.0
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distributi**	**%**	**1.8%**

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

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Table 2. Evaluation of Blood Lead Concentrations (PbBs) for Recreational Exposures at the Driftwood Bay Electronic Debris Area Site.
(assuming 14 days of continuous exposure)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee
Version date 05/19/05

Exposure Variable	Description of Exposure Variable	Units	Region OR Ethnic GSDi and PbBo Data from NHANES III Analysis West/All
PbS	Soil lead concentration	ug/g or ppm	12978
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	2.1
PbB_0	Baseline PbB	ug/dL	1.4
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S,D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	14
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	30
PbB_{adult}	**PbB of adult, geometric mean**	**ug/dL**	**30.5**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult	ug/dL	93.7
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	10.0
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribut**	**%**	**91.2%**

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for a[illegible]terim Approach to Assessing Risks Associated with Adult Exp[illegible]res to Lead in Soil

Table 3. Evaluation of Blood Lead Concentrations (PbBs) for Recreational Exposures at the Driftwood Bay LF006 Site.
(assuming 14 days of continuous exposure)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee
Version date 05/19/05

Exposure Variable	Description of Exposure Variable	Units	Region OR Ethnic GSDi West/All
PbS	Soil lead concentration	ug/g or ppm	13595
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	2.1
PbB_0	Baseline PbB	ug/dL	1.4
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S,D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	14
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	30
PbB_{adult}	**PbB of adult, geometric mean**	**ug/dL**	**31.9**
$PbB_{fetal,0.95}$	95th percentile PbB among fetuses of adult	ug/dL	97.9
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	10.0
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribut**	**%**	**92.1%**

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

APPENDIX I

Ecological Risk Assessment Calculations

Table I-1
Maximum Exposure Doses for Arctic Ground Squirrel (*Citellus parryi*) Exposed to Soil, Water, and Contaminated Food at SS007, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g$_{sed}$ (dry wt)	Conc Water mg/L	BCF$_{plants}$ mg/kg (dry wt)	PC mg/g$_{plant}$ (dry wt)	P$_{plant}$	IR$_{soil}$ kg/day	IR kg$_{diet}$/day (Dry wt)	WI L/day	IP mg/day plant	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Benzene	3.32E-03		2.27E+00	7.55E-03	1	0.0025	0.05	7.2E-02	3.8E-04	8.3E-06	0.0E+00	1.00E+00	1.000	0.7	5.5E-04
Ethylbenzene	2.29E-01	1.00E-03	5.85E-01	1.34E-01	1	0.0025	0.05	7.2E-02	6.7E-03	5.7E-04	7.2E-05	1.00E+00	1.000	0.7	1.0E-02
Xylene	9.50E-01		5.85E-01	5.56E-01	1	0.0025	0.05	7.2E-02	2.8E-02	2.4E-03	0.0E+00	1.00E+00	1.000	0.7	4.3E-02
Benzo(a)anthracene	1.51E-01		2.02E-02	3.05E-03	1	0.0025	0.05	7.2E-02	1.5E-04	3.8E-04	0.0E+00	1.00E+00	1.000	0.7	7.6E-04
Benzo(a)pyrene	1.30E-01		1.11E-02	1.44E-03	1	0.0025	0.05	7.2E-02	7.2E-05	3.3E-04	0.0E+00	1.00E+00	1.000	0.7	5.7E-04
Benzo(b)fluoranthene	4 50E-01		1.01E-02	4.53E-03	1	0.0025	0.05	7.2E-02	2.3E-04	1.1E-03	0.0E+00	1.00E+00	1.000	0.7	1.9E-03
Benzo(k)fluoranthene	1.14E-01		1.01E-02	1.15E-03	1	0.0025	0.05	7.2E-02	5.8E-05	2.9E-04	0.0E+00	1.00E+00	1.000	0.7	4.9E-04
Dibenzo(a,h)anthracene	3.71E-02		6.37E-03	2.36E-04	1	0.0025	0.05	7.2E-02	1.2E-05	9.3E-05	0.0E+00	1.00E+00	1.000	0.7	1.5E-04
Indeno(1,2,3-c,d)pyrene	1.14E-01		3.90E-03	4.45E-04	1	0.0025	0.05	7.2E-02	2.2E-05	2.9E-04	0.0E+00	1.00E+00	1.000	0.7	4.4E-04
Naphthalene	4.55E-01		4.79E-01	2.18E-01	1	0.0025	0.05	7.2E-02	1.1E-02	1.1E-03	0.0E+00	1.00E+00	1.000	0.7	1.7E-02
Phenanthrene	4.22E-01		8.84E-02	3.73E-02	1	0.0025	0.05	7.2E-02	1.9E-03	1.1E-03	0.0E+00	1.00E+00	1.000	0.7	4.2E-03
Pyrene	2.91E-01		4.31E-02	1.25E-02	1	0.0025	0.05	7.2E-02	6.3E-04	7.3E-04	0.0E+00	1.00E+00	1.000	0.7	1.9E-03

BCF$_{inv}$ = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF$_{sed}$ = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g$_{diet}$/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate, plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate, plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; plant, sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

Table I-2
Hazard Quotients for Arctic Ground Squirrel (*Citellus parryi*)
Exposed to Soil, Water, and Contaminated Food at SS007, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Benzene	--	5.51E-04	NA
Ethylbenzene	--	1.05E-02	NA
Xylene	--	4.31E-02	NA
Benzo(a)anthracene	1.00E+00	7.57E-04	8E-04
Benzo(a)pyrene	1.00E+00	5.67E-04	6E-04
Benzo(b)fluoranthene	1.00E+00	1.93E-03	2E-03
Benzo(k)fluoranthene	1.00E+00	4.89E-04	5E-04
Dibenzo(a,h)anthracene	1.00E+00	1.49E-04	1E-04
Indeno(1,2,3-c,d)pyrene	1.00E+00	4.39E-04	4E-04
Naphthalene	1.00E+00	1.72E-02	2E-02
Phenanthrene	1.00E+00	4.17E-03	4E-03
Pyrene	1.00E+00	1.94E-03	2E-03
		Hazard Index	3E-02

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-3
Maximum Exposure Doses for Masked Shrew (*Sorex cinereus*) Exposed to Soil, Water, and Contaminated Food at SS007, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil	BCF_{inv}	IC	Conc Water	P_{inv}	IR_{soil}	IR	WI	II	IS	IW	HRF	ED	BW	OD
	mg/g_{sed} (dry wt)	mg/kg wet	mg/g_{inv} (wet wt)	mg/L		kg/day	kg_{diet}/day (Dry wt)	L/day	mg/day inv	mg/day soil	mg/day water		fraction of year	kg	mg/kg/day
Benzene	3.32E-03	3.97E+00	1.3E-02		1.00	0.001	0.00795	8.4E-04	1.0E-04	3.4E-06	0.0E+00	1.00E+00	1.000	0.005	2.2E-02
Ethylbenzene	2.29E-01	2.72E+01	6.2E+00	1.00E-03	1.00	0.001	0.00795	8.4E-04	4.9E-02	2.4E-04	8.4E-07	1.00E+00	1.000	0.005	9.9E+00
Xylene	9.50E-01	2.72E+01	2.6E+01		1.00	0.001	0.00795	8.4E-04	2.1E-01	9.8E-04	0.0E+00	1.00E+00	1.000	0.005	4.1E+01
Benzo(a)anthracene	1.51E-01	3.00E-02	4.5E-03		1.00	0.001	0.00795	8.4E-04	3.6E-05	1.6E-04	0.0E+00	1.00E+00	1.000	0.005	3.8E-02
Benzo(a)pyrene	1.30E-01	7.00E-02	9.1E-03		1.00	0.001	0.00795	8.4E-04	7.2E-05	1.3E-04	0.0E+00	1.00E+00	1.000	0.005	4.1E-02
Benzo(b)fluoranthene	4.50E-01	7.00E-02	3.2E-02		1.00	0.001	0.00795	8.4E-04	2.5E-04	4.6E-04	0.0E+00	1.00E+00	1.000	0.005	1.4E-01
Benzo(k)fluoranthene	1.14E-01	8.00E-02	9.1E-03		1.00	0.001	0.00795	8.4E-04	7.3E-05	1.2E-04	0.0E+00	1.00E+00	1.000	0.005	3.8E-02
Dibenzo(a,h)anthracene	3.71E-02	7.00E-02	2.6E-03		1.00	0.001	0.00795	8.4E-04	2.1E-05	3.8E-05	0.0E+00	1.00E+00	1.000	0.005	1.2E-02
Indeno(1,2,3-c,d)pyrene	1.14E-01	8.00E-02	9.1E-03		1.00	0.001	0.00795	8.4E-04	7.3E-05	1.2E-04	0.0E+00	1.00E+00	1.000	0.005	3.8E-02
Naphthalene	4.55E-01	3.60E+01	1.6E+01		1.00	0.001	0.00795	8.4E-04	1.3E-01	4.7E-04	0.0E+00	1.00E+00	1.000	0.005	2.6E+01
Phenanthrene	4.22E-01	3.95E+02	1.7E+02		1.00	0.001	0.00795	8.4E-04	1.3E+00	4.3E-04	0.0E+00	1.00E+00	1.000	0.005	2.7E+02
Pyrene	2.91E-01	1.09E+03	3.2E+02		1.00	0.001	0.00795	8.4E-04	2.5E+00	3.0E-04	0.0E+00	1.00E+00	1.000	0.005	5.1E+02

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate, plant, sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; plant; sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

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Table I-4
Hazard Quotients for Masked Shrew (*Sorex cinereus*)
Exposed to Soil, Water, and Contaminated Food at SS007, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Benzene	--	2.16E-02	NA
Ethylbenzene	--	9.93E+00	NA
Xylene	--	4.12E+01	NA
Benzo(a)anthracene	1.00E+00	3.83E-02	4E-02
Benzo(a)pyrene	1.00E+00	4.12E-02	4E-02
Benzo(b)fluoranthene	1.00E+00	1.43E-01	1E-01
Benzo(k)fluoranthene	1.00E+00	3.80E-02	4E-02
Dibenzo(a,h)anthracene	1.00E+00	1.18E-02	1E-02
Indeno(1,2,3-c,d)pyrene	1.00E+00	3.80E-02	4E-02
Naphthalene	1.00E+00	2.62E+01	**3E+01**
Phenanthrene	1.00E+00	2.65E+02	**3E+02**
Pyrene	1.00E+00	5.06E+02	**5E+02**
		Hazard Index	**8E+02**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-5
Maximum Exposure Doses for Least Sandpiper (*Calidris minutilla*) Exposed to Soil, Water, and Contaminated Food at SS007, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g_{sed} (dry wt)	BCF_{inv} mg/kg wet	IC mg/g_{inv} (wet wt)	Conc Water mg/L	P_{inv}	IR_{soil} g/day	IR kg_{diet}/day (Dry wt)	WI L/day	II mg/day inv	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Benzene	3.32E-03	3.97E+00	1.3E-02		1.00	0.646	0.00885	3.8E-03	1.2E-04	2.1E-03	0.0E+00	1.00E+00	0.333	0.017	4.4E-02
Ethylbenzene	2.29E-01	2.72E+01	6.2E+00	1.00E-03	1.00	0.646	0.00885	3.8E-03	5.5E-02	1.5E-01	3.8E-06	1.00E+00	0.333	0.017	4.0E+00
Xylene	9.50E-01	2.72E+01	2.6E+01		1.00	0.646	0.00885	3.8E-03	2.3E-01	6.1E-01	0.0E+00	1.00E+00	0.333	0.017	1.7E+01
Benzo(a)anthracene	1.51E-01	3.00E-02	4.5E-03		1.00	0.646	0.00885	3.8E-03	4.0E-05	9.8E-02	0.0E+00	1.00E+00	0.333	0.017	1.9E+00
Benzo(a)pyrene	1.30E-01	7.00E-02	9.1E-03		1.00	0.646	0.00885	3.8E-03	8.1E-05	8.4E-02	0.0E+00	1.00E+00	0.333	0.017	1.6E+00
Benzo(b)fluoranthene	4.50E-01	7.00E-02	3.2E-02		1.00	0.646	0.00885	3.8E-03	2.8E-04	2.9E-01	0.0E+00	1.00E+00	0.333	0.017	5.7E+00
Benzo(k)fluoranthene	1.14E-01	8.00E-02	9.1E-03		1.00	0.646	0.00885	3.8E-03	8.1E-05	7.4E-02	0.0E+00	1.00E+00	0.333	0.017	1.4E+00
Dibenzo(a,h)anthracene	3.71E-02	7.00E-02	2.6E-03		1.00	0.646	0.00885	3.8E-03	2.3E-05	2.4E-02	0.0E+00	1.00E+00	0.333	0.017	4.7E-01
Indeno(1,2,3-c,d)pyrene	1.14E-01	8.00E-02	9.1E-03		1.00	0.646	0.00885	3.8E-03	8.1E-05	7.4E-02	0.0E+00	1.00E+00	0.333	0.017	1.4E+00
Naphthalene	4.55E-01	3.60E+01	1.6E+01		1.00	0.646	0.00885	3.8E-03	1.5E-01	2.9E-01	0.0E+00	1.00E+00	0.333	0.017	8.6E+00
Phenanthrene	4.22E-01	3.95E+02	1.7E+02		1.00	0.646	0.00885	3.8E-03	1.5E+00	2.7E-01	0.0E+00	1.00E+00	0.333	0.017	3.4E+01
Pyrene	2.91E-01	1.09E+03	3.2E+02		1.00	0.646	0.00885	3.8E-03	2.8E+00	1.9E-01	0.0E+00	1.00E+00	0.333	0.017	5.9E+01

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate; plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; plant; sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

Table I-6
Hazard Quotients for Least Sandpiper (*Calidris minutilla*)
Exposed to Soil, Water, and Contaminated Food at SS007, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Benzene	--	4.43E-02	NA
Ethylbenzene	--	3.98E+00	NA
Xylene	--	1.65E+01	NA
Benzo(a)anthracene	--	1.91E+00	NA
Benzo(a)pyrene	--	1.65E+00	NA
Benzo(b)fluoranthene	--	5.71E+00	NA
Benzo(k)fluoranthene	--	1.45E+00	NA
Dibenzo(a,h)anthracene	--	4.70E-01	NA
Indeno(1,2,3-c,d)pyrene	--	1.45E+00	NA
Naphthalene	--	8.61E+00	NA
Phenanthrene	--	3.43E+01	NA
Pyrene	--	5.89E+01	NA
		Hazard Index	0E+00

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-7

Maximum Exposure Doses for Northern Shrike (*Lanius excubitor*) Exposed to Soil, and Contaminated Food at SS007, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil (SC) mg/g$_{sed}$ (dry wt)	BCF$_{inv}$ mg/kg wet	IC mg/g$_{inv}$ (wet wt)	Conc Water mg/L	BCF$_{vert}$ mg/kg (dry wt)	VC mg/g$_{vert}$ (dry wt)	Pvert	P$_{invert}$	IR$_{soil}$ Kg/d	IR kg$_{diet}$/day (Dry wt)	WI L/day	II mg/day inv	IV mg/day vert	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Benzene	3.32E-03	3.97E+00	1.3E-02		1.18E-08	3.92E-11	0.50	0.5	0.00258	0.0258	9.0E-03	1.7E-04	5.1E-13	8.6E-06	0.0E+00	1.00E+00	1.000	0.06	3.0E-03
Ethylbenzene	2.29E-01	2.72E+01	6.2E+00	1.00E-03	7.97E-09	1.83E-09	0.50	0.5	0.00258	0.0025	9.0E-03	7.8E-03	2.3E-12	5.9E-04	9.0E-06	1.00E+00	1.000	0.06	1.4E-01
Xylene	9.50E-01	2.72E+01	2.6E+01		7.97E-09	2.58E+01	0.50	0.5	0.00258	0.0258	9.0E-03	3.3E-01	3.3E-01	2.5E-03	0.0E+00	1.00E+00	1.000	0.06	1.1E+01
Benzo(a)anthracene	1.51E-01	3.00E-02	4.5E-03		1.73E-05	4.53E-03	0.50	0.5	0.00258	0.0258	9.0E-03	5.8E-05	5.8E-05	3.9E-04	0.0E+00	1.00E+00	1.000	0.06	8.4E-03
Benzo(a)pyrene	1.30E-01	7.00E-02	9.1E-03		4.86E-05	9.11E-03	0.50	0.5	0.00258	0.0258	9.0E-03	1.2E-04	1.2E-04	3.4E-04	0.0E+00	1.00E+00	1.000	0.06	9.5E-03
Benzo(b)fluoranthene	4.50E-01	7.00E-02	3.2E-02		5.75E-05	3.15E-02	0.50	0.5	0.00258	0.0258	9.0E-03	4.1E-04	4.1E-04	1.2E-03	0.0E+00	1.00E+00	1.000	0.06	3.3E-02
Benzo(k)fluoranthene	1.14E-01	8.00E-02	9.1E-03		5.73E-05	9.13E-03	0.50	0.5	0.00258	0.0258	9.0E-03	1.2E-04	1.2E-04	2.9E-04	0.0E+00	1.00E+00	1.000	0.06	8.8E-03
Dibenzo(a,h)anthracene	3.71E-02	7.00E-02	2.6E-03		1.27E-04	2.60E-03	0.50	0.5	0.00258	0.0258	9.0E-03	3.4E-05	3.4E-05	9.6E-05	0.0E+00	1.00E+00	1.000	0.06	2.7E-03
Indeno(1,2,3-c,d)pyrene	1.14E-01	8.00E-02	9.1E-03		2.98E-04	9.15E-03	0.50	0.5	0.00258	0.0258	9.0E-03	1.2E-04	1.2E-04	2.9E-04	0.0E+00	1.00E+00	1.000	0.06	8.8E-03
Naphthalene	4.55E-01	3.60E+01	1.6E+01		7.61E-09	1.64E+01	0.50	0.5	0.00258	0.0258	9.0E-03	2.1E-01	2.1E-01	1.2E-03	0.0E+00	1.00E+00	1.000	0.06	7.1E+00
Phenanthrene	4.22E-01	3.95E+02	1.7E+02		5.50E-09	1.67E+02	0.50	0.5	0.00258	0.0258	9.0E-03	2.2E+00	2.2E+00	1.1E-03	0.0E+00	1.00E+00	1.000	0.06	7.2E+01
Pyrene	2.91E-01	1.09E+03	3.2E+02		4.92E-09	3.18E+02	0.50	0.5	0.00258	0.0258	9.0E-03	4.1E+00	4.1E+00	7.5E-04	0.0E+00	1.00E+00	1.000	0.06	1.4E+02

BCF$_{vert}$ = bioconcentration factor for contaminants from sediment into vertebrates (wet wt / dry wt)
BCF$_{inv}$ = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF$_{sed}$ = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g$_{diet}$/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IV = daily intake concentration from vertebrates (VC x Pvert x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)

mg/day = milligrams per day from food item (inv = invertebrate; vert = vertebrate, sed = sediment)
mg/day = milligrams per day from food item (inv = invertebrate, vert = vertebrate, sed = sediment)
milligrams per gram of food item (inv = invertebrate, vert = vertebrate; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IV+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; vert = vertebrate, sed = sediment)
SC = concentration of COPC in soil
wt = weight
WI = daily water ingestion rate

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Table I-8
Hazard Quotients for Northern Shrike (*Lanius excubitor*)
Exposed to Soil, and Contaminated Food at SS007, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Benzene	--	2.97E-03	NA
Ethylbenzene	--	1.40E-01	NA
Xylene	--	1.11E+01	NA
Benzo(a)anthracene	--	8.44E-03	NA
Benzo(a)pyrene	--	9.50E-03	NA
Benzo(b)fluoranthene	--	3.29E-02	NA
Benzo(k)fluoranthene	--	8.83E-03	NA
Dibenzo(a,h)anthracene	--	2.71E-03	NA
Indeno(1,2,3-c,d)pyrene	--	8.83E-03	NA
Naphthalene	--	7.07E+00	NA
Phenanthrene	--	7.17E+01	NA
Pyrene	--	1.37E+02	NA
		Hazard Index	0E+00

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-9
Maximum Exposure Doses for Sea Otter (*Enhydra lutris*) Exposed to Soil, Water, and Contaminated Food at SS007, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g_{sed} (dry wt)	BCF_{inv} mg/kg wet	IC mg/g_{inv} (wet wt)	PC mg/g_{plant} (dry wt)	P_{inv}	IR_{sed} Kg/d	IR kg_{diet}/day (Dry wt)	II mg/day inv	IS mg/day soil	HRF	ED fraction of year	BW kg	OD mg/kg/day
Benzene	3.32E-03	C-3	ND	1.32E-02	1.00	0.07	7	0.0E+00	2.3E-04	1.00E+00	0.667	30	5.2E-06
Ethylbenzene	2.29E-01	C-3	ND	6.22E+00	1.00	0.07	7	0.0E+00	1.6E-02	1.00E+00	0.667	30	3.6E-04
Xylene	9.50E-01	C-3	ND	2.58E+01	1.00	0.07	7	0.0E+00	6.7E-02	1.00E+00	0.667	30	1.5E-03
Benzo(a)anthracene	1.51E-01	C-3	ND	7.94E+02	1.00	0.07	7	0.0E+00	1.1E-02	1.00E+00	0.667	30	2.3E-04
Benzo(a)pyrene	1.30E-01	C-3	ND	6.84E+02	1.00	0.07	7	0.0E+00	9.1E-03	1.00E+00	0.667	30	2.0E-04
Benzo(b)fluoranthene	4.50E-01	C-3	ND	2.37E+03	1.00	0.07	7	0.0E+00	3.2E-02	1.00E+00	0.667	30	7.0E-04
Benzo(k)fluoranthene	1.14E-01	C-3	ND	5.99E+02	1.00	0.07	7	0.0E+00	8.0E-03	1.00E+00	0.667	30	1.8E-04
Dibenzo(a,h)anthracene	3.71E-02	C-3	ND	1.95E+02	1.00	0.07	7	0.0E+00	2.6E-03	1.00E+00	0.667	30	5.8E-05
Indeno(1,2,3-c,d)pyrene	1.14E-01	C-3	ND	5.99E+02	1.00	0.07	7	0.0E+00	8.0E-03	1.00E+00	0.667	30	1.8E-04
Naphthalene	4.55E-01	C-3	ND	1.64E+01	1.00	0.07	7	0.0E+00	3.2E-02	1.00E+00	0.667	30	7.1E-04
Phenanthrene	4.22E-01	C-3	ND	1.67E+02	1.00	0.07	7	0.0E+00	3.0E-02	1.00E+00	0.667	30	6.6E-04
Pyrene	2.91E-01	C-3	ND	3.18E+02	1.00	0.07	7	0.0E+00	2.0E-02	1.00E+00	0.667	30	4.5E-04

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area; estimated to be 0.85)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate; plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; plant; sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
SC_{max} = maximum detected concentration in sediment
WC_{max} = maximum detected concentration in surface water
wt = weight
WI = daily water ingestion rate

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Table I-10
Hazard Quotients for Sea Otter (*Enhydra Lutris*)
Exposed to Soil, Water, and Contaminated Food at SS007,
Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Benzene	--	2.05E-03	NA
Ethylbenzene	--	9.86E-01	NA
Xylene	--	4.01E+00	NA
Benzo(a)anthracene	1.00E+00	3.43E-02	3E-02
Benzo(a)pyrene	1.00E+00	3.24E-02	3E-02
Benzo(b)fluoranthene	1.00E+00	1.13E-01	1E-01
Benzo(k)fluoranthene	1.00E+00	2.87E-02	3E-02
Dibenzo(a,h)anthracene	1.00E+00	9.35E-03	9E-03
Indeno(1,2,3-c,d)pyrene	1.00E+00	2.87E-02	3E-02
Naphthalene	1.00E+00	2.55E+00	**3E+00**
Phenanthrene	1.00E+00	2.59E+01	**3E+01**
Pyrene	1.00E+00	4.95E+01	**5E+01**
		Hazard Index	**8E+01**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-11
Maximum Exposure Doses for Arctic Ground Squirrel (*Citellus parryi*) Exposed to Soil, Water, and Contaminated Food at LF006, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g_{sed} (dry wt)	Conc Water mg/L	BCF_{plants} mg/kg (dry wt)	PC mg/g_{plant} (dry wt)	P_{plant}	IR_{soil} kg/day	IR kg_{diet}/day (Dry wt)	WI L/day	IP mg/day plant	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Anthracene	7.50E+01		9.08E-02	6.81E+00	1	0.0025	0.05	7.2E-02	3.4E-01	1.9E-01	0.0E+00	1.00E+00	1.000	0.7	7.5E-01
Benzo(a)anthracene	1.20E+02	1.00E-03	2.02E-02	2.43E+00	1	0.0025	0.05	7.2E-02	1.2E-01	3.0E-01	7.2E-05	1.00E+00	1.000	0.7	6.0E-01
Benzo(a)pyrene	1 00E+02		1.11E-02	1.11E+00	1	0.0025	0.05	7.2E-02	5.6E-02	2.5E-01	0.0E+00	1.00E+00	1.000	0.7	4 4E-01
Benzo(b)fluoranthene	7.70E+01		1.01E-02	7.76E-01	1	0.0025	0.05	7.2E-02	3.9E-02	1.9E-01	0.0E+00	1.00E+00	1.000	0.7	3.3E-01
Benzo(g,h,i)perylene	5.70E+01		5.19E-03	2 96E-01	1	0.0025	0.05	7.2E-02	1.5E-02	1.4E-01	0.0E+00	1.00E+00	1.000	0.7	2.2E-01
Benzo(k)fluoranthene	8.00E+01		1 01E-02	8 08E-01	1	0.0025	0 05	7 2E-02	4.0E-02	2 0E-01	0.0E+00	1.00E+00	1.000	0.7	3.4E-01
Chrysene	1 30E+02		1 87E-02	2.43E+00	1	0.0025	0.05	7.2E-02	1.2E-01	3.3E-01	0.0E+00	1.00E+00	1.000	0.7	6.4E-01
Dibenzo(a,h)anthracene	2.00E+01		6.37E-03	1.27E-01	1	0.0025	0.05	7.2E-02	6.4E-03	5 0E-02	0.0E+00	1.00E+00	1.000	0.7	8.1E-02
Fluorene	3.60E+01		1.43E-01	5.14E+00	1	0.0025	0.05	7.2E-02	2.6E-01	9.0E-02	0.0E+00	1.00E+00	1.000	0.7	5.0E-01
Indeno(1,2,3-c,d)pyrene	7.10E+01		3.90E-03	2.77E-01	1	0.0025	0.05	7.2E-02	1.4E-02	1.8E-01	0.0E+00	1 00E+00	1.000	0.7	2.7E-01
Naphthalene	9.00E+00		4.79E-01	4.31E+00	1	0.0025	0.05	7.2E-02	2.2E-01	2 3E-02	0.0E+00	1.00E+00	1.000	0.7	3.4E-01
Phenanthrene	2.60E+02		8.84E-02	2.30E+01	1	0.0025	0.05	7.2E-02	1.1E+00	6.5E-01	0.0E+00	1.00E+00	1.000	0.7	2.6E+00
Pyrene	2 20E+02		4.31E-02	9.48E+00	1	0.0025	0.05	7.2E-02	4.7E-01	5.5E-01	0.0E+00	1.00E+00	1.000	0.7	1.5E+00
Arsenic	8 91E+00		3.60E-02	3.21E-01	1	0.0025	0.05	7.2E-02	1.6E-02	2.2E-02	0 0E+00	1.00E+00	1.000	0.7	5.5E-02
Barium	1 08E+02		1.50E-01	1.62E+01	1	0.0025	0.05	7.2E-02	8.1E-01	2.7E-01	0 0E+00	1 00E+00	1.000	0.7	1.5E+00
Cadmium	9 11E-01		3.64E-01	3.32E-01	1	0.0025	0.05	7.2E-02	1.7E-02	2.3E-03	0.0E+00	1.00E+00	1.000	0.7	2.7E-02
Selenium	6.13E-01		1.60E-02	9.81E-03	1	0.0025	0.05	7.2E-02	4.9E-04	1.5E-03	0.0E+00	1.00E+00	1.000	0.7	2.9E-03
Lead	2.25E+05		4 50E-02	1 01E+04	1	0.0025	0.05	7.2E-02	5.1E+02	5.6E+02	0.0E+00	1.00E+00	1.000	0.7	1.5E+03

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate; plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; plant; sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

Table I-12
Hazard Quotients for Arctic Ground Squirrel (*Citellus parryi*)
Exposed to Soil, Water, and Contaminated Food at LF006, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Anthracene	1.00E+00	7.54E-01	8E-01
Benzo(a)anthracene	1.00E+00	6.02E-01	6E-01
Benzo(a)pyrene	1.00E+00	4.36E-01	4E-01
Benzo(b)fluoranthene	1.00E+00	3.30E-01	3E-01
Benzo(g,h,i)perylene	0.00E+00	2.25E-01	NA
Benzo(k)fluoranthene	1.00E+00	3.43E-01	3E-01
Chrysene	1.00E+00	6.38E-01	6E-01
Dibenzo(a,h)anthracene	1.00E+00	8.05E-02	8E-02
Fluorene	1.00E+00	4.96E-01	5E-01
Indeno(1,2,3-c,d)pyrene	1.00E+00	2.73E-01	3E-01
Naphthalene	1.00E+00	3.40E-01	3E-01
Phenanthrene	1.00E+00	2.57E+00	**3E+00**
Pyrene	1.00E+00	1.46E+00	**1E+00**
Arsenic	1.25E+00	5.47E-02	4E-02
Barium	5.10E+00	1.54E+00	3E-01
Cadmium	1.00E+00	2.69E-02	3E-02
Selenium	2.00E-01	2.89E-03	1E-02
Lead	8.00E+00	1.53E+03	**2E+02**
		Hazard Index	**2E+02**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-13
Maximum Exposure Doses for Masked Shrew (*Sorex cinereus*) Exposed to Soil, Water, and Contaminated Food at LF006, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g_{sed} (dry wt)	BCF_{inv} mg/kg wet	IC mg/g_{inv} (wet wt)	Conc Water mg/L	P_{inv}	IR_{soil} kg/day	IR kg_{diet}/day (Dry wt)	WI L/day	II mg/day inv	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Anthracene	7.50E+01	3.81E+02	2.9E+04		1.00	0.001	0.00795	8.4E-04	2 3E+02	7.7E-02	0.0E+00	1.00E+00	1.000	0.005	4.5E+04
Benzo(a)anthracene	1.20E+02	3.00E-02	3.6E+00		1.00	0.001	0.00795	8.4E-04	2.9E-02	1.2E-01	0.0E+00	1.00E+00	1.000	0.005	3.0E+01
Benzo(a)pyrene	1.00E+02	7.00E-02	7.0E+00		1.00	0.001	0.00795	8.4E-04	5.6E-02	1.0E-01	0.0E+00	1.00E+00	1.000	0.005	3.2E+01
Benzo(b)fluoranthene	7.70E+01	7.00E-02	5.4E+00		1.00	0.001	0.00795	8.4E-04	4.3E-02	7.9E-02	0.0E+00	1.00E+00	1.000	0.005	2.4E+01
Benzo(g,h,i)perylene	5.70E+01	2.19E+04	1.3E+06		1.00	0.001	0.00795	8.4E-04	9.9E+03	5.9E-02	0.0E+00	1.00E+00	1.000	0.005	2.0E+06
Benzo(k)fluoranthene	8.00E+01	8.00E-02	6.4E+00		1.00	0.001	0.00795	8.4E-04	5.1E-02	8.2E-02	0.0E+00	1.00E+00	1.000	0.005	2.7E+01
Chrysene	1.30E+02	4 00E-02	5.2E+00		1.00	0.001	0.00795	8.4E-04	4.1E-02	1.3E-01	0.0E+00	1.00E+00	1.000	0.005	3.5E+01
Dibenzo(a,h)anthracene	2.00E+01	7.00E-02	1.4E+00		1.00	0.001	0.00795	8.4E-04	1.1E-02	2.1E-02	0.0E+00	1.00E+00	1.000	0.005	6.3E+00
Fluorene	3.60E+01	2.00E+02	7.2E+03		1.00	0.001	0.00795	8.4E-04	5.7E+01	3.7E-02	0.0E+00	1.00E+00	1.000	0.005	1.1E+04
Indeno(1,2,3-c,d)pyrene	7.10E+01	8.00E-02	5.7E+00		1.00	0.001	0.00795	8.4E-04	4.5E-02	7.3E-02	0.0E+00	1.00E+00	1.000	0.005	2.4E+01
Naphthalene	9.00E+00	3.60E+01	3.2E+02		1.00	0.001	0.00795	8.4E-04	2.6E+00	9.3E-03	0.0E+00	1.00E+00	1.000	0.005	5.2E+02
Phenanthrene	2.60E+02	3.95E+02	1.0E+05		1.00	0 001	0.00795	8.4E-04	8.2E+02	2.7E-01	0 0E+00	1.00E+00	1.000	0.005	1.6E+05
Pyrene	2.20E+02	1.09E+03	2.4E+05		1.00	0.001	0.00795	8.4E-04	1.9E+03	2.3E-01	0.0E+00	1.00E+00	1.000	0.005	3.8E+05
Arsenic	8.91E+00	1.10E-01	9.8E-01		1.00	0.001	0.00795	8.4E-04	7.8E-03	9.2E-03	0.0E+00	1.00E+00	1.000	0.005	3.4E+00
Barium	1.08E+02	2.20E-01	2.4E+01		1.00	0.001	0.00795	8.4E-04	1.9E-01	1.1E-01	0.0E+00	1.00E+00	1.000	0.005	6.0E+01
Cadmium	9.11E-01	9.60E-01	8.7E-01		1.00	0.001	0.00795	8.4E-04	7.0E-03	9.4E-04	0.0E+00	1.00E+00	1.000	0.005	1.6E+00
Selenium	6.13E-01	2.20E-01	1.3E-01		1.00	0.001	0 00795	8.4E-04	1.1E-03	6.3E-04	0.0E+00	1.00E+00	1.000	0.005	3.4E-01
Lead	2.25E+05	3.00E-02	6.8E+03		1.00	0.001	0.00795	8.4E-04	5.4E+01	2.3E+02	0.0E+00	1.00E+00	1.000	0.005	5.7E+04

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate, plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate, plant, sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; plant, sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

Table I-14
Hazard Quotients for Masked Shrew (*Sorex cinereus*)
Exposed to Soil, Water, and Contaminated Food at LF006, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Anthracene	1.00E+00	4.54E+04	**5E+04**
Benzo(a)anthracene	1.00E+00	3.04E+01	**3E+01**
Benzo(a)pyrene	1.00E+00	3.17E+01	**3E+01**
Benzo(b)fluoranthene	1.00E+00	2.44E+01	**2E+01**
Benzo(g,h,i)perylene	0.00E+00	1.99E+06	NA
Benzo(k)fluoranthene	1.00E+00	2.67E+01	**3E+01**
Chrysene	1.00E+00	3.50E+01	**4E+01**
Dibenzo(a,h)anthracene	1.00E+00	6.35E+00	**6E+00**
Fluorene	1.00E+00	1.15E+04	**1E+04**
Indeno(1,2,3-c,d)pyrene	1.00E+00	2.37E+01	**2E+01**
Naphthalene	1.00E+00	5.17E+02	**5E+02**
Phenanthrene	1.00E+00	1.63E+05	**2E+05**
Pyrene	1.00E+00	3.83E+05	**4E+05**
Arsenic	1.25E+00	3.39E+00	**3E+00**
Barium	5.10E+00	6.00E+01	**1E+01**
Cadmium	1.00E+00	1.58E+00	**2E+00**
Selenium	2.00E-01	3.41E-01	**2E+00**
Lead	8.00E+00	5.71E+04	**7E+03**
		Hazard Index	**6E+05**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

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Table I-15

Maximum Exposure Doses for Least Sandpiper (*Calidris minutilla*) Exposed to Soil, Water, and Contaminated Food at LF006, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g_{sed} (dry wt)	BCF_{inv} mg/kg wet	IC mg/g_{inv} (wet wt)	Conc Water mg/L	P_{inv}	IR_{soil} g/day	IR kg_{diet}/day (Dry wt)	WI L/day	II mg/day inv	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Anthracene	7.50E+01	3.81E+02	2.9E+04		1.00	0.646	0.00885	3.8E-03	2.5E+02	4.8E+01	0.0E+00	1.00E+00	0.333	0.017	5.9E+03
Benzo(a)anthracene	1.20E+02	3.00E-02	3.6E+00		1.00	0.646	0.00885	3.8E-03	3.2E-02	7.8E+01	0.0E+00	1.00E+00	0.333	0.017	1.5E+03
Benzo(a)pyrene	1.00E+02	7.00E-02	7.0E+00		1.00	0.646	0.00885	3.8E-03	6.2E-02	6.5E+01	0.0E+00	1.00E+00	0.333	0.017	1.3E+03
Benzo(b)fluoranthene	7.70E+01	7.00E-02	5.4E+00		1.00	0.646	0.00885	3.8E-03	4.8E-02	5.0E+01	0.0E+00	1.00E+00	0.333	0.017	9.8E+02
Benzo(g,h,i)perylene	5.70E+01	2.19E+04	1.3E+06		1.00	0.646	0.00885	3.8E-03	1.1E+04	3.7E+01	0 0E+00	1.00E+00	0.333	0.017	2.2E+05
Benzo(k)fluoranthene	8.00E+01	8.00E-02	6.4E+00		1.00	0.646	0.00885	3.8E-03	5.7E-02	5.2E+01	0 0E+00	1.00E+00	0.333	0.017	1.0E+03
Chrysene	1.30E+02	4.00E-02	5.2E+00		1.00	0.646	0.00885	3.8E-03	4.6E-02	8.4E+01	0.0E+00	1.00E+00	0.333	0.017	1.6E+03
Dibenzo(a,h)anthracene	2.00E+01	7.00E-02	1.4E+00		1.00	0.646	0.00885	3.8E-03	1.2E-02	1.3E+01	0 0E+00	1.00E+00	0.333	0.017	2.5E+02
Fluorene	3.60E+01	2.00E+02	7.2E+03		1.00	0.646	0.00885	3.8E-03	6.4E+01	2.3E+01	0 0E+00	1.00E+00	0.333	0.017	1.7E+03
Indeno(1,2,3-c,d)pyrene	7.10E+01	8.00E-02	5.7E+00		1.00	0.646	0.00885	3.8E-03	5.0E-02	4 6E+01	0.0E+00	1.00E+00	0.333	0.017	9.0E+02
Naphthalene	9.00E+00	3.60E+01	3 2E+02		1.00	0.646	0.00885	3 8E-03	2.9E+00	5.8E+00	0.0E+00	1.00E+00	0.333	0.017	1.7E+02
Phenanthrene	2.60E+02	3.95E+02	1.0E+05		1.00	0.646	0.00885	3.8E-03	9.1E+02	1.7E+02	0.0E+00	1.00E+00	0.333	0.017	2.1E+04
Pyrene	2.20E+02	1.09E+03	2.4E+05		1.00	0.646	0.00885	3.8E-03	2.1E+03	1 4E+02	0.0E+00	1.00E+00	0.333	0.017	4.5E+04
Arsenic	8.91E+00	1.10E-01	9.8E-01		1.00	0.646	0.00885	3.8E-03	8.7E-03	5.8E+00	0.0E+00	1.00E+00	0.333	0.017	1.1E+02
Barium	1.08E+02	2.20E-01	2.4E+01		1.00	0.646	0.00885	3.8E-03	2.1E-01	7.0E+01	0.0E+00	1.00E+00	0.333	0.017	1.4E+03
Cadmium	9.11E-01	9.60E-01	8.7E-01		1.00	0.646	0.00885	3.8E-03	7 7E-03	5.9E-01	0.0E+00	1.00E+00	0.333	0.017	1.2E+01
Selenium	6.13E-01	2.20E-01	1.3E-01		1.00	0.646	0.00885	3.8E-03	1.2E-03	4.0E-01	0.0E+00	1.00E+00	0.333	0.017	7.8E+00
Lead	2.25E+05	3.00E-02	6.8E+03		1.00	0.646	0.00885	3.8E-03	6.0E+01	1.5E+05	0.0E+00	1.00E+00	0.333	0.017	2.9E+06

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate; plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; plant, sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

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Table I-16
Hazard Quotients for Least Sandpiper (*Calidris minutilla*)
Exposed to Soil, Water, and Contaminated Food at LF006, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Anthracene	--	5.90E+03	NA
Benzo(a)anthracene	--	1.52E+03	NA
Benzo(a)pyrene	--	1.27E+03	NA
Benzo(b)fluoranthene	--	9.76E+02	NA
Benzo(g,h,i)perylene	0.00E+00	2.18E+05	NA
Benzo(k)fluoranthene	--	1.01E+03	NA
Chrysene	--	1.65E+03	NA
Dibenzo(a,h)anthracene	--	2.54E+02	NA
Fluorene	--	1.71E+03	NA
Indeno(1,2,3-c,d)pyrene	--	9.00E+02	NA
Naphthalene	--	1.70E+02	NA
Phenanthrene	--	2.11E+04	NA
Pyrene	--	4.46E+04	NA
Arsenic	2.46E+00	1.13E+02	**5E+01**
Barium	2.08E+01	1.37E+03	**7E+01**
Cadmium	1.45E+00	1.17E+01	**8E+00**
Selenium	5.00E-01	7.79E+00	**2E+01**
Lead	3.85E+00	2.85E+06	**7E+05**
		Hazard Index	**7E+05**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-17
Maximum Exposure Doses for Northern Shrike (*Lanius excubitor*) Exposed to Soil, and Contaminated Food at LF006, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g$_{sed}$ (dry wt)	BCF$_{inv}$ mg/kg wet	IC mg/g$_{inv}$ (wet wt)	Conc Water mg/L	BCF$_{vert}$ mg/kg (dry wt)	VC mg/g$_{vert}$ (dry wt)	Pvert	P$_{invert}$	IR$_{soil}$ Kg/d	IR kg$_{diet}$/day (Dry wt)	WI L/day	II mg/day inv	IV mg/day vert	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Anthracene	7.50E+01	3.81E+02	2.9E+04		5.52E-09	4.14E-07	0.50	0.5	0.00258	0.0258	9.0E-03	3.7E+02	5.3E-09	1.9E-01	0.0E+00	1.00E+00	1.000	0.06	6.1E+03
Benzo(a)anthracene	1.20E+02	3.00E-02	3.6E+00		1.73E-05	2.08E-03	0.50	0.5	0.00258	0.0258	9.0E-03	4.6E-02	2.7E-05	3.1E-01	0.0E+00	1.00E+00	1.000	0.06	5.9E+00
Benzo(a)pyrene	1.00E+02	7.00E-02	7.0E+00		4.86E-05	4.86E-03	0.50	0.5	0.00258	0.0258	9.0E-03	9.0E-02	6.3E-05	2.6E-01	0.0E+00	1.00E+00	1.000	0.06	5.8E+00
Benzo(b)fluoranthene	7.70E+01	7.00E-02	5.4E+00		5.75E-05	4.43E-03	0.50	0.5	0.00258	0.0258	9.0E-03	7.0E-02	5.7E-05	2.0E-01	0.0E+00	1.00E+00	1.000	0.06	4.5E+00
Benzo(g,h,i)perylene	5.70E+01	2.19E+04	1.3E+06		3.75E-09	2.14E-07	0.50	0.5	0.00258	0.0258	9.0E-03	1.6E+04	2.8E-09	1.5E-01	0.0E+00	1.00E+00	1.000	0.06	2.7E+05
Benzo(k)fluoranthene	8.00E+01	8.00E-02	6.4E+00		5.73E-05	4.58E-03	0.50	0.5	0.00258	0.0258	9.0E-03	8.3E-02	5.9E-05	2.1E-01	0.0E+00	1.00E+00	1.000	0.06	4.8E+00
Chrysene	1.30E+02	4.00E-02	5.2E+00		1.99E-05	2.59E-03	0.50	0.5	0.00258	0.0258	9.0E-03	6.7E-02	3.3E-05	3.4E-01	0.0E+00	1.00E+00	1.000	0.06	6.7E+00
Dibenzo(a,h)anthracene	2.00E+01	7.00E-02	1.4E+00		1.27E-04	2.54E-03	0.50	0.5	0.00258	0.0258	9.0E-03	1.8E-02	3.3E-05	5.2E-02	0.0E+00	1.00E+00	1.000	0.06	1.2E+00
Fluorene	3.60E+01	2.00E+02	7.2E+03		5.97E-09	2.15E-07	0.50	0.5	0.00258	0.0258	9.0E-03	9.3E+01	2.8E-09	9.3E-02	0.0E+00	1.00E+00	1.000	0.06	1.6E+03
Indeno(1,2,3-c,d)pyrene	7.10E+01	8.00E-02	5.7E+00		2.98E-04	2.12E-02	0.50	0.5	0.00258	0.0258	9.0E-03	7.3E-02	2.7E-04	1.8E-01	0.0E+00	1.00E+00	1.000	0.06	4.3E+00
Naphthalene	9.00E+00	3.60E+01	3.2E+02		7.61E-09	6.85E-08	0.50	0.5	0.00258	0.0258	9.0E-03	4.2E+00	8.8E-10	2.3E-02	0.0E+00	1.00E+00	1.000	0.06	7.0E+01
Phenanthrene	2.60E+02	3.95E+02	1.0E+05		5.50E-09	1.43E-06	0.50	0.5	0.00258	0.0258	9.0E-03	1.3E+03	1.8E-08	6.7E-01	0.0E+00	1.00E+00	1.000	0.06	2.2E+04
Pyrene	2.20E+02	1.09E+03	2.4E+05		4.92E-09	1.08E-06	0.50	0.5	0.00258	0.0258	9.0E-03	3.1E+03	1.4E-08	5.7E-01	0.0E+00	1.00E+00	1.000	0.06	5.2E+04
Arsenic	8.91E+00	1.10E-01	9.8E-01		2.88E-06	2.57E-05	0.50	0.5	0.00258	0.0258	9.0E-03	1.3E-02	3.3E-07	2.3E-02	0.0E+00	1.00E+00	1.000	0.06	5.9E-01
Barium	1.08E+02	2.20E-01	2.4E+01		2.16E-07	2.33E-05	0.50	0.5	0.00258	0.0258	9.0E-03	3.1E-01	3.0E-07	2.8E-01	0.0E+00	1.00E+00	1.000	0.06	9.8E+00
Cadmium	9.11E-01	9.60E-01	8.7E-01		1.73E-07	1.58E-07	0.50	0.5	0.00258	0.0258	9.0E-03	1.1E-02	2.0E-09	2.4E-03	0.0E+00	1.00E+00	1.000	0.06	2.3E-01
Selenium	6.13E-01	2.20E-01	1.3E-01		3.27E-06	2.00E-06	0.50	0.5	0.00258	0.0258	9.0E-03	1.7E-03	2.6E-08	1.6E-03	0.0E+00	1.00E+00	1.000	0.06	5.5E-02
Lead	2.25E+05	3.00E-02	6.8E+03		4.23E-07	9.52E-02	0.50	0.5	0.00258	0.0258	9.0E-03	8.7E+01	1.2E-03	5.8E+02	0.0E+00	1.00E+00	1.000	0.06	1.1E+04

BCF^{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate; plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate, plant, sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

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Table I-18
Hazard Quotients for Northern Shrike (*Lanius excubitor*)
Exposed to Soil, and Contaminated Food at LF006, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Anthracene	--	6.14E+03	NA
Benzo(a)anthracene	--	5.93E+00	NA
Benzo(a)pyrene	--	5.81E+00	NA
Benzo(b)fluoranthene	--	4.47E+00	NA
Benzo(g,h,i)perylene	0.00E+00	2.69E+05	NA
Benzo(k)fluoranthene	--	4.82E+00	NA
Chrysene	--	6.71E+00	NA
Dibenzo(a,h)anthracene	--	1.16E+00	NA
Fluorene	--	1.55E+03	NA
Indeno(1,2,3-c,d)pyrene	--	4.28E+00	NA
Naphthalene	--	7.01E+01	NA
Phenanthrene	--	2.21E+04	NA
Pyrene	--	5.18E+04	NA
Arsenic	2.46E+00	5.94E-01	2E-01
Barium	2.08E+01	9.75E+00	5E-01
Cadmium	1.45E+00	2.27E-01	2E-01
Selenium	5.00E-01	5.54E-02	1E-01
Lead	3.85E+00	1.11E+04	**3E+03**
		Hazard Index	**3E+03**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

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Table I-19
Maximum Exposure Doses for Arctic Ground Squirrel (*Citellus parryi*) Exposed to Soil, Water, and Contaminated Food at Electronic Debris Area, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g_{sed} (dry wt)	Conc Water mg/L	BCF_{plants} mg/kg (dry wt)	PC mg/g_{plant} (dry wt)	P_{plant}	IR_{soil} kg/day	IR kg_{diet}/day (Dry wt)	WI L/day	IP mg/day plant	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Lead	6.23E+04		[5]	ND	1	0.0025	0.05	7.2E-02	0.0E+00	1 6E+02	0.0E+00	1.00E+00	1.000	0.7	2.2E+02

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate; plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate, plant; sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

Table I-20
Hazard Quotients for Arctic Ground Squirrel (*Citellus parryi*)
Exposed to Soil, Water, and Contaminated Food at Electronic Debris Area, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Lead	8.00E+00	4.23E+02	**5E+01**
		Hazard Index	**5E+01**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-21
Maximum Exposure Doses for Masked Shrew (*Sorex cinereus*) Exposed to Soil, Water, and Contaminated Food at Electronic Debris Area, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g_{sed} (dry wt)	BCF_{inv} mg/kg wet	IC mg/g_{inv} (wet wt)	Conc Water mg/L	P_{inv}	IR_{soil} kg/day	IR kg_{diet}/day (Dry wt)	WI L/day	II mg/day inv	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Lead	6.23E+04	3.00E-02	1.9E+03		1.00	0 001	0.00795	8.4E-04	1.5E+01	6 4E+01	0.0E+00	1.00E+00	1.000	0.005	1.6E+04

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate; plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; plant; sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

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Table I-22
Hazard Quotients for Masked Shrew (*Sorex cinereus*)
Exposed to Soil, Water, and Contaminated Food at Electronic Debris Area, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Lead	8.00E+00	1.58E+04	**2E+03**
		Hazard Index	**2E+03**

Notes:
1-Values with bold and shading indicate an elevated potential for adverse ecological effects
HQ = COPEC-specific hazard quotient
mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-23

Maximum Exposure Doses for Least Sandpiper (*Calidris minutilla*) Exposed to Soil, Water, and Contaminated Food at Electronic Debris Area, Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g_{sed} (dry wt)	BCF_{inv} mg/kg wet	IC mg/g_{inv} (wet wt)	Conc Water mg/L	P_{inv}	IR_{soil} g/day	IR kg_{diet}/day (Dry wt)	WI L/day	II mg/day inv	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Lead	6.23E+04	3.00E-02	1.9E+03		1.00	0.646	0.00885	3.8E-03	1.7E+01	4.0E+04	0.0E+00	1.00E+00	0.333	0.017	7.9E+05

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate; plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant, sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; plant; sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

Table I-24
Hazard Quotients for Least Sandpiper (*Calidris minutilla*)
Exposed to Soil, Water, and Contaminated Food at Electronic Debris Area, Driftwood Bay Radio Relay Station, Driftwood Bay, Alaska

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Lead	3.85E+00	7.89E+05	**2E+05**
		Hazard Index	**2E+05**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-25
Maximum Exposure Doses for Northern Shrike (*Lanius excubitor*) Exposed to Soil, and Contaminated Food at Electronic Debris Area, Driftwood Bay Radio Relay Station, Driftwood Bay, Alaska

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil (SC) mg/g_{sed} (dry wt)	BCF_{inv} mg/kg wet	IC mg/g_{inv} (wet wt)	Conc Water mg/L	BCF_{vert} mg/kg (dry wt)	VC mg/g_{vert} (dry wt)	Pvert	P_{invert}	IR_{soil} Kg/d	IR kg_{diet}/day (Dry wt)	WI L/day	II mg/day inv	IV mg/day vert	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Lead	6.23E+04	3 00E-02	1.9E+03		4 23E-07	2.63E-02	0.50	0 5	0.00258	0.0258	9.0E-03	2.4E+01	3.4E-04	1 6E+02	0 0E+00	1.00E+00	1.000	0.06	3 1E+03

BCF_{vert} = bioconcentration factor for contaminants from sediment into vertebrates (wet wt / dry wt)
BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IV = daily intake concentration from vertebrates (VC x Pvert x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)

mg/day = milligrams per day from food item (inv = invertebrate; vert = vertebrate, sed = sediment)
mg/day = milligrams per day from food item (inv = invertebrate, plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate, vert = vertebrate, sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IV+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; vert = vertebrate, sed = sediment)
VC = concentration in vertebrates (SC x BCFvert)
wt = weight
WI = daily water ingestion rate

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Table I-26
Hazard Quotients for Northern Shrike (*Lanius excubitor*)
Exposed to Soil, and Contaminated Food at Electronic Debris Area, Driftwood Bay Radio Relay Station, Driftwood Bay, Alaska

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Lead	3.85E+00	3.1E+03	**8E+02**
		Hazard Index	**8E+02**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-27
Maximum Exposure Doses for Arctic Ground Squirrel (*Citellus parryi*) Exposed to Soil, Water, and Contaminated Food at LF006 without 'TP01C-SO', Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil	Conc Water	BCF_{plants}	PC	P_{plant}	IR_{soil}	IR	WI	IP	IS	IW	HRF	ED	BW	OD
	mg/g_{sed} (dry wt)	mg/L	mg/kg (dry wt)	mg/g_{plant} (dry wt)		kg/day	kg_{diet}/day (Dry wt)	L/day	mg/day plant	mg/day soil	mg/day water		fraction of year	kg	mg/kg/day
Anthracene	2.40E+00		9.08E-02	2 18E-01	1	0.0025	0.05	7.2E-02	1.1E-02	6.0E-03	0.0E+00	1.00E+00	1.000	0.7	2.4E-02
Benzo(a)anthracene	6.10E+00	1.00E-03	2.02E-02	1.23E-01	1	0.0025	0.05	7.2E-02	6.2E-03	1.5E-02	7.2E-05	1.00E+00	1.000	0.7	3.1E-02
Benzo(a)pyrene	5.60E+00		1.11E-02	6.22E-02	1	0.0025	0.05	7.2E-02	3.1E-03	1.4E-02	0.0E+00	1.00E+00	1.000	0.7	2.4E-02
Benzo(b)fluoranthene	7.30E+00		1.01E-02	7 35E-02	1	0.0025	0.05	7.2E-02	3.7E-03	1.8E-02	0.0E+00	1.00E+00	1.000	0.7	3.1E-02
Benzo(g,h,i)perylene	2.70E+00		5.19E-03	1.40E-02	1	0.0025	0.05	7.2E-02	7.0E-04	6.8E-03	0.0E+00	1.00E+00	1.000	0.7	1.1E-02
Benzo(k)fluoranthene	2.60E+00		1.01E-02	2.63E-02	1	0.0025	0.05	7.2E-02	1.3E-03	6.5E-03	0.0E+00	1.00E+00	1.000	0.7	1.1E-02
Chrysene	7.20E+00		1.87E-02	1.34E-01	1	0.0025	0.05	7.2E-02	6.7E-03	1.8E-02	0.0E+00	1.00E+00	1.000	0.7	3.5E-02
Dibenzo(a,h)anthracene	9.50E-01		6.37E-03	6.05E-03	1	0.0025	0.05	7.2E-02	3.0E-04	2.4E-03	0.0E+00	1.00E+00	1.000	0.7	3.8E-03
Fluorene	1.10E+01		1.43E-01	1.57E+00	1	0.0025	0.05	7.2E-02	7.9E-02	2.8E-02	0.0E+00	1.00E+00	1.000	0.7	1.5E-01
Indeno(1,2,3-c,d)pyrene	3.20E+00		3.90E-03	1.25E-02	1	0.0025	0.05	7.2E-02	6.2E-04	8.0E-03	0.0E+00	1.00E+00	1.000	0.7	1.2E-02
Naphthalene	7.90E-01		4.79E-01	3.79E-01	1	0.0025	0.05	7.2E-02	1.9E-02	2.0E-03	0.0E+00	1.00E+00	1.000	0.7	3.0E-02
Phenanthrene	7.30E+00		8.84E-02	6.45E-01	1	0.0025	0.05	7.2E-02	3.2E-02	1.8E-02	0.0E+00	1.00E+00	1.000	0.7	7.2E-02
Pyrene	1.10E+01		4.31E-02	4.74E-01	1	0.0025	0.05	7.2E-02	2.4E-02	2.8E-02	0.0E+00	1.00E+00	1.000	0.7	7.3E-02
Lead	2.25E+05		4.50E-02	1.01E+04	1	0.0025	0.05	7.2E-02	5.1E+02	5.6E+02	0.0E+00	1.00E+00	1.000	0.7	1.5E+03

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate; plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate, plant; sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

Table I-28
Hazard Quotients for Arctic Ground Squirrel (*Citellus parryi*)
Exposed to Soil, Water, and Contaminated Food at LF006 without 'TP01C-SO', Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Anthracene	1.00E+00	2.41E-02	2E-02
Benzo(a)anthracene	1.00E+00	3.07E-02	3E-02
Benzo(a)pyrene	1.00E+00	2.44E-02	2E-02
Benzo(b)fluoranthene	1.00E+00	3.13E-02	3E-02
Benzo(g,h,i)perylene	0.00E+00	1.06E-02	NA
Benzo(k)fluoranthene	1.00E+00	1.12E-02	1E-02
Chrysene	1.00E+00	3.53E-02	4E-02
Dibenzo(a,h)anthracene	1.00E+00	3.82E-03	4E-03
Fluorene	1.00E+00	1.51E-01	2E-01
Indeno(1,2,3-c,d)pyrene	1.00E+00	1.23E-02	1E-02
Naphthalene	1.00E+00	2.99E-02	3E-02
Phenanthrene	1.00E+00	7.22E-02	7E-02
Pyrene	1.00E+00	7.31E-02	7E-02
Lead	8.00E+00	1.53E+03	**2E+02**
		Hazard Index	**2E+02**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-29

Maximum Exposure Doses for Masked Shrew (*Sorex cinereus*) Exposed to Soil, Water, and Contaminated Food at LF006 without 'TP01C-SO', Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g_{sed} (dry wt)	BCF_{inv} mg/kg wet	IC mg/g_{inv} (wet wt)	Conc Water mg/L	P_{inv}	IR_{soil} kg/day	IR kg_{diet}/day (Dry wt)	WI L/day	II mg/day inv	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Anthracene	2.40E+00	3.81E+02	9.1E+02		1.00	0.001	0.00795	8.4E-04	7.3E+00	2.5E-03	0.0E+00	1.00E+00	1.000	0.005	1.5E+03
Benzo(a)anthracene	6.10E+00	3.00E-02	1.8E-01		1.00	0.001	0.00795	8.4E-04	1.5E-03	6.3E-03	0.0E+00	1.00E+00	1.000	0.005	1.5E+00
Benzo(a)pyrene	5.60E+00	7.00E-02	3.9E-01		1.00	0.001	0.00795	8.4E-04	3.1E-03	5.8E-03	0.0E+00	1.00E+00	1.000	0.005	1.8E+00
Benzo(b)fluoranthene	7.30E+00	7.00E-02	5.1E-01		1.00	0.001	0.00795	8.4E-04	4.1E-03	7.5E-03	0.0E+00	1 00E+00	1.000	0.005	2.3E+00
Benzo(g,h,i)perylene	2.70E+00	2.19E+04	5.9E+04		1.00	0.001	0.00795	8.4E-04	4.7E+02	2.8E-03	0.0E+00	1.00E+00	1.000	0.005	9.4E+04
Benzo(k)fluoranthene	2.60E+00	8.00E-02	2.1E-01		1.00	0.001	0.00795	8.4E-04	1.7E-03	2.7E-03	0.0E+00	1.00E+00	1.000	0.005	8.7E-01
Chrysene	7.20E+00	4.00E-02	2.9E-01		1.00	0.001	0.00795	8.4E-04	2.3E-03	7.4E-03	0.0E+00	1 00E+00	1.000	0.005	1.9E+00
Dibenzo(a,h)anthracene	9.50E-01	7.00E-02	6.7E-02		1.00	0.001	0.00795	8.4E-04	5.3E-04	9.8E-04	0.0E+00	1 00E+00	1.000	0.005	3.0E-01
Fluorene	1.10E+01	2.00E+02	2.2E+03		1.00	0.001	0.00795	8.4E-04	1.8E+01	1.1E-02	0.0E+00	1 00E+00	1.000	0.005	3.5E+03
Indeno(1,2,3-c,d)pyrene	3.20E+00	8.00E-02	2.6E-01		1.00	0.001	0.00795	8.4E-04	2.0E-03	3.3E-03	0.0E+00	1 00E+00	1.000	0.005	1.1E+00
Naphthalene	7.90E-01	3.60E+01	2.8E+01		1.00	0.001	0.00795	8.4E-04	2.3E-01	8.1E-04	0.0E+00	1.00E+00	1.000	0.005	4.5E+01
Phenanthrene	7.30E+00	3.95E+02	2.9E+03		1.00	0.001	0.00795	8.4E-04	2.3E+01	7.5E-03	0.0E+00	1.00E+00	1.000	0.005	4.6E+03
Pyrene	1.10E+01	1.09E+03	1.2E+04		1.00	0.001	0.00795	8.4E-04	9.6E+01	1.1E-02	0.0E+00	1.00E+00	1.000	0.005	1.9E+04
Lead	2.25E+05	3.00E-02	6.8E+03		1.00	0.001	0.00795	8.4E-04	5.4E+01	2.3E+02	0.0E+00	1.00E+00	1.000	0.005	5.7E+04

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms

mg/day = milligrams per day from food item (inv = invertebrate; plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; plant; sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

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Table I-30
Hazard Quotients for Masked Shrew (*Sorex cinereus*)
Exposed to Soil, Water, and Contaminated Food at LF006 without 'TP01C-SO', Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Anthracene	1.00E+00	1.45E+03	**1E+03**
Benzo(a)anthracene	1.00E+00	1.55E+00	**2E+00**
Benzo(a)pyrene	1.00E+00	1.78E+00	**2E+00**
Benzo(b)fluoranthene	1.00E+00	2.32E+00	**2E+00**
Benzo(g,h,i)perylene	0.00E+00	9.42E+04	NA
Benzo(k)fluoranthene	1.00E+00	8.66E-01	9E-01
Chrysene	1.00E+00	1.94E+00	**2E+00**
Dibenzo(a,h)anthracene	1.00E+00	3.01E-01	3E-01
Fluorene	1.00E+00	3.51E+03	**4E+03**
Indeno(1,2,3-c,d)pyrene	1.00E+00	1.07E+00	**1E+00**
Naphthalene	1.00E+00	4.54E+01	**5E+01**
Phenanthrene	1.00E+00	4.59E+03	**5E+03**
Pyrene	1.00E+00	1.91E+04	**2E+04**
Lead	8.00E+00	5.71E+04	**7E+03**
		Hazard Index	**4E+04**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-31
Maximum Exposure Doses for Least Sandpiper (*Calidris minutilla*) Exposed to Soil, Water, and Contaminated Food at LF006 without 'TP01C-SO', Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g_{sed} (dry wt)	BCF_{inv} mg/kg wet	IC mg/g_{inv} (wet wt)	Conc Water mg/L	P_{inv}	IR_{soil} g/day	IR kg_{diet}/day (Dry wt)	WI L/day	II mg/day inv	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Anthracene	2.40E+00	3.81E+02	9.1E+02		1.00	0.646	0.00885	3.8E-03	8.1E+00	1.6E+00	0.0E+00	1.00E+00	0.333	0.017	1.9E+02
Benzo(a)anthracene	6.10E+00	3.00E-02	1.8E-01		1.00	0.646	0.00885	3.8E-03	1.6E-03	3.9E+00	0.0E+00	1.00E+00	0.333	0.017	7.7E+01
Benzo(a)pyrene	5.60E+00	7.00E-02	3.9E-01		1.00	0 646	0.00885	3.8E-03	3.5E-03	3.6E+00	0.0E+00	1.00E+00	0.333	0.017	7.1E+01
Benzo(b)fluoranthene	7.30E+00	7.00E-02	5.1E-01		1.00	0.646	0.00885	3.8E-03	4.5E-03	4.7E+00	0.0E+00	1.00E+00	0.333	0.017	9.3E+01
Benzo(g,h,i)perylene	2.70E+00	2.19E+04	5.9E+04		1.00	0 646	0.00885	3.8E-03	5.2E+02	1.7E+00	0.0E+00	1.00E+00	0.333	0.017	1.0E+04
Benzo(k)fluoranthene	2.60E+00	8.00E-02	2.1E-01		1.00	0.646	0.00885	3.8E-03	1.8E-03	1.7E+00	0.0E+00	1.00E+00	0.333	0.017	3.3E+01
Chrysene	7.20E+00	4.00E-02	2.9E-01		1.00	0.646	0.00885	3.8E-03	2.5E-03	4.7E+00	0.0E+00	1.00E+00	0.333	0.017	9.1E+01
Dibenzo(a,h)anthracene	9.50E-01	7.00E-02	6.7E-02		1.00	0.646	0.00885	3.8E-03	5.9E-04	6.1E-01	0.0E+00	1.00E+00	0.333	0.017	1.2E+01
Fluorene	1.10E+01	2.00E+02	2.2E+03		1.00	0.646	0.00885	3.8E-03	2.0E+01	7.1E+00	0.0E+00	1.00E+00	0.333	0.017	5.2E+02
Indeno(1,2,3-c,d)pyrene	3.20E+00	8.00E-02	2.6E-01		1.00	0.646	0.00885	3.8E-03	2.3E-03	2.1E+00	0.0E+00	1.00E+00	0.333	0.017	4.1E+01
Naphthalene	7.90E-01	3.60E+01	2.8E+01		1.00	0.646	0.00885	3.8E-03	2.5E-01	5.1E-01	0.0E+00	1.00E+00	0.333	0.017	1.5E+01
Phenanthrene	7.30E+00	3.95E+02	2.9E+03		1.00	0.646	0.00885	3.8E-03	2.6E+01	4.7E+00	0.0E+00	1.00E+00	0.333	0.017	5.9E+02
Pyrene	1.10E+01	1.09E+03	1.2E+04		1.00	0.646	0.00885	3.8E-03	1 1E+02	7.1E+00	0.0E+00	1.00E+00	0.333	0.017	2.2E+03
Lead	2.25E+05	3 00E-02	6.8E+03		1.00	0.646	0.00885	3.8E-03	6.0E+01	1.5E+05	0.0E+00	1.00E+00	0.333	0.017	2.9E+06

BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate; plant; sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant; sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate; plant; sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

Table I-32
Hazard Quotients for Least Sandpiper (*Calidris minutilla*)
Exposed to Soil, Water, and Contaminated Food at LF006 without 'TP01C-SO', Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Anthracene	--	1.89E+02	NA
Benzo(a)anthracene	--	7.73E+01	NA
Benzo(a)pyrene	--	7.10E+01	NA
Benzo(b)fluoranthene	--	9.26E+01	NA
Benzo(g,h,i)perylene	0.00E+00	1.03E+04	NA
Benzo(k)fluoranthene	--	3.30E+01	NA
Chrysene	--	9.12E+01	NA
Dibenzo(a,h)anthracene	--	1.20E+01	NA
Fluorene	--	5.22E+02	NA
Indeno(1,2,3-c,d)pyrene	--	4.06E+01	NA
Naphthalene	--	1.49E+01	NA
Phenanthrene	--	5.93E+02	NA
Pyrene	--	2.23E+03	NA
Lead	3.85E+00	2.85E+06	**7E+05**
		Hazard Index	**7E+05**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-33

Maximum Exposure Doses for Northern Shrike (*Lanius excubitor*) Exposed to Soil, and Contaminated Food at LF006 without 'TP01C-SO', Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Conc. Soil mg/g_{sed} (dry wt)	BCF_{inv} mg/kg wet	IC mg/g_{inv} (wet wt)	Conc Water mg/L	BCF_{vert} mg/kg (dry wt)	VC mg/g_{vert} (dry wt)	Pvert	P_{invert}	IR_{soil} Kg/d	IR kg_{diet}/day (Dry wt)	WI L/day	II mg/day inv	IV mg/day vert	IS mg/day soil	IW mg/day water	HRF	ED fraction of year	BW kg	OD mg/kg/day
Anthracene	2.40E+00	3.81E+02	9.1E+02		5.52E-09	1.32E-08	0.50	0.5	0.00258	0.0258	9.0E-03	1.2E+01	1.7E-10	6.2E-03	0.0E+00	1.00E+00	1.000	0.06	2.0E+02
Benzo(a)anthracene	6.10E+00	3.00E-02	1.8E-01		1.73E-05	1.06E-04	0.50	0.5	0.00258	0.0258	9.0E-03	2.4E-03	1.4E-06	1.6E-02	0.0E+00	1.00E+00	1.000	0.06	3.0E-01
Benzo(a)pyrene	5.60E+00	7.00E-02	3.9E-01		4.86E-05	2.72E-04	0.50	0.5	0.00258	0.0258	9.0E-03	5.1E-03	3.5E-06	1.4E-02	0.0E+00	1.00E+00	1.000	0.06	3.3E-01
Benzo(b)fluoranthene	7.30E+00	7.00E-02	5.1E-01		5.75E-05	4.20E-04	0.50	0.5	0.00258	0.0258	9.0E-03	6.6E-03	5.4E-06	1.9E-02	0.0E+00	1.00E+00	1.000	0.06	4.2E-01
Benzo(g,h,i)perylene	2.70E+00	2.19E+04	5.9E+04		3.75E-09	1.01E-08	0.50	0.5	0.00258	0.0258	9.0E-03	7.6E+02	1.3E-10	7.0E-03	0.0E+00	1.00E+00	1.000	0.06	1.3E+04
Benzo(k)fluoranthene	2.60E+00	8.00E-02	2.1E-01		5.73E-05	1.49E-04	0.50	0.5	0.00258	0.0258	9.0E-03	2.7E-03	1.9E-06	6.7E-03	0.0E+00	1.00E+00	1.000	0.06	1.6E-01
Chrysene	7.20E+00	4.00E-02	2.9E-01		1.99E-05	1.43E-04	0.50	0.5	0.00258	0.0258	9.0E-03	3.7E-03	1.8E-06	1.9E-02	0.0E+00	1.00E+00	1.000	0.06	3.7E-01
Dibenzo(a,h)anthracene	9.50E-01	7.00E-02	6.7E-02		1.27E-04	1.21E-04	0.50	0.5	0.00258	0.0258	9.0E-03	8.6E-04	1.6E-06	2.5E-03	0.0E+00	1.00E+00	1.000	0.06	5.5E-02
Fluorene	1.10E+01	2.00E+02	2.2E+03		5.97E-09	6.56E-08	0.50	0.5	0.00258	0.0258	9.0E-03	2.8E+01	8.5E-10	2.8E-02	0.0E+00	1.00E+00	1.000	0.06	4.7E+02
Indeno(1,2,3-c,d)pyrene	3.20E+00	8.00E-02	2.6E-01		2.98E-04	9.54E-04	0.50	0.5	0.00258	0.0258	9.0E-03	3.3E-03	1.2E-05	8.3E-03	0.0E+00	1.00E+00	1.000	0.06	1.9E-01
Naphthalene	7.90E-01	3.60E+01	2.8E+01		7.61E-09	6.01E-09	0.50	0.5	0.00258	0.0258	9.0E-03	3.7E-01	7.8E-11	2.0E-03	0.0E+00	1.00E+00	1.000	0.06	6.2E+00
Phenanthrene	7.30E+00	3.95E+02	2.9E+03		5.50E-09	4.01E-08	0.50	0.5	0.00258	0.0258	9.0E-03	3.7E+01	5.2E-10	1.9E-02	0.0E+00	1.00E+00	1.000	0.06	6.2E+02
Pyrene	1.10E+01	1.09E+03	1.2E+04		4.92E-09	5.41E-08	0.50	0.5	0.00258	0.0258	9.0E-03	1.6E+02	7.0E-10	2.8E-02	0.0E+00	1.00E+00	1.000	0.06	2.6E+03
Lead	2.25E+05	3.00E-02	6.8E+03		4.23E-07	9.52E-02	0.50	0.5	0.00258	0.0258	9.0E-03	8.7E+01	1.2E-03	5.8E+02	0.0E+00	1.00E+00	1.000	0.06	1.1E+04

BCF^{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{inv} = bioconcentration factor for contaminants from sediment into invertebrates (wet wt / dry wt)
BCF_{sed} = bioaccumulation factor for contaminants from sediment into aquatic plants (dry wt)
BW = organism body weight
C = moisture content correction factor (dry weight basis to wet weight basis)
ED = migration factor is the proportion of year in which exposure could occur
g_{diet}/day = grams of dietary intake per day
HRF = home range factor (site area/home range area)
IC = concentration in invertebrate tissue (SC x BAFinv)
II = daily intake concentration from invertebrates (IC x Pinv x IR)
IP = daily intake concentration from plant material (PC x Pplant x IR)
IR = daily ingestion rate (wet wt)
IS = daily intake concentration from direct sediment ingestion (SC x Psed x IR)
IW = daily intake concentration from direct water ingestion (WC x IRW)
kg = kilograms
mg/day = milligrams per day from food item (inv = invertebrate, plant, sed = sediment)
mg/g = milligrams per gram of food item (inv = invertebrate; plant, sed = sediment)
mg/kg/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter of water
NA = not applicable
ND = contaminant not detected in medium at a concentration above its reporting limit
OD = exposure dose to the omnivore = ([II+IP+IS+IW] x HRF x ED) / BW
P = proportion of ingestion composed of food item (inv = invertebrate, plant, sed = sediment)
PC = concentration in plant material (SC x C x SCFsed)
wt = weight
WI = daily water ingestion rate

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Table I-34
Hazard Quotients for Northern Shrike (*Lanius excubitor*)
Exposed to Soil, and Contaminated Food at LF006 without 'TP01C-SO', Driftwood Bay Radio Relay Station, Driftwood Bay, AK

Contaminant of Potential Ecological Concern (COPEC)	Effect Dose (mg/kg/day)	Exposure Dose Maximum (mg/kg/day)	HQ[1]
Anthracene	--	1.96E+02	NA
Benzo(a)anthracene	--	3.02E-01	NA
Benzo(a)pyrene	--	3.25E-01	NA
Benzo(b)fluoranthene	--	4.24E-01	NA
Benzo(g,h,i)perylene	0.00E+00	1.27E+04	NA
Benzo(k)fluoranthene	--	1.57E-01	NA
Chrysene	--	3.72E-01	NA
Dibenzo(a,h)anthracene	--	5.52E-02	NA
Fluorene	--	4.75E+02	NA
Indeno(1,2,3-c,d)pyrene	--	1.93E-01	NA
Naphthalene	--	6.15E+00	NA
Phenanthrene	--	6.21E+02	NA
Pyrene	--	2.59E+03	NA
Lead	3.85E+00	1.11E+04	**3E+03**
		Hazard Index	**3E+03**

Notes:

1-Values with bold and shading indicate an elevated potential for adverse ecological effects.

HQ = COPEC-specific hazard quotient

mg/kg/day = milligrams COPEC per kilogram body weight per day

Table I-35 Toxicity Reference Values Driftwood Bay											
		Mammals				Birds				Source	
Method Group	Chemical Name	NOAEL (mg/kg/d)	Test Species	Body Wt. (kg)	Test Endpoint	NOAEL (mg/kg/d)	Test Species	Body Wt. (kg)	Test Endpoint	Mammals	Birds
MET	Arsenic	1.25E+00	mouse	0.03	Reproduction	2.46E+00	Brown-headed cowbird	--	Mortality	ORNL TM86r3	ORNL TM86r3
MET	Barium	5.10E+00	rat	0.435	Growth, hypertension	2.08E+01	chicks	0 121	Mortality	Sample et al. 1996	Sample et al. 1996
MET	Cadmium	1.00E+00	rat	0.303	Reproduction	1.45E+00	mallard duck	1.153	Reproduction	Sample et al. 1996	Sample et al. 1996
MET	Lead	8.00E+00	rat	0.35	Reproduction	3.85E+00	Am. Kestrel	0.13	Reproduction	Sample et al. 1996	Sample et al. 1996
MET	Selenium	2.00E-01	rat	0.35	Reproduction	5.00E-01	mallard duck	1	Reproduction	Sample et al. 1996	Sample et al. 1996
PCB	Total PCBs	6.80E-02	oldfield mouse	0.014	Reproduction	1.80E-01	ring-necked pheasant	1	Reproduction	Sample et al. 1996	Sample et al. 1996
SV	Anthracene	1.00E+00	mouse	0.03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
SV	Benzo(a)anthracene	1.00E+00	mouse	0.03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
SV	Benzo(a)pyrene	1.00E+00	mouse	0.03	Reproduction	--	--	--		Sample et al. 1996	--
SV	Benzo(b)fluoranthene	1.00E+00	mouse	0.03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
SV	Benzo(g,h,i)perylene										
SV	Benzo(k)fluoranthene	1.00E+00	mouse	0.03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
SV	Bis(2-ethylhexyl)phthalate	1.83E+01	mouse	0.03	Reproduction	1.11E+00	ringed dove	0.155	Reproduction	Sample et al. 1996	Sample et al. 1996
SV	Chrysene	1.00E+00	mouse	0.03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
SV	Dibenzo(a,h)anthracene	1.00E+00	mouse	0 03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
SV	Fluorene	1.00E+00	mouse	0.03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
SV	Pyrene	1.00E+00	mouse	0.03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
SV	Indeno(1,2,3-c,d)pyrene	1.00E+00	mouse	0 03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
SV	Naphthalene	1.00E+00	mouse	0.03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
SV	Phenanthrene	1.00E+00	mouse	0.03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
SV	Pyrene	1.00E+00	mouse	0.03	Reproduction	--	--	--		Benzo(a)pyrene as surrogate	--
VOC	Benzene	--	--	--		--	--	--		--	--
VOC	Ethylbenzene	--	--	--		--	--	--		--	--
VOC	Xylene	--	--	--		--	--	--		--	--

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APPENDIX J

Work Plan Addition and Comment Responses

DEPARTMENT OF THE AIR FORCE
PACIFIC AIR FORCES

2 November 2007

611 CES/CEVR
10471 20th Street Suite 348
Elmendorf AFB AK 99506-2200

State of Alaska
Department of Environmental Conservation
Division of Spill Prevention and Response
Contaminated Sites Program
555 Cordova Street
Anchorage, AK 99501

Dear Mr. Halverson,

The *Draft Driftwood Bay Risk Assessment Work Plan* was issued on 26 April 2007. Since that time, the Alaska Department of Environmental Conservation (ADEC) provided comments (8 May 2007), the 611 Civil Engineer Squadron (CES) responded to those comments (5 June 2007), and ADEC provided additional comments based on those responses (8 June 2007). In addition, the field investigation indicated the need to evaluate potential risk associated with lead contamination.

The purpose of this letter is to address outstanding issues regarding the draft risk assessment work plan. The two primary outstanding issues are:

- Evaluation of potential risk that may be present in a residential land use scenario
- Procedures to assess potential risk due to lead

Other outstanding issues are summarized in the attached comment-response form.

Evaluation of risk under a Potential Future Residential Land Use Scenario. It is acceptable to conduct activities that are consistent with 18 AAC 75. In accordance with 18 AAC 75.340(f)(1), the Driftwood Bay Radio Relay Station (RRS) risk assessment will estimate potential risk to human and ecological receptors. For the recreational scenario, potential human health risk will be evaluated in the risk assessment.

Evaluation of potential risk that may be present in a residential scenario will be performed using Method Two or Method Three, as described in 18 AAC 75.340 and 18 AAC 75.341, and will be calculated with the Method Three and Cumulative Risk Calculator. When Method Three is used to calculate soil cleanup levels, only the ADEC default parameter for fraction organic carbon

(f_{OC}) will be modified by incorporating site-specific f_{OC} data. To evaluate potential risk under aresidential land use scenario using Method Two or Method Three, the cumulative carcinogenic risk and non-carcinogenic risk across all exposure pathways will be calculated. Chemicals detected in soil at one-tenth or more of the Table B1 ingestion and inhalation cleanup levels set out in 18 AAC 75.341(c) and chemicals detected at one-tenth or more of the Table C value will be included when calculating cumulative risk (*Cumulative Risk Guidance* November 2002). The default residential exposure assumptions will be used in evaluation of Method 2, Method 3, and cumulative risk for these methods. This methodology will evaluate potential risk for the residential land use scenario; eliminating the need for a residential land use exposure scenario in the risk assessment.

To summarize, for each site, Method 2 or 3 will be used to address potential risks associated with the residential exposure scenario, and Method 4 will be used to address potential risks associated with the recreational scenario. Cleanup levels calculated under Method Two or Method Three will be addressed in a site characterization report or remedial investigation report rather than the risk assessment work plan or risk assessment report. This meets the requirements of 18 AAC 75 and is consistent with previous discussion.

Procedures to Assess Potential Risk Due to Lead. The *Final Driftwood Bay Site Characterization Work Plan* (May 2007) called for the following approach to address lead contamination at the site:

> "Lead contamination has been identified in the Burned Battery Area and will be investigated using excavation and field screening. Field screening, using a Niton XRF, will be conducted throughout the visibly impacted soil area at the surface and to a depth of 1 to 2 feet. Hydroxyapatite will be applied to the soil prior to excavation and generation of a waste stream. The purpose of hydroxyapatite application is to stabilize lead in soil to achieve less than 5 milligrams per liter lead using toxicity characteristic leaching procedure analysis. This will provide assurance that hazardous waste will not be generated at this site. Hydroxyapatite will be applied in accordance with manufacturer specifications. Treated soil will be excavated to a depth of approximately 1 to 2 feet to access the underlying soil for sampling. The removed soil will be placed into Super Sacks and shipped offsite as IDW (see the WMP [Appendix E]). The excavation will be guided using Niton XRF field-screening techniques for lead."

During execution of field work at the site, it was determined that the extent of lead contamination at the Burned Battery Area was significantly larger than anticipated. At that time, detailed information on the extent of lead contamination was presented to ADEC. Following consultations with ADEC, it was agreed that the large volume of lead-contaminated soil prevented excavation and off site disposal from occurring as part of the investigation. However, approximately 1,000 pounds of metallic lead were removed as a proactive measure. In addition, calcium hydroxyapatite (EcoBond) was applied to the site in accordance with the *Final Driftwood Bay Site Characterization Work Plan* and the manufacturer's directions.

During investigation, batteries and lead-impacted soil were also found west of the LF006 site.

When the *Draft Driftwood Bay Risk Assessment Work Plan* (April 2007) was prepared, it was assumed that risk associated with lead-contaminated soil at the facility would be addressed using a combination of in situ treatment with calcium hydroxyapatite, excavation, and off site disposal. Thus, procedures for assessing risk associated with lead contamination were not described.

The following paragraphs present the proposed approach for the evaluation of potential human health and ecological risk that may result from potential exposure to lead at the Driftwood Bay RRS.

ADEC and the U.S. Environmental Protection Agency (EPA) recommend the use of the Integrated Exposure Biokinetic Uptake Model (IEUBK) to evaluate potential childhood exposures and the Adult Lead Methodology (ALM) to evaluate potential adult exposures to lead in environmental media.

The Driftwood Bay site is not reasonably anticipated to be used for residential development because site access is limited to plane or boat. ADEC's *Draft Risk Assessment Procedures Manual* (November 2005) states that: "The ALM should be used to assess exposure to lead in a non-residential setting." To be consistent with the Draft RAPM, the ALM will be used to evaluate potential lead risk due to exposure under a recreational or other short-term use scenario.

The EPA developed the Adult Lead Methodology (ALM) for evaluating the potential risks from lead to pregnant females(http://www.epa.gov/unix0008/r8risk/hh_lead.html). The decision criteria for each lead-impacted Driftwood Bay RRS site will be no more than a 5% chance that the blood lead level in a fetus will exceed a value of 10 μg/dL.

Under a recreational land use scenario, current or future potential exposures to lead-contaminated soil at the Driftwood Bay RRS would be neither continuous nor chronic (e.g., recreational land use). Because of the discontinuous nature of potential exposures, the following guidance document will guide assessment of lead-related risk: Assessing Intermittent or Variable Exposures at Lead Sites (OSWER 9285.7-76, November 2003).

Two sites at Driftwood Bay, the Burned Battery Area and a portion of LF006 Old Disposal Area contain lead in soils at concentrations that exceed 18 AAC 75.341 Table B1 standards. The Burned Battery Area measures approximately 72 feet by 52 feet (3,744 $feet^2$). The area of lead contamination and distressed vegetation at the Old Disposal Area measures approximately 75 feet by 25 feet (1,875 $feet^2$). The size of these areas precludes them from being considered as sole source exposure units for most human exposure scenarios, therefore, a fraction intake (FI) term will be applied to account for the portion of exposure attributable to the site relative to the total potential intake. This term will be calculated by dividing the area of the site by the total area to which the receptor is assumed to be exposed (Attachment 2).

The available data indicate that application of EcoBond to lead contaminated soil at the Burned Battery Area has decreased the bioavailability of lead. However, because of the difficulty in accurately measuring bioavailability, default biavailability parameters will be used. The calculations will also be performed adjusting the bioavailability parameter based on the results from the toxicity characteristic leaching procedure analysis. This will allow for an assessment of the uncertainties associated with potential lead uptake based on bioavailability. Please refer to Attachment 2 for details.

The potential for adverse effects to populations of ecological receptors will be evaluated using ecological soil screening levels (ECO-SSLs) and toxicity reference values (TRVs). ECO-SSLs developed by EPA and TRVs obtained from literature sources are available for the evaluation of potential risks to ecological receptors exposed to lead in soil.

ECO-SSLs are concentrations of lead "that are protective of ecological receptors that commonly come into contact with soil or ingest biota that live in or on soil" (EPA 2005 *Ecological Soil Screening Levels for Lead Interim Final* OSWER Directive 9285.7-70 March 2005). ECO-SSLs derived separately for plants, soil invertebrates, birds, and mammals are considered to provide adequate protection to terrestrial ecosystems. ECO-SSLs will be used as screening values. The ECO-SSLs are not designed to be used as cleanup levels and EPA emphasizes that it would be inappropriate to adopt or modify these ECO-SSLs as cleanup standards (EPA 2005). If measured concentrations exceed ECO-SSLs, a hazard quotient will be calculated. Toxicity reference values combined with estimates of contaminant intake through food chain exposures will used to calculate a hazard quotient. The hazard quotient provides an indication of the potential for adverse effects to populations of ecological receptors.

In summary, human health risk associated the residual lead at the Driftwood Bay RRS will be calculated using the ALM. Ecological risks associated with lead will be assessed using TRVs to calculate a hazard quotient.

I will call on 13 November to follow up on this letter. If ADEC does not concur with the proposed resolutions, I encourage you to contact me to arrange a face-to-face meeting so that the issues can be resolved. You may reach me by calling (907) 552-7303.

Sincerely,

SCOTT TARBOX, YD-02
Remedial Project Manager

Enclosure: Attachment 1 Responses to Comments
Attachment 2 Adult Lead Methodology and Proposed Values

cc: Stephen Witzmann, Jacobs
Mark Goodwin, AFCEE

Attachment 2
Adult Lead Methodology and Proposed Values

The Adult Lead Methodlogy is based on the following equation:

$$PbB_{adult,central} = PbB_{adult,0} + \frac{PbS \cdot BKSF \cdot IR_S \cdot AF_S \cdot EF_S}{AT}$$

where,

$PbB_{adult,\ central}$	= Central estimate of blood lead concentrations (µg/dL) in adults (i.e. women of child-bearing age) that have site exposures to soil ead at concentration, PbS
$PbB_{adult,\ 0}$	= Typical blood lead concenatration (µg/dL) in adults (i.e. women of child-bearing age) in the absence of exposures to the site that is being addressed
PbS	= Soil lead concenatration (µg/g)
BKSF	= Biokenetic slope factor relating (quasi-steady state) increase in typical adult blood lead concentration to average daily lead uptake (µg/dL blood lead increase per µg/day lead uptake)
IR_S	= Intake rate of soil, including both outdoor and indoor soil-derived dust (g/day)
AF_s	= Absolute gastrointestional absorption fraction for ingested lead in soil and lead in dust derived from soil (dimensionless)
EF_S	= Exposure frequency for contact with assessed soils and/or dust derived in part from these soils (days of exposure during averaging period)
AT	= Averaging time; the total period during which soil contact may occur

The absorption factor is derived as follows:

$$AF_S = AF_{soluble} \cdot RBF_{soil/soluble}$$

where,

$AF_{soluble}$	= Abosrption factor
$RBF_{soil/soluble}$	= Relative bioavailability of lead in soil compared to soluble lead

Attachment 2
Adult Lead Methodology and Proposed Values

Table 2-1 compares default values to values proposed for the LF006 and Burned Battery Area at the Driftwood Bay RRS. Other values proposed for use will remain at the default level.

Parameter	Unit	Default Value	Proposed LF006 Value	Proposed Burned Battery Area Value
PbS (Note 3)	µg/g	Site-specific average concentration	11,907	1,430
IR_S	g/day	0.05	0.05	0.05
FI (Note 2)	--	1.0	0.086	0.17
AF_s	--	0.12	0.12	0.12/Note 4
EF_S	day/year	219	Note 1	Note 1
AT	day/year	365	Note 1	Note 1
$AF_{soluble}$	--	0.2	0.2	0.2/Note 4
$RBF_{soil/soluble}$	--	0.6	0.6	0.6/Note 4

Note 1: Exposure frequency and averaging time will be determined based on community surveys. As previously promised, once the Driftwood Bay RRS Risk Assessment Work Plan is finalized, a table with default values and proposed values for exposure assumptions will be presented to ADEC.
Note 2: The size of the impacted areas preclude them from consideration as sole source exposure units for most human exposure scenarios, therefore a fraction intake term will be applied to account for the portion of exposure attributable to the site relative to the toal potential intake. This term is calculated by dividing the area of each site by an assumed 0.5 acre (21,780 square feet). The Burned Battery Area measures approximately 72 feet by 52 feet (3,744 feet^2). Lead impacted soil at the LF006 Old Disposal Area measures approximately 75 feet by 25 feet (1,875 feet^2).
Note 3: Lead in soil concentrations were calculated as the average of the measured concentrations and correspond to the area used in the fraction intake calculation.
Note 4: For the Burned Battery Area, the uncertainty analysis will include a semi-quantitative assessment of the impacts of EcoBond treatment on bioavailability. This assessment will take into account the following factors:

- The average post-treatment TCLP value of 262.5 µg/L
- The fact that TCLP is conducted at a significantly higher pH (4.93) than EPA's in vitro bioaccessibility test
- The increased solubility (and bioavailability) of lead with decreasing pH
- Data available on the solubility and bioavailability of metallic lead and lead phosphate
- Other factors that ADEC may identify prior to work plan finalization

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Responses: 611 CES/CEVR, 907-552-7303

Comment Number	Page	Section	Comment	Response	ADEC	Response
1	1-1	1.0	How will the determination to perform a risk assessment be made after the 2007 supplemental investigation? Suggest including the decision logic flow diagram that was developed during the TRIAD meeting.	The determination as to the need for risk assessment will be based on: • The estimated volume of soil at concentrations above ADEC 18 AAC 75.341 Table B1 and B2 (Method 2) • An assessment of anticipated future land use • An evaluation of costs versus benefits of using risk-based cleanup levels or using cleanup levels that would allow for unrestricted land use	Please provide the decision logic tree from the TRIAD meeting.	Although it assisted discussion in the TRIAD meeting, detail in the logic tree is insufficient to make decisions at this point. As a result of discussions with ADEC, it does not completely reflect how sites will be handled, and will not be included in this work plan.
2	2-5	Figure 2-1	Why are site visitors or seasonal workers not considered at Top Camp for the ingestion of groundwater and inhalation of indoor air pathways? Please confirm that CSM information is consistent with the text (pg 2-4).	There is no exposure route to groundwater for the visitor or seasonal worker nor are there habitable buildings which may have contaminated air. The text and CSM are consistent.	CSM is not consistent with text on page 2-4. *"Current or future recreational visitors and seasonal workers could be exposed to surface soil contamination through the inhalation of dust or vapors, ingestion, or dermal contact exposure pathways. Recreational visitors could ingest contaminated biota. Drinking water sources (groundwater and surface water) are*	Text will be revised to state, *"Current or future site visitors, trespassers, or recreational users could be exposed to surface soil contamination through the inhalation of fugitive dust, inhalation of outdoor air, incidental soil ingestion, or dermal absorption of contaminants from soil, or ingestion of wild food. The term*

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					not known at this point. Future residents and site workers could be exposed through these routes or through inhalation, ingestion, or dermal exposure to contaminated subsurface soils or groundwater. If a building were constructed at the site, future residents and site workers could be exposed to contaminated indoor air. Data will be collected to further analyze these pathways because currently no data exist to eliminate these receptors or pathways.	*recreational user will be used synonymously with site visitors, trespassers, or recreational users. Drinking water sources (groundwater and surface water) are not known at this point. Data collected during the field investigation will be analyzed to assess receptors and pathways."* Concerning assessment of risk for potential future residents, please see the attached letter.
3	2-13	Figure 2-3	Please confirm that the CSM information is consistent with the text (pg 2-12).	The text and CSM are consistent.	Please revisit the text.	Please see comment response #2.
4	3-4	3.3	Note that each analyte should be screened to 1/10 of the ingestion and inhalation standards listed in 18AAC 75.	The third paragraph on page 3-4 will be reworded to state that the maximum detected concentration of each analyte will be compared to one-tenth of the ingestion and inhalation standards listed in 18 AAC 75.	Acceptable.	-
5	3-4	3.3	Please refer to ADEC's	The text will be revised as suggested.	Additional screening	Noted.

			Sediment Quality Guidelines (ADEC 2004) which recommends the TEL and PEL sediment quality guidelines as published in the NOAA SQUIRT Tables for appropriate sediment screening values.	The following text will be added, "In accordance with ADEC's Sediment Quality Guidelines (ADEC 2004), freshwater sediment sample data will be compared to the lower of the threshold effects level (TEL) or probable effects level (PEL) concentrations published in the NOAA Screening Quick Reference Tables (NOAA 1999). Additional sediment screening values obtained from *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota* (Oak Ridge National Laboratory [ORNL] 1997b), and ORNL sediment preliminary remediation goals (PRG) for ecological endpoints (ORNL 1997b) will be considered. The lowest of the NOAA, benchmark, or PRG, values will be used as the screening criterion for sediment."	criterion other than those prescribed shall be approved prior to use.	
6	3-6	3.4	Please confirm that analytical laboratory data will be reported down to the method detection limit and analytical results presented as "U" indicate a non detection at this level rather than the reporting level.	The text will be modified as suggested. Concentrations between the reporting limit and the detection limit will be "J" flagged, concentrations below the detection limit will be "U" flagged.	Acceptable.	-
7	3-6	3.4	As suggested in the Risk Assessment Procedures Manual (ADEC's RAPM 2005), please substitute ½	The text will be modified as suggested.	Acceptable.	-

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			the method detection limit rather than the reporting limit for non-detects.			
8	3-7	3.4	Please provide a discussion of how an exposure point concentration will be determined if the analytical data are found to not be normal or log normal.	The text will be modified to state that "EPA's PRO UCL software will be used to calculate exposure point concentrations. The distribution and UCL recommended by PROUCL will be used. However, if the recommended UCL exceeds the maximum detected concentration, the maximum detected concentration will be used as the exposure point concentration.	Acceptable.	-
9	4-1	4.0	Include ADEC's Sediment Quality Guidelines in the references.	ADEC's Sediment Quality Guidelines have been added to the references.	Acceptable.	-
10	4-2	4.1	It was ADEC's understanding of the closure options discussed during the TRIAD meeting, that further remedial action necessary for unrestricted use and acceptable relinquishment to USFWS or BLM/tribe Native Corporation would be evaluated. The department therefore understood that the risk assessment would evaluate for unrestricted and recreational land use. However, three potential exposure scenarios are	We are only proposing to evaluate risk in single recreational scenario which will be developed based on community survey results or EPA exposure assumptions. Soil data will be screened against ADEC's Table B1 and B2 (Method 2) values to evaluate the applicability of a no further action decision for the individual sites, the need for remedial action, or the need for action based on the risk assessment. Risks associated with potential future residential land use will be assessed based on comparison of contaminant concentration data with ADEC Method 2 values (or ADEC	Unacceptable. It is ADEC's understanding that both recreational and unrestricted land use would be evaluated. The exposure scenarios presented in the risk assessment work plan are not consistent with those discussed in the TRIAD.	Please refer to the accompanying letter.

			discussed in this risk assessment work plan (residential, recreational, and site worker), but text states that only the recreational scenario will be evaluated. Are all three scenarios to be evaluated?	Method 3 values based on TOC data). Use of any other cleanup levels will necessitate land use controls.		
11	4-3	Table 4-1	Please provide zone specific exposure frequency information as appropriate.	The exposure parameters are for a recreational scenario as indicated in footnote 1 and are not zone specific.	Unacceptable. See comment 10.	Please refer to the accompanying letter.
12	4-6	4.2.3	Please provide reference for the default K_p value of 0.00cm/hour to be used for inorganics with no chemical specific values available.	Text will be modified to follow RAGS Part E guidance.	Acceptable.	-
13	4-7	4.2.4	Consumption of game animals and fish equation presented lists only venison ingestion rate as an equation parameter. Please provide references for ingestion rates of game and fish to be evaluated for the ingestion of wild foods pathway.	The following text has been added: "Exposure parameters for ingestion of game animals and fish will be obtained from the available literature. Preference for intake rate parameters will be from the Alaska Department of Fish and Game *Community Profile Database* (ADF&G 2000) and EPA's *Exposure Factors Handbook* (EPA 1997). "Venison" will be replaced with "game animals and fish".	Acceptable.	-
14	Section 4	General	Please provide a discussion of how risks will be calculated for fuels and lead. As for fuels, ADEC's understanding was that if	As noted in the Site Characterization Work Plan, PAH and BTEX data will be collected where field evidence indicates that the highest concentrations of fuel contaminants are present.	Please revisit comment. Response discusses risk screening not risk calculation.	Fuels risk will be evaluated using BTEX and/or PAH data as appropriate.

			removal to Method 2 levels was not feasible, then BTEX and PAH data would be evaluated for risk determination. A discussion of the evaluation of lead risks is needed. Will the IEUBK Childhood risk model be used? What concentration will be used in the model? Also, if lead risks are calculated independent of other co-contaminants, calculation of alternative cleanup levels must take this into consideration and must be adjusted accordingly.	Concentrations of fuel components will be screened against 1/10[th] the Method 2 criteria in ADEC's Guidance for Cleanup of Petroleum Contaminated Sites". The evaluation of risks from potential exposure to these constituents, if warranted, will use the toxicity values for DRO, GRO, and RRO specified under Method 4 of the guidance. The constituent specific data (e.g., BTEX and PAH) will be used in the risk assessment. Separate evaluation of potential risks from exposure to Lead using the IEUBK model is not warranted at this time as children are not considered potential receptors under the recreational scenario. See response to comment 24, Norberg, in Site Characterization Work Plan. If conditions change as discussed in the response to comment 10 and future residential use of the site is applicable, the IEUBK model will be used to evaluate potential risks to potential child residential receptors.	Please indicate that fuels risks will be evaluated using BTEX and PAH data as appropriate. It is understood that lead contaminated soil will be treated and removed. Please clarify that the screening criteria for lead excavation confirmation will be 40ppm (1/10[th] Method 2). In event that confirmation results exceed screening criteria, please propose further actions (i.e further removal or risk assessment).	For additional information regarding lead, please refer to the accompanying letter.
15	5-3	5.1.1	Text states that the sea otter was selected as the measurement receptor. Per ADEC's RAPM, *DEC requires that threatened and endangered species be identified in the ecological*	The text will be revised to state that the sea otter is an assessment endpoint (this change has also been made for the Arctic ground squirrel, the masked shrew, the northern shrike, the least sandpiper, and salmon species).	Acceptable.	-

			risk assessment. DEC also recommends that, where applicable, threatened and endangered species be used as ***assessment endpoints, but not as measures****. An indicator species from the same trophic level be selected as a surrogate to assess ecological risk to the endangered species.*			
16	5-2	5.1.1	Suggest revising text to state that *the selection of the Arctic ground squirrel as an assessment measure is appropriate to evaluate other trophic level-2 terrestrial receptors.*	The suggested change will be made.	Acceptable.	-
17	5-2	5.1.1	Suggest revising text to state that *the selection of the masked shrew as an assessment measure is appropriate to evaluate other trophic level-3 terrestrial receptors.*	The suggested change will be made.	Acceptable.	-
18	3-1	3.1.1	Please provide a discussion of how data quality will be evaluated and data determined for inclusion in the risk assessment. (i.e. data will be evaluated according to the AFCEE QAPP?) See Section 3.1 of the	The following text will be added as suggested, "Appendices B and C of the *Driftwood Bay RRS Site Characterization Work Plan* (USAF 2007) present the field sampling plan technical approach and the quality control plan, respectively. Appendix B delineates technical sampling and sample management procedures to be	Reference to the Site Characterization work plan is acceptable with additional text indicating that data shall be of sufficient quality to support risk assessment as prescribed in the	The text to be added will be modified to include the following statement. "…Adherence to the procedures in these appendices will assure that the data are of adequate

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			RAPM for details in data evaluation and usability criteria.	followed during the execution of fieldwork and specifies the data quality objectives to be adhered to for collecting analytical samples. Appendix C outlines the procedures that will be followed to ensure adequate data quality. Adherence to the procedures in these appendices will assure that the data are of adequate quality to meet the needs of the project, including the needs of the human health and ecological risk assessments."	RAPM.	quality to meet the needs of the project, including the needs of the human health and ecological risk assessments as prescribed in the ADEC Risk Assessment Procedures Manual (ADEC 2005)."
19	3	A-2	Direct contact with sediment is checked in the CSM on Figure 2-3, but not in the checklist in Appendix A-2.	The box will be checked as suggested.	Acceptable.	-
20	B-5	ARARs	Please refer to ADEC's Sediment Screening Guidelines for sediment screening values.	ADEC's Sediment Screening Guidelines for sediment screening values will be added.	Acceptable.	-
21	B-6	GW ARARs	USAF may propose a groundwater use determination under 18 AAC 75.350. However, ADEC will not consider elevation of groundwater cleanup levels by 10 times.	Comment noted.	Proposal noted, but ADEC will not consider elevation of groundwater cleanup levels by 10 times. Adjustment of groundwater screening levels is not appropriate for the risk assessment.	Comment noted.
22	B-7	PCB Contaminated Construction Material	Please clarify that this section pertains to waste characterization only and does not represent an ARAR	The clarification will be made. The text will be modified to replace "construction materials" with "waste".	Acceptable.	-

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			for site contamination. Waste removed from the site is not pertinent to the risk assessment.			
23	Appx. C	Survey	Suggest the survey also inquire about what game, fish or plants are harvested, in what quantities, and ingestion rates.	The suggested text will be added with the exception of ingestion rates. Rates can be estimated based on quantities harvested.	Acceptable.	-
24	General	Site COPCs	A table of media specific site COPCs would be helpful in the work plan.	The suggested table will be added.	Acceptable.	-
25	2-3	2.1	Please indicate that lead is the only COPC at the Burned Battery Site.	The suggested text will be added.	Acceptable.	-
26	CSMs	CSMs	The CSMs in the Site Characterization Work Plan and Risk Assessment Work Plan are not consistent. Recommend revising for consistency and to avoid confusion. The CSMs should be reviewed and updated as appropriate after the 2007 characterization is completed.	The CSMs in the Site Characterization Work Plan have been replaced with the CSMs provide in the Draft Risk Assessment Work Plan. Any changes to the CSMs requested in these comments have not been incorporated in the Site Characterization Work Plan. The CSMs will be updated throughout the project as data is collected. CSMs that are presented in the Site Characterization Report and the Risk Assessment Report will be consistent.	Please revisit to assure that all CSMs have addressed comments and are all consistent.	CSM will be revisited to assure consistency and that comments are addressed.
27	2-10	2.2	RRO should be considered a COPC at the Water Supply Pump House (SS010) as well as DRO, PAH, and BTEX. See TRIAD notes - Uncertainties for which	RRO will be added as a potential COPC.	Acceptable.	-

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			Sampling is Required.			
28	2-10	2.2	Please indicate COPCs for each subsite within the Drum Storage Area (SS004) as discussed in the TRIAD notes-Uncertainties for which Sampling is Required.	The following text will be added as suggested, "DRO and RRO are the only COPCs at the SS004 500-gallon AST area. During 2005 sampling at the Drum Storage Area, elevated photoionization detector readings, stained soil, and a strong hydrocarbon odor were noted, indicating the presence of contaminants in surface and subsurface soil. The COPCs at the Drum Storage Area are PCB, DRO, and chromium. At the SS004 trench, mercury and arsenic were detected above ADEC Method Two soil cleanup levels. However, metals concentrations are near regional background concentrations and no evidence of a source from site activities is present. Potential fuel spills from the SS004 construction camp have been identified as a concern. The COPCs for the construction camp are DRO and RRO."	Acceptable.	-
29	2.11	2.2	RRO should be included as a COPC as well for SS011.	RRO has been added as a potential COPC.	Acceptable.	-
30	3-3	3.2	The Risk Assessment Work Plan suggests speciating chromium for risk consideration. ADEC recommends this is noted in the Site Characterization Work Plan as well to assure the appropriate analyses are	The suggested change has been made to the Site Characterization Work Plan.	Acceptable.	-

			requested.			
31	3-3	3.2	Text states that no laboratory analysis of arsenic or mercury will be conducted as they were discussed in the metals background study. However, mercury is considered a COPC for FL009 as indicated in Section 2.1 on page 2-3. Please confirm that mercury will be evaluated as a COPC at FL009.	Mercury will be considered a COPC for FL009.	Acceptable.	-

APPENDIX K

Alaska Department of Environmental Conservation Exposure Assumptions Letter

STATE OF ALASKA

DEPT. OF ENVIRONMENTAL CONSERVATION

DIVISION OF SPILL PREVENTION AND RESPONSE
CONTAMINATED SITES PROGRAM

SARAH PALIN, GOVERNOR

555 Cordova Street
Anchorage, AK 99501
PHONE: (907) 269-3053
FAX: (907) 269-7649
www.dec.state.ak.us

File: 2541.38.001

October 24, 2008

Mr. Scott Tarbox
USAF 611 CES/CEVR
10471 20th St Ste 302
Elmendorf AFB, AK 99506-2200

Re: Driftwood Bay Risk Assessment Exposure Assumptions Concurrence

Dear Mr. Tarbox:

Marti Brewer and I have reviewed the proposed exposure assumptions for the baseline Driftwood Bay Radio Relay Station Risk Assessment that we discussed and agreed to at the meeting June 5, 2008 at Jacobs Engineering. The DEC concurs that the parameter values outlined in your October 2, 2008 letter are acceptable. Exposure frequency is quantified at 14 continuous days for the lower camp and 12 days for upper camp (one day a week for three months). Other exposure parameters are standard recreation default values.

If you have any questions concerning this letter, please call me at 907-269-3053.

Sincerely,

Jeff Brownlee
Environmental Program Specialist

cc: Steve Witzman, Jacobs Engineering (via email)
Marty Brewer, ADEC (via email)
Earl Crapps, ADEC (via email)

DEPARTMENT OF THE AIR FORCE
PACIFIC AIR FORCES

2 October 2008

611 CES/CEAN
10471 20th Street, Suite 337
Elmendorf AFB AK 99506-2200

Mr. Jeff Brownlee
Alaska Department of Environmental Conservation
555 Cordova Street
Anchorage, AK 99501-2617

Subject: Driftwood Bay Radio Relay Station, Proposed Exposure Scenarios

Dear Mr. Brownlee,

As detailed in the *Final Driftwood Bay Risk Assessment Work Plan*, exposure assumptions for the baseline Driftwood Bay Radio Relay Station (RRS) risk assessment are to be based on completed community survey questionnaires, provided to you previously. The purpose of this letter is to request formal written concurrence consistent with your verbal concurrence expressed on 5 June 2008.

Based on the results of the community survey, travel to Driftwood Bay is dangerous and infrequent. As presented below, for Lower Camp, the exposure frequency of 14 continuous days per year is proposed to conservatively reflect maximum potential exposure based upon the approved methodology incorporating results of the community survey.

As discussed with you and your team on 5 June 2008, the USAF is proposing a recreational exposure scenario of 1 day on-site each week for 3 months (12 days exposure, averaged over 90 days) each year for Top Camp. Given the harsh climatic conditions of the area and the results of the community survey on the use of the site, this exposure scenario conservatively estimates reasonable maximum exposure under the reasonably anticipated land use.

For both Lower Camp and Top Camp, exposure would continue to take place over 30 years.

The following table summarizes the parameters for each geographical location.

Exposure Parameter	Values[1] – Top Camp	Values[1] – Lower Camp
THQ=target hazard quotient (no units)	1	1
BW=body weight (kg)	70	70
AT=averaging time (days)	10,950 (noncancer) 25,500 (cancer)	10,950 (noncancer) 25,550 (cancer)
ED=exposure duration (year)	30	30
EF=exposure frequency (days per year)	12	14
IR=water ingestion rate (L/day)	2	2
IR=soil ingestion rate (mg/d)	100	100
A=absorption factor (no units)	1	1

Notes:
[1] Exposure parameters are based on the reasonably anticipated use. The receptor is assumed to be an adult who visits the site for two weeks each year (Lower Camp) and one day per week over 12 weeks (Top Camp)

When we discussed the exposure scenarios on 5 June 2008, you provided verbal approval of the exposure scenarios. Please provide written confirmation of approval of exposure scenarios as previously discussed. If you have questions or concerns, I encourage you to contact me at (907) 552-7303. You may also send me a message at scott.tarbox@elmendorf.af.mil.

Sincerely,

Scott Tarbox
Chief, Natural Resource Management

APPENDIX L

Response to Comments

Date: January 13, 2009

Comment on Pre-Draft Driftwood Bay Radio Relay Station Risk Assessment
Marty Brewer 907-269-3084 Marlena_Brewer@dec.state.ak.us

Comment Number	Page	Section	Comment	Response
1	2-6	2.3	It appears that COPC screening was done against the old cleanup levels. (See Appendix G COPC Screening) Please screen against the latest cleanup levels adjusted to the appropriate risk screening level of 10^(-6) and HQ 0.1.	The document will be modified as suggested. COPC screening in the pre-draft version of the Risk Assessment Report used one-tenth of the ADEC cleanup levels that were in effect at the time of publications. COPCs will be screened against one-tenth of the 2008 cleanup levels for the Draft version of the report.
2	2-7	2.3	Please confirm that the maximum detected concentration for a contaminant was used for risk screening purposes.	We believe that the maximum detected concentration of each contaminant was used for risk screening purposes. We will reconfirm this prior to issuing the Draft Risk Assessment, and make any required changes.
3	2-9	2.4.1	Text states that exposure point concentrations were calculated for normal or log normal distributions. However, no discernable distribution was defined for several data sets, yet the UCL was used for the PCL.	The paragraph preceding Section 2.4.1 states "The following paragraphs describe the general statistical approaches used to derive exposure point concentrations. The EPA statistical software package ProUCL Version 4 was used to compute estimated mean and UCL_{95} concentrations." The following text will be added, "The recommended output from ProUCL was used. In the case where a recommended distribution was not selected, the maximum concentration was used." However, it is recognized that the inclusion of Section 2.4.1 is confusing; therefore, Section 2.4.1 will be deleted.

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Date: January 13, 2009

Comment on Pre-Draft Driftwood Bay Radio Relay Station Risk Assessment
Marty Brewer 907-269-3084 Marlena_Brewer@dec.state.ak.us

Comment Number	Page	Section	Comment	Response
4	2-10	2.4.1	Please confirm that the method detection limit was input into ProUCL along with non detect results and that appropriate censoring was conducted in accordance with ProUCL 4.0 Guidance on the handling of non detect data. See also ADEC's Guidelines for Data Reporting, Data Reduction, and Treatment of Non-Detect Values Technical Memorandum 08-001 (August 12, 2008)	We used the RAPM Draft November 2005 which recommended using ½ the MDL for screening purposes. Prior to issuing the Draft Risk Assessment, the ProUCLs will be recalculated using the ProUCL 4.0 Guidance as suggested.
5		Table 4-2	Please note that there is no ABS provided for DRO and RRO in ADEC's Cleanup Levels Guidance whereas the table represents an ABS of 0.1. Please enter 0.	The ABS for DRO and RRO will be corrected to 0.
6	4-16	4.4.3	It is not acceptable to assume that a pregnant woman would not access the site and therefore only adult lead levels be considered. This was not discussed nor approved of by ADEC and is not acceptable.	The last 2 sentences of Section 4.4.3 referring to pregnant women will be deleted.
7		Table 4-5	Only risks due to petroleum related contaminants are presented in the table. What about PCBs?	Table 4-5 presents estimates of cumulative Hazard Index (HI) and Cancer Risk from potential exposure to all COPCs at WP003 and OT001. PCBs were not detected at WP003, but were detected and retained as COPCs at OT001. The cumulative cancer risk estimates for OT001 include the contribution from total PCBs.

Date: January 13, 2009

Comment on Pre-Draft Driftwood Bay Radio Relay Station Risk Assessment
Marty Brewer 907-269-3084 Marlena_Brewer@dec.state.ak.us

Comment Number	Page	Section	Comment	Response
8	4-19	4.5	Text states that lead does not pose a risk to adult recreational receptors, but this does not include pregnant women.	The text will be changed as follows, "The results of the ALM suggest potential exposures to lead at the BBA do not pose an unacceptable hazard to adult recreational receptors, including pregnant women receptors. However, potential exposure to lead at the EDA and LF006 may pose an unacceptable health hazard to adult recreational receptors including pregnant women receptors."
9	4-27	4.6.7 and Table 4-7	The suspected source of the high concentrations of PAHs at LF006 is irrelevant in risk assessment of the site. The toxicity is the same for a given contaminant. Please present the cancer and non cancer risks separately in the table and consider all of the data in the risk elements.	The cancer and non-cancer risks based on the entire data set are presented in Table 4-6. Section 4.6.7 focuses on uncertainty in the cancer risk calculation for LF006 due to inclusion of the ash sample, specifically the measured PAHs. In accordance with the ADEC-approved work plan, sampling of waste from within the landfill was not planned. However, during field activities, ash was encountered. The finding was reported to ADEC the next day, and ADEC requested that laboratory analysis be conducted for PAHs and other contaminants. This represented a departure from the planned strategy for the site, which included: o Determining whether contamination was migrating from the site o Determining whether drums were present that could result in a future release.

Date: January 13, 2009

Comment on Pre-Draft Driftwood Bay Radio Relay Station Risk Assessment
Marty Brewer 907-269-3084 Marlena_Brewer@dec.state.ak.us

Comment Number	Page	Section	Comment	Response
				(Please refer to Process Map 2-7 of the work plan). The following text will be added to Section 4.6.7: "Results for the single ash sample indicate elevated concentrations of PAHs. This sample was collected from 1-foot bgs and represents a de minimus amount of PAH-containing ash present within the body of the landfill. The ash does not extend to the ground surface; therefore, exposure is mitigated by the soil cover. "Table 4-7 presents calculated cancer risk both with and without inclusion of the results for the ash sample. As with the sampling strategy used at landfill sites across Alaska, waste within the LF006 landfill has not been fully characterized with regards to potential risk associated with direct contact to the waste. The data presented in Table 4-7 can be interpreted as follows: o Direct exposure to the waste within the landfill could cause risk at levels above ADEC's target level o Incidental exposure to the site (i.e. activities short of digging into the landfill) will not cause risk at levels above ADEC's target o Contamination is not migrating from the landfill"

Date: January 13, 2009

Comment on Pre-Draft Driftwood Bay Radio Relay Station Risk Assessment
Marty Brewer 907-269-3084 Marlena_Brewer@dec.state.ak.us

Comment Number	Page	Section	Comment	Response
10	P4-27	Section 4.6.7	Explain the location of the sample- a test pit in a landfill and that the surface exposure pathway is mitigated by soil cover	See comment response to #9.
11	5-25	5.5	Explain the text "Only *terrestrial hazards were estimated for the* ***raccoon*** *because of limited extent of aquatic habitat at the site.*"	The text referencing the raccoon was accidently held over from the boiler-plate document used to develop the Risk Assessment and will be deleted.
12	P5-26	5.5	What kind of ecological effects does the HQ represent- lethality or reproductive problems?	The Toxicity Reference Values used to calculate the HQs represent a range of effects and are dependent on the test species and receptor type (mammal or avian). The specific effect will be added to the TRV table at the end of Appendix I (Currently Labeled Table 4-1).
13	P5-26	5-2	Are the high HQs at Site LF006 from PAHs due to the ash sample? Is so the ash sample should be separated out as was done for human health.	Yes. The high HQs at Site LF006 are due to PAHs detected in the ash sample. A discussion will be added to the Uncertainty Analysis (Section 5.6) discussing uncertainty associated with the inclusion of results from the ash sample in the ecological risk assessments. A table will be added comparing hazard quotients for LF006 with and without the ash sample.
14	App A		Why is the ingestion of wild foods checked as a completed exposure pathway at Top Camp when eco risk is dismissed for Top Camp due to inhabitability to wildlife receptors?	The ingestion of wild foods should not be checked for Top Camp. This will be corrected in the Draft version of the report.

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Date: January 13, 2009

Comment on Pre-Draft Driftwood Bay Radio Relay Station Risk Assessment
Marty Brewer 907-269-3084 Marlena_Brewer@dec.state.ak.us

Comment Number	Page	Section	Comment	Response
15	App A		Inhalation of indoor air pathway at Top Camp marked complete for PCE only?	PCE was detected in a single sample at a concentration of 0.031 mg/kg. This concentration is above the Method 2 migration to groundwater standard (0.024 mg/kg). It has been determined that no groundwater is present at Top Camp, so this standard is not applicable. The measured concentration is below the standards for direct contact standard (13 mg/kg) and outdoor inhalation (7.3 mg/kg). PCE will be removed from the CSM scoping form.
16	App F		Please confirm that the method detection limit was input into ProUCL along with non detect results and that appropriate censoring was conducted in accordance with ProUCL 4.0 Guidance on the handling of non detect data.	Please refer to the response to comment 4.
17	App F		Groundwater DRO and RRO UCLs calculations for SS007 an LF006 are provided but risks are not discussed in the text of the report.	Cancer risk and hazard estimates were not calculated for groundwater because there is no plausible exposure route to groundwater for the recreational receptor. Groundwater at SS007 was included in a proposed Groundwater Use Determination submitted to ADEC separately. This Groundwater Use Determination will be cited in the risk assessment. Groundwater DRO and RRO UCLs for LF006

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Date: January 13, 2009

Comment on Pre-Draft Driftwood Bay Radio Relay Station Risk Assessment
Marty Brewer 907-269-3084 Marlena_Brewer@dec.state.ak.us

Comment Number	Page	Section	Comment	Response
				are dominated by the results from DBLF006-SP04-WG (DRO = 0.36 mg/L and RRO = 0.99 mg/L). As is evidenced by the attached chromatogram, the organics measured do not appear to be due to petroleum compounds.
18	App F		It appears that no discernable distribution was defined for several data sets, yet the UCL was used for the EPC in calculating risks	ProUCL calculates a non-parametric UCL when a distribution cannot be determined. Non-parametric UCLs were used when recommended by ProUCL.
19	App F		Is the extent of PCB contamination adequately assessed with only 2 sample points?	These samples were collected from directly underneath capacitors that were removed to assess whether a release had occurred. Based on the lack of mobility of the contaminant and the lack of stressed vegetation outside of the area, these samples are sufficient to address any potential releases from the removed equipment.
20	App G		Screening was performed against old cleanup levels	Please see response to comment #1.

Data File: \\Terastation\share\GCdata\GC71A.I\072707.B\0727-43.D

Date : 28-JUL-2007 07:14

Client ID:

Instrument: GC71A.i

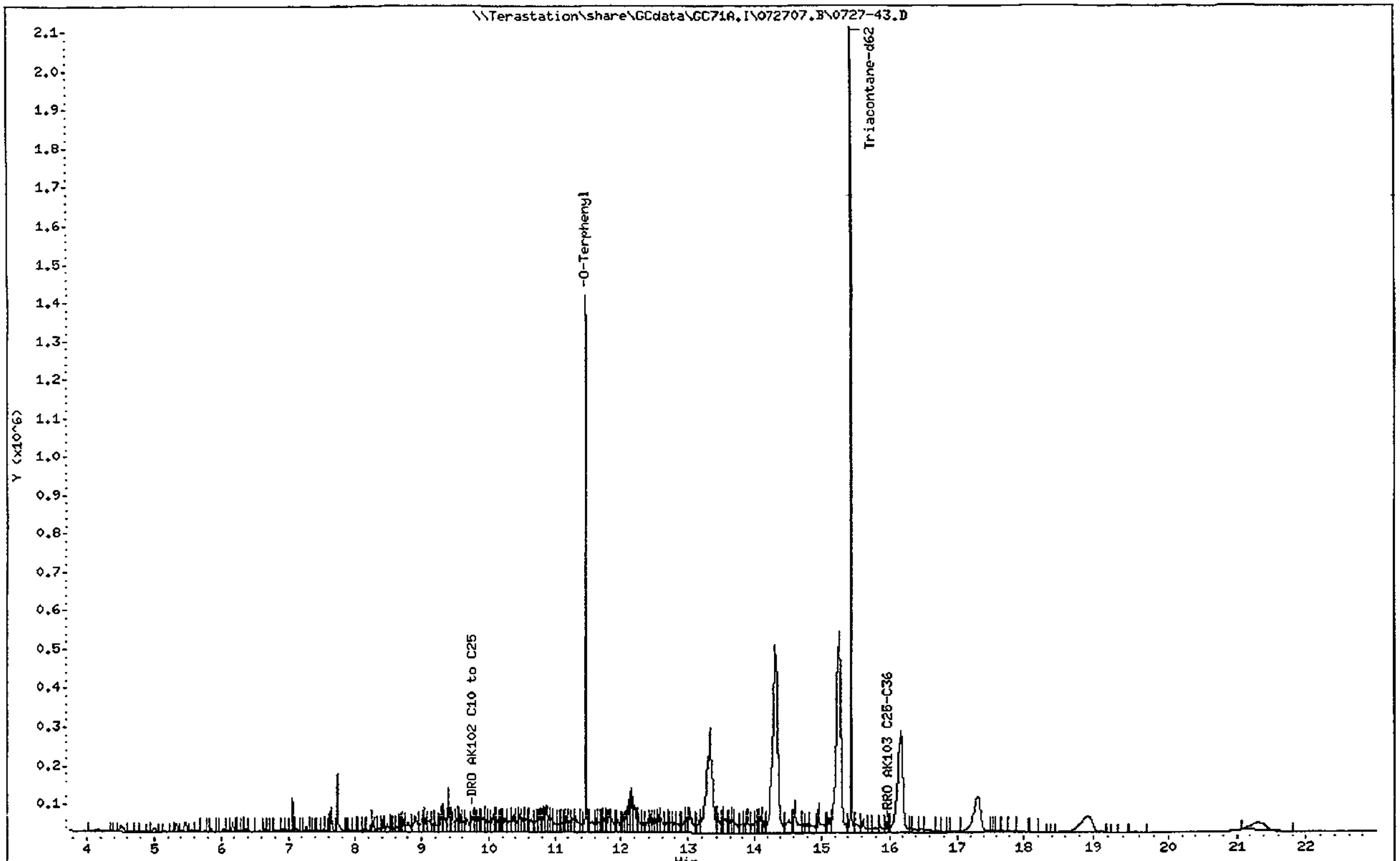
Sample Info: J22981AG 7199242 G170323-17;0;;;893.37;;

Volume Injected (uL): 2.0

Operator: KT

Column phase: STX-CLP

Column diameter: 0.32



STATE OF ALASKA

DEPT. OF ENVIRONMENTAL CONSERVATION

DIVISION OF SPILL PREVENTION AND RESPONSE
CONTAMINATED SITES PROGRAM

SARAH PALIN, GOVERNOR

555 Cordova Street
Anchorage, AK 99501
PHONE: (907) 269-3053
FAX: (907) 269-7649
www.dec.state.ak.us

File: 2541.38.001

June 5, 2009

Mr. Steve Hunt
USAF 611 CES/CEVR
10471 20th St Ste 302
Elmendorf AFB, AK 99506-2200

Re: Driftwood Bay Draft Risk Assessment, Site Characterization, and Remedial Investigation Reports - ADEC Comments

Dear Mr. Hunt:

Our risk assessor, Marty Brewer and myself have completed review of three draft reports titled *Risk Assessment Report, Site Characterization Report, Remedial Investigation Report, Driftwood Bay Radio Relay Station, Driftwood Bay, Alaska, (March, 2009).* We received the reports on April 8, 2009.

It appears we have gone through all the outstanding issues on the review of the preliminary draft documents and follow meetings. I don't have any additional comments. The water quality criteria should be calculated for the wells sampled at Site SS007, but that can be discussed in the revised 350 determination request that should contain the institutional control information we requested.

If you have any questions concerning this letter, please call me at 907-269-3053.

Sincerely,

Jeff Brownlee
Environmental Program Specialist

Cc: Steve Witzman, Jacobs Engineering (via email)
Marty Brewer, ADEC (via email)

Printed on Recycled Paper

APPENDIX M

Groundwater Use Determination

GROUNDWATER USE DETERMINATION
FOR SS007: POL TANK FARM AT DRIFTWOOD BAY

In accordance with Alaska Administrative Code (AAC), Title 18, Section 75.350, groundwater is considered to be a drinking water source unless a responsible person demonstrates or the Alaska Department of Environmental Conservation determines that:

- The water is not a current source of drinking water or within the zone of contribution or recharge area of a drinking water source;
- The groundwater is not a reasonably expected future source of groundwater; and
- The groundwater affected by the hazardous substance will not be transported such that it impacts a current or reasonably expected future source of drinking water.

The purpose of this document is to demonstrate that an 18 AAC 75.350 Groundwater Use Determination is applicable to the SS007: Spill/Leak No. 7 at Petroleum, Oil, and Lubricants Tank Farm site at the former Driftwood Bay Radio Relay Station (RRS).

This document includes a table that addresses each of the criteria set forth for the Groundwater Use Determination in 18 AAC 75.350. The following additional information has also been provided:

- A figure of sampling locations at the SS007 site
- A conceptual cross-section of the SS007 site
- A table of TAH/TAqH calculations for groundwater monitoring points
- Groundwater Sampling Data Sheets

The State of Alaska *Oil and Other Hazardous Substances Pollution Control* regulations (18 AAC 75.350) state that groundwater is considered source of drinking water unless the criteria established by the Department of Environmental Conservation are met. It is the intent of this table to demonstrate that the criteria set forth in 18 AAC 75.350 are met for the SS007: Spill/Leak No. 7 at Petroleum, Oil, and Lubricants Tank Farm site.

18 AAC 75.350 Criteria	Application to SS007 Site	Remarks
Subject to 18 AAC 75.345(c), groundwater at the site is considered to be a drinking water source unless a responsible person demonstrates or the department determines that ***(1) the groundwater is not***		
(A) used for a private or public drinking water system;	• Groundwater in the vicinity of SS007 is not used for a private or public drinking water system.	• Groundwater at the site is not used as a drinking water source. • The deeper aquifer groundwater at SS007 is influenced by salt water intrusion. Therefore, it could not be a reasonably acceptable drinking water source. • The shallow aquifer groundwater at SS007 is not currently used, nor does it have sufficient recharge to be used as a viable drinking water source.
(B) within the zone of contribution of an active private or public drinking water system; or	• Groundwater at SS007 is not within the zone of contribution of an active private or public drinking water system.	• The area is currently uninhabited. There are no roads to the site and the only access is by plane or boat. The bay is very rough and boat landings are dangerous. This area is not expected to be inhabited in the future.
(C) within a recharge area for a private or public drinking water well, a wellhead protection area, or a sole source aquifer;	• Groundwater at SS007 is not within the recharge area for a private or public drinking water well, a wellhead protection area, or a sole source aquifer.	• No wells, well head protection areas, or sole source aquifers are nearby. • The site is bordered by Humpy Creek on the south and Driftwood Bay on the north. • Surface water and co-located sediment samples indicate that neither Humpy Creek nor Driftwood Bay have been impacted by the contamination.

18 AAC 75.350 Criteria	Application to SS007 Site	Remarks
Subject to 18 AAC 75.345(c), groundwater at the site is considered to be a drinking water source unless a responsible person demonstrates or the department determines that: ***(2) the groundwater is not a reasonably-expected potential future source of drinking water, based on an evaluation of***		
(A) the availability of the groundwater as a drinking water source, including depth to groundwater, the storativity and transmissivity of the aquifer, the presence of permafrost, and other relevant information;	• Groundwater was encountered within all 34 borings advanced at SS007. • The transmissivity is dependant upon tidal variations and is not expected to be used as a potential future source of drinking water.	• Groundwater grab samples indicated a fluctuating groundwater level associated with the tidal influence. Groundwater recharge decreased with decreasing tide. • The depth to groundwater ranges from 7 to 14. • Groundwater alternatives exist further inland from this site that would provide more consistent groundwater recharge.
(B) actual or potential quality of the groundwater both including organic and inorganic substances, and as affected by background, saltwater intrusion, and known or existing areawide contamination;	• Groundwater quality parameters indicate that the water quality is not adequate for drinking water. • Surface water quality parameters of TAH and TAqH were calculated for several groundwater wells at the site. Results indicate that TAqH values exceed 15 ppb for groundwater Monitoring Point 03, which is near Driftwood Bay, and Monitoring Point 05, which is near Humpy Creek (refer to attached table for calculations).	• Dissolved oxygen values are low and oxidation reduction potential values are generally negative indicating an anaerobic aquifer. • Turbidity was high in all groundwater grab samples ranging from 20 to 540 NTU. • Saltwater intrusion is inferred due to increased recharge coinciding with incoming tide. • Saltwater intrusion inferred due to change in groundwater parameters coinciding with the incoming tide. • Saltwater intrusion is demonstrated by a sudden increase in conductivity readings at Monitoring Point 04 from approximately 0.24 to 158, coincident with the incoming tide. • Because of the shallow nature of the aquifer, disinfection would likely be required.

18 AAC 75.350 Criteria	Application to SS007 Site	Remarks
		• The exceedance of TAqH at Monitoring Point 05 is driven by the elevated PQLs summed for nondetect values (refer to attached table). • Several PAHs were detected at Monitoring Point 03 and drive the exceedance of ADEC surface water criteria of TAqH at this location. The location of this well is near the shoreline and under the direct influence of saltwater intrusion, making it unsuitable for use as a potential source of drinking water. • At Monitoring Point 3, TAqH exceeded surface water standards. However this groundwater discharges to a rocky beach that experiences vigorous wave action. Results for the marine surface water sample and collocated sediment sample were nondetect for all BTEX and PAH analytes, suggesting that PAH contamination is naturally degraded under these conditions. • Sheen was noted during groundwater sampling at SS007. In some cases, once initial purging was conducted, sheen was no longer noted; however, results from surface water and sediment samples collected from the adjacent creek and marine waters showed no indication of fuel contamination on the groundwater table. Refer to attached Groundwater Sampling Data Sheets for additional sampling observations.

18 AAC 75.350 Criteria	Application to SS007 Site	Remarks
(C) the existence and enforceability of institutional controls described in 18 AAC 75.375 or municipal ordinances or comprehensive plans that either prohibit or limit access to the groundwater for use as drinking water;	• The Air Force holds this property under public land order. The Air Force controls air access to the site and land activities; therefore access to groundwater at the site is limited. • Landing on the Driftwood Bay RRS runway requires a civilian landing permit to be issued by the USAF. • Regardless of the existence and enforceability of institutional controls, the quantity and quality of groundwater is insufficient to support a drinking water well. If a drinking water source were to be required, it is anticipated that surface waters would be used, as has been the case in the past.	• The Air Force holds this property under a Public Land Order and will prepare an Institutional Control plan to help ensure that unacceptable exposure to contamination does not occur. Prior to finalizing it, a draft will be provided to ADEC for review and comment. ADEC review and approval will be obtained on the final Institutional Control plan. • Current land use is not expected to change and no demand for groundwater resources is expected in the future from SS007.
(D) land use of the site and neighboring property, using the factors in EPA's *Land Use in the CERCLA Remedy Selection Process*, adopted by reference in 18 AAC 75.340;	• Surrounding land is unoccupied and will likely remain as such in the foreseeable future.	• OSWER Directive No. 9355.7-04, Land Use in the CERCLA Remedy Selection Process (http://www.epa.gov/superfund/community/relocation/landuse.pdf) was reviewed and evaluated with respect to the SS007 site. • As discussed in the cited directive, a variety of factors must be considered in determining future land use including current land use, accessibility of the site to existing infrastructure, and site location relative to developed areas. • Currently, there are no structures in the immediate area and access is restricted. • A lack of existing infrastructure would make development of the site cost prohibitive. There is no infrastructure for electricity, natural gas, telephones, drinking water, or septic at the site, nor is

18 AAC 75.350 Criteria	Application to SS007 Site	Remarks
		there reliable transportation alternatives at the site. • The site is approximately 14 air miles from the City of Unalaska in an isolated valley bordered by mountains on three sides and the Bering Sea on the other. • Nearby freshwater sources (such as Humpy Creek) would be most likely used in place of this aquifer. • During purging and sampling of monitoring points installed during the 2007 Site Characterization field effort, it was noted that the affected aquifer has low recharge. Purge rates ranged from 0.03 to 0.1 gallons per minute. Details are provided in the attached Groundwater Sampling Data Sheets. Thus, the aquifer would not be able to supply an adequate volume of water for drinking.
(E) the need for a drinking water source and the availability of an alternative source; and	• No need for a temporary or permanent drinking water source in the vicinity of SS007 has been identified.	• The remote location of the site makes it unlikely that a drinking water source would be necessary at the site. • If the need arose, surface water bodies would be more likely used as a drinking water source, as was done when the Radio Relay Station was operational.
(F) whether the groundwater is exempt under 40 CFR 146.4, revised as of July 1, 1997, and adopted by reference; and	• The site may be exempt under the cited regulation.	• Exemption criteria listed in 40 CFR 146.4 appear to be applicable because it does not currently serve as a source of drinking water; and it cannot now and will not in the future serve as a source of drinking water because b-2) It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical.

18 AAC 75.350 Criteria	Application to SS007 Site	Remarks
Subject to 18 AAC 75.345(c), groundwater at the site is considered to be a drinking water source unless a responsible person demonstrates or the department determines that ***(3) the groundwater affected by the hazardous substance will not be transported to groundwater that is a source of drinking water, or that is a reasonably-expected potential future source of drinking water, in concentrations in the receiving groundwater that exceed the groundwater cleanup levels; in reviewing the demonstration required under this paragraph, the department will consider***		
(A) the areal extent of the affected groundwater;	• The areas of affected groundwater are limited to the site.	• Monitoring Point 01 through Monitoring Point 05 show an indication of DRO contamination for the groundwater at SS007. All other monitoring points at SS007 have had no detection or have had detections below 18 AAC 75.345 Table C criteria for contaminants of potential concern (COPCs). • Contamination measured at Monitoring Points 01 through Monitoring Point 04 is associated with groundwater impacted by saltwater intrusion. • Monitoring points 03 and 05 had values of TAqH that exceeded ADEC surface water criteria (refer to attached table for calculations). The exceedance of TAqH in Monitoring point 05 is driven by the summation of elevated PQLs for nondetect values.
(B) the distance to any existing or reasonably anticipated future water supply well;	• There are no known drinking water wells near the SS007 site or within several miles of the site.	• There are no residents at the Driftwood Bay site. • Due to the remote location of the site and the limited access to the site, a drinking water source is not an anticipated need.

18 AAC 75.350 Criteria	Application to SS007 Site	Remarks
(C) the likelihood of an aquifer connection due to well construction practices in the area where the site is located;	• No wells were left on the site at SS007 and there is low likelihood of an aquifer connection resulting from shallow monitoring point construction practices.	• The likelihood of an aquifer connection from the wells is unlikely. The temporary monitoring points were installed into the same aquifer at approximately 5 to 20 feet below current ground surface.
(D) the physical and chemical characteristics of the hazardous substance;	• DRO is the only contaminant measured at concentrations above Table C values. Results indicate that PAHs and VOCs are all below cleanup criteria. • TAH/TAqH values were calculated for three groundwater monitoring points. TAqH values exceeded ADEC surface water standards at two of these locations.	• Natural degradation of fuel-related compounds is a well-documented process. • DRO is not highly mobile and is expected to remain on the site in smear zone soils. • When fuel was spilled at the site, initial DRO concentrations in soil likely ranged up to 100,000 mg/kg. The current maximum measured DRO concentration is 3,400 mg/kg. This reduction indicates the impact of natural processes. These processes will continue to reduce fuel concentrations into the future. • The rate of biodegradation is currently limited by the availability of oxygen at the site. However, the available data indicate that DRO and fuel-related compounds will continue to naturally degrade without impacting surface waters or causing human health exposure.
(E) the hydrogeological characteristics of the site;	• Basalt cobbles and boulders with organic silts comprise the subsurface lithology and the substantial aquifer in the surrounding area does not appear to be impacted by the site. The presence of the fine organic silts acts as a leaky aquitard locally.	• Two out of seven monitoring points purged dry during sampling. The hydrogeological characteristics may not support a viable drinking water well. • Groundwater appears to flow on and off shore from the site due to tidal influence.
(F) the presence of discontinuities in the affected geologic stratum at the site;	• Sampling was advanced into the groundwater, but not to bedrock so the full extent of discontinuities at the site is not known.	• The hydrogeology at the site and fuel fate and transport characteristics indicate that the likelihood of contaminant migration through geological discontinuities is very

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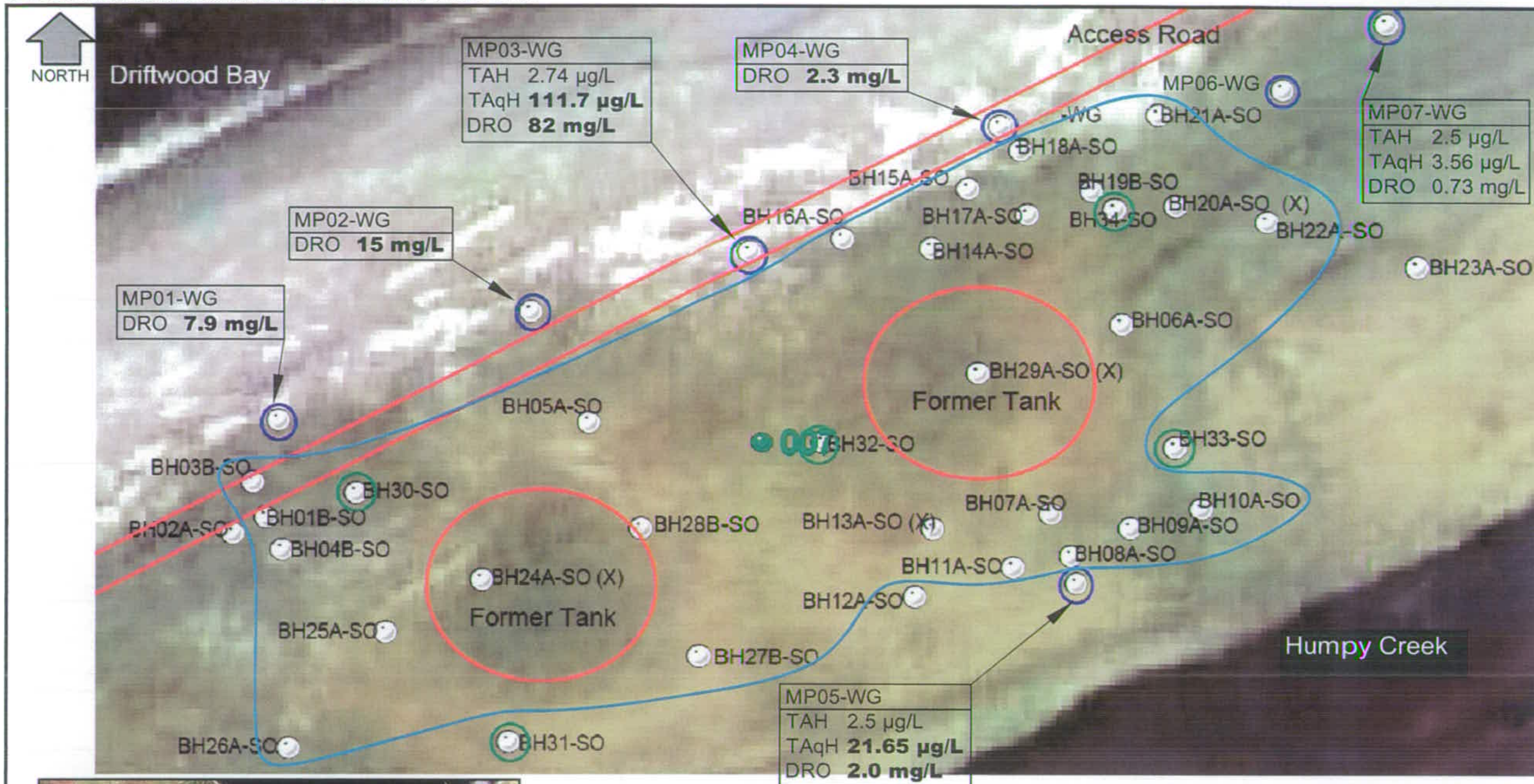
18 AAC 75.350 Criteria	Application to SS007 Site	Remarks
		low. A perched aquifer (approximately 4 feet bgs) is recharged by surface waters from Humpy Creek, and the deep aquifer is affected by saline intrusion.
(G) the local climate;	• Driftwood Bay is located on the Aleutian chain and experiences very cold, windy, and wet weather.	• Annual precipitation averages approximately 62 inches. This includes approximately 90 inches of snowfall. (Data for Dutch Harbor from www.dri.edu.) • High winds are common throughout the area. • The harsh climate greatly limits access to the site and potential exposure to groundwater contamination.
(H) the degree of confidence in any predictive modeling performed; and	• No predictive modeling was performed for the site.	• The fate and transport attributes of the contaminant present (DRO) are well understood. • Diesel fuel has limited solubility is water, and sorbs strongly in soils. Diesel fuel will biodegrade rapidly if sufficient oxygen is present, but sufficient oxygen is generally lacking in the subsurface.
(I) other relevant information; the department will request additional information if the department determines that the information is necessary to protect either the environment or human health, safety, or welfare, or. (Eff. 1/22/99, Register 149; am 8/27/2000, Register 155).	• Information will be provided to ADEC as requested.	Note the following: • There are no known water supply wells near SS007. • The site is located on a remote section of Unalaska Island. • The aquifer in question is subject to saltwater intrusion and therefore would not be used as a drinking water source. • Natural attenuation of DRO a well-documented and reliable process.

G:\Autocad\Driftwood Bay \05BC7101 \Characterization Rpt \Fig 2-11_M-1 SS007 Spill 7.dwg Jul 08,2009 -avakarcs



SITE VICINITY MAP

NOT TO SCALE

SITE SS007

LEGEND

- AREA ABOVE ADEC METHOD TWO
- GROUNDWATER MONITORING POINT
- EXPLORATORY BORING (NO ANALYTICAL SAMPLES WERE COLLECTED)

NOTES

1. ALL SOIL SAMPLE RESULTS WERE BELOW ADEC METHOD THREE.
2. RESULTS IN **BOLD** TEXT EXCEEDED ACTION LEVEL.

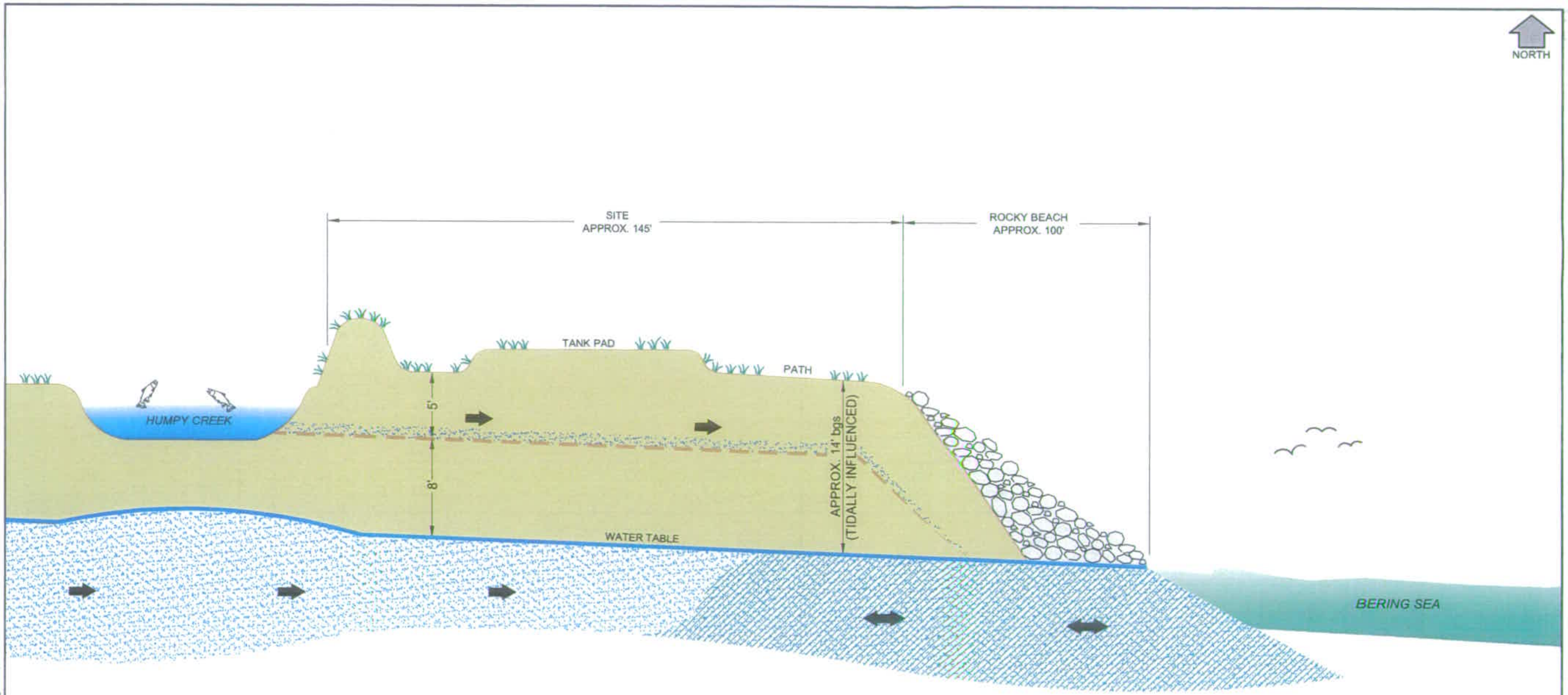
0 15 30 60

SCALE IN FEET

SAMPLE LOCATIONS AT SS007 SPILL/LEAK NO. 7 AT THE FORMER POL TANK FARM UNALASKA ISLAND, ALASKA		
PROJECT MANAGER: S. Witzmann	FILE NAME: Fig 2-11_M-1 SS007 Spill 7.dwg	DATE: June 29, 09
JE — DRAWN BY:	LAYOUT TAB: Fig M-1 SS007 Spill 7	FIGURE NO.: M-1
	FILE LOCATION: Driftwood Bay \ 05BC7101 \ Characterization Rpt	

23 287

882



LEGEND:

- GROUNDWATER FLOW
- GROUNDWATER
- SALTWATER INTRUSION
- LEAKY AQUITARD

SS007 CROSS SECTION

UNALASKA ISLAND, ALASKA

PROJECT MANAGER: S. Witzmann	FILE NAME: Fig 2-13_M-2 SS007 X-Section.dwg	DATE: June 29, 09
DRAWN BY: BJP	LAYOUT TAB: Fig M-2 SS007 X-Section	FIGURE NO.: M-2
	FILE LOCATION: Driftwood Bay / 05BC7101 / Characterization Rpt	

Driftwood Bay
SS007 TAH/TAqH Values for Monitoring Points

SampleID	Method	Analyte	Result	Units	MDL	PQL	SDG	1/2 PQL	UG/L
DBSS007-MP03-WG	SW8260B	Benzene	ND	UG/L	0.13	1	G7G070139	0.5	0.5
DBSS007-MP03-WG	SW8260B	Toluene	ND	UG/L	0.25	1	G7G070139	0.5	0.5
DBSS007-MP03-WG	SW8260B	Ethylbenzene	0.74	UG/L	0.27	1	G7G070139	0.74	0.74
DBSS007-MP03-WG	SW8260B	Xylene, Isomers m & p	ND	UG/L	0.18	1	G7G070139	0.5	0.5
DBSS007-MP03-WG	SW8260B	o-Xylene	ND	UG/L	0.1	1	G7G070139	0.5	0.5
DBSS007-MP03-WG	8270SIM	Acenaphthene	6900	NG/L	150	2400	G7G070139	6900	6.9
DBSS007-MP03-WG	8270SIM	Acenaphthylene	7700	NG/L	150	2400	G7G070139	7700	7.7
DBSS007-MP03-WG	8270SIM	Anthracene	360	NG/L	210	2400	G7G070139	360	0.36
DBSS007-MP03-WG	8270SIM	Benzo(a)anthracene	ND	NG/L	580	2400	G7G070139	1200	1.2
DBSS007-MP03-WG	8270SIM	Benzo(a)pyrene	ND	NG/L	630	2400	G7G070139	1200	1.2
DBSS007-MP03-WG	8270SIM	Benzo(b)fluoranthene	ND	NG/L	590	2400	G7G070139	1200	1.2
DBSS007-MP03-WG	8270SIM	Benzo(g,h,i)perylene	ND	NG/L	770	2400	G7G070139	1200	1.2
DBSS007-MP03-WG	8270SIM	Benzo(k)fluoranthene	ND	NG/L	940	2400	G7G070139	1200	1.2
DBSS007-MP03-WG	8270SIM	Chrysene	ND	NG/L	720	2400	G7G070139	1200	1.2
DBSS007-MP03-WG	8270SIM	Dibenzo(a,h)anthracene	ND	NG/L	690	2400	G7G070139	1200	1.2
DBSS007-MP03-WG	8270SIM	Fluorene	29000	NG/L	190	2400	G7G070139	29000	29
DBSS007-MP03-WG	8270SIM	Fluoranthene	ND	NG/L	560	2400	G7G070139	1200	1.2
DBSS007-MP03-WG	8270SIM	Indeno(1,2,3-cd)pyrene	ND	NG/L	670	2400	G7G070139	1200	1.2
DBSS007-MP03-WG	8270SIM	Naphthalene	37000	NG/L	60	2400	G7G070139	37000	37
DBSS007-MP03-WG	8270SIM	Phenanthrene	16000	NG/L	300	2400	G7G070139	16000	16
DBSS007-MP03-WG	8270SIM	Pyrene	ND	NG/L	630	2400	G7G070139	1200	1.2

DBSS007-MP03-WG

TAqH	=	**111.7**	**µg/L**
TAH	=	2.74	**µg/L**

Notes: Sheen present
TAH is the sum of the BTEX analytes. TAqH is the sum of the BTEX and PAH analytes.
For nondetect results, 1/2 the PQL was used.
The DRO result of 82 mg/L for this monitoring point exceeds the ADEC Table C groundwater cleanup level of 1.5 mg/L.

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Driftwood Bay
SS007 TAH/TAqH Values for Monitoring Points

Sample ID	Method	Analyte	Result	Units	MDL	PQL	SDG	1/2 PQL	UG/L
DBSS007-MP05-WG	SW8260B	Benzene	ND	UG/L	0.13	1	G7G070139	0.5	0.5
DBSS007-MP05-WG	SW8260B	Toluene	ND	UG/L	0.25	1	G7G070139	0.5	0.5
DBSS007-MP05-WG	SW8260B	Ethylbenzene	ND	UG/L	0.27	1	G7G070139	0.5	0.5
DBSS007-MP05-WG	SW8260B	Xylene, Isomers m & p	ND	UG/L	0.18	1	G7G070139	0.5	0.5
DBSS007-MP05-WG	SW8260B	o-Xylene	ND	UG/L	0.1	1	G7G070139	0.5	0.5
DBSS007-MP05-WG	8270SIM	Acenaphthene	ND	NG/L	160	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Acenaphthylene	ND	NG/L	150	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Anthracene	ND	NG/L	220	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Benzo(a)anthracene	ND	NG/L	590	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Benzo(a)pyrene	ND	NG/L	650	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Benzo(b)fluoranthene	ND	NG/L	610	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Benzo(g,h,i)perylene	ND	NG/L	790	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Benzo(k)fluoranthene	ND	NG/L	970	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Chrysene	ND	NG/L	740	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Dibenzo(a,h)anthracene	ND	NG/L	710	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Fluorene	ND	NG/L	200	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Fluoranthene	ND	NG/L	580	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Indeno(1,2,3-cd)pyrene	ND	NG/L	690	2500	G7G070139	1250	1.25
DBSS007-MP05-WG-X	8270SIM	Naphthalene	400	NG/L	59	2400	G7G070139	400	0.4
DBSS007-MP05-WG	8270SIM	Phenanthrene	ND	NG/L	310	2500	G7G070139	1250	1.25
DBSS007-MP05-WG	8270SIM	Pyrene	ND	NG/L	650	2500	G7G070139	1250	1.25

DBSS007-MP05-WG

TAqH	=	**21.65**	**μg/L**
TAH	=	2.5	**μg/L**

Notes: Sheen present

TAH is the sum of the BTEX analytes. TAqH is the sum of the BTEX and PAH analytes.

For nondetect results, 1/2 the PQL was used.

TAqH exceedance is driven by elevated PQLs for nondetect results. Sample was analyzed at a 50X dilution during 8270SIM analysis.

The DRO result of 2 mg/L for this monitoring point exceeds the ADEC Table C groundwater cleanup level of 1.5 mg/L.

Driftwood Bay
SS007 TAH/TAqH Values for Monitoring Points

Sample ID	Method	Analyte	Result	Units	MDL	PQL	SDG	1/2 PQL	UG/L
DBSS007-MP07-WG	SW8260B	Benzene	ND	UG/L	0.13	1	G7G070139	0.5	0.5
DBSS007-MP07-WG	SW8260B	Toluene	ND	UG/L	0.25	1	G7G070139	0.5	0.5
DBSS007-MP07-WG	SW8260B	Ethylbenzene	ND	UG/L	0.27	1	G7G070139	0.5	0.5
DBSS007-MP07-WG	SW8260B	Xylene, Isomers m & p	ND	UG/L	0.18	1	G7G070139	0.5	0.5
DBSS007-MP07-WG	SW8260B	o-Xylene	ND	UG/L	0.1	1	G7G070139	0.5	0.5
DBSS007-MP07-WG	8270SIM	Acenaphthene	140	NG/L	3.2	50	G7G070139	140	0.14
DBSS007-MP07-WG	8270SIM	Acenaphthylene	9.7	NG/L	3.1	50	G7G070139	9.7	0.0097
DBSS007-MP07-WG	8270SIM	Anthracene	ND	NG/L	4.4	50	G7G070139	25	0.025
DBSS007-MP07-WG	8270SIM	Benzo(a)anthracene	ND	NG/L	12	50	G7G070139	25	0.025
DBSS007-MP07-WG	8270SIM	Benzo(a)pyrene	ND	NG/L	13	50	G7G070139	25	0.025
DBSS007-MP07-WG	8270SIM	Benzo(b)fluoranthene	ND	NG/L	12	50	G7G070139	25	0.025
DBSS007-MP07-WG	8270SIM	Benzo(g,h,i)perylene	ND	NG/L	16	50	G7G070139	25	0.025
DBSS007-MP07-WG	8270SIM	Benzo(k)fluoranthene	ND	NG/L	20	50	G7G070139	25	0.025
DBSS007-MP07-WG	8270SIM	Chrysene	ND	NG/L	15	50	G7G070139	25	0.025
DBSS007-MP07-WG	8270SIM	Dibenzo(a,h)anthracene	ND	NG/L	14	50	G7G070139	25	0.025
DBSS007-MP07-WG	8270SIM	Fluorene	240	NG/L	4	50	G7G070139	240	0.24
DBSS007-MP07-WG	8270SIM	Fluoranthene	ND	NG/L	12	50	G7G070139	25	0.025
DBSS007-MP07-WG	8270SIM	Indeno(1,2,3-cd)pyrene	ND	NG/L	14	50	G7G070139	25	0.025
DBSS007-MP07-WG	8270SIM	Naphthalene	360	NG/L	1.2	50	G7G070139	360	0.36
DBSS007-MP07-WG	8270SIM	Phenanthrene	ND	NG/L	6.3	50	G7G070139	25	0.025
DBSS007-MP07-WG	8270SIM	Pyrene	ND	NG/L	13	50	G7G070139	25	0.025

DBSS007-MP07-WG

TAqH	=	3.5497	**µg/L**
TAH	=	2.5	**µg/L**

Notes: Sheen present in the first 5 gallons of purge water; no sheen observed in the second bucket.
TAH is the sum of the BTEX analytes. TAqH is the sum of the BTEX and PAH analytes.
For nondetect results, 1/2 the PQL was used.
The DRO result of 0.73 mg/L for this monitoring point is below the ADEC Table C groundwater cleanup level of 1.5 mg/L.

JACOBS
Groundwater Sampling Data Sheet

Site Name: ~~Drum Disposal Area~~	Well ID: ~~MW-7~~ SS007 MP01	Acceptable Range for Field Parameters	
Project ID: ~~T.O. 05 Cold Bay~~	Well Type: ☒ Monitor ☐ Extraction	pH	± 10%
Project #: ~~95M...~~	Well Material: ☐ PVC ☐ Stainless Steel	Conductivity	± 10%
Date: 7/3/07		Temp.	± 10%
Start Time: 0911	Well Integrity: ☐ Excellent ☐ Good ☐ Fair ☐ Poor	Turbidity	±10% NTU
Finish Time: 1110			
Sampled By: Forest J.			
PID Reading: max'd at ~1000			
Weather Conditions: Overcast/windy			
Probe Type: ☑ Water Interface ☐ Electronic Water Indicator ☐ Other____	Casing Diameter (in): ☒ ~~2~~ ☐ 4	Gallons/Linear Foot: ☒ ~~0.17~~ ☐ 0.66	Casing Radius² (ft): ☒ ~~0.0069~~ ☐ 0.0280

Purging Information

Start Time: 1005	Depth to Product:	**Purging Equipment**
Finish Time: 1051	Depth to GW: 11.6'	☐ Poly Bailer
	Total Depth (T.D.) of Well Casing:	☐ Submersible Pump
	Product Thickness:	☒ Peristaltic Pump

Casing Volume (Gallons) = (____ T.D. well casing - ____ Depth to GW) = (____ Ft. water in well) * (0.17 Gallons/Linear Foot) = (____ Gallons in well) * 3 = (____ Proposed Purge Volume)

Actual Volume Purged____ Gallons

	Time Elapsed (Minutes)	Volume (Gallons)	pH	Conductivity (µS/cm)	Temp. (°F) (°C)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Salinity (ppm)	TDS	ORP (mV)
1025		2	5.94	.126	6.58	288	.65			-82.3
1030	5	2.25	5.93	.125	6.57	186	.59			-10.3
	5	2.5	5.91	.123	6.39	205	.60			-136.7
	5	2.6	5.84	.121	6.42	123	.59			-137.5
	5	2.7	5.81	.123	6.34	63.1	.58			-140.8
	~~5~~ 3	2.75	5.83	.122	6.28	57.2	.59			-145.5
	3	2.8	5.83	.121	6.27	77.4	.57			-140.0

Color	Odor	Purged Dry?	Meters Used	Purge Water
* ☒ Clear	☐ None	☐ Yes ☒ No	☐ Horiba U-10	☐ Treated
☒ Cloudy	☐ Faint	Sheen?	☐ Horiba U-22	☐ Discharged
☐ Yellow	☐ Moderate	☒ Yes ☐ No	☒ YSI	☐ Stored
☐ Brown	☒ Strong		☒ Hach	

* very strong odor and lots of sheen

Sampling Information

Date: 7/3/07	**Sampling Equipment**
Start Time: 1053	☐ Teflon Bailer
Finish Time: 1110	☐ Submersible Pump
Depth of Tubing:	☒ Peristaltic Pump

Sample ID #	Volume/Container	Analysis Requested	Preservative	Comments
	2x1L preserved		HCL	

Other Sample Types

QC Duplicate Sample #	QA Triplicate Sample #	Trip Blank Sample #

* H_2O starts cloudy & smelly but as H_2O clears odor lessens

* PID reading ... ~ 0.0 ppm

Recorded [illegible]

SCN E5 23 293

JACOBS
Groundwater Sampling Data Sheet

Site Name: ~~Drum Disposal Area~~	Well ID: ~~MW-5~~ SS007 MP02	**Acceptable Range for Field Parameters**	
Project ID: ~~T.O. 05 Cold Bay~~	Well Type: ☒ Monitor ☐ Extraction	pH	± 10%
Project #: ~~05M00000~~	Well Material: ☐ PVC ☐ Stainless Steel	Conductivity	± 10%
Date: 7/3/07	Well Integrity: ☐ Excellent ☐ Good ☐ Fair ☐ Poor	Temp.	± 10%
Start Time: 1120		Turbidity	±10% NTU
Finish Time:			
Sampled By:			
PID Reading: @12:12 = 42.5 ppm			
Weather Conditions: overcast			
Probe Type: ☒ Oil/Water Interface ☐ Electronic Water Indicator ☐ Other	Casing Diameter (in): ☒ ~~2~~ ☐ 4	Gallons/Linear Foot: ☒ ~~0.17~~ ☐ 0.66	Casing Radius² (ft): ☒ ~~0.0069~~ ☐ 0.0280

Purging Information

Start Time: 1205	Depth to Product:	**Purging Equipment**
Finish Time: 1238	Depth to GW: 14.7'	☐ Poly Bailer
	Total Depth (T.D.) of Well Casing:	☐ Submersible Pump
	Product Thickness:	☒ Peristaltic Pump

Casing Volume (Gallons) = (____ T.D. well casing - ____ Depth to GW) = (____ Ft. water in well) * (0.17 Gallons/Linear Foot) = (____ Gallons in well) * 3 = (____ Proposed Purge Volume)

Actual Volume Purged ____ Gallons

	Time Elapsed (Minutes)	Volume (Gallons)	pH	Conductivity (µS/cm)	Temp. (°F) (°C)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Salinity (ppm)	TDS	ORP (mV)
1218		1.5	6.17	0.170	5.55	54.6	0.61			-70.1
	5	1.75	6.11	0.169	5.51	36.5	0.57			-71.1
	5	2	6.05	0.168	5.48	27.0	1.22			-75.0
	3	2.2	6.07	0.168	5.76	20.0	1.23			-76.4
	3	2.4	6.06	0.168	5.72	26.1	1.30			-78.3

Color	Odor	Purged Dry?	Meters Used	Purge Water
☒ Clear	☐ None	☐ Yes ☐ No	☐ Horiba U-10	☒ Treated
☒ Cloudy	☐ Faint	Sheen?	☐ Horiba U-22	☐ Discharged
☐ Yellow	☐ Moderate	☒ Yes ☐ No	☒ YSI	☒ Stored
☐ Brown	☒ Strong		☒ Hach	

Sampling Information

Date: 7/3/07	**Sampling Equipment**
Start Time: 1238	☐ Teflon Bailer
Finish Time: 1241	☐ Submersible Pump
Depth of Tubing:	☒ Peristaltic Pump

Sample ID #	Volume/Container	Analysis Requested	Preservative	Comments
	2x 1L Amber		HCL	

Other Sample Types

QC Duplicate Sample #	QA Triplicate Sample #	Trip Blank Sample #

* H2O starts cloudy but clears and odor lessens

1000 * PID breathing zone = 0.0 ppm

[illegible]

SS-01
LP007
MP03

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JACOBS
Groundwater Sampling Data Sheet

Site Name: ~~Drum Disposal Area~~	Well ID: ~~MW-3~~	**Acceptable Range for Field Parameters**
Project ID: ~~T.O. 05 Cold Bay~~	Well Type: ☒ Monitor ☐ Extraction	pH ± 10%
Project #: ~~05M00009~~	Well Material: ☐ PVC ☐ Stainless Steel	Conductivity ± 10%
Date: 7/3/07	Well Integrity: ☐ Excellent ☐ Good ☐ Fair ☒ Poor	Temp. ± 10%
Start Time: 1420		Turbidity ±10% NTU
Finish Time: 1710		
Sampled By:		
PID Reading:		
Weather Conditions: foggy & damp		

Probe Type	Casing Diameter (in)	Gallons/Linear Foot	Casing Radius² (ft)
☒ Oil/Water Interface	☒ 2	☒ 0.17	☒ 0.0069
☐ Electronic Water Indicator	☐ 4	☐ 0.66	☐ 0.0280
☐ Other ______			

Purging Information

Start Time: 1442	Depth to Product:	**Purging Equipment**
Finish Time: 1545	Depth to GW: 13.80	☐ Poly Bailer
	Total Depth (T.D.) of Well Casing: 17.60	☐ Submersible Pump
	Product Thickness:	☒ Peristaltic Pump

Casing Volume (Gallons) = (______ T.D. well casing - ______ Depth to GW) = (______ Ft. water in well) * (0.17 Gallons/Linear Foot) = (______ Gallons in well) * 3 = (______ Proposed Purge Volume)

Actual Volume Purged 2 Gallons

Time Elapsed (Minutes)	Volume (Gallons)	pH	Conductivity (µS/cm)	Temp. (°F) (°C)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Salinity (ppm)	TDS	ORP (mV)
slowest setting - strong fuel odor - more than sheen on water table -									
1528					671				
1536					1030				
1545					410				

Color	Odor	Purged Dry?	Meters Used	Purge Water
☐ Clear	☐ None	☐ Yes ☒ No	☐ Horiba U-10	☐ Treated
☒ Cloudy	☐ Faint		☐ Horiba U-22	☐ Discharged
☐ Yellow	☐ Moderate	Sheen?	☒ YSI	☐ Stored
☐ Brown	☒ Strong	☒ Yes ☐ No	☒ Hach	

Sampling Information

Date: 7/3/07	**Sampling Equipment**
Start Time: 1545	☐ Teflon Bailer
Finish Time:	☐ Submersible Pump
Depth of Tubing:	☒ Peristaltic Pump

Sample ID #	Volume/Container	Analysis Requested	Preservative	Comments
	3X 40mL VOA	AK101/8260	MeOH	
	1X1L Amber		none	
	~~[illegible]~~ 2X1L Amber		HCL	

Other Sample Types

QC Duplicate Sample #	QA Triplicate Sample #	Trip Blank Sample #

strong fuel odor - Very turbid/sediment initially - will allow to sit for 15 min & then [illegible]

[illegible]

ECL ES

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JACOBS
Groundwater Sampling Data Sheet

Site Name: ~~Asphalt Seep Area~~	Well ID: ~~WP-02~~ 007 MP04	**Acceptable Range for Field Parameters**
Project ID: ~~LO-05 Cold Bay~~	Well Type: ☒ Monitor ☐ Extraction	pH ± 10%
Project #: ~~05M00600~~	Well Material: ☐ PVC ☐ Stainless Steel	Conductivity ± 10%
Date: 7/3/07	Well Integrity: ☐ Excellent ~~☐ Good ☒ Fair~~ ☐ Poor	Temp. ± 10%
Start Time: 1705		Turbidity ±10% NTU
Finish Time:		
Sampled By:		
PID Reading:		
Weather Conditions: Overcast / fog		

Probe Type	Casing Diameter (in)	Gallons/Linear Foot	Casing Radius² (ft)
☒ Oil/Water Interface ☐ Electronic Water Indicator ☐ Other______	~~☒ 2 ☐ 4~~	~~☒ 0.17~~ ☐ 0.66	~~☒ 0.0069~~ ☐ 0.0280

Purging Information

Start Time: 1735	Depth to Product:	**Purging Equipment**
Finish Time:	Depth to GW:	☐ Poly Bailer
	Total Depth (T.D.) of Well Casing:	☐ Submersible Pump
	Product Thickness:	☒ Peristaltic Pump

Casing Volume (Gallons) = (______ T.D. well casing - ______ Depth to GW) = (______ Ft. water in well) * (0.17 Gallons/Linear Foot)= (______ Gallons in well) * 3 = (______ Proposed Purge Volume)

* lowest setting and barely recharging

Actual Volume Purged______ Gallons

Time Elapsed (Minutes)	Volume (Gallons)	pH	Conductivity (µS/cm)	Temp. (°C)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Salinity (ppm)	TDS (g/L)	ORP (mV)
	1.25				919				
	1.4				606				
	1.6	6.04	.238	8.31	458	134.9			29.2
1905	1.65	6.01	.237	8.19	416	131.5			19.4
1905	1.70	6.01	.236	8.04	363	129.2			13.3
* jumped suddenly *		+8.20	158	-9.99	308	-72.3			605.5

Color	Odor	Purged Dry?	Meters Used	Purge Water
☐ Clear	☐ None	☒ Yes ☒ No	☐ Horiba U-10	☒ Treated
☒ Cloudy	☐ Faint	**Sheen?**	☐ Horiba U-22	☐ Discharged
☐ Yellow	☒ Moderate	☒ Yes ☐ No	☐ YSI	☒ Stored
☒ Brown	☐ Strong		☒ Hach	

Sampling Information

Date:	**Sampling Equipment**
Start Time:	☐ Teflon Bailer
Finish Time:	☐ Submersible Pump
Depth of Tubing:	☐ Peristaltic Pump

Sample ID #	Volume/Container	Analysis Requested	Preservative	Comments
	2x1L Amber	AK102/103	HCL	

Other Sample Types

QC Duplicate Sample #	QA Triplicate Sample #	Trip Blank Sample #

* sheen and fuel odor

[illegible]

entered .LH

297 23 23 296

JACOBS
Groundwater Sampling Data Sheet

Site Name: ~~Drum Disposal Area~~	Well ID: ~~MW-6~~ SS007 MP05	Acceptable Range for Field Parameters	
Project ID: ~~T.O. 05 Cold Bay~~	Well Type: ☒ Monitor ☐ Extraction	pH	± 10%
Project #: ~~05M30009~~	Well Material: ☐ PVC ☐ Stainless Steel	Conductivity	± 10%
Date: 7/4/07	Well Integrity: ☐ Excellent ~~☐ Good~~ ~~☐ Fair~~ ☐ Poor	Temp.	± 10%
Start Time: 0900		Turbidity	±10% NTU
Finish Time: 1220			
Sampled By: Forrest			
PID Reading:			
Weather Conditions: overcast/fog			

Probe Type: ☒ Oil/Water Interface ☐ Electronic Water Indicator ☐ Other____

Casing Diameter (in): ~~☒ 2~~ ~~☐ 4~~ | Gallons/Linear Foot: ~~☒ 0.17~~ ☐ 0.66 | Casing Radius² (ft): ~~☒ 0.0069~~ ☐ 0.0280

Purging Information

Start Time: 0944
Finish Time: 1043

Depth to Product:
Depth to GW: 4.7'
Total Depth (T.D.) of Well Casing:
Product Thickness:

Purging Equipment: ☐ Poly Bailer ☐ Submersible Pump ☒ Peristaltic Pump

Casing Volume (Gallons) = (____ T.D. well casing - ____ Depth to GW) = (____ Ft. water in well) * (0.17 Gallons/Linear Foot) = (____ Gallons in well) * 3 = (____ Proposed Purge Volume)

* sheen & fuel odor

Actual Volume Purged____ Gallons

1010- setup YSI PID 1047

Time Elapsed (Minutes)	Volume (Gallons)	pH	Conductivity (µS/cm)	Temp. (°F) (°C)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Salinity (ppm)	TDS	ORP (mV)
	2	10.60	.107	6.26	493	14.5			-31.8
5	2.2	10.16	.107	5.96	544	15.6			-33.6
5	2.4	10.48	.107	6.17	338	15.1			-36.8
5	2.5	11.03	.106	6.28	264	15.3			-38.9
5	2.6	10.84	.106	6.32	235	14.8			-41.4
5	2.7	10.70	.106	6.59	206	15.1			-45.3
5	2.8	11.31	.106	6.23	192	15.1			-45.7
5	3	11.27	.105	6.41	139	14.8			-46.7

Color: ☐ Clear ☒ Cloudy ☐ Yellow ☐ Brown
Odor: ☐ None ☐ Faint ☒ Moderate ☐ Strong
Purged Dry? ☐ Yes ☒ No
Sheen? ☒ Yes ☐ No
Meters Used: ☐ Horiba U-10 ☐ Horiba U-22 ☒ YSI ☒ Hach
Purge Water: ☒ Treated ☐ Discharged ☒ Stored

Sampling Information

Date: 7/4/07
Start Time: 1130
Finish Time: 1220
Depth of Tubing:

Sampling Equipment: ☐ Teflon Bailer ☐ Submersible Pump ☒ Peristaltic Pump

Sample ID #	Volume/Container	Analysis Requested	Preservative	Comments
DBSS007-MP05-WG	3X 40mL VOA vial	8260 B		
	2x1L Amber	AK102/103	HCl	
	2x1L Amber	8270C SIM	4°C	

Other Sample Types

QC Duplicate Sample #	QA Triplicate Sample #	Trip Blank Sample #

DBSS007-MP05-WG(x) 3x40mL VOA 8260B
2x1L Amber AK102/103
2x1L Amber 8270C SIM

entered

JACOBS
Groundwater Sampling Data Sheet

Site Name: SS007	Well ID: SS007 MP06	Acceptable Range for Field Parameters	
Site ID:	Well Type: ☐ Monitor ☐ Extraction	pH	± 10%
Project #:		Conductivity	± 10%
Date: 7/4/07	Well Material: ☐ PVC ☐ Stainless Steel	Temp.	± 10%
Start Time:		Turbidity	±10% NTU
Finish Time:	Well Integrity: ☐ Excellent ☐ Good ☐ Fair ☐ Poor		
Sampled By: FJ			
PID Reading:			
Weather Conditions:			

Probe Type:	Casing Diameter (in)	Gallons/Linear Foot	Casing Radius^2 (ft)
☐ Oil/Water Interface	☐ 2	☐ 0.17	☐ 0.0069
☐ Electronic Water Indicator	☐ 4	☐ 0.66	☐ 0.0280
☐ Other______			

Purging Information

Start Time:	Depth to Product:	**Purging Equipment**
Finish Time:	Depth to GW:	☐ Bailer
	Total Depth (T.D.) of Well Casing:	☐ Submersible Pump
	Product Thickness:	☐ Peristaltic Pump

Casing Volume (Gallons) = (______ T.D. well casing - ______ Depth to GW) = (______ Ft. water in well) * (______ Gallons/ Linear Foot) = (______ Gallons in well) * 3 = (______ Proposed Purge Volume)

Actual Volume Purged______ Gallons

Time Elapsed (Minutes)	Volume (Gallons)	pH	Conductivity (µS/cm)	Temp. (°C)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Salinity (ppm)	TDS	ORP (mV)

Color	Odor	Purged Dry?	Meters Used	Purge Water
☐ Clear	☐ None	☐ Yes ☐ No	☐ Horiba U-10	☐ Treated
☐ Cloudy	☐ Faint		☐ Horiba U-22	☐ Discharged
☐ Yellow	☐ Moderate	Sheen?	☐ Multimeter	☐ Stored
☐ Brown	☐ Strong	☐ Yes ☐ No	☐ Hach	

Sampling Information

Date:	**Sampling Equipment**
Start Time:	☐ Bailer
Finish Time:	☐ Submersible Pump
Depth of Tubing:	☐ Peristaltic Pump

Sample ID #	Volume/Container	Analysis Requested	Preservative	Comments
* will not collect sample due to presence of fuel.				

Other Sample Types

QC Duplicate Sample #	QA Triplicate Sample #	Trip Blank Sample #

entered [illegible]

JACOBS
Groundwater Sampling Data Sheet

Site Name: Asphalt Seep Area	Well ID: WP-01 MP07 SS007	Acceptable Range for Field Parameters	
Project ID: T.O. 05 Cold Bay	Well Type: ☒ Monitor ☐ Extraction	pH	± 10%
Project #: 05M30609	Well Material: ☐ PVC ☐ Stainless Steel	Conductivity	± 10%
Date: 7/4/07		Temp.	± 10%
Start Time: 1231	Well Integrity: ☐ Excellent ☐ Good ☐ Fair ☐ Poor	Turbidity	±10% NTU
Finish Time: 1445			
Sampled By: [illegible]			
PID Reading:			
Weather Conditions: Foggy			
Probe Type: ☒ Water Interface ☐ Electronic Water Indicator ☐ Other	Casing Diameter (in): ☒ 2 ☐ 4	Gallons/Linear Foot: ☒ 0.17 ☒ 0.66	Casing Radius[3] (ft): ☒ 0.0069 ☐ 0.0280

Purging Information

Start Time: 1232	Depth to Product:	**Purging Equipment**
Finish Time: 1425	Depth to GW: 23'	☐ Poly Bailer
	Total Depth (T.D.) of Well Casing:	☐ Submersible Pump
	Product Thickness:	☒ Peristaltic Pump

Casing Volume (Gallons) = (____ T.D. well casing - ____ Depth to GW) = (____ Ft. water in well) * (0.17 Gallons/Linear Foot) = (____ Gallons in well) * 3 = (____ Proposed Purge Volume)

Actual Volume Purged ____ Gallons

Time Elapsed (Minutes)	Volume (Gallons)	pH	Conductivity (µS/cm)	Temp. (°C)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Salinity (ppm)	TDS (g/L)	ORP (mV)
1406	5.5	6.58	.370	4.91	18.9	15.5			-69.8
5	6	6.54	.407	4.76	12.8	11.5			-82.3
5	6.5	6.51	.367	4.76	7.96	9.0			-97.7
5	7	6.50	.379	4.86	6.01	7.5			-104.6
3	7.3	6.49	.375	4.84	6.50	7.2			-108.6
3	7.6	6.49	.376	4.82	5.68	7.1			-109.0

Color	Odor	Purged Dry?	Meters Used	Purge Water
* ☒ Clear w/yellowish tint	☐ None	☐ Yes ☒ No	☐ Horiba U-10	☐ Treated
☒ Cloudy was dirty but cleared	☒ Faint	**Sheen?**	☐ Horiba U-22	☐ Discharged
☐ Yellow	☐ Moderate	☒ Yes ☐ No	☒ YSI	☒ Stored
☐ Brown	☐ Strong		☒ Hach	

Sampling Information

Date: 7/4/07	**Sampling Equipment**
Start Time: 1425	☐ Teflon Bailer
Finish Time: 1441	☐ Submersible Pump
Depth of Tubing:	☒ Peristaltic Pump

Sample ID #	Volume/Container	Analysis Requested	Preservative	Comments
DBSS007-	3 x 40mL vials		none	
MP07-	2 x 1L Amber jar		HCL	
WG	2 x 1L Amber jar		none	

Other Sample Types

QC Duplicate Sample #	QA Triplicate Sample #	Trip Blank Sample #

* first 5 gal had sheen and odor → 2nd bucket no sheen & slight sulfur odor

entered AH

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE