Final

Savoonga Federal Scout Readiness Center Data Gap Investigation Report

Prepared for

Alaska Army National Guard
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Acronyms and Abbreviations

°F	degrees Fahrenheit
µg/L	micrograms per liter
AAC	*Alaska Administrative Code*
ACL	alternate cleanup level
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation & Public Facilities
AOC	area of concern
Alaska Offshore	Alaska Offshore, Inc.
ARNG	Army National Guard
AST	aboveground storage tank
ASTM	ASTM International
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
Clarus	Clarus Technologies, LLC
CSM	conceptual site model
DGI	data gap investigation
DQO	data quality objective
DRO	diesel-range organics
EPA	U.S. Environmental Protection Agency
EPH	extractable aliphatic and aromatic petroleum hydrocarbons
ERM	ERM-West, Inc.
FSRC	Federal Scout Readiness Center
GPS	global positioning system
GRO	gasoline-range organics
Hart Crowser	Hart Crowser, Inc.
HI	hazard index
HRC	hydrocarbon risk calculator
IC	institutional control
mg/kg	milligrams per kilogram
NAPL	non-aqueous-phase liquid
North Wind	North Wind, Inc.
Ogden	Ogden Environmental and Energy Services, Inc.

PA	preliminary assessment
PAH	polynuclear aromatic hydrocarbon
PID	photoionization detector
ppm	parts per million
RI	remedial investigation
RRO	residual-range organics
SI	site investigation
SL	screening level
SSC	secondary site characterization
UFP-QAPP	Unified Federal Program-Quality Assurance Project Plan
VPH	volatile aliphatic and aromatic petroleum hydrocarbons
yd^3	cubic yards

SECTION 1

Introduction

This data gap investigation (DGI) report provides background information, summarizes previous investigations, describes the updated conceptual site model (CSM), and provides the results of the recently completed field investigation at Savoonga Federal Scout Readiness Center (FSRC). The report includes recommendations for further remedial actions. This work was conducted under National Guard Bureau Contract W90FYQ-09-D-003, Task Order 2Z01.

1.1 Goals and Objectives of Data Gap Investigation

The goal of this DGI was to ensure that the Alaska Army National Guard (ARNG) has all the environmental data necessary to conduct remedial actions at Savoonga FSRC to allow divestiture of the leased property without the use of institutional controls (ICs).

To fulfill this goal, the following primary project objectives of the DGI for Savoonga FSRC were established:

- Ensure that adequate data are available to delineate the extent of petroleum-contaminated soil and groundwater related to previous heating oil spills and releases at Savoonga FSRC in accordance with Title 18, Chapter 75, Section 335 of the *Alaska Administrative Code* (18 AAC 75.335), which requires that, before proceeding with site cleanup under the site cleanup rules, a responsible person characterize the extent of hazardous substance contamination at the site including:
  - Identifying each (potential) hazardous substance at the site, including the concentration and extent of contamination; this information must be sufficient to determine cleanup options without ICs.
  - Evaluating the potential threat to human health, safety, and welfare, as well as to the environment, from site contamination.
  - Locating sources of known site contamination, including a description of possible releases into soil, sediment, groundwater, or surface water.
  - Evaluating the size of the contaminated area, including the concentrations and extent of any soil, sediment, groundwater, or surface water contamination.
  - Identifying the vertical depth to groundwater and the horizontal distance to nearby wells, surface water, and water supply intakes.
  - Evaluating the potential for surface water runoff from the site and the potential for surface water or sediment contamination.
  - Identifying the soil type and determining whether the soil is a continuing source of groundwater contamination.
- Evaluate the possibility of alternate cleanup levels (ACLs) for soil
- Identify appropriate remedial alternatives

1.2 Report Organization

The findings resulting from site activities are provided in the following sections:

- **Section 1–Introduction.** The introduction presents an overview of the DGI, including goals and objectives and report organization.
- **Section 2–Site Background.** The regional setting and site background information is presented in this section.

- **Section 3–Previous Investigations and Remedial Actions**. This section summarizes information from previous preliminary assessments (PAs), site investigations (SIs), and remedial actions conducted at Savoonga FSRC.
- **Section 4–Data Gap Analysis.** This section summarizes the project screening levels (SLs), data quality objectives (DQOs), identified data gaps, and the CSM.
- **Section 5–Field Activities.** This section describes and summarizes methods and procedures used to investigate the affected soil for Savoonga FSRC.
- **Section 6–Contamination Assessment.** This section assesses the extent of contamination across the site for all affected media, using historical and recently obtained data.
- **Section 7–Cumulative Risk Assessment.** Analytical results are analyzed to establish the potential risk to humans and the environment associated with the existing site contamination.
- **Section 8–Recommendations.** This section presents conclusions derived from the investigation data, presents proposed ACLs, and estimates the volume of contaminated soil that will require remedial action.
- **Section 9–References.** This section lists sources referenced in the text.

SECTION 2

Site Background

This section summarizes the site location, climate, characteristics, and history of Savoonga FSRC.

2.1 Site Location and Climate

The City of Savoonga is located on the northern coast of St. Lawrence Island in the Bering Sea, approximately 164 miles west of Nome and 39 miles southeast of Gambell, Alaska (Figure 2-1). Atuk Mountain, with an elevation of 2,207 feet, is located approximately 8 miles to the south of the city. Savoonga FSRC is located at latitude 63.695329 degrees north and longitude –170.482770 degrees west, based on the 1984 (revised 2004) World Geodetic System (WGS 84) datum.

Savoonga has a subarctic maritime climate with some continental influences during winter. Summer temperatures average 40 degrees Fahrenheit (°F) to 51°F. Winter temperatures average –7°F to 11°F. Average annual total precipitation is 10 inches, with 58 inches of snowfall (Western Regional Climate Center, 2012). The island is subject to prevailing winds that average 18 miles per hour. The Bering Sea freezes in that area in mid-November, with ice breaking up in late May (Alaska Department of Commerce, Community, and Economic Development, Division of Community and Regional Affairs, 2012).

2.2 Site Characteristics

The Savoonga FSRC property is adjacent to the main beach access road on the northwestern side of the city, approximately 200 feet south of the Bering Sea waterfront. This well-traveled road forms the southeastern boundary of the site. Wet tundra occupies the area north and west of the FSRC. Surrounding properties include a store to the north, houses to the east, and two Alaska Department of Transportation & Public Facilities (ADOT&PF) buildings to the south. A single aboveground storage tank (AST) of unknown volume is located on ADOT&PF property between the FSRC buildings and the ADOT&PF buildings.

2.2.1 Surface Water

Standing surface water was noted immediately west of the armory buildings on adjoining properties. A crushed-gravel pad occupies much of the site. The FSRC buildings, the ASTs, and the storage shed are situated on the gravel pad. The elevation of the gravel pad results in a potentially radial surface drainage pattern that would direct runoff offsite in the immediate vicinity of the FSRC. To the north of the FSRC, the land begins to slope more steeply toward the Bering Sea. The potential for surface runoff is low, however, because of the coarse nature of the gravel pad material.

2.2.2 Hydrogeology

Savoonga is built on clayey silt that contains basalt boulders overlain by a layer of peat, roots, and organic material up to 1 foot in thickness. A series of scoracious basalt lava flows underlie the clayey silt overburden at approximately 12 feet bgs (Ogden Environmental and Energy Services, Inc. [Ogden], 1998; ERM-West, Inc. [ERM] and Hart Crowser, Inc. [ERM/Hart Crowser], 1999).

A permafrost map of Alaska compiled by the U.S. Geologic Survey characterizes the region as generally underlain by moderately thick to thin permafrost (Ogden, 1998). A 1996 community profile indicates that permafrost is continuous under Savoonga, with a 2- to 3-foot-thick surface-thaw layer (Ogden, 1998). In 1994, Clarke Engineering Company conducted a subsurface soil investigation for the City of Savoonga (Ogden, 1998). As part of the investigation, 11 test borings were installed, with 2 located near the FSRC. The soil boring logs indicated that permafrost was present at depths ranging from 1 to 3 feet below ground surface (bgs). Soil borings (with the exception of a background boring) from the remedial investigation (RI) (ERM/Hart Crowser, 1999) were limited in

depth because of the coarse nature of the gravel pad where FSRC buildings are located. Permafrost was encountered in the background boring at 3 feet bgs.

The water supply for Savoonga is a well that is located adjacent to the runway, approximately 0.75 mile southeast of and upgradient from the armory. The well log for this well was obtained from the Alaska Department of Natural Resources (ADNR) Well Log Tracking System (ADNR, 2012).The well was drilled in 1972 to 195 feet bgs. Permafrost was not encountered while the runway well was being drilled because the well was located within the thaw bulb associated with the drainage east of the village. In summer, water is found in the shallow subsurface soils above the permafrost table; the water is classified primarily as active layer (suprapermafrost) groundwater. Except for this seasonally thawed water in the active layer, true groundwater generally does not exist above the permafrost table (Ogden, 1998).

2.3 Site Description and History

Savoonga FSRC is an inoperable readiness center located on an approximately 1-acre, fairly flat lot near the west side of Savoonga. Buildings and equipment remaining at the FSRC include the following (Figure 2-2 and Photograph 1):

PHOTOGRAPH 1
Savoonga FSRC buildings (Old FSRC at right, New FSRC at left), ASTs, and storage van. Looking northwest.

- A 20- by 60-foot, wood-framed building constructed in 1960 (Old FSRC); the prefabricated scout readiness center is a Butler-style building on an integrated foundation.
- A 30- by 40-foot, wood-framed building (New FSRC) constructed in 1985 to the southwest of the Old FSRC; the prefabricated scout readiness center is a Butler-style building on an integrated foundation.
- An elevated breezeway connecting the two FSRCs.
- A 1,500-gallon, double-walled, self-diked AST installed in 2002 adjacent to the New FSRC building.
- Two 1,500-gallon, double-walled ASTs located installed in 1993 near the Old FSRC building.
- A crushed-rock (gravel) pad.
- A storage van.
- A hazardous material storage locker.
- A storage shed.

Abandoned or removed equipment relevant to the site characterization is:

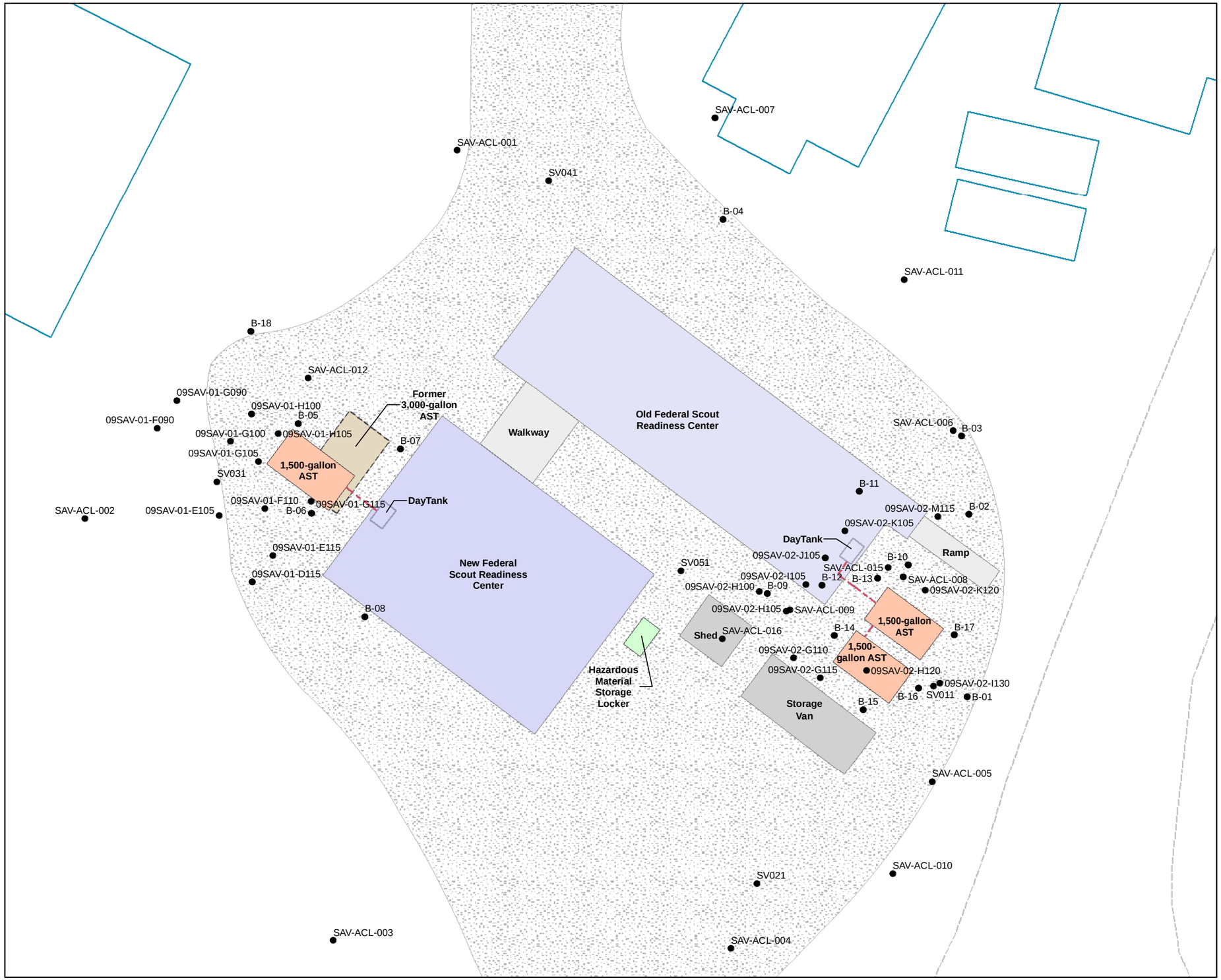
- A 3,000-gallon, double-walled AST replaced in 2002 adjacent to the New FSRC building

North

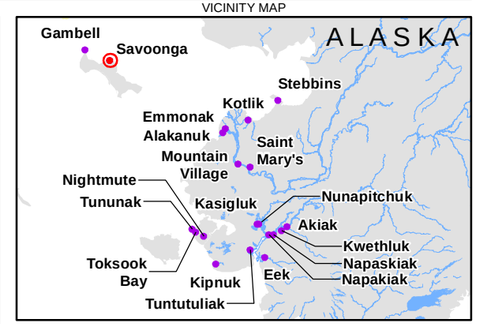
0 150 300

Approximate scale in feet

FIGURE 2-1
Savoonga Location Map
Data Gap Investigation Report
Army National Guard FSRCs, Alaska



VICINITY MAP



LEGEND

- Federal Scout Readiness Center (FSRC)
- Old FSRC
- Storage Facility
- AST
- Former AST
- Day Tank
- Hazardous Material Storage Locker
- Gravel Pad
- Tank Piping
- Other Building
- Unpaved Road
- Historical Sample Location

Notes:

1. Location of historical samples is approximate based on historical figures and on orthophotography courtesy of Alaska Department of Commerce, Division of Community & Regional Affairs (DCRA), 1-foot pixels.
2. Definition:
   AST = aboveground storage tank

N

0 7.5 15
Feet

FIGURE 2-2
Site Features and Historical Sample Locations
Savoonga FSRC Data Gap Investigation
Savoonga, Alaska

SECTION 3

Previous Investigations and Remedial Actions

This section briefly discusses known spills, previous investigations, and the results of each investigation at Savoonga FSRC. SLs discussed in this section are based on those used at the time of each investigation unless otherwise noted. Figure 2-2 presents all known historical sample locations and site features.

A spill of 500 to 3,000 gallons of fuel oil from a tank or fuel line at the site was reported in 1985. The spill reportedly was cleaned up by Alaska Offshore, Inc. (Alaska Offshore) in July 1985 (Alaska Offshore, 1985). The spill is assumed to have been associated with tanks near the Old FSRC building because the New FSRC building had not yet been constructed. No record of confirmation sampling or sampling conducted to determine whether residual contamination remained in the ground was found in ARNG files. During visual observation, it was estimated that the fuel had spread under the Old FSRC building, 30 feet to the main road (south), 150 feet to a neighboring store (north), and 75 feet to a house (east). A final spill report (Alaska Offshore, 1985) indicated that, in addition to the AST spill, holes in eight drums had resulted in the release of approximately 200 gallons of Jet A fuel. Contaminated snow and absorbents were collected and disposed of or were burned at the city dump (Clarus Technologies, LLC [Clarus], 2006).

A second release was reported during a 1992 ARNG site inspection. The discharge was a heating oil release of unknown quantity originating from an AST fuel line to the day tank; however, the location of the spill or associated tank was not specified (ERM/Hart Crowser, 1999).

Environmental investigations conducted at Savoonga FSRC include the following:

- PA/SI conducted by in August 1996 (Ogden, 1998)
- RI conducted by ERM/Hart Crowser in 1998 (ERM/Hart Crowser, 1999)
- ACL demonstration project conducted by Clarus in 2004 (Clarus, 2006)
- Secondary site characterization (SSC) conducted by North Wind, Inc. (North Wind) in 2008 (North Wind, 2009)

3.1 1996 Preliminary Assessment/Site Investigation

The 1996 PA/SI consisted of performing a soil survey using infrared spectrophotometer field screening as a tool to delineate several areas suspected of soil contamination (Ogden, 1998). The investigated locations were the area of the 1985 fuel spill, the area of the 1992 fuel spill, areas beneath the three ASTs, and the drum storage area. Ogden collected seven field screening and five analytical soil samples from the site. Samples were collected from the areas of concern (AOCs) and from areas of obvious contamination that were observed during the visit.

Field screening results of the soil samples collected from the AOCs ranged from nondetect to 400 parts per million (ppm). The two highest readings, 190 and 400 ppm, were from samples collected immediately adjacent to the northernmost Old FSRC AST and the New FSRC former AST; however, samples were not collected for laboratory analysis from those two locations. All samples submitted for analytical testing were collected at 0.5 foot bgs and were analyzed for diesel-range organics (DRO) and gasoline-range organics (GRO) by Alaska Methods AK102 and AK101, respectively. Laboratory results for DRO concentrations in the soil ranged from 12 to 160 mg/kg. Laboratory analysis did not indicate the presence of petroleum hydrocarbons at concentrations greater than SLs.

3.2 1998 Remedial Investigation

The RI consisted of installing and sampling 20 soil borings and installing one well point in September 1998 (ERM/Hart Crowser, 1999). A total of 12 soil borings were located to investigate the area around the former AST near the Old FSRC building and an area adjacent to the storage shed where drums had been stored, five borings were located near the former AST at the New FSRC, and three borings were located in background areas. A total of 42 soil samples were collected and submitted for laboratory analysis of DRO (Alaska Method AK102); GRO (Alaska Method AK101); residual-range organics (RRO) (Alaska Method AK103); and benzene, toluene, ethylbenzene, and xylenes (BTEX) (U.S. Environmental Protection Agency [EPA] Method SW8021). A groundwater

sample was not collected because of poor water flows at the installed well point. Because of the coarse nature of the gravel pad in which the FSRC is located, subsurface sample depths were generally limited to 2 to 2.5 feet bgs. Permafrost was encountered in only one boring, at 3 feet bgs. Concentrations of DRO that exceeded the SL were identified in samples from soil near the 3,000-gallon AST and the two 1,500-gallon ASTs (Figure 2-2). The maximum DRO concentration was reported at 17,000 milligrams per kilogram (mg/kg), in a sample taken near the Old FSRC ASTs. GRO, RRO, and BTEX compounds were also detected in the soil samples submitted for laboratory analysis; however, concentrations were less than their respective SLs.

3.3 2004 Alternate Cleanup Level Demonstration Project

The ACL demonstration project consisted of collecting soil and suprapermafrost groundwater samples at Savoonga FSRC in August 2004 to develop and present potentially applicable ACLs in accordance with regulation and guidance provided in 18 AAC 75 (Clarus, 2006). Seven primary soil samples and one field duplicate soil sample were collected to determine background concentrations of DRO. Five soil samples and one field duplicate were collected in known areas of contamination that had been identified during previous investigations. All soil samples were analyzed for DRO by Alaska Method AK102. Selected samples were also analyzed for GRO by Alaska Method AK101, for BTEX by EPA Method SW8021B, and for total organic carbon by EPA Method SW9060. Bulk density and grain size were also measured. DRO was not detected in soil samples at concentrations greater than the 250-mg/kg DRO SL. The maximum DRO concentration (233 mg/kg) was found in sample ACL-008, located near the 1,500-gallon AST.

Two well points were installed to approximately 4.5 bgs, and suprapermafrost groundwater was collected from each well point and submitted for laboratory analysis of DRO by Alaska Method AK102, GRO by Alaska Method AK101, BTEX by EPA Method SW8021B, and total dissolved solids by EPA Method 160.1. A third well point was not sampled because of refusal encountered during installation prior to reaching groundwater. No free product was encountered during collection of suprapermafrost groundwater samples. Suprapermafrost groundwater contained concentrations of DRO, toluene, and xylenes at both well point locations sampled; concentrations of GRO, benzene, and ethylbenzene were detected in the well point near the Old FSRC ASTs. DRO and benzene were detected at concentrations greater than SLs. Concentrations of DRO and BTEX compounds were higher in suprapermafrost groundwater samples collected near the two 1,500-gallon ASTs adjacent to the Old FSRC building.

3.4 2008 Secondary Site Characterization

A total of 48 soil borings were installed and sampled at Savoonga FSRC in June 2008 to delineate the extent and volume of petroleum-contaminated soil containing DRO at concentrations exceeding the Alaska Department of Environmental Conservation (ADEC) cleanup level of 250 mg/kg (North Wind, 2009). Borings were established and completed on 5-foot grids from both the Old and New FSRC building edges and concentrated around the ASTs. Frozen soil was encountered in all Grid 1 borings (west of the New FSRC building) at depths ranging from 0.5 to 1.5 feet bgs. Frozen soil was encountered in Grid 2 borings at depths ranging from 0.7 to 1.5 feet bgs. Not all borings from Grid 2 encountered frozen soil. A total of 90 soil samples were collected and field screened by photoionization detector (PID) to evaluate the presence or absence of hydrocarbons in the field. A total of 22 primary and 3 duplicate samples were selected for laboratory analysis of DRO by Alaska Method AK102. Field screening data and analytical results were compared. Results of field screening (PID analyses and hydrocarbon odor) and laboratory analyses exhibited a poor correlation for the Grid 1 samples collected west of the New FSRC. Because of auger refusal at shallow depths, limitations of accurate PID readings from soil at these shallow depths, heterogeneity of the sample material, and biogenic interference, an accurate estimate of and the extent and volume of DRO contamination could not be completed. Maximum PID readings were detected in the samples collected at the northwestern edge of the two 1,500-gallon ASTs. DRO was detected at concentrations greater than the SL in samples collected west and northwest of the New FSRC AST. Samples collected near the Old FSRC ASTs contained DRO at concentrations less than the SL. The investigation effort estimated a total area and volume of soil contaminated by DRO at concentrations exceeding 250 mg/kg (based on best professional judgment and

limited correlation of results) at 308 cubic feet (11 cubic yards [yd^3]). A final report has not been submitted for this investigation.

SECTION 4

Data Gap Analysis

This section summarizes how the SLs and DQOs were established for the DGI and how previous investigation data were used, and presents the CSM of site conditions and the means of potential exposure at Savoonga FSRC. This section also presents the data gaps identified for Savoonga FSRC that were examined as part of the DGI.

4.1 Project Screening Levels

SLs are conservative, predominantly risk-based values that are used to characterize and determine the nature and extent of contamination in soil and groundwater. SLs are intended to be used for screening purposes only; exceedance of an SL is not necessarily an indication of unacceptable risk. Details about the SL selection process for each medium are provided in the Unified Federal Program-Quality Assurance Project Plan (UFP-QAPP) published as *Final Work Plan for Site Characterization at 21 Alaska Federal Scout Readiness Centers* (CH2M HILL, 2011).

4.1.1 Soil Screening Levels

Soil SLs are established in consideration of cumulative exposure of human receptors to contaminants in soil (and sediment) through direct contact and outdoor inhalation, as well as protection of groundwater. The project SLs established for Savoonga FSRC were based on ADEC cleanup levels provided in 18 AAC 75.

As presented in 18 AAC 75.340(a)(2), proposed soil cleanup levels for a site must be based on an estimate of the reasonable maximum exposure expected to occur under current and future site conditions. Soil SLs must be developed using ADEC Method 2 for soil contaminated with chemicals other than petroleum hydrocarbons, as set out in Table B1 of 18 AAC 75.341(c) and for soil contaminated with petroleum hydrocarbons, as set out in Table B2 of 18 AAC 75.341(d). The ADEC Method 2 cleanup levels presented in Tables B1 and B2 were determined for three potential exposure pathways—direct contact/ingestion, inhalation, and migration to groundwater—depending on the climatic zone in which the soil is located (arctic zone, under-40-inch zone, or over-40-inch zone). The cleanup level from Table B1 or B2 that applies to Savoonga FSRC is based on the exposure pathway with the most stringent value calculated for a site within the under-40-inch climatic zone. Based on available data, all three exposure pathways were considered potentially complete for Savoonga FSRC.

The project SLs are shown in Table 4-1. The project SLs for GRO and DRO in soil were set equal to the ADEC Method 2 cleanup levels for the migration-to-groundwater pathway; for RRO in soil, the SL was set equal to the ADEC Method 2 cleanup level for the ingestion pathway. For chemicals other than petroleum hydrocarbons, to account for possible cumulative risk associated with multiple chemical exposures, direct contact, and outdoor inhalation, cleanup levels were divided by a factor of 10. The SL for a specific chemical in soil was determined to be the lowest of the adjusted ADEC Method 2 direct contact or outdoor inhalation cleanup level and the ADEC Method 2 migration-to-groundwater cleanup level. Because of the extensive list of possible contaminants, only SLs for BTEX compounds are shown in Table 4-1.

4.1.2 Groundwater Screening Levels

Groundwater SLs are established in consideration of potential cumulative exposure of human receptors to contaminants through drinking groundwater. As defined under 18 AAC 75.345(b)(1), contaminated groundwater must meet the cleanup levels in 18 AAC 75.345(b)(1), Table C, if the current use or the reasonably expected potential future use of the groundwater, determined under 18 AAC 75.350, is a drinking-water source. In addition, 18 AAC 75.345(g) states that groundwater that is closely connected hydrologically to nearby surface water may not cause a violation of the water quality standards in 18 AAC 70 for surface water.

TABLE 4-1
Soil Screening Levels
Savoonga Federal Scout Readiness Center Data Gap Investigation

Contaminant of Concern	ADEC Method 2 Cleanup Level			Exposure Route of Primary Concern	Proposed ADEC Method 2 Soil Cleanup Level	Project Screening Level
	Direct Contact/ Ingestion	Outdoor Inhalation	Migration to Groundwater			
Gasoline-range organics	1,400	1,400	300	Migration to GW	300	300
Diesel-range organics	10,250	12,500	250	Migration to GW	250	250
Residual-range organics	10,000	22,000	11,000	Ingestion	10,000	10,000
Benzene	150	11	0.025	Migration to GW	0.025	0.025
Toluene	8,100	220	6.5	Migration to GW	6.5	6.5
Ethylbenzene	10,100	110	6.9	Migration to GW	6.9	6.9
Xylenes (total)	20,300	63	63	Inhalation	63	6.3

Note: All values are presented in milligrams per kilogram.
ADEC = Alaska Department of Environmental Conservation
GW = groundwater
Source: 18 AAC 75.341, Tables B1 and B2, under-40-inch zone

For GRO, DRO, and RRO, the project SLs were set equal to the cleanup levels in Table C of 18 AAC 75.345(b)(1). For all other compounds, SLs were derived by dividing the cleanup levels in Table C by a factor of 10 to account for possible cumulative risk associated with multiple chemical exposures. Table 4-2 summarizes the project SLs for contaminants that were expected to be encountered at Savoonga FSRC.

TABLE 4-2
Groundwater Screening Levels
Savoonga Federal Scout Readiness Center Data Gap Investigation

Contaminant of Concern	18 AAC 75 Groundwater Cleanup Level (mg/L)	18 AAC 70 Water Supply, Aquiculture, Cleanup Level (µg/L)	Project Screening Level (mg/L)
Gasoline-range organics	2.2	--	2.2
Diesel-range organics	1.5	--	1.5
Residual-range organics	1.1	--	1.1
Benzene	0.005	--	0.0005
Toluene	1.0	--	0.1
Ethylbenzene	0.7	--	0.07
Xylenes (total)	10	--	1.0
Total aromatic hydrocarbons	--	10	--
Total aqueous hydrocarbons	--	15	--

-- = not analyzed
µg/L = micrograms per liter
AAC = *Alaska Administrative Code*
mg/L = milligrams per liter
Source: 18 AAC 75.345(b)(1), Table C, and 18 AAC 70.020(b)(5)(A)(iii)

4.2 Data Quality Objectives

DQOs were established to provide benchmarks against which the quality of fieldwork and the quality of the resulting analytical data could be evaluated. The DQOs specified the type, quality, quantity, and uses of the data needed to adequately support environmental decisions at Savoonga FSRC. The DQOs could be fulfilled by using either existing data or data gathered during the 2011 DGI. Three DQOs were established for the 2011 DGI at Savoonga FSRC. The DQOs established the type and quantity of data necessary for determining the nature and extent of contamination in the soil and groundwater at the FSRC and specified the quality and quantity of data required to assess cumulative human health risk.

- DQO 1 established what data were necessary to determine whether further sampling of the soil would be required to define the nature and extent of contamination (and, secondarily, to support a remedial decision and cost savings for future remedial actions). The lateral extent of soil contamination would be adequately delineated only if all soil samples surrounding the potential source or release location contained concentrations of all target analytes below SLs. To help fulfill this objective, historical (previous investigation) data were evaluated for usability following the general procedures outlined in the UFP-QAPP (CH2M HILL, 2011). Data that (1) had been properly validated, (2) had been derived through use of ADEC-approved or EPA-approved analytical methods, and (3) reflected analytical detections greater than the limits of detection or lower than the SLs were considered usable for the purposes of determining the extent of contamination. Those data considered usable were also retained to characterize the site.
- DQO 2 established the type and quantity of data that were necessary to determine whether groundwater was present, contaminated, and acting as a transport mechanism to nearby surface water bodies. Historical (previous investigation) data were evaluated to determine (1) whether permafrost was present in the soil, (2) whether suprapermafrost groundwater was present and had been sampled between the apparent source area and the nearest surface water body, and (3) whether concentrations of all target analytes in the samples were below SLs and detection limits were appropriate.
- DQO 3 was established to determine the type and quantity of data required to ascertain whether current or hypothetical future residents, occupational workers, or construction/excavation workers might be exposed to constituent contaminant concentrations that could pose potentially unacceptable risks. Historical (previous investigation) data were also evaluated for usability, and those data that were considered usable were retained for use in risk assessment.

4.3 Conceptual Site Model

A CSM integrates (1) existing information and working assumptions about the physical site conditions; (2) the nature, occurrence, and distribution of chemicals; and (3) fate and transport processes. The CSM for Savoonga FSRC is based on the current understanding of site history and conditions.

As a pure product, heating oil is less dense than water and is referred to as light non-aqueous-phase liquid (NAPL). When released to the ground surface, NAPL products spread laterally across the ground surface and infiltrate into the soil. The extent of lateral spreading across the ground surface is a function of quantity and rate of release and the permeability of surface soil. The infiltrating product from a surface spill tends to flow primarily vertically under the influence of gravity through larger air-filled soil pores, although capillary forces may cause some lateral spreading. When released in sufficient quantities, light NAPL product can migrate downward through soil and accumulate at the capillary fringe of the groundwater table surface. Because known spills at Savoonga FSRC are more than one decade old, it is very likely that gravity drainage and flow of the light NAPL product to a point of immobility have already occurred.

The CSM for the Savoonga FSRC site integrates information about leaks and spills of heating oil concentrated around the former heating oil AST. Each spill and leak of heating oil has spread both laterally and vertically from its point of release, resulting in surface and subsurface soil hydrocarbon contamination down to suprapermafrost groundwater (Figure 4-1).

The conceptual model for exposure at Savoonga FSRC, including past or current sources of contamination, chemical release mechanisms, transport/exposure media, potential exposure points, potential exposure routes, and potential receptors, is incidental human ingestion of surface soil and dermal contact with soil (Figure 4-2). Exposure to very shallow suprapermafrost groundwater and, subsequently, to surface water is considered a complete pathway; however, the nearest drinking water aquifer is present upgradient and beneath Savoonga FSRC at more than 180 feet bgs and is protected by nearly 170 feet of permafrost and therefore is not considered a complete exposure pathway. All potentially complete ecological exposure pathways are considered insignificant because of the small size of the site, the location within Savoonga, and the presence of more optimal habitat nearby.

4.4 Identification of Data Gaps

Historical site use and previous investigation findings suggest that the primary source of contamination at Savoonga FSRC is associated with spills/leaks in an area concentrated around the former heating oil ASTs. Data collected during previous investigations indicated the presence of DRO in concentrations greater than the SL in soil to approximately 4.5 feet bgs. Historical investigation data indicate that detected concentrations of DRO at this site are likely to have been affected by biogenic material.

Concentrations of DRO detected in suprapermafrost groundwater samples exceed the groundwater SL, indicating that suprapermafrost groundwater has been contaminated. However, it is unknown whether contaminated suprapermafrost groundwater is migrating offsite toward the Savoonga River.

The data gaps that needed to be filled to determine the nature and extent of contamination at the site and to support risk assessment efforts were as follows:

- The lateral extent of DRO contamination present in soil at concentrations greater than the SL had not been adequately delineated. Consequently, additional surface and subsurface soil data were needed to adequately delineate the extent of DRO contamination in the soil.
- The lateral extent of DRO and benzene contamination present in suprapermafrost groundwater at concentrations greater than the SL had not been adequately delineated. Consequently, additional groundwater data were needed to adequately delineate the extent of DRO contamination and to determine whether contaminated suprapermafrost groundwater was migrating offsite toward the Bering Sea.
- Data for polynuclear aromatic hydrocarbons (PAHs), extractable aliphatic and aromatic petroleum hydrocarbons (EPH), volatile aliphatic and aromatic petroleum hydrocarbons (VPH), and BTEX were limited or not available because of IRA activities. PAH and BTEX data were necessary to assess cumulative risk to human health that could result from exposure to DRO. EPH and VPH data would aid in differentiating between aliphatic and aromatic hydrocarbons for the remaining contamination. These data could be used to help generate future site-specific cleanup levels for residual hydrocarbons.

Actions taken to fill these data gaps are discussed in Section 5.

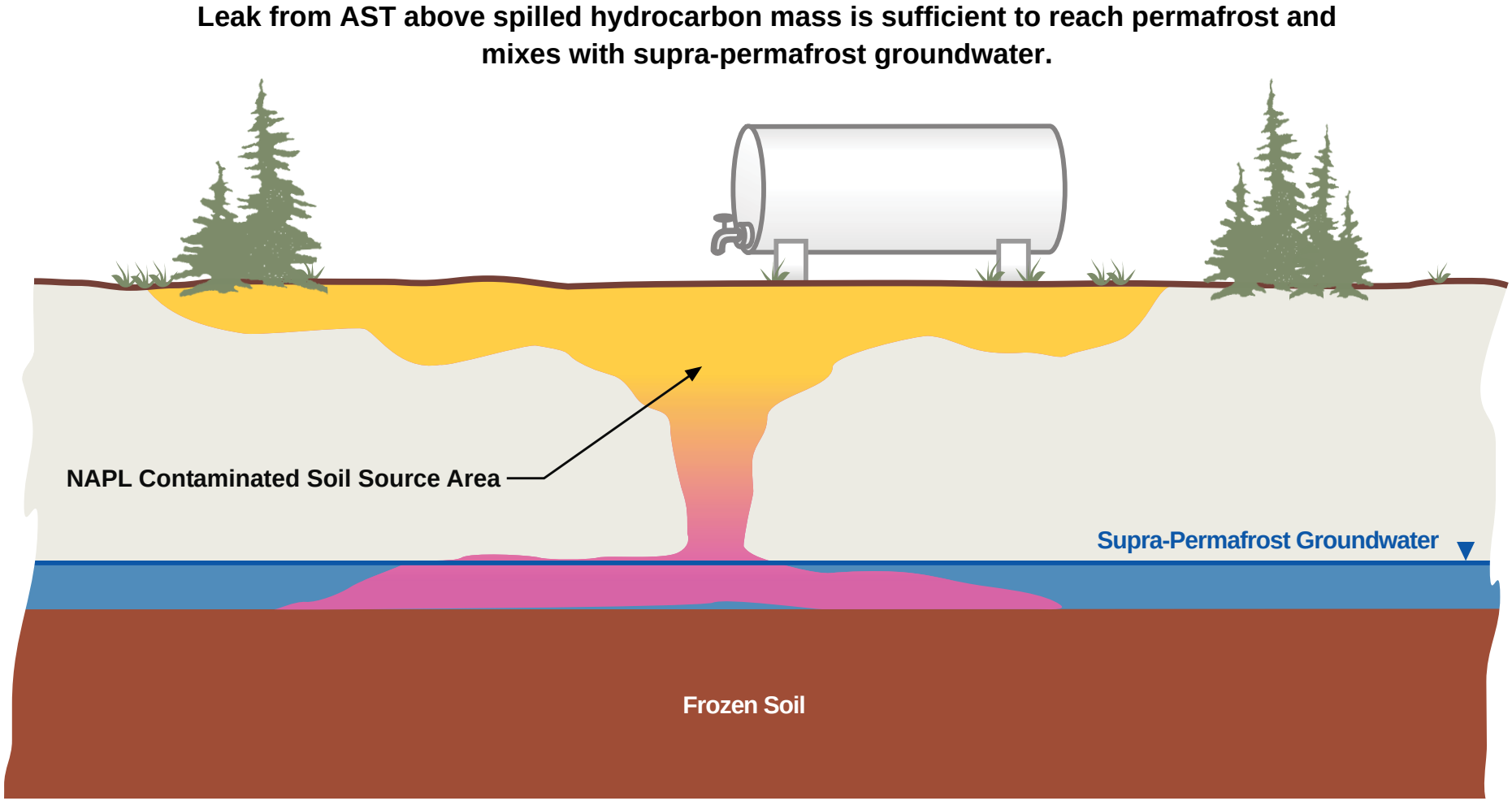
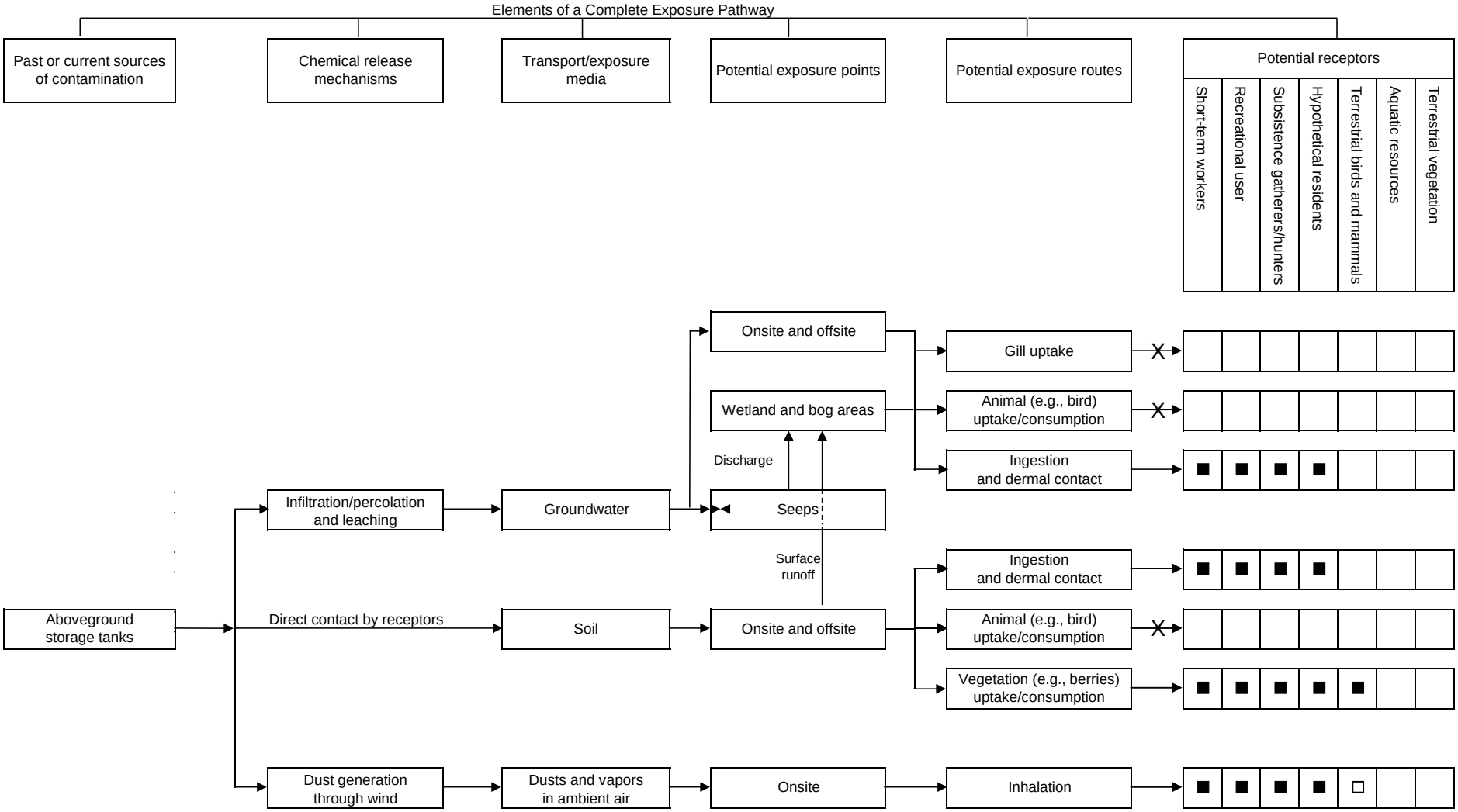


FIGURE 4-1
Conceptual Site Model
Savoonga FSRC Data Gap Investigation Report
Savoonga, Alaska



■ = Potentially complete pathway (to be addressed quantitatively)
□ = Pathway considered minor (to be addressed qualitatively)

Blank = Incomplete pathway

X = Exposure route is not complete

Note: Exposure pathways assume current conditions of the site.

FIGURE 4-2
Conceptual Exposure Model
Potential Human and Ecological Exposures
Savoonga Federal Scout Readiness Center Data Gap Investigation
Savoonga, Alaska

SECTION 5

Field Investigation Activities

The DGI field activities at Savoonga FSRC occurred on July 5, 6, 23, and 24, 2011. The field activities were conducted to satisfy the DQOs as presented in Section 4.1, to fill the data gaps identified in Section 4.3, and to support recommendations for remedial actions at the site.

5.1 Site Reconnaissance

On July 5, 2011, CH2M HILL field personnel conducted a site reconnaissance at Savoonga FSRC to find site features to assist in locating proposed nature-and-extent sampling points, including previous excavation limits, previous boreholes, and AST locations. Efforts were also made to identify any new areas of soil staining or distressed vegetation. No new sources of contamination were identified, and no evidence of stained soil, recent spills, or stressed vegetation was observed.

5.2 Sample Locations

The 13 initially planned soil boring locations (11SAVSB001 through 11SAVSB017) proposed in the UFP-QAPP (CH2M HILL, 2011) for Savoonga FSRC were established on July 5, 2011, (Figure 5-1), through use of a global positioning system (GPS) and were verified by taking measurements from building corners (Photograph 2). No stepout sample locations were established for the initial round of soil samples, based on visual observations and the lack of detection of hydrocarbon odors in the soil.

The locations for the two groundwater monitoring wells were established by GPS approximately 20 feet northeast and 38 feet northwest of the Old FSRC on July 5, 2011.

PHOTOGRAPH 2
Soil sample locations (flags from right to left) 11SAVSB004, 11SAVSB005, and 11SAVSB006. Looking northwest.

5.3 Soil Sampling

A total of 21 soil samples were collected from 12 of the 13 originally proposed locations, at depths ranging from 0 to 3 feet bgs. Samples were planned to be collected at greater depths throughout the site, but either frozen soil (permafrost) or shallow refusal caused by large gravel (cobbles) was encountered nearer the surface than anticipated, limiting soil collection depths. At 11SAVSB002, frozen soil was encountered before the desired sampling depth was reached; this location was not sampled.

Sample locations were drilled by using hand-auger or post-holing equipment augmented by use of a pry bar to remove large cobbles; discrete soil samples were collected using the methods described in the UFP-QAPP (CH2M HILL, 2011). All samples were field screened using a PID and were submitted for analysis of DRO (Alaska Method AK102); a subset of samples (from 11SAVSB001 and 11SAVSB007) were analyzed for EPH (Washington Method Northwest EPH), VPH (Washington Method Northwest VPH), BTEX (EPA Method SW8260B), and PAHs (EPA Method SW8270CSIM). Headspace PID readings were taken at each sample location and depth. Detected concentrations of volatile organic compounds ranged from less than 1 to 231 ppm. PID readings of the soil samples are summarized in Table 5-1. Moderate hydrocarbon odors were reported from the samples collected at deeper depths in 11SAVSB001.

5.4 Groundwater Sampling

Four temporary monitoring wells were installed at locations 11SAVGW0001, 11SAVGW002, 11SAVSB004, and 11SAVSB007 on June 24, 2011 (Photograph 3) through use of a peristaltic pump. The groundwater was slow to recover in the wells because the groundwater resided primarily in a very thin saturated layer lying directly above the permafrost; therefore, the wells were routinely pumped dry as a means of development.

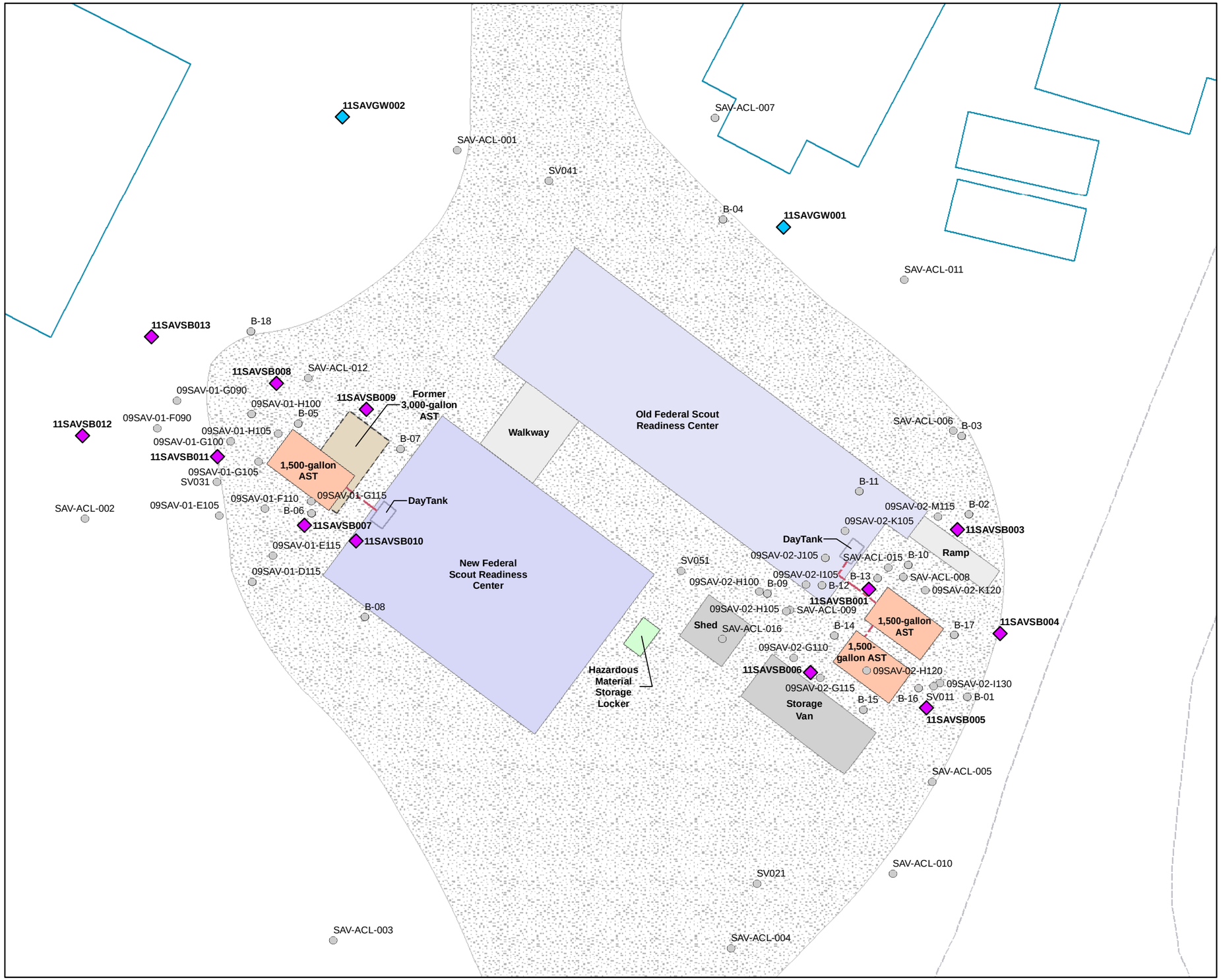
Groundwater samples were collected from the four monitoring wells on June 24, 2011, using the methods described in the UFP-QAPP (CH2M HILL, 2011). The samples were submitted for analysis of DRO; the sample from 11SAVSB007 was also submitted for analysis of BTEX, PAH, EPH, and VPH.

PHOTOGRAPH 3
Groundwater monitoring wells 11SAVGW001 (adjacent to Old FSRC) and 11SAVGW002 (near) are shown.
Looking southwest.

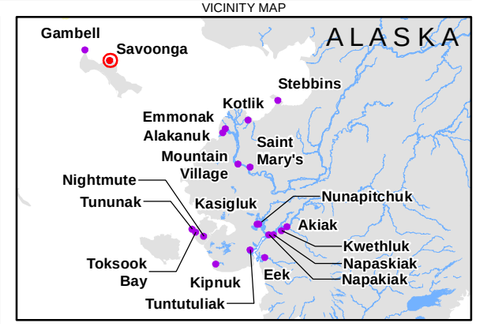
TABLE 5-1
Field Screening Results
Savoonga Federal Scout Readiness Center Data Gap Investigation

Sample Location	Sample Depth (feet bgs)	PID Reading (ppm)
11SAVSB001	0 – 1	10.4
	2	24
	2.6	231
11SAVSB003	0 – 1	<1
	2.5	<1
11SAVSB004	0 – 1	1.2
	2 – 3	2
11SAVSB005	0 – 1	<1
	1 – 2	<1
11SAVSB006	0 – 1	<1
	1 – 2	5.7
11SAV SB007	0 – 1	1.0
	2 – 3	<1
11SAVSB008	0 – 1	1.4
	2 – 3	<1
11SAVSB009	0 – 1	1.3
	2 – 3	1.1
11SAVSB010	0 – 0.5	1.4
11SAVSB011	0 – 1	1.5
	2 – 3	<1
11SAVSB012	0 – 1	1.7
	2 – 3	<1
11SAVSB013	0 – 1	<1
	1 – 1.5	1.3

bgs = below ground surface
PID = photoionization detector
ppm = parts per million



VICINITY MAP



LEGEND

- Federal Scout Readiness Center (FSRC)
- Old FSRC
- Storage Facility
- AST
- Former AST
- Day Tank
- Hazardous Material Storage Locker
- Gravel Pad
- Tank Piping
- Other Building
- Unpaved Road
- 2011 Soil Sample Location
- 2011 Groundwater Sample Location
- Previous Sample Location

Notes:
1. Location of historical samples is approximate based on historical figures and on orthophotography courtesy of Alaska Department of Commerce, Division of Community & Regional Affairs (DCRA), 1-foot pixels.
2. Definition:
   AST = aboveground storage tank

N

0 7.5 15
Feet

FIGURE 5-1
Soil and Groundwater Sample Locations
Savoonga FSRC Data Gap Investigation
Savoonga, Alaska

5.5 Quality Control

As established in the UFP-QAPP (CH2M HILL, 2011), samples were collected at Savoonga FSRC to satisfy the quality control requirements for the DGI. Quality control samples included field duplicate samples, matrix spike/matrix spike duplicate samples, equipment blank samples, and trip blank samples.

5.5.1 Field Duplicate Samples

Field duplicate samples are defined as two or more field samples taken at the same time from the same location. They are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner. These samples are used to assess precision of the entire data collection activity, including sampling, analysis, and site heterogeneity. Field duplicate samples are collected simultaneously or in immediate succession using identical recovery techniques and are treated in an identical manner during storage, transportation, and analysis.

Field duplicate soil samples for DRO were subsamples of a single sample collected. Each sample container was assigned a unique identification number in the field. One field duplicate of soil sample 11SAVB001_SO00-01 was collected for analysis of DRO, but the jar was broken in transit prior to submittal to the laboratory for analysis. A second field duplicate sample was scheduled to be collected from a deeper soil sample planned for 11SAVSB001, but refusal was encountered before sampling depth was reached and a second field duplicate sample was not collected.

A duplicate sample of groundwater was obtained from the monitoring well installed in 11SAVSB007 for analysis of DRO, PAH, BTEX, EPH, and VPH.

5.5.2 Equipment Blanks

An equipment blank is a sample of ASTM International (ASTM) Type II reagent-grade water poured into or poured over the sampling device, collected in a sample container, and transported to the laboratory for analysis. Equipment blanks may also be called rinse blanks or rinsate blanks. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures.

One equipment blank was collected immediately after the sampling equipment (in this case, the hand auger) had been decontaminated for the final time at Savoonga FSRC. The equipment blank sample was submitted for analysis of DRO, BTEX, and PAH.

5.5.3 Trip Blanks

Trip blanks are used to assess the potential introduction of contaminants to sample containers during the field collection event, including transportation and storage procedures. A trip blank consists of a volatile organic analysis vial filled in the laboratory with ASTM Type II reagent-grade water or methanol, transported to the sampling site, handled like an environmental sample (without being opened), and returned to the laboratory for analysis. One trip blank accompanied the Savoonga FSRC soil samples sent to the laboratory for BTEX analysis, and one trip blank accompanied the equipment blank and groundwater samples sent to the laboratory for BTEX analysis.

SECTION 6

Contamination Assessment

This section presents the completed assessment of the nature and extent of contamination at Savoonga FSRC. Field notes and other field forms generated during the field effort of the DGI are provided in Appendix A. Analytical data generated from the DGI by TestAmerica and an evaluation of the data quality are included as Appendix B.

6.1 Nature and Extent of Soil Contamination

Based on analytical results for soil samples collected during the DGI and on available historical data (as presented in Table 6-1), the lateral extent of petroleum-contaminated soil at Savoonga FSRC has been adequately delineated to the project SLs (DQO 1), as shown in Figure 6-1. Soil contaminated with DRO at concentrations above the SL appears to exist in three distinct areas adjacent to the two sets of site ASTs:

- The largest area is southeast of the Old FSRC between the building, the two 1,500-gallon ASTs, and the storage van.
- The second area is beneath the footprint of the 1,500-gallon AST located northwest of the New FSRC.
- The third and smallest area is approximately 40 feet northwest of the New FSRC, just off the edge of the gravel pad.

The vertical extent of DRO-contaminated soil appears to be limited to the depth of permafrost, which was reached during the DGI and other previous investigations at 2.5 to 3 feet bgs.

To further assess the nature of the soil contamination present at Savoonga FSRC, multiple soil samples were collected from the primary (southeast of the Old FSRC) and secondary source area (northwest of the New FSRC) that showed the highest remaining petroleum contamination. These samples were analyzed for BTEX, PAHs, EPH, and VPH. Laboratory results are presented in Tables 6-1 (BTEX) and 6-2 (PAHs). Laboratory results for EPH and VPH are discussed in Section 7.

6.2 Nature and Extent of Groundwater Contamination

As indicated by historical and current groundwater analytical results (summarized in Table 6-3 and presented in Figure 6-2), there is one known area at Savoonga FSRC where DRO concentrations in samples from suprapermafrost groundwater exceeded ADEC cleanup levels. Groundwater quality data obtained during the DGI (Figure 6-2) indicate that the contaminated groundwater south and east of the Old FSRC does not appear to be migrating toward the Bering Sea (DQO2). However, groundwater containing DRO in concentrations above cleanup levels remains in 11SAVSB004, southeast of the Old FSRC, and appears to be migrating offsite to the east.

To further assess the nature of the groundwater contamination present at Savoonga FSRC, a sample of groundwater was collected and analyzed for BTEX, PAHs, EPH, and VPH. Laboratory results of this sample (and historical sample results) are presented in Tables 6-3 (BTEX) and 6-4 (PAHs). Laboratory results for EPH and VPH are discussed in Section 7.

TABLE 6-1
Soil Results for BTEX, DRO, GRO, and RRO
Savoonga Federal Scout Readiness Center Data Gap Investigation

Location	Sample ID	Sample Depth (feet bgs)	Analyte	DRO	GRO	RRO	Benzene	Ethyl-benzene	Toluene	Xylenes (Total)
			Screening Level	250	300	10000	0.025	6.9	6.5	6.3
			Sample Date							
11SAVSB001	11SAVSB001_SO02-2.6	2 – 2.6	7/6/2011	**17000**	--	--	**3.1**	**48**	**160**	**250**
SAV-B-13	SAVB-13S1SS	0 – 0.5	9/2/1998	**17000**	--	--	--	--	--	--
SAV-B-12	SAVB-12S2SS	0.5 – 1	9/2/1998	**11000**	--	--	--	--	--	--
SAV-B-13	SAVB-13S2SS	1.5 – 2	9/2/1998	**8900**	--	--	--	--	--	--
11SAVSB001	11SAVSB001_SO02	1 – 2	7/6/2011	**4300**	--	--	**0.27 J**	**11 J**	**29 J**	**50 J**
SAV-B-06	SAVB-6S2SS	1.5 – 2	9/2/1998	**1500**	--	--	--	--	--	--
SAV-B-05	SAVB-5S2SS	1.5 – 2	9/2/1998	**1300**	--	--	--	--	--	--
SAV-B-12	SAVB-12S1SS	0 – 0.5	9/2/1998	**1100**	--	--	--	--	--	--
SAV-B-14	SAVB-14S2SS	1 – 1.5	9/2/1998	**860**	--	--	--	--	--	--
09SAV-01-G105	09-SAV-01-G105-1_1	1.1 – 1.1	6/13/2009	**844**	--	--	--	--	--	--
11SAVSB006	11SAVSB006_SO02	2 – 2	7/6/2011	**660**	--	--	--	--	--	--
11SAVSB001	11SAVSB0001_SO00-01	0 – 1	7/6/2011	**630**	--	--	--	--	--	--
09SAV-01-F090	09-SAV-01-F090-0.7	0.7 – 0.7	6/13/2009	**606**	--	--	--	--	--	--
09SAV-01-G090	09-SAV-01-G090-0.7	0.7 – 0.7	6/13/2009	**491**	--	--	--	--	--	--
SAV-B-10	SAVB-10S3SS	1 – 1.5	9/2/1998	**400**	--	--	--	--	--	--
SAV-B-17	SAVB-17S2SS	2 – 2.5	9/2/1998	**310**	**6**	**57**	0.018 U	**0.04**	--	**0.062**
09SAV-01-F110	09-SAV-01-F110-0_8	0.8 – 0.8	6/13/2009	**301**	--	--	--	--	--	--
SAV-B-10	SAVB-10S1SS	0.5 – 1	9/2/1998	**250**	**0.79**	**360**	0.017 U	0.017 U	--	**0.019**
SAV-B-09	SAVB-9S2SS	1 – 1.5	9/2/1998	**240**	**27**	**93**	0.021 U	**0.11**	--	**0.24**
SAV-ACL-008	SAV-ACL-008	1.33 – 1.58	8/24/2004	**233 J**	**73 J**	--	0.0135 U	0.027 U	--	**0.715 J**
SAV-B-14	SAVB-14S1SS	0.5 – 1	9/2/1998	**190**	--	--	--	--	--	--

TABLE 6-1
Soil Results for BTEX, DRO, GRO, and RRO
Savoonga Federal Scout Readiness Center Data Gap Investigation

Location	Sample ID	Sample Depth (feet bgs)	Analyte	DRO	GRO	RRO	Benzene	Ethyl-benzene	Toluene	Xylenes (Total)
			Screening Level	250	300	10000	0.025	6.9	6.5	6.3
			Sample Date							
09SAV-02-I105	09-SAV-02-I105-1.0	1 – 1	6/13/2009	**182**	--	--	--	--	--	--
SAV-B-11	SAVB-11S1SS	0 – 0.5	9/2/1998	**180**	--	--	--	--	--	--
09SAV-01-G115	09-SAV-01-G115-0.5	0.5 – 0.5	6/13/2009	**176**	--	--	--	--	--	--
SAV-ACL-004	SAV-ACL-004	0.58 – 0.58	8/24/2004	**166**	--	--	--	--	--	--
SAV-ACL-002	SAV-ACL-002	0.83 – 0.83	8/24/2004	166 U	--	--	--	--	--	--
SV051	96SV051SL	0.5 – 0.5	8/6/1996	**160**	--	--	--	--	--	--
09SAV-02-J105	09-SAV-02-J105-0_9	0.9 – 0.9	6/13/2009	**151**	--	--	--	--	--	--
11SAVSB009	11SAVSB009_SO02-03	2 – 3	7/23/2011	**140**	--	--	--	--	--	--
09SAV-01-D115	09-SAV-01-D115-1.5	1.5 – 1.5	6/13/2009	**123**	--	--	--	--	--	--
09SAV-02-G115	09-SAV-02-G115-1.5	1.5 – 1.5	6/13/2009	**110**	--	--	--	--	--	--
09SAV-02-G110	09-SAV-02-G110-1.5	1.5 – 1.5	6/13/2009	**81.4**	--	--	--	--	--	--
11SAVSB003	11SAVSB003_SO02-2.5	2 – 2.5	7/6/2011	**74**	--	--	--	--	--	--
SAV-B-07	SAVB-7S2SS	1 – 1.5	9/2/1998	**72**	--	--	--	--	--	--
11SAVSB007	11SAVSB007_SO02-03	2 – 3	7/23/2011	**71**	--	--	0.0089 U	0.0089 U	0.012 U	0.027 U
SAV-B-07	SAVB-7S1SS	0.5 – 1	9/2/1998	**71**	--	--	--	--	--	--
09SAV-02-K120	09-SAV-02-K120-1_8	1.8 – 1.8	6/13/2009	**69.6**	--	--	--	--	--	--
SAV-ACL-009	SAV-ACL-009	0.92 – 1.17	8/24/2004	**64.9**	**6.31**	--	0.0139 U	0.0278 U	--	**0.099**
11SAVSB007	11SAVSB007_SO00-01	0 – 1	7/5/2011	**63**	--	--	--	--	--	--
SAV-ACL-011	SAV-ACL-011	0.87 – 1.08	8/24/2004	**62.4**	--	--	--	--	--	--
11SAVSB013	11SAVSB0013_SO00-01	0 – 1	7/5/2011	**62**	--	--	--	--	--	--
11SAVSB011	11SAVSB011_SO02-03	2 – 3	7/24/2011	**53**	--	--	--	--	--	--

TABLE 6-1
Soil Results for BTEX, DRO, GRO, and RRO
Savoonga Federal Scout Readiness Center Data Gap Investigation

Location	Sample ID	Sample Depth (feet bgs)	Analyte	DRO	GRO	RRO	Benzene	Ethyl-benzene	Toluene	Xylenes (Total)
			Screening Level	250	300	10000	0.025	6.9	6.5	6.3
			Sample Date							
09SAV-02-K105	09-SAV-02-K105-0.7	0.7 – 0.7	6/13/2009	**52**	--	--	--	--	--	--
SAV-B-09	SAVB-9S1SS	0.5 – 1	9/2/1998	**49**	--	--	--	--	--	--
09SAV-01-E105	09-SAV-01-E105-0.7	0.7 – 0.7	6/13/2009	**48.3**	--	--	--	--	--	--
09SAV-01-E115	09-SAV-01-E115-1.0	1 – 1	6/13/2009	**45.2**	--	--	--	--	--	--
SAV-B-16	SAVB-16S1SS	0.5 – 1	9/2/1998	**42**	--	--	--	--	--	--
09SAV-02-H105	09-SAV-02-H105-1.8	1.8 – 1.8	6/13/2009	**41.4**	--	--	--	--	--	--
SAV-B-02	SAV-2S1SS	0.5 – 1	9/2/1998	**38**	--	--	--	--	--	--
SAV-ACL-010	SAV-ACL-010	0.83 – 1	8/24/2004	**37.7**	2.77 U	--	0.0139 U	0.0277 U	--	0.0416 U
SAV-ACL-003	SAV-ACL-003	0.83 – 0.83	8/24/2004	**33.4**	--	--	--	--	--	--
09SAV-02-H120	09-SAV-02-H120-1.1	1.1 – 1.1	6/13/2009	**32.8**	--	--	--	--	--	--
SAV-B-01	SAVB-1S1SS	0.5 – 1	9/2/1998	**32**	--	--	--	--	--	--
11SAVSB012	11SAVSB0012_SO02-03	2 – 3	7/24/2011	**29**	--	--	--	--	--	--
SAV-ACL-006	SAV-ACL-006	0.67 – 0.83	8/24/2004	29.2 U	--	--	--	--	--	--
SAV-ACL-005	SAV-ACL-005	0.67 – 0.83	8/24/2004	29.1 U	--	--	--	--	--	--
SAV-ACL-012	SAV-ACL-012	0.79 – 1	8/24/2004	29.1 U	--	--	--	--	--	--
SAV-ACL-001	SAV-ACL-001	0.58 – 0.58	8/24/2004	29 U	--	--	--	--	--	--
SAV-ACL-007	SAV-ACL-007	0.58 – 0.58	8/24/2004	28.1 U	--	--	--	--	--	--
09SAV-02-M115	09-SAV-02-M115-1.5	1.5 – 1.5	6/13/2009	**27.3**	--	--	--	--	--	--
09SAV-01-H100	09-SAV-01-H100-0.7	0.7 – 0.7	6/13/2009	26.3 U	--	--	--	--	--	--
SAV-B-03	SAVB-3S2SS	1 – 1.5	9/2/1998	**26**	--	--	--	--	--	--
SAV-B-06	SAVB-6S1SS	0.5 – 1	9/2/1998	**26**	--	--	--	--	--	--

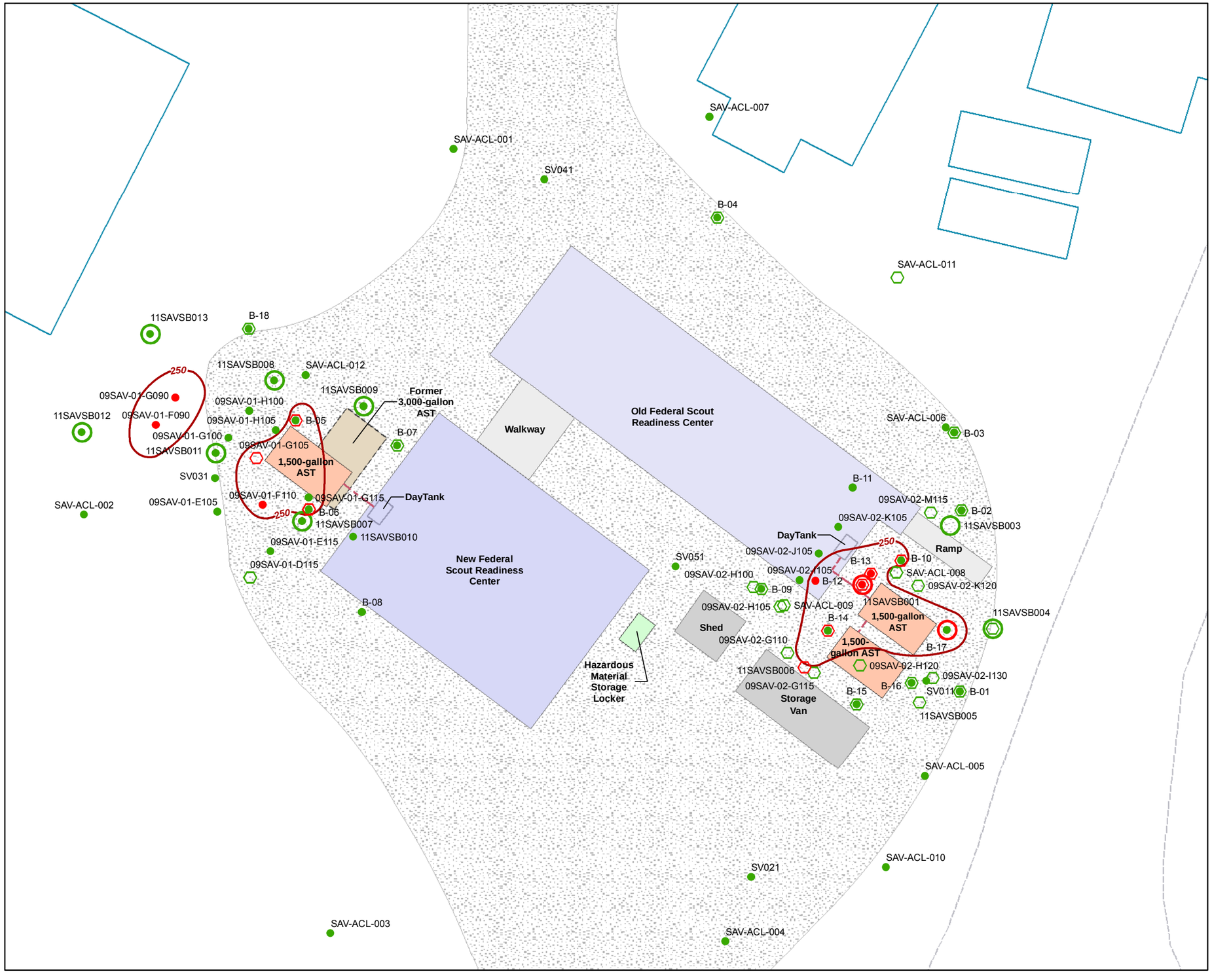
TABLE 6-1
Soil Results for BTEX, DRO, GRO, and RRO
Savoonga Federal Scout Readiness Center Data Gap Investigation

Location	Sample ID	Sample Depth (feet bgs)	Analyte	DRO	GRO	RRO	Benzene	Ethyl-benzene	Toluene	Xylenes (Total)
			Screening Level	250	300	10000	0.025	6.9	6.5	6.3
			Sample Date							
SAV-B-18	SAVB-18S2SS	1 – 1.5	9/2/1998	**26**	--	--	--	--	--	--
09SAV-02-H100	09-SAV-02-H100-1.8	1.8 – 1.8	6/13/2009	24.3 U	--	--	--	--	--	--
11SAVSB012	11SAVSB0012_SO00-01	0 – 1	7/5/2011	**24**	--	--	--	--	--	--
11SAVSB008	11SAVSB008_SO02-03	2 – 3	7/24/2011	**23**	--	--	--	--	--	--
SV011	96SV011SL	0.5 – 0.5	8/6/1996	**23**	--	--	--	--	--	--
09SAV-01-G100	09-SAV-01-G100-1.0	1 – 1	6/13/2009	22.6 U	--	--	--	--	--	--
09SAV-01-H105	09-SAV-01-H105-0.5	0.5 – 0.5	6/13/2009	22.6 U	--	--	--	--	--	--
09SAV-02-I130	09-SAV-02-I130-2.0	2 – 2	6/13/2009	22.4 U	--	--	--	--	--	--
SAV-B-18	SAVB-18S1SS	0.5 – 1	9/2/1998	**22**	--	--	--	--	--	--
SAV-B-15	SAVB-15S1SS	0.5 – 1	9/2/1998	**20**	--	--	--	--	--	--
SAV-B-02	SAV-2S2SS	1 – 1.5	9/2/1998	**18**	--	--	--	--	--	--
SV031	96SV031SL	0.5 – 0.5	8/6/1996	**18**	--	--	--	--	--	--
11SAVSB004	11SAVSB004_SO02-03	2 – 3	7/6/2011	**16**	--	--	--	--	--	--
SAV-B-01	SAVB-1S2SS	1 – 1.5	9/2/1998	**15**	--	--	--	--	--	--
11SAVSB013	11SAVSB013_SO02-03	2 – 3	7/24/2011	**14**	--	--	--	--	--	--
SV041	96SV041SL	0.5 – 0.5	8/6/1996	**14**	--	--	--	--	--	--
SAV-B-15	SAVB-15S2SS	1.5 – 2	9/2/1998	**13**	--	--	--	--	--	--
SV021	96SV021SL	0.5 – 0.5	8/6/1996	**12**	--	--	--	--	--	--
SAV-B-03	SAVB-3S1SS	0.5 – 1	9/2/1998	12 U	--	--	--	--	--	--
SAV-B-05	SAVB-5S1SS	0.5 – 1	9/2/1998	12 U	--	--	--	--	--	--
SAV-B-08	SAVB-8S1SS	0 – 0.5	9/2/1998	12 U	0.64 U	**63**	0.016 U	0.016 U	--	0.016 U

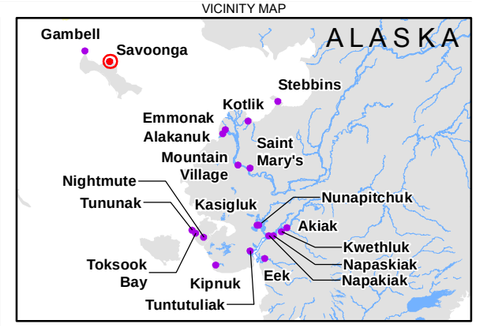
TABLE 6-1
Soil Results for BTEX, DRO, GRO, and RRO
Savoonga Federal Scout Readiness Center Data Gap Investigation

Location	Sample ID	Sample Depth (feet bgs)	Analyte	DRO	GRO	RRO	Benzene	Ethyl-benzene	Toluene	Xylenes (Total)
			Screening Level	250	300	10000	0.025	6.9	6.5	6.3
			Sample Date							
SAV-B-08	SAVB-8S2SS	0.5 – 1	9/2/1998	12 U	--	--	--	--	--	--
SAV-B-11	SAVB-11S2SS	0.5 – 1	9/2/1998	12 U	--	--	--	--	--	--
SAV-B-16	SAVB-16S2SS	1 – 1.5	9/2/1998	12 U	--	--	--	--	--	--
SAV-B-04	SAVB-4S1SS	0.5 – 1	9/2/1998	11 U	--	--	--	--	--	--
SAV-B-04	SAVB-4S2SS	1 – 1.5	9/2/1998	11 U	--	--	--	--	--	--
11SAVSB005	11SAVSB005_SO01_8	1.5 – 1.8	7/6/2011	**2.9 B**	--	--	--	--	--	--
11SAVSB004	11SAVSB004_SO01-02	1 – 2	7/6/2011	**2.6 B**	--	--	--	--	--	--
11SAVSB010	11SAVSB0010_SO00-01	0 – 1	7/5/2011	**2.4 B**	--	--	--	--	--	--
11SAVSB008	11SAVSB008_SO00-01	0 – 1	7/5/2011	**1.7 B**	--	--	--	--	--	--
11SAVSB009	11SAVSB009_SO00-01	0 – 1	7/5/2011	**1.6 B**	--	--	--	--	--	--
11SAVSB011	11SAVSB0011_SO00-01	0 – 1	7/5/2011	**1.1 B**	--	--	--	--	--	--
SAV-B-17	SAVB-17S1SS	0.5 – 1	9/2/1998	0.25 U	0.69 U	**110**	0.017 U	0.017 U	--	0.017 U

Notes:
1. All units are in milligrams per kilogram.
2. Bold indicates that the analyte was detected.
3. Shading indicates that the result exceeded screening criteria.
-- = not analyzed
B = The analyte was detected in the associated method and/or calibration blank.
bgs = below ground surface
DRO = diesel-range organics
GRO = gasoline-range organics
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
RRO = residual-range organics
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.



VICINITY MAP



LEGEND

- Federal Scout Readiness Center (FSRC)
- Old FSRC
- Storage Facility
- AST
- Former AST
- Day Tank
- Hazardous Material Storage Locker
- Gravel Pad
- Tank Piping
- Other Building
- Unpaved Road
- Inferred DRO Concentration (mg/kg)

Soil DRO Results

- DRO ≤ 250 mg/kg
- DRO > 250 mg/kg (exceeds screening level)

Guide to Symbol Shapes

- Small Circle = soil samples from 0 to ≤ 1 feet bgs
- Medium Hexagon = soil samples from > 1 to ≤ 2 feet bgs
- Large Circle = soil samples > 2 feet bgs

Notes:

1. Location of historical samples is approximate based on historical figures and on orthophotography courtesy of Alaska Department of Commerce, Division of Community & Regional Affairs (DCRA), 1-foot pixels.
2. Definitions:
   AST = aboveground storage tank
   bgs = below ground surface
   DRO = diesel-range organics
   mg/kg = milligrams per kilogram

N

0 7.5 15
Feet

FIGURE 6-1
Soil Sampling Results
Savoonga FSRC Data Gap Investigation
Savoonga, Alaska

TABLE 6-2
Soil Results for PAHs
Savoonga Federal Scout Readiness Center Data Gap Investigation

Location	Sample ID	Sample Depth (feet bgs)	Analyte	1-Methyl-naphthalene	2-Methyl-naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
			Screening Level	6.2	6.1	180	180	2060	0.49	0.049	0.49	140	4.9	49	0.049	190	220	0.49	2.8	2060	140
			Sample Date																		
11SAVSB001	11SAVSB0001_SO00-01	0 – 1	7/6/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB001	11SAVSB001_SO02	1 – 2	7/6/2011	**30**	**47**	**0.83 J**	0.41 U	0.49 U	0.37 U	0.49 U	0.62 U	1.2 U	0.92 U	0.43 U	1.5 U	0.36 U	**0.77 J**	0.59 U	**24**	0.43 U	0.43 U
11SAVSB001	11SAVSB001_SO02-2.6	2 – 2.6	7/6/2011	**230**	**360**	**6.9 J**	2.9 U	3.5 U	2.7 U	3.6 U	4.5 U	8.9 U	6.7 U	3.1 U	11 U	2.6 U	**5.4 J**	4.3 U	**180**	3.1 U	3.1 U
11SAVSB003	11SAVSB003_SO02-2.5	2 – 2.5	7/6/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB004	11SAVSB004_SO01-02	1 – 2	7/6/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB004	11SAVSB004_SO02-03	2 – 3	7/6/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB005	11SAVSB005_SO01_8	1.5 – 1.8	7/6/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB006	11SAVSB006_SO02	2 – 2	7/6/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB007	11SAVSB007_SO00-01	0 – 1	7/5/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB007	11SAVSB007_SO02-03	2 – 3	7/23/2011	0.011 U	0.011 U	0.012 U	0.0082 U	0.0098 U	0.0076 U	0.0099 U	0.013 U	0.025 U	0.019 U	0.0087 U	0.03 U	0.0073 U	0.012 U	0.012 U	0.0077 U	0.0087 U	0.0087 U
11SAVSB008	11SAVSB008_SO00-01	0 – 1	7/5/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB008	11SAVSB008_SO02-03	2 – 3	7/24/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB009	11SAVSB009_SO00-01	0 – 1	7/5/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB009	11SAVSB009_SO02-03	2 – 3	7/23/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB010	11SAVSB0010_SO00-01	0 – 1	7/5/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB011	11SAVSB0011_SO00-01	0 – 1	7/5/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB011	11SAVSB011_SO02-03	2 – 3	7/24/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB012	11SAVSB0012_SO00-01	0 – 1	7/5/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB012	11SAVSB0012_SO02-03	2 – 3	7/24/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB013	11SAVSB0013_SO00-01	0 – 1	7/5/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB013	11SAVSB013_SO02-03	2 – 3	7/24/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SAV-B-13	SAVB-13S1SS	0.5 – 1	9/2/1998	--	--	10 UJ	--	10 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	**0.09 J**	1 UJ	10 UJ	10 UJ	1 UJ	10 UJ	10 UJ	**0.11 J**
SAV-B-17	SAVB-17S1SS	0.5 – 1	9/2/1998	--	--	0.22 UJ	--	0.22 UJ	0.22 UJ	0.22 UJ	0.22 UJ	0.22 UJ	0.22 UJ	0.22 UJ	0.22 UJ	**0.009 J**	0.22 UJ	0.22 UJ	0.22 UJ	0.22 UJ	0.22 UJ

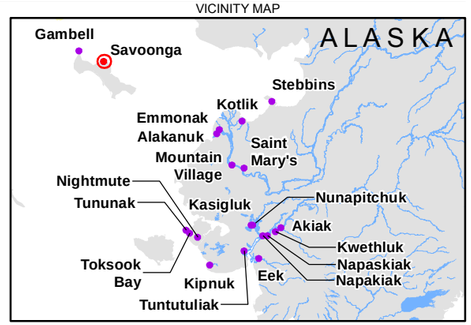
Notes:
1. All units are in milligrams per kilogram.
2. Bold indicates that the analyte was detected.
3. Shading indicates that the result exceeded screening criteria.
-- = not analyzed
bgs = below ground surface
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
PAHs = polynuclear aromatic hydrocarbons
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

TABLE 6-3
Groundwater Results for BTEX, DRO, and GRO
Savoonga Federal Scout Readiness Center Data Gap Investigation

		Analyte	DRO	GRO	Benzene	Ethylbenzene	Toluene	Xylenes (Total)
		Screening Level	**1500**	**2200**	**0.5**	**70**	**100**	**1000**
Location	**Sample ID**	**Sample Date**						
11SAVGW001	11SAVGW001_GWOX	7/24/2011	**660**	--	--	--	--	--
11SAVGW002	11SAVGW002_GWOX	7/24/2011	**810**	--	--	--	--	--
11SAVSB004	11SAVSB004_GWOX	7/24/2011	**18,000 J**	--	--	--	--	--
11SAVSB007	11SAVSB007_GWOX	7/24/2011	**1,100**	--	0.2 UJ	0.2 UJ	0.4 UJ	1.2 UJ
SAV-ACL-015	SAV-ACL-015	8/25/2004	**30,200**	**2,110**	**80.5**	**166**	**127**	**581**
SAV-ACL-016	SAV-ACL-016	8/25/2004	**4,070**	50 U	0.5 U	0.5 U	**7.18**	**4.43**

Notes:
1. All units are in micrograms per liter.
2. Bold indicates that the analyte was detected.
3. Shading indicates that the result exceeded screening criteria.
-- = not analyzed
BTEX = benzene, toluene, ethylbenzene, and xylenes
DRO = diesel-range organics
GRO = gasoline-range organics
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

VICINITY MAP



LEGEND

- Federal Scout Readiness Center (FSRC)
- Old FSRC
- Storage Facility
- AST
- Former AST
- Day Tank
- Hazardous Material Storage Locker
- Gravel Pad
- Tank Piping
- Inferred Surface Water Flow Direction
- Other Building
- Unpaved Road

Groundwater DRO Results

- DRO ≤ 1.5 mg/L
- DRO > 1.5 mg/L (exceeds screening level)

Notes:

1. Location of historical samples is approximate based on historical figures and on orthophotography courtesy of Alaska Department of Commerce, Division of Community & Regional Affairs (DCRA), 1-foot pixels.
2. Surface water flow information was obtained from the PA/SI report (HartCrowser, 1998).
3. [a] A supra-permafrost groundwater shall be collected from 11SAVSB007 or 11SAVSB009, if encountered.
   [b] Well point shall be driven only if supra-permafrost groundwater is encountered in 11SAVSB007 or 11SAVSB009.
4. Definitions:
   AST = aboveground storage tank
   DRO = diesel-range organics
   mg/L = milligrams per liter

N

0 7.5 15
Feet

FIGURE 6-2
Groundwater Sampling Results
Savoonga FSRC Data Gap Investigation
Savoonga, Alaska

TABLE 6-4
Groundwater Results for PAHs
Savoonga Federal Scout Readiness Center Data Gap Investigation

		Analyte	1-Methyl naphtha-lene	2-Methyl-naphtha-lene	Ace-naphth-ene	Ace-naphthyl-ene	Anthra-cene	Benzo(a)-anthra-cene	Benzo(a)-pyrene	Benzo(b)-fluor-anthene	Benzo-(g,h,i)-perylene	Benzo(k)-fluor-anthene	Chrysene	Dibenz(a,h)-anthra-cene	Fluor-anthene	Fluorene	Indeno-(1,2,3-cd)-pyrene	Naphtha-lene	Phen-anth-rene	Pyrene
		Screening Level	15	15	220	220	1100	0.12	0.02	0.12	110	1.2	12	0.012	150	150	0.12	73	1100	110
Location	Sample ID	Sample Date																		
11SAVGW001	11SAVGW001_GWOX	7/24/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVGW002	11SAVGW002_GWOX	7/24/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB004	11SAVSB004_GWOX	7/24/2011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11SAVSB007	11SAVSB007_GWOX	7/24/2011	**0.25 J**	**0.27 J**	0.052 UJ	0.052 UJ	0.052 UJ	0.052 UJ	0.052 UJ	0.1 UJ	0.052 UJ	0.052 UJ	0.052 UJ	0.1 UJ	0.052 UJ	**0.027 J**	0.1 UJ	**0.098 J**	0.052 UJ	0.052 UJ
SAV-ACL-015	SAV-ACL-015	8/25/2004	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SAV-ACL-016	SAV-ACL-016	8/25/2004	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
1. All units are in micrograms per liter.
2. Bold indicates that the analyte was detected.
3. Shading indicates that the result exceeded screening criteria.
-- = not analyzed
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
PAHs = polynuclear aromatic hydrocarbons
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

SECTION 7

Cumulative Risk Assessment

This section summarizes the assessment of cumulative risk to human health completed for Savoonga FSRC, based on current site conditions (DQO 3) and based on a potential future remedial action.

7.1 Assessing Cumulative Risk

As defined by 18 AAC 75.325(g), the risk from remaining hazardous substances must not exceed a cumulative carcinogenic risk standard of 1 in 100,000 across all exposure pathways and must not exceed a cumulative noncarcinogenic risk standard at a hazard index (HI) of 1 across all exposure pathways.

The ADEC-approved hydrocarbon risk calculator (HRC) was used to determine the current cumulative risk for Savoonga FSRC (ADEC, 2011). The HRC is an alternative, peer-reviewed model used for calculating site-specific risks to human health under ADEC Method 3 (18 AAC 75.340[e]). The HRC is designed for use in assessing sites where there is petroleum contamination—specifically, the petroleum fractions, BTEX, PAHs, and other compounds dissolved in petroleum. In addition to petroleum compounds, a subset of approximately 120 additional compounds, selected based on their solubility characteristics from 18 AAC 75.341(c), Table B1, are included in the HRC to allow representative cumulative risk calculations for these compounds when they are present as constituents of a NAPL.

The use of the HRC requires collection of site-specific data to further characterize the nature of the hydrocarbon contamination at each site. This includes NAPL source area samples analyzed using Washington Method Northwest EPH and Washington Method Northwest VPH in addition to the ADEC methods for GRO, DRO and RRO. In the HRC, these hydrocarbon ranges are broken into narrower subsets and separated into aromatic and aliphatic hydrocarbon fractions. The HRC calculates the risk posed by the GRO, DRO, and RRO aromatic and aliphatic groups rather than presenting a hydrocarbon ACL. This approach allows the responsible party and ADEC to assess whether the site meets the risk criteria stipulated in 18 AAC 75. Consistent with ADEC guidance (ADEC, 2011), the HRC calculates risk for each of the hydrocarbon ranges, presents the numbers separately for each exposure pathway, and does not include those risks in the cumulative risk calculation for the site.

Each contaminant detected at a concentration above one-tenth of its respective Table B1 inhalation or direct contact cleanup level or 18 AAC 75.345(b)(1), Table C, cleanup level was included in the cumulative risk calculations. For groundwater, the site concentration used was the maximum concentration as identified in 18 AAC 75.380(c)(2).

7.2 Cumulative Risk Results

The HRC was used to assess cumulative risk for the Savoonga FSRC site, based on site current conditions (site soil properties, length of plume, and depth to groundwater), and it was assumed that all exposure pathways were complete. The contaminant concentrations used in the cumulative risk calculations were based on the maximum soil and groundwater concentrations documented for the site. Results of the assessment, provided in Appendix C and summarized in Table 7-1, showed a cumulative carcinogenic risk of 2×10^{-4} and a cumulative noncarcinogenic HI of 4. The risk results for current site conditions exceed the carcinogenic risk regulatory limit of 1×10^{-5} and the non-carcinogenic risk regulatory limit of an HI of 1. A significant portion of the risk identified for Savoonga FSRC is the result of elevated laboratory detection limits for certain PAH compounds that were not detected in soil.

The HRC was also used to assess risk associated with petroleum hydrocarbons for the Savoonga FSRC site. The concentrations for RRO, DRO, and GRO that were used in the calculations were based on the maximum reported soil concentrations of 360 mg/kg, 17,000 mg/kg, and 73 mg/kg, respectively. The EPH and VPH results for soil sampled from the secondary source area were not included in assessing site risk associated with petroleum hydrocarbons because the concentrations detected in

TABLE 7-1
Cumulative Risk Assessment
Savoonga Federal Scout Readiness Center Data Gap Investigation

	Chemical of Potential Concern										
	Benzene	**Toluene**	**Ethyl-benzene**	**Xylenes**	**1-Methyl-naphtha-lene**	**2-Methyl-naphtha-lene**	**Benzo(a)-pyrene**	**Benzo(b)-fluor-anthene**	**Dibenz(a,h)-anthra-cene**	**Indeno-(1,2,3-cd)-pyrene**	**Naphtha-lene**
Soil concentration (mg/kg)	3.1	160	48	250	230	360	0.49 U	0.62 U	1.5 U	0.59 U	180
GW concentration (mg/L)	0.085	0.127	0.166	0.581	0.00025	0.00027	0.000052 U	0.0001 U	0.0001 U	0.0001 U	0.000098
Individual Component Risk											
Soil direct contact HQ	0.0076	0.0043	0.0047	0.012	0.83	1.3	--	--	--	--	0.13
Outdoor HQ	0.00014	1.5×10^{-6}	1.2×10^{-5}	3.6×10^{-4}	5.0×10^{-7}	4.5×10^{-7}	--	--	--	--	7.5×10^{-7}
Indoor HQ	0.037	3.5×10^{-4}	0.0024	0.070	1.2×10^{-5}	9.2×10^{-6}	--	--	--	--	2.0×10^{-5}
GW Ingestion HQ	0.58	0.0435	0.046	0.080	0.0017	0.0018	--	--	--	--	1.3×10^{-4}
Soil direct contact ILCR	2.1×10^{-7}	--	--	--	--	--	3.7×10^{-5}	1.3×10^{-6}	3.7×10^{-5}	1.2×10^{-6}	--
Outdoor inhalation ILCR	1.4×10^{-8}	--	5.8×10^{-9}	--	--	--	6.0×10^{-10}	9.2×10^{-11}	1.6×10^{-10}	1.7×10^{-12}	3.3×10^{-11}
Indoor inhalation ILCR	3.7×10^{-6}	--	1.1×10^{-6}	--	--	--	5.0×10^{-12}	9.7×10^{-13}	4.3×10^{-12}	6.1×10^{-13}	8.5×10^{-10}
GW Ingestion ILCR	5.5×10^{-5}	--	--	--	--	--	4.5×10^{-6}	8.6×10^{-7}	8.6×10^{-6}	8.6×10^{-7}	--
Cumulative Risk Summation											
Hazard index						3					
ILCR						2×10^{-4}					

Note: Shading indicates that the result exceeded applicable regulatory criteria (>10^{-5} or 1).
-- = not applicable
GW = groundwater
HQ = hazard quotient
ILCR = incremental lifetime cancer risk
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

the sample were extremely low. Only the primary source area samples were used to evaluate the nature of site contamination. The contaminated soil identified northwest of the New FSRC was assumed to be equivalent to the contamination southeast of the Old FSRC because leaks occurred from tanks that held the same heating oil and both spills (1985 and 1992) are more than two decades old (28 years and 21 years, respectively). Results of the assessment are provided in Appendix C and summarized in Table 7-2. The assessment determined that there is an ingestion risk for aliphatic DRO compounds for the Savoonga FSRC site.

TABLE 7-2
Risk Assessment of Petroleum Hydrocarbons
Savoonga Federal Scout Readiness Center Data Gap Investigation

	GRO Aromatics	DRO Aromatics	RRO Aromatics	GRO Aliphatics	DRO Aliphatics	RRO Aliphatics
Soil concentration (mg/kg)	0[a]	1,567	124	25	15,433	236
GW concentration (mg/L)	0.044	1.24	0.00015	0.0047	0.0156	4.35×10^{-12}
Soil direct contact HQ	--	0.39	0.041	5.0×10^{-5}	1.5	0.0012
Outdoor inhalation HQ	1.6×10^{-5}	3.7×10^{-4}	No RfC	1.9×10^{-5}	1.2×10^{-5}	No RfC
Indoor inhalation HQ	0.0015	0.0018	No RfC	0.0067	0.0018	No RfC
Migration-to-GW HQ	--	0.089	1.5×10^{-5}	2.7×10^{-6}	6.3×10^{-15}	6.3×10^{-15}
GW Ingestion HQ	0.0061	0.052	0.000014	0.00020	0.00012	6.0×10^{-14}

Note: Shading indicates that the result exceeded regulatory criteria (>1)
[a]Measured GRO aromatic concentration less than summation of benzene, toluene, ethylbenzene, and total xylenes concentration
-- = not applicable
DRO = diesel-range organics
GRO = gasoline-range organics
GW = groundwater
HQ = hazard quotient
mg/kg = milligrams per kilogram
No RfC = no reference risk-based concentration available
RRO = residual-range organics

SECTION 8

Conclusions and Recommendations

This section presents the conclusions of the DGI and provides recommendations for potential remedial action of contaminated soil and groundwater at Savoonga FSRC.

8.1 Conclusions

The following conclusions can be made about Savoonga FSRC, based on data provided in this report:

- Concentrations of DRO detected in soil exceeded 18 AAC 75.341(d), Table B2, cleanup levels and concentrations of benzene, toluene; concentrations of total xylenes detected in soil exceeded 18 AAC 75.341(c), Table B1, cleanup levels.
- The lateral extent of DRO-contaminated soil has been adequately delineated to the project SL. Soil contaminated with DRO above the SL exists in proximity to the two site AST locations.
- The vertical extent of DRO-contaminated soil is limited by the presence of permafrost. The estimated vertical depth of DRO-contaminated soil is 2.5 to 3 feet bgs.
- Concentrations of DRO and benzene detected in suprapermafrost groundwater exceeded 18 AAC 75.345, Table C, cleanup levels.
- The suprapermafrost groundwater does not appear to be migrating offsite northward toward the Bering Sea, the nearest surface water body; however, contaminated groundwater does appear to be migrating offsite to the east.
- Cumulative risk was assessed for the site based on current conditions. Each contaminant detected at a concentration above one-tenth of its 18 AAC 75.345(b)(1), Table B1, inhalation or direct contact cleanup level for soil or its 18 AAC 75.345(b)(1), Table C, cleanup level for groundwater was included in the cumulative risk calculations. The risk results for current site conditions were determined to be above the regulatory limit of 1 x 10^{-5} for carcinogenic risk and the regulatory HI limit of 1 for noncarcinogenic risk.
- The HRC was used to assess risk posed by the GRO, DRO, and RRO aromatic and aliphatic groups, based on current site conditions. The risk posed by the DRO aliphatic groups was found to be above the regulatory HI limit of 1 for noncarcinogenic risk.

8.2 Proposed Soil Alternative Cleanup Levels

As stated in 18 AAC 75.340(e), an ACL can be proposed under ADEC Method 3, provided that the ACL modifies only the migration-to-groundwater or inhalation cleanup levels from Table B1 of 18 AAC 75.341(c) or Table B2 of 18 AAC 75.341(d), based on use of approved site-specific data and an approved fate-and-transport model. The cleanup level that would then apply at the site for a hazardous substance would be the most stringent of the Table B1 direct contact cleanup level or the Table B2 ingestion cleanup level and the site-specific calculated cleanup levels for inhalation and migration to groundwater. A proposed migration-to-groundwater ACL must be protective of applicable groundwater cleanup levels under 18 AAC 75.345 and must not exceed the ingestion and inhalation levels of Tables B1 and B2.

The ingestion cleanup level for petroleum hydrocarbons in soil is presented in Table B2 of 18 AAC 75.341(d). To determine the total DRO concentration that would exceed the ingestion cleanup level for the aliphatic and aromatic fractions for Savoonga FSRC, the ingestion cleanup level for each fraction was divided by its calculated mass fraction (Table C-4 of Appendix C) (Table 8-1). The lesser of the calculated aliphatic and aromatic ingestion cleanup levels for DRO in soil was established as the Savoonga FSRC ingestion cleanup level for DRO in soil.

TABLE 8-1
Soil Ingestion Cleanup Levels
Savoonga Federal Scout Readiness Center Data Gap Investigation

	Mass Fraction[a] (Percent)		Ingestion Cleanup Level[b]		Savoonga Soil Ingestion Cleanup Level[c]
	Aromatics	Aliphatics	Aromatics	Aliphatics	
Diesel-range organics	9.22	90.78	4,100	10,000	11,015

Note: All units are in milligrams per kilogram.
[a]Mass fraction obtained from application of Washington Methods Northwest VPH and Northwest EPH
[b]Ingestion cleanup levels obtained from 18 AAC 75.341(d), Table B2
[c]Ingestion cleanup level = the lesser of the aromatic ingestion cleanup level ÷ aromatic mass fraction and the aliphatic ingestion cleanup level ÷ aliphatic mass fraction

Similarly to the ingestion cleanup level, the inhalation cleanup level for DRO was calculated for Savoonga FSRC, based on 18 AAC 75.341(d), Table B2, inhalation cleanup levels for the aliphatic and aromatic range divided by the site-specific calculated mass fraction (Table C-4 of Appendix C) (Table 8-2). The lesser of the calculated aliphatic and aromatic ingestion cleanup levels for DRO in soil was established as the Savoonga FSRC inhalation cleanup level for DRO in soil.

TABLE 8-2
Soil Inhalation Cleanup Levels
Savoonga Federal Scout Readiness Center Data Gap Investigation

	Mass Fraction[a] (Percent)		Inhalation Cleanup Level[b] (mg/kg)		Savoonga Soil Inhalation Cleanup Level[c] (mg/kg)
	Aromatics	Aliphatics	Aromatics	Aliphatics	
Diesel-range organics	9.22	90.78	5,000	10,000	11,015

[a]Mass fraction obtained from application of Washington Methods Northwest VPH and Northwest EPH
[b]Inhalation cleanup levels obtained from 18 AAC 75.341(d), Table B2
[c]Inhalation cleanup level = the lesser of the aromatic inhalation cleanup level ÷ aromatic mass fraction and the aliphatic inhalation cleanup level ÷ aliphatic mass fraction
mg/kg = milligrams per kilogram

Because a proposed migration-to-groundwater ACL cannot exceed a site's calculated ingestion cleanup level (18 AAC 75.340[e]), the ingestion cleanup level for DRO (11,015 mg/kg) was used as input to the HRC to determine whether this soil concentration would produce a groundwater ingestion concentration that exceeds regulatory criteria (18 AAC 75.345). Similarly, because benzene concentrations in soil exceeded the 18 AAC 75.341(c), Table B1, migration-to-groundwater cleanup level, an initial benzene concentration of 0.27 (the remaining concentration, assuming that the soils containing high levels of DRO were excavated) was used as input into the HRC to determine whether this soil concentration would produce a groundwater ingestion concentration that exceeds regulatory criteria.

Initial modeling results indicated that the initially proposed DRO soil concentration did not exceed groundwater ingestion criteria. The initially modeled benzene soil concentration, on the other hand, caused an exceedance of groundwater ingestion criteria. Using an iterative approach, the benzene soil concentration was lowered until the modeled soil concentration achieved groundwater regulatory compliance. The results of the modeled soil impacts to site groundwater are presented in Table 8-3.

Based on the calculated ingestion cleanup level presented in Table 8-1, the inhalation cleanup level presented in Table 8-2, and the results of the calculated impacts to groundwater presented in Table 8-3, the proposed soil ACLs for Savoonga FSRC are 0.13 mg/kg for benzene and 11,015 mg/kg for DRO.

TABLE 8-3
Modeled Contaminated Soil Impacts to Groundwater
Savoonga Federal Scout Readiness Center Data Gap Investigation

	Soil ACL (mg/kg)	Pore Water Concentration (mg/L)[a]			Groundwater Concentration (mg/L)[b]		
		Aromatics	Aliphatics	Total	Aromatics	Aliphatics	Total
Benzene	0.13	N/A	N/A	0.0394	N/A	N/A	0.0049
Diesel-range organics	11,015	1.21	0.0152	1.22	0.127	0.0016	0.129

[a]Modeled dissolved concentration in equilibrium with soil (results from cells P253 through P261 in the hydrocarbon risk calculator)
[b]Modeled pore water concentration divided by calculated site-specific dilution attenuation factor
ACL = alternative cleanup level proposed for the migration-to-groundwater pathway
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
N/A = not applicable

8.3 Recommended Remedial Actions

Based on the known extents of petroleum-contaminated soil and groundwater and the assessment of cumulative risk, the following recommendations for future remedial actions are made for each contaminated medium present at Savoonga FSRC.

8.3.1 Contaminated Soil

Given the inadequate site infrastructure, restricted usable space, and limited site access to Savoonga FSRC, onsite treatment of contaminated soil was not considered a possibility. Therefore, only offsite remedial actions for contaminated soil were considered. The only remedial action that was judged suitable for the contaminated soil at Savoonga FSRC was excavation and offsite disposal. Given a lateral extent of contaminated soil of approximately 570 square feet (Figure 6-1), with an assumed vertical extent of 3.5 feet bgs, there is approximately 74 in situ yd^3 of contaminated soil above ADEC Method 2 cleanup levels (DRO concentrations above 250 mg/kg).

Because of the presence of contaminated groundwater, consideration needs to be given to the ACL as well as the complete removal of contaminated soil in terms of funding, site conditions, and projected long-term monitoring costs. Because of the large quantity of petroleum-contaminated soil present at the site, it is recommended that contaminated soil be excavated and removed only to the proposed ACL.

As shown in Table 6-1, there are three sample locations (for a total of three soil samples) where soil contains contaminant concentrations that exceed the proposed soil ACLs and requires remedial action. The three sample locations are borings 11SAVSB001, B12, and B13. The area of contamination is located between the northern AST and the Old FSRC and is approximately 12 feet wide by 6 feet long (Figure 8-1). It is recommended that the contaminated soil associated with these samples be excavated from the surface down to permafrost and shipped offsite for either thermal treatment or inclusion into an approved landfill for disposal.

Upon completion of the soil excavation efforts, confirmation soil samples should be collected to comply with regulatory guidance and submitted for laboratory analysis of BTEX, GRO, and DRO (including EPH and VPH), with at least one confirmation sample (from the location with highest remaining contamination) also being analyzed for PAHs. A cumulative risk assessment must again be completed subsequent to the remedial action (soil excavation efforts) to verify that the site meets the regulatory limits of 1×10^{-5} for carcinogenic risk and an HI of 1 for noncarcinogenic risk.

As required by 18 AAC 75.325(i), approval from ADEC will be required prior to any future excavation or disturbance of soil at Savoonga FSRC to prevent placement of petroleum-contaminated soil in environmentally sensitive areas.

8.3.2 Contaminated Groundwater

Petroleum-contaminated suprapermafrost groundwater exists at Savoonga FSRC and requires remedial action. The concentrations of petroleum hydrocarbons (DRO) and benzene detected in groundwater samples are above the respective cleanup levels of 1.5 mg/L and 0.005 mg/L. Investigation results show that the contaminated groundwater is not migrating towards the Bering Sea to the north, but is migrating offsite to the east. There are no known drinking water wells onsite that could access the contaminated groundwater, nor are there known drinking water wells to the east of the site. The community of Savoonga currently obtains its water from a well located adjacent to the runway, approximately 0.75 mile southeast of and upgradient from Savoonga FSRC. In addition, the community well is set at a depth of 195 feet bgs and is not hydraulically connected to the contaminated shallower active-layer groundwater.

The recommended remedial action for the petroleum-contaminated groundwater at Savoonga FSRC is long-term monitoring of the natural reduction of petroleum contamination, verifying that the plume is stable or continuing to shrink subsequent to the proposed soil remedial action. Future groundwater samples should be collected from at least one source area well and one well to the east. The well locations would require ADEC approval. The groundwater quality should be monitored in the long term until contaminant concentrations in groundwater meet regulatory requirements.

8.4 Estimated Volume

The proposed area that requires excavation measures approximately 50 square feet (Figure 8-1). To be conservative, the DRO-contaminated soil is assumed to reach 3.5 feet bgs (given the elevated results for sample 11SAVSB001_SO02-2.6 and assuming that permafrost is not encountered sooner). Therefore, the in situ volume of DRO-contaminated soil is estimated at 6.5 yd^3.

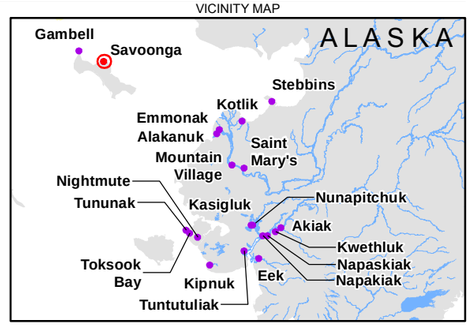
8.5 Summary

The lateral and vertical extent of DRO-contaminated soil has been delineated to the project SL. Based on the results of the cumulative risk assessment completed for the Savoonga FSRC site under current conditions, carcinogenic and noncarcinogenic risk levels for hazardous substances in soil and groundwater are above regulatory limits. In addition, based on results from use of the HRC, the DRO aliphatic fractions pose an ingestion risk greater than State of Alaska regulations allow.

Based on proposed soil ACLs, it is estimated that 6.5 in situ yd^3 of contaminated soil would require excavation to achieve the DRO and BTEX soil cleanup levels of 11,015 mg/kg and 0.13 mg/kg, respectively. The proposed remedial action would mitigate the ingestion risk posed by the aliphatic fractions of DRO.

Concentrations of DRO and benzene detected in groundwater are above the respective cleanup levels of 1.5 mg/L and 0.005 mg/L. There are no known drinking water wells onsite that could access the contaminated groundwater, nor are there known drinking water wells to the east of the site. The community of Savoonga currently obtains its water from a well located adjacent to the runway, approximately 0.75 mile southeast of and upgradient from the FSRC. The community well is set at a depth of 195 feet bgs and is not hydraulically connected to the contaminated shallower active-layer groundwater. The petroleum-contaminated groundwater at Savoonga FSRC should be sampled in the long term to monitor the natural reduction of petroleum contamination.

VICINITY MAP



LEGEND

- Federal Scout Readiness Center (FSRC)
- Old FSRC
- Storage Facility
- AST
- Former AST
- Day Tank
- Hazardous Material Storage Locker
- Gravel Pad
- Tank Piping
- Other Building
- Unpaved Road
- Area To Be Excavated

Soil DRO Results

- DRO ≤ 250 mg/kg
- DRO > 250 mg/kg (exceeds screening level)

Guide to Symbol Shapes

- Small Circle = soil samples from 0 to ≤ 1 feet bgs
- Medium Hexagon = soil samples from > 1 to ≤ 2 feet bgs
- Large Circle = soil samples > 2 feet bgs

Notes:

1. Location of historical samples is approximate based on historical figures and on orthophotography courtesy of Alaska Department of Commerce, Division of Community & Regional Affairs (DCRA), 1-foot pixels.
2. Definitions:
   AST = aboveground storage tank
   bgs = below ground surface
   DRO = diesel-range organics
   mg/kg = milligrams per kilogram

N

0 7.5 15
Feet

FIGURE 8-1
Proposed Area of Soil Excavation
Savoonga FSRC Data Gap Investigation
Savoonga, Alaska

SECTION 9

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Appendix A
Field Notes, Boring Logs, and Well Logs

SANDOVAL
ARMY NATIONAL GUARD - FLORENCE SUSTAINMENT READINESS CENTER
SANDOVAL SITE INVESTIGATION
NATIONAL GUARD CONTRACT No. W90YRB-09-D-0003 TASK ORDER 2202
CH2M HILL PROJECT NUMBER 403507

DATE 05 JULY 2011
SITE CONDITION: GOOD - CLOUDY
WEATHER 41° RAINING
FIELD PERSONNEL JNH, RH, ML
EQUIPMENT CALIBRATION MINI RAE PID CALIBRATE W/ISOBUTYLENE 100

ARRIVE AT AIRPORT & WALK TO SITE MARK OUT BORING LOCATIONS & GRABS WATER FOR DECON FROM LOCAL STORE. BEGIN SOIL BORINGS AT 12:00 → TRIMBLE NOT WORKING - MARK OUT LOCATIONS BY SCALE + MEASURE

SAMPLED THE FOLLOWING SOIL

	11SANSB0007_S000-01	DRO @	1340
	11SANSB0009_S000-01	DRO @	1345
	11SANSB0013_S000-01	DRO @	1415
	11SANSB0014_S000-01	DRO @	1430
*	11SANSB0011_S000-01	DRO @	1496
*	11SANSB0008_S000-01	DRO @	1455
	11SANSB0010_S000-01	DRO @	1515

SURFACE ACROSS THE SITE AT ~ ONE FOOT BELOW GRADE; CLAYEY SAND WITH GRAVEL

PACK UP EQUIPMENT AND WALK TO AIRSTRIP. PLANE LOADED BY 1600 & READY TO DEPART TO GAMBELL THEN TO NOME. BACK AT NOME AIRPORT @ 1750. GRABS GLOVES & STOP AT HARDWARE STORE FOR POST HOLE DIGGER. NONE OBTAINED. RH BOUGHT A CHIPPER TOOL.

* DISREGARD SAMPLE IF GOAL OF (2-3) & (4-5) FEET BELOW GRADE ARE MET

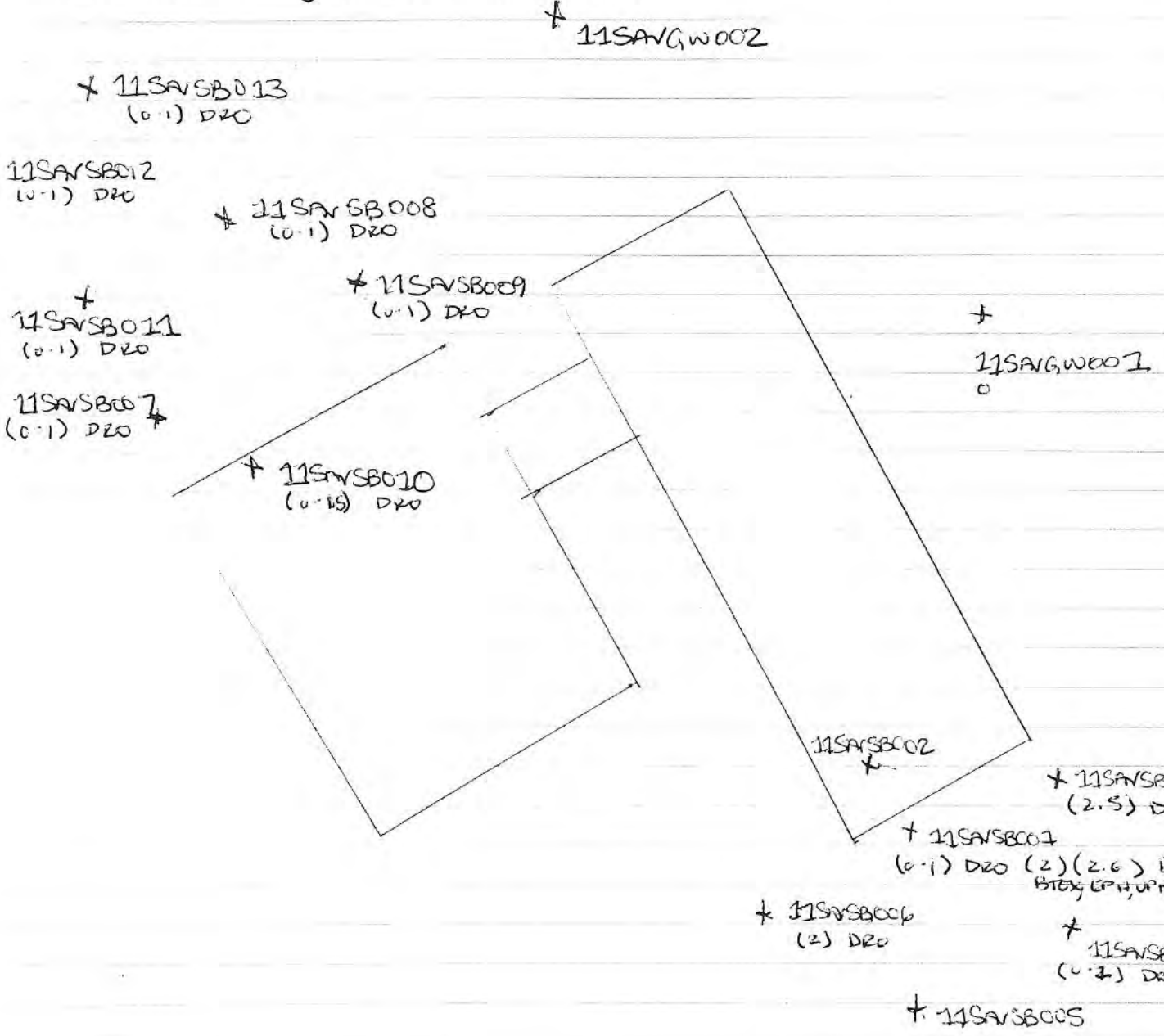
SAVANNAH

ARMY NATIONAL GUARD - FORMER SCOUT READINESS CENTER

SAVANNAH SITE INVESTIGATION

NATIONAL GUARD CONTRACT NO. W90FYB-09-D-003 TASK ORDER ZZ07

CH2M HILL PROJECT NUMBER 403507



ale: 1 square =

SAVANNAH
ARMY NATIONAL GUARD - FLORENCE STAGE READINESS CENTER
SAVANNAH SITE INVESTIGATION
NATIONAL GUARD CONTRACT NO: W9QFYQ 09-D-003 TASK ORDER 2207
CHEM HILL PROJECT NUMBER 403507

DATE 06 July 2011
SITE CONDITION Good. Cleaning in Heat in New Building
WEATHER 42° Windy, Rain,
FIELD PERSONNEL JMH RH ML
EQUIPMENT CALIBRATION MiniRAE PID CALIBRATE W/ISOBUTYLENE

ARRIVE AT AIRPORT & WALK TO SITE & SET UP FOR THE DAY GO TO LOCAL STORE FOR DECON WATER

COLLECTED THE FOLLOWING SAMPLES
11SAVSB001_S000-01 ; DECO @ 1200
11SAVSB004_S000-01 ; DECO @ 1215
11SAVSB001_S002.6 ; DECO @ 1245 BTEX, GRIT, VPH, PAH
11SAVSB001_S002 ; DECO @ 1230 BTEX, GRIT, VPH, PAH
11SAVSB003_S02.5 ; DECO @ 1330
11SAVSB006_S002 ; DECO @ 1405
11SAVSB005_S001.5 ; DECO @ 1440
11SAVSB004_S002-03 ; DECO @ 1505

PACK UP EQUIPMENT AND WALK TO AIRSTRIP PLANE LOADED & DEPARTED TO NOME AT NOME AIRPORT @ 1700

Jmy Hughes

SAVONGA
ARMY NATIONAL GUARD - FEDERAL
SAVONNA SITE INVESTIGATION
NATIONAL GUARD CONTRACT NO. W90FYQ-09-D-003 TASK ORDER 2602
CH2M HILL PROJECT NUMBER 405507

DATE 23 JULY 2011
SITE CONDITION GOOD
WEATHER 45° RAIN
FIELD PERSONNEL JMH, RH, ML
CALIBRATE MINI RAE PID AT 0.02294 W/ 15% BUTYLENE @ 1250 ppm
LOT 103902 FRESH AIR 0.0 SPAN 100, 101, 100 ppm
INDOOR AIR <1 ppm OUTDOOR AIR <1 ppm

ARRIVED @ ~950 - WALK TO ARMORY & SET UP FOR DAY. TALKED ABOUT UTILITY LOCATE. NONE WAS COMPLETED FOR THIS SITE.

11SAVSB004; ADVANCED TO 3.2 FEET BELOW GRADE 2 FOOT PVC DRILLED SURELY TO 3.2
NO GROUNDWATER ENCOUNTERED. RAIN WATER FILTERING THROUGH CLAYEY GRAVEL. ~~HEADSPACE~~ N/A

11SAVSB007; USED POST HOLE DIGGER & BAR TO ADVANCE TO 3 FEET BELOW GRADE. HAND AUGER TO COLLECT (2-3) @ 1240 OF DRO, BTEX, VPH, EPH, PAH; SCREEN SET TO ~4.0 FT HOLE COMPLETELY FILLED WITH WATER.

11SAVGW002; USED POST HOLE DIGGER TO ADVANCE BORING TO ~2 FEET BELOW GRADE NO SOIL SAMPLES COLLECTED. MOSTLY ORGANIC MATERIAL & SILT. INSTALLED IN 10N. MANY WATER FILLED AREA

11SAVGW001; USED POST HOLE DIGGER TO ADVANCE BORING TO ~3.5 FEET BELOW GRADE. NO SOIL SAMPLES COLLECTED MOSTLY CLAYEY GRAVEL. OFFSET FROM NEARBY DRIVEWAY

~~11SAVSB005 ADVANCED~~ 11SAVSB009 ADVANCED TO ~3 FT BELOW GRADE; MOSTLY CLAYEY GRAVEL; COLLECTED DRO 2-3 @ 1515

Scale: 1 square =

SAVOONGA
ARMY NATIONAL GUARD · FEDERAL READINESS CENTER
SAVOONGA SITE INVESTIGATION
NATIONAL GUARD CONTRACT NO. W90FYB-09-D-003 TASK ORDER 2201
CH2M HILL PROJECT NUMBER 403507

DATE 24 JULY 2011
SITE CONDITION WELLS GW001 AND SB007 PULLED OUT OF GROUND
WEATHER 50 FOG
FIELD PERSONNEL JMH RLH ML
EQUIPMENT CALIBRATION: CALIBRATE MINI RAE PID CH 010 22299
W/ ISOBUTYLENE LOT: 1059010
INITIAL FRESH AIR 0.0 INITIAL SPAN GAS 101, 103, 100 ppm
OUTSIDE ~~AIR~~ 0.0 INSIDE <1 ppm

11SAVSB003_S002-03 COLLECTED @ 0740; POST HOLE DIGGER USED TO ADVANCE BORING TO ~3 FEET BELOW GRADE ~~SAND SILT~~; BLACK SATURATED/FROZEN ~2.7 FEET COLLECTED DUP @ 0740; HEADSPACE <1 ppm; SILTY CLAY

11SAVSB002_S002-03 COLLECTED @ 0810; POST HOLE DIGGER USED TO ADVANCE BORING TO ~3 FEET BELOW GRADE; FROZEN ~3 FEET; ~~SAND SILT~~ SILTY CLAY; BLACK SATURATED HEADSPACE <1 ppm

11SAVSB011_S002-03; COLLECTED @ 0840; POST HOLE DIGGER USED TO ADVANCE BORING TO ~2.5 FEET BELOW GRADE; ROCK @ ~2.5; ~~SAND SILT~~ SILTY CLAY, BLACK SATURATED HEADSPACE <1 ppm

11SAVSB013_S002-03; COLLECTED @ 0900; POST HOLE DIGGER USED TO ADVANCE BORING TO ~3 FEET BELOW GRADE; SILTY CLAY; BLACK SATURATED HEADSPACE <1 ppm

COLLECTED METHANOL BLANK @ 0900; THE ONE IN THE COOLER APPEARED TO HAVE LEAKED.

RLH RE-INSTALLED PVC WELLS GW001 + SB007. NO DECON PROCEDURES. POSSIBLE CROSS CONTAMINATION.

SAVOONGA NOME - SAVOONGA - NOME

7/5/2011 TUESDAY

0600 Rain in NOME & forecast for Savoonga is rain with 15-30mph wind and areas of patchy fog.

0700 Subway breakfast/lunch

0750 Purchase case water & tape 2 boxes nitrils ship cargo to Gambell Remove 2 gal Typell from cooler & add tools, nitrils as baggage to Savoonga. Rodney Natl Guard rep meet e airport & is going with us to Savoonga

0900 Leave Nome. 10-20mph wind from north light rain ~45°

1023 Ar Gambell 1040 Ar Savoonga

Mob gear from airport to FSRC ($20 to haul). unpack & get potable (COLD) decon H_2O at store GPS battery is dead. Use tape & measure sample locations & place flags.

The pad material is volcanic that has large rock & not very conducive to hand auger. Michael used small dia auger and you have to really work to get down 1'.

Scale: 1 square=

SAVOONGA NOME

7/5/2011 TUESDAY SAVOONGA NOME

Most of the holes down to 1' have water seeping into them from surface water. The hand augers will not go more than 1' bgs due to refusal hitting rocks. Plan to try & buy a post hole digger & metal bar to dig down

Locals are very happy to see us and are continuously bringing in carvings for sale.

Tried to track down 4 coolers from the lab. Took 4 calls to find them & they were at the H_2O treatment plant. Paid local $10 to bring them to the FSRC.

Worked all sample locations & limited to 1' with augers we have.

1530 Demob & lock up gear in FSRC & go to airport

1600 ERA picks us up. Go to Gambell (drill rig & materials are on tarmac) Leave Gambell

1740 Ar NOME

Purchase steel bar w point & nitrils e

Scale: 1 square=

7/6/2011 WEDNESDAY

0730 Drop Jenny, Michael, Rodney & Airport Pizza & go to Builders Supply & purchase post hole digger, Pick up everyone & go to ERA & then pick up Tom & return to ERA On hold waiting for people

Tom & Rodney are going to Gambell Get a call from drillers (Gary) they are flying ANC-Nome & in ~1200 & flight to Gambell ~ 1600 hrs on Bearing Air, Let Tom & Rodney know they should be coming into Gambell in afternoon

0950 Leave Nome, 1052 Ar Gambell ~48°

1109 Ar Savoonga (20-30 mph wind/rain)

1139 Jenny, Michael get decon water & Rich starts on SB1 Dig down to ~2.6' & transition from fill & hit native tundra (organic matt) & sample brown silty material beneath which is frozen. Very strong hydrocarbon water is seeping into the hole from ~1' bgs.

7/6/2011 WEDNESDAY SAVOONGA

Start on SB4 dig down to ~2.5' & go ~~through~~ RH to native material mild hydrocarbon odor. frozen Water seeping into hole @ ~ 1' bgs

Start on SB03 dig down to ~2.5' hit frozen material. Water seeping into hole.

Start on SB005 dig down to 2' and hit large rock across whole bottom of hole. REJECT

Try SB7 very rocky/gravelly at surface & surface water is continuously flowing into the hole (sheen present). Abandone boring due to extensive water,

Start on SB4 dig down to ~2.8' water is seeping into hole @ ~2' & ~~hit~~ water is seeping in at bottom of hole.

SAVOONGA STEEL BAR POST HOLE DIGGER SAVOONGA NOME

7/6/2011 WEDNESDAY

It has been raining and blowing all day & wind is continuous 20-30 mph.

1530 Pack gear & demob. We did not complete all borings and sampling at depth due to inadequate tools on Tuesday and limited time on ground Weds. (Shorted us 1hr waiting in morning). Get Robin from across the street to haul our gear to the airport

1600 ERA arrives & load our gear and return to Nome.

1652 Ar Nome
Separate gear into "stay in Nome" palat & go to Gamble palat. Pull samples & field gear to dry, Collect equip. & pack samples.
Introduce John Culley to Jenny & Mike drop them off @ Airport Pizza & go to ERA to pick my bag & get tape for sample cooler. AK Air Cargo closed, John starts SSC training w Jenny

0840 Rodney calls bring 12 pak DC & any food We cook @ Lodge & there is a store

GAMBELL ERA NOME-GAMBELL

7/7/2011 THURSDAY

0630 Pack up gel ice & begin to demob Nome to Gambell, Drop Jenny & Mike @ Airport Pizza. John helps ship samples. Ship samples AK Air Cargo. Drop off gear @ ERA Sample Air Bill 027 7775 4202
Call test America/ANC & Lv message
Refuel return rental car, & had shopped @ store for food to bring & also 12 pac diet coke for Rodney
0906 Lv Nome 0955 Ar Gambell
Drillers made it to Gambell on Bering Air
Utility locates water & sewer clear
Check w AVEC Roy or Fred 1800 478 1818
UUI Phone Leon 800 478-2020

Call AVEC ANC Diane & she faxes drawing of elec utility lines Took 2 faxes to get right location & have to go to City office (one where we were at not working). Elec is clear of where we are drilling

7/22/2011 FRIDAY Gambell/Nome

0700 Repack sample coolers with fresh gel ice. Record WL's

	Location	WL' BTOC	
0716	GW5	11.63	
0719	GW6	10.69	Well riser hit with 4Whooler
	GW7	10.44	
	GW8	10.12	
0727	GW9	10.97	

1000 Jenny & Michael leave on ERA to Nome
1630 Rich leaves ERA to Nome
1730 Ar Nome

7/23/2011 SATURDAY NOME SAVOONGA NOME Stuck in Savoon

0820 Meet Jenny Michael & ERA 0900 Leave for Savoonga
1000 Ar Savoonga & setup
1045 Start on SB10/GW (sampled soil previously)
0-2.7' Silty Sandy Gravel
2.7-3.2 Peat
3.2 frozen silt No water seep on side at 1'
Set well 1.2-3.2' screen

7/23/2011 SATURDAY Savoonga

Start on GW1
Silty Sandy Gravel to 1.5' Peat to 2.0
water seeping in @ 1.5'
2.5' Frozen Silt grey

1422 Start on GW2
0-1' Dark brown soil with organics
1 - Grey silt

Start SB9
Gravel to 2' tundra matt + water
Water flowing in @ 1'
2.5' frozen grey silt
1551 Pack up & go to airport
No plane - fogged in. Rent house from Rowland Akuwa $125/person-night

7/24/2011 SUNDAY Savoonga

0700 Ar FSRC GW1 & SB7 GW wells were pulled & left by boring.
NRO Start SB8 Gravel 1-1.5' wet, Tundra matt @ 1.5. Top 6" brown soil w organics
0741 End roots water seeping in from 6" down
SB12 Brown soil w organics 0-6"
Grey silt 6" - 2.5' & boulders 2.5' & frozen

Scale: 1 square=

SAVOONGA

7/24/2011 SUNDAY ALL BTOC

0836 GW2 WL=2.69, TD=4.46, Stickup=2.50
SB4GW WL=3.93, TD=5.44, Stickup=2.49
Jenny Mike sample remaing borings
0908 Reset GW1 & SB7GW
1145 GW1 WL=4.19' 3.2' stickup
SB7GW WL=3.80' WL=4.96' BTOC
Jenny goes back to Nome on Bearing Air
Prep & label GW sample jars & COC
1445 ERA arrives w peripump & masterflex hose
Start GW sampling, SB4GW, GW1, GW2
are all low flow & purge dry. SB7GW
Slight breeze drizzly is good producer & stabilize quickly
1810 Sample SB7 GW for primary & dup
1848 Sample SB4 (keeps purging dry)
1902 Sample GW1
1953 Sample GW2
2030 Pack samples & gear & leave FSRC mike
Rent Roland Alowa's house $125/person Rich

7/25/2011 SAVOONGA NOME MONDAY Foggy & drizzely ~48° calm
0630 Cancell Nome Nugget (CA725) charge 366.35 for Same Day Cancel
0730 Call Matt proj update & need return to Stebbins
SB5 - Stepout @E end bldg & middle @ SE corner
1123 Leave Savoonga for Nome 1210 Ar Nome Ship GW Samples ERA to ANC & Notified Lab
1315 Leave Nome for Stebbins - St Marys

Refer to RH BOOK 2/2

Scale: 1 square=

John Ohlson Travel Indus | Gambell Fax City | City office 5927

GAMBELL Moses Soonagrook whale
Savoonga earrings Larry Kingeekuk 6928 fossilized Jaw bone
GAMBELL Joanie & Eddie Unga
GAMBELL Veronica James
Winnie 2018 goose on
Dad whale bone
Savoonga Harrison Miklahook harpoon
Savoonga walrus
Ben Pungowiyi
esva.bssd.org
Alexandria
James Oozeva Savoonga
bear w baby
985-2205 CELL 984-2377
GLORIA MOM Dean KALOWIYI vsik
Harlan Kingeekuk
Arena dad Charles - bow head whale
Mike - diamond guy
Carson Oozeva Jr horned puffin painted
Ida Akutan 5114 Yo-Yo (Iyakiutan)
Brandon ~ Ivory Walrus / Glenn OOzevasuk eagle/bear

Silook99@yahoo
Savoonga Frank Seppilic Baleen
Paul Apangalook Phone 1985-2111
Holden Apatiki Sr

Arrca-Lodge Cheryl - acct
Unga is brother-in-law
ose
ouse) Sells stuff
5-2110
Antagomi
rows)
gruk makes harpoon
-5833
985 owl 5718
985-5235
-5833 5235
seal 985 5738
5034 msg

9852222 Its like we looking in the wrong area there far more worse spill like cove were to sve army natioual by at least 4-6 houses

CH2MHILL

SAMPLE TRACKING LOG

Project # 403507 Site: SAVONGA Page 1 of

Sample						Shipment				
Date	ID	Location	Depth	Matrix	Type	~~Cooler~~ ID / TIME	Ship Date	Method	Shipped To	Date Received
7.5.11	11SAVSB0007	S000 02	0-1	Soil	DRO	1340				
7.5.11	11SAVSB0009	S000 01	0-1	Soil	DRO	1345				
7.5.11	11SAVSB0013	S000-01	0-1	Soil	DRO	1415				
7.5.11	11SAVSB0012	S000 01	0-1	Soil	DRO	1430				
7.5.11	11SAVSB0011	S000 02	0-1	Soil	DRO	1446				
7.5.11	11SAVSB0008	S000-01	0-1	Soil	DRO	1455				
7.5.11	11SAVSB0010	S000 01	0.5	Soil	DRO	1515				
7.6.11	11SAVSB0001	S000-01	0-1	Soil	DRO	1200				
7.6.11	11SAVSB0004	S000-02	0-1	Soil	DRO	1215				
7.6.11	11SAVSB0001	S002	2	Soil	DRO	1230				
					BTEX, GRO, VPH, CHM					
7.6.11	11SAVSB0001	S02.6	2.6	Soil	DRO BTEX GRO VPH	1245				
~~7.6.11~~	~~11SAVSB0003~~	~~S0~~		~~Soil~~	~~FAIL~~					
7.6.11	11SAVSB0003	S02.5	2.5	Soil	DRO	1330				
7.6.11	11SAVSB0006	S002	2	Soil	DRO	1405				
7.6.11	11SAVSB0005	S001.8	1.8	Soil	DRO	1440				
7.6.11	11SAVSB0004	S002.3	2.3	Soil	DRO	1503				

* DISCARD IF GOAL MET

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9405 SW Nimbus Ave,Beaverton, OR 97008-7145 503-906-9200 FAX 906-9210
2000 W International Airport Rd Ste A10, Anchorage, AK 99502-1119 907-563-9200 FAX 563-9210

CHAIN OF CUSTODY REPORT

Work Order #:

CLIENT: ARMY NATIONAL GUARD

INVOICE TO: MATT FLYNN
412TH HILL
949 EAST 36TH AVE, SUITE 500
ANCHORAGE AK 99508

REPORT TO: MATT FLYNN
ADDRESS: 412TH HILL
949 36TH AVE, SUITE 500
ANCHORAGE AK 99508

PHONE: 907.428.9[illegible] FAX: 907.257.2054

P.O. NUMBER:

PROJECT NAME: SAVONGA FSRC

PROJECT NUMBER: 411351

SAMPLED BY: MATT HENN, MICHAEL LANDON

TURNAROUND REQUEST

in Business Days *

Organic & Inorganic Analyses: [10] STD. [7] [5] [4] [3] [2] [1] [<1]

Petroleum Hydrocarbon Analyses: [5] STD. [4] [3] [2] [1] [<1]

[OTHER] Specify:

* Turnaround Requests less than standard may incur Rush Charges.

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	PRESERVATIVE: NONE	NONE	METHANOL	NONE									REQUESTED ANALYSES: DRO/GRO AK102	SEPH NWTPH	VPH NWTPH	BTEX 8260C	PAH 8270C									MATRIX (W, S, O)	# OF CONT.	LOCATION/ COMMENTS	TA WO ID
1	11SAVSB007_S000-01	7.5.11 1340													1	-	-	-	-									S	1		
2	11SAVSB009_S000-01	7.5.11 1345													1	-	-	-	-									S	1		
3	11SAVSB013_S000-01	7.5.11 1415													1	-	-	-	-									S	1		
4	11SAVSB012_S000-01	7.5.11 1430													1	-	-	-	-									S	1		
5	11SAVSB011_S000-01	7.5.11 1446													1	-	-	-	-									S	1		
6	11SAVSB008_S000-01	7.5.11 1455													1	-	-	-	-									S	1		
7	11SAVSB010_S000-01	7.5.11 1515													1	-	-	-	-									S	1		
8	11SAVSB001_S002	7.6.11 1230													1	1	1	1	1									S	5		
9	11SAVSB0004_S000-02	7.6.11 1245													1	-	-	-	-									S	1		
10	11SAVSB0001_S000-01	7.6.11 1200													1	-	-	-	-									S	1		

RELEASED BY: JENNY HOLMES DATE: 7.6.11
PRINT NAME: JENNY HOLMES FIRM: CH2M HILL TIME: 1720

RECEIVED BY: [illegible] DATE: 7.6.11
PRINT NAME: MICHAEL LANDON FIRM: CH2MHILL TIME: 1720

RELEASED BY: MICHAEL LANDON DATE: 7.6.11
PRINT NAME: MICHAEL LANDON FIRM: CH2MHILL TIME: 1751

RECEIVED BY: DATE:
PRINT NAME: FIRM: TIME:

ADDITIONAL REMARKS:

TEMP:

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2000 W International Airport Rd Ste A10, Anchorage, AK 99502-1119 907-563-9200 FAX 563-9210

CHAIN OF CUSTODY REPORT

Work Order #:

CLIENT: ARMY NATIONAL GUARD

INVOICE TO: MATT FLYNN
CH2M HILL
949 EAST 36 AVE, SUITE 500
ANCHORAGE, AK 99508

REPORT TO: MATT FLYNN
ADDRESS: CH2M HILL
949 36th AVE, SUITE 500
ANCHORAGE AK 99508
PHONE: 907 490 9408 FAX: 907 257 2044

P.O. NUMBER:

PROJECT NAME: SAVOONGA FSR

PROJECT NUMBER: 103507

SAMPLED BY: MICH Hand MICHAEL LANDON

TURNAROUND REQUEST
in Business Days *
Organic & Inorganic Analyses: [10] STD. [7] [5] [4] [3] [2] [1] [<1]
Petroleum Hydrocarbon Analyses: [5] STD. [4] [3] [2] [1] [<1]
[OTHER] Specify:
* Turnaround Requests less than standard may incur Rush Charges.

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	PRESERVATIVE													MATRIX (W, S, O)	# OF CONT.	LOCATION/ COMMENTS	TA WO ID
			NONE	NONE	MeOH	NONE	NONE	HCl	HCl	NONE									
			REQUESTED ANALYSES																
			DRO AK102	GRO NWTPH	VPH NWTPH	BTEX 8260B	PAH 8270C	DRO AK102	BTEX 8260B	PAH 8270C									
1	11SNSB001-S02.6	7.6.11 1245	1	1	1	1	1	-	-	-						S	5		
2	11SNSB003-S02.5	7.6.11 1330	1	-	-	-	-	-	-	-						S	1		
3	11SNSB006-S002	7.6.11 1405	1	-	-	-	-	-	-	-						S	1		
4	11SNSB005-S0018	7.6.11 1440	1	-	-	-	-	-	-	-						S	1		
5	11SNSB009-S002-03	7.6.11 1505	1	-	-	-	-	-	-	-						S	1		
6	EQUIPMENT BLANK	7.6.11 1751	-	-	-	-	-	2	3	2						W	7		
7	TRIP BLANK	- -	-	-	-	1	-	-	-	-						W	1		
8	TRIP BLANK	- -	-	-	-	-	-	-	3	-						W	3		
9																			
10																			

RELEASED BY: Jen Holmes
PRINT NAME: JENNY HOLMES FIRM: CH2M HILL DATE: 7.6.11 TIME: 1720
RECEIVED BY: MICHAEL LANDON
PRINT NAME: MICHAEL LANDON FIRM: CH2MHILL DATE: 7.6.11 TIME: 1720

RELEASED BY: MICHAEL LANDON
PRINT NAME: MICHAEL LANDON FIRM: CH2M HILL DATE: 7.6.11 TIME: 1751
RECEIVED BY:
PRINT NAME: FIRM: DATE: TIME:

ADDITIONAL REMARKS:

TEMP:

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2000 W International Airport Rd Ste A10, Anchorage, AK 99502-1119 907-563-9200 FAX 563-9210

CHAIN OF CUSTODY REPORT

Work Order #:

CLIENT: ARMY NATIONAL GUARD

REPORT TO: MATT FLYNN
ADDRESS: CH2M HILL
949 EAST 36TH AVE, SUITE 500
ANCHORAGE AK 99508

PHONE: FAX:

INVOICE TO: MATT FLYNN
CH2M HILL
949 EAST 36TH AVE, SUITE 500
ANCHORAGE AK 99508

P.O. NUMBER:

PROJECT NAME: SAVOONGA

PROJECT NUMBER: 403507

SAMPLED BY: RICH HOLM

TURNAROUND REQUEST
in Business Days *

Organic & Inorganic Analyses: [10] STD. [7] [5] [4] [3] [2] [1] [<1]

Petroleum Hydrocarbon Analyses: [5] STD. [4] [3] [2] [1] [<1]

[OTHER] Specify:

* Turnaround Requests less than standard may incur Rush Charges.

CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	PRESERVATIVE					MATRIX (W, S, O)	# OF CONT.	LOCATION/ COMMENTS	TA WO ID
		NONE	NONE	METHANOL	METHANOL	NONE				
		REQUESTED ANALYSES								
		DRO AK102	GRO AK102	VPH MADEP	BTEX SW8260B	PAH SW8270C				
1 11SAVSB007_S002-03	7.23.11 1240	1	1	1	1	1	S	5		
2 11SAVSB009_S002-03	7.23.11 1515	1	–	–	–	–	S	1		
3 11SAVSB008_S002-03	7.24.11 0740	1	–	–	–	–	S	1		
4 11SAVSB012_S002-03	7.24.11 0810	1	–	–	–	–	S	1		
5 11SAVSB011_S002-03	7.24.11 0840	1	–	–	–	–	S	1		
6 11SAVSB013_S002-03	7.24.11 0900	1	–	–	–	–	S	1		
7 TRIP BLANK	– –	–	–	–	1	–	W	1	METHANOL VIAL GLASS	
8 TRIP BLANK	7.24.11 0900	–	–	–	1	–	W	1		
9										
10										

RELEASED BY: JIM HOMER
PRINT NAME: JENNY HOLMES FIRM: CH2M HILL DATE: 7.24.11 TIME: 1230

RECEIVED BY: DATE:
PRINT NAME: FIRM: TIME:

RELEASED BY: DATE:
PRINT NAME: FIRM: TIME:

RECEIVED BY: DATE:
PRINT NAME: FIRM: TIME:

ADDITIONAL REMARKS:

TEMP:

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9405 SW Nimbus Ave,Beaverton, OR 97008-7145 503-906-9200 FAX 906-9210
2000 W International Airport Rd Ste A10, Anchorage, AK 99502-1119 907-563-9200 FAX 563-9210 X

CHAIN OF CUSTODY REPORT

Work Order #:

CLIENT: CH2M HILL

REPORT TO: Bernie Kidd - Redding

ADDRESS:

PHONE: FAX:

INVOICE TO: CH2M HILL

P.O. NUMBER:

PROJECT NAME: AVG Data Gap Analysis Savoonga

PROJECT NUMBER: 403507.ES.SVSC

SAMPLED BY: R Horn, M Landon

TURNAROUND REQUEST

in Business Days *

Organic & Inorganic Analyses: [10] STD. [7] [5] [4] [3] [2] [1] [<1]

Petroleum Hydrocarbon Analyses: [X] STD. [4] [3] [2] [1] [<1]

[OTHER] Specify:

* Turnaround Requests less than standard may incur Rush Charges.

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	PRESERVATIVE													MATRIX (W, S, O)	# OF CONT.	LOCATION/ COMMENTS	TA WO ID
			HCL	HCL	NA	HCL	HCL												
			REQUESTED ANALYSES																
			DRO AK102	EPH NWEPH	PAH SW8270SIM	BTEX SW8260B	VPH NWVPH												
1	11SAVSB007_GW0X	7/24/2011 1810	2	2	1	3	3									W	11		
2	11SAVSB907_GW0X	1825	2	2	1	3	3										11		
3	11SAVSB004_GW0X	1848	2														2		
4	11SAVGW001_GW0X	1902	2														2		
5	11SAVGW002_GW0X	1953	2														2		
6	TRIP BLANK					X	X										3		
7																			
8																			
9																			
10																			

25 RH

RELEASED BY: Rick Horn DATE: 7/24/2011

PRINT NAME: RICK HORN FIRM: CH2M HILL TIME: 1225

RECEIVED BY: DATE:

PRINT NAME: FIRM: TIME:

RELEASED BY: DATE:

PRINT NAME: FIRM: TIME:

RECEIVED BY: DATE:

PRINT NAME: FIRM: TIME:

ADDITIONAL REMARKS: 2 Cooler CoC in Cooler 1/2

TEMP:

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CH2MHILL

PROJECT NUMBER	BORING NUMBER	
403501	11SANGW0001	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Army National Guard — LOCATION: SAN SONGA
ELEVATION: — DRILLING CONTRACTOR:
DRILLING METHOD AND EQUIPMENT USED: Hand Auger
WATER LEVELS: — START: 7.6.11 — END: 7.6.11 — LOGGER: Josh

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0						
0.5		6	HA	<1	0-1 Clayey SAND with Gravel. Brown moist	
1						
					END OF BORING 1 FOOT BELOW GRADE	
					23 July 2011 INSTALLED TO ~3.5 FEET BELOW GRADE	
					24 July 2011 Well pulled same time last night. PVC on ground this morning	GW ONLY GOAL: DRO/RRO Supra Permafrost & Impacts to Bering Sea

CH2MHILL

PROJECT NUMBER: 403507

BORING NUMBER: 11SAVGW002

SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Army National Guard

LOCATION: Savoonga

ELEVATION:

DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT USED: Hand Auger

WATER LEVELS:

START: 7.5.11

END: 7.5.11

LOGGER: JMH

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0		6	HA	<1	0-1 Peat, organic Brown	
0.5						
1		6	HA	<1	2 3 Peat, organic Brown Saturated	
1.5						
2.0						
2.5						
3.0						
				23 July 2011	End of Boring 3 Ft Below Grade Sample 0-2 Ft Below Grade	
						GW Only Goal Supra Perma Frost & Impacts to Bering Sea Only if Supra-Permafrost is encountered at SB003 + SB004

CH2MHILL

PROJECT NUMBER: 403507

BORING NUMBER: 11SAV SB001 SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Army National Guard LOCATION: SAVANNA

ELEVATION: DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT USED: HAND AUGER

WATER LEVELS: START: 7.6.11 END: 7.6.11 LOGGER:

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS PID 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0.5						
1.0		6	HA	10 4	0-1 Clayey SAND WITH GRAVEL BLACK MOIST	DRO
1.5						
2.0		6	HA	24	2 Clayey SAND WITH GRAVEL BLACK MOIST, SATURATED FROM SIDES OF BORE	DRO, GPH, VPH, BTEX, PAH
2.5						
3.0		6	HA			
3.5				231	2.6 ORIGINAL TUNDRA STRONG PETRO ODOR	
						GRAB SOIL (0-1) DRO/~~GRO~~ @ 1200 (2-3') DRO, GPH, VPH BTEX, PAH @ 1230
						2.6 (~~4.5~~) DRO/GRO, GPH VPH, BTEX, PAH @ 1245 @ LOT-SPL OR GW INTERFACE

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 1
403507	11SAR SB002	

SOIL BORING LOG

PROJECT : Army National Guard LOCATION : SARCONYA

ELEVATION : DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

WATER LEVELS : START : END : LOGGER :

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
						GOAL. SOIL (2-3) DRO/RRO (4-5) DRO/RRO

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 1
403507	11SANSB003	

SOIL BORING LOG

PROJECT: ARMY NATIONAL GUARD LOCATION: SAVOONGA

ELEVATION: DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT USED: HAND AUGER

WATER LEVELS: START: 7.6.11 END: 7.6.11 LOGGER: JMH

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
6.5						
1.0		6	HA	0.1	ARMY SAND WITH GRAVEL DARK BROWN	
1.5				<1		
2.0		6	HA	<1	2.5 TUNDRA MAT, ORGANIC PEAT, LIGHT BROWN	DRO
					EOB 2.5 WATER SEEPING IN FROM SURFACE 1 FOOT BELOW GRADE	
						GOAL: SOIL (2-3) DRO/~~RRO~~ 2.5@1331 (4-5) ~~DRO~~/~~RRO~~ @REFUSAL OR GW INTERFACE

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 1
403507	11SAVSB00004	

SOIL BORING LOG

PROJECT: ARMY NATIONAL GUARD
LOCATION: SAVOONGA
ELEVATION:
DRILLING CONTRACTOR:
DRILLING METHOD AND EQUIPMENT USED: HAND AUGER
WATER LEVELS:
START: 7.5.11 END: 7.5.11 LOGGER: JMH

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0						
0.5		6	HA	1.2	0-1 Clayey Sand with GRAVEL, Brown M, St	DRO
10						
15		6	HA	2	~~1-2~~ 2-3 TUNDRA MAT Clayey Sand Brown SATURATED	
20					23 JUL 2011	
					3.2 FT BGS W GRADE	
33 JUL				JUNK	SLUFF SET 1.2-3.2 WATER SEEPING FROM SIDEWALL NO GROUNDWATER. BACKFILL USED ~~ADL~~ NO SCREEN	Soil & GW GRAB: (0-1) DRO/~~RRO~~ @ 1215 (2-3) DRO/~~RRO~~ @ 1515 (4-5) DRO/~~RRO~~ GROUNDWATER TBD DRO/~~RRO~~ SUPRA PERMAFROST HEADSPACE > 5PPM OR VISUAL ADDITIONAL SAMPLES COST (GW)

CH2MHILL

PROJECT NUMBER: 403507

BORING NUMBER: 11SAN SB005

SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Army National Guard

LOCATION: Saipan, MA

ELEVATION:

DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT USED: Hand Auger

WATER LEVELS:

START: 7.6.11

END: 7.6.11

LOGGER:

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0					0-1 Clayey Sand with Gravel	
0.5		6	HA			
1.0						
1.5		6	HA	<1	1-2 Clayey Sand with Gravel, Saturated	DRO 1.3@ MAD
2.0						
						Goal Soil (2-3) DRO/ MAD (4-5) DRO/ RRO

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 1
403507	11SAVSB006	

SOIL BORING LOG

PROJECT: ARMY NATIONAL GUARD LOCATION: SAVANNAH

ELEVATION: DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT USED: HAND AUGER

WATER LEVELS: START: 7.6.11 END: 7.6.11 LOGGER: [illegible]

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0.5		6	HA	41	0-2 Clay Sand with Gravel Dark Brown Moist	
1.0						
1.5						
2.0		6	HA	5.7	1-2 Clayey Sand with Gravel Dark Brown Saturated	DRO
2.5						

Grab Soil

(2-3) DRO / ~~1200~~ @ 1405

(4-5) DRO / ~~1200~~

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 1
403807	11SAN SB007	

SOIL BORING LOG

PROJECT: Army National Guard LOCATION: SAN DIEGO

ELEVATION: DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT USED: Hand Auger

WATER LEVELS: START: 7/5/11 END: 7/5/11 LOGGER: JWT

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0.5		6	HA	10	0-1 Clayey SAND with Gravel, moist, brown; Refusal on rock; Surface water pooling; Siltation on surface	DRO
1.0						
1.5						
2.0						
2.5					End of Boring 1.0 @ Feet Below Grade	
3.0						
3.5					DRO (0-1) @ 1340	
4.0						
4.5					23 Jul 2011	
5.0				21	2-3 Feet Below Grade Saturated From Surface; Hole Filled with Water	
					Blank: ~~Silty Sand~~ w/ Gravel, Sandy Silt	
					Screen Set 2-9 Ft Below Grade	Soil + GW
					24 July 2011 @ 1240	7.23.11 (Grab) (0-1) DRO @ 1340 (2-3) DRO, EPA, VPH, BTEX, PAH (4-5) DRO, EPA, VPH, BTEX, PAH
					Water Filled Some Time Last Night. PVC on Ground This Morning	Groundwater: TBD Surface-Penetrating Soil DRO/ORO, EPA, VPH, BTEX, PAH

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 1
403507	11SNSB0008	

SOIL BORING LOG

PROJECT: Army National Guard
LOCATION:
ELEVATION:
DRILLING CONTRACTOR:
DRILLING METHOD AND EQUIPMENT USED:
WATER LEVELS:
START: 7.5.11 END: 7.5.11 LOGGER: JMH

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0						
0.5		6	HA	1.4	0-1 Clayey Sand and Gravel with organic; Brown. Moist	DRO
1.0					Frozen	
					End of Boring 1.0	
					DRO (0-1) @ 1455	
				<1	24 JUN 2011	
					2.3 Sandy Clay Silt Frozen 2.7	
					@ 0740	
						Gore. Soil
						(2) DRO/RRO
						(4.5) DRO/RRO
						@ Refusal or End Interval

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 1
403507	IISAVSB009	

SOIL BORING LOG

PROJECT: ARMY NATIONAL GUARD LOCATION: SAVOONGA

ELEVATION: DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT USED:

WATER LEVELS: START: 7.5.11 END: 7. LOGGER: JMH

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0		6	HA	1.3	0-1 Clayey SAND with GRAVEL Moist Brown with organics FILL/SOIL ON ROCK	DRO
0.5						
1.0						
1.5						
					END OF BORING 1.0 FEET BELOW GRADE	
					DRO (0-1) @ 1345	
				1.1	2-3 7.23.11 Clayey SAND w/ GRAVEL (2-3) @ 1515	Soil & GW
						GRAB (0-1) DRO/RRO @ 1345
						(2-3) DRO/RRO @ 1515
						(4-5) DRO/RRO
						GROUNDWATER TBD Supplemental if GW encountered or not collected in SB007 DRO/RRO GRO VPH BTEX
						HEADSPACE >5PPM OR VISUAL Additional samples to lab (GW)

CH2MHILL

PROJECT NUMBER: 403507
BORING NUMBER: 11SAVSB0020
SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Army National Guard
LOCATION:
ELEVATION:
DRILLING CONTRACTOR:
DRILLING METHOD AND EQUIPMENT USED:
WATER LEVELS:
START: 7.5.11
END: 7.5.11
LOGGER: JMH

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0 - 0.5 - 1.0		6	1A	1 4	0-2 0.5 CLAYEY SAND WITH GRAVEL MOIST BROWN REFUSAL FROZEN GLOVE BOXING 0.5 (0-0.5) @ ISLS DRO	DRO GOAL: SOIL (0-1) DRO/~~RRO~~ (2-3) DRO/~~RRO~~ (4-5) DRO/~~RRO~~ @ REFUSAL OR GW IMPACTS HEADSPACE >5PPM OR STAINING ADDITIONAL SAMPLES

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 1
403607	11SANSB0011	

SOIL BORING LOG

PROJECT: Army National Guard — LOCATION: Georgia

ELEVATION: — DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT USED:

WATER LEVELS: — START: 7.5.11 — END: 7.5.11 — LOGGER: JMH

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0		6	HA	1.5	0-1 Clayey SAND with Gravel Brown Moist Diffusion Fluorescent	DRO
0.5						
1.0						
1.5						
					End of Boring 1.0 DRO (0.1) @ 1446	
					7.24.11 2-3	
				<1	Sandy Silty Black, Saturated (2-3) @ 0840	
						Grab Soil (2-3) DRO/RRO (4-5) DRO/RRO @ Diffusion or GW Interface

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
403507	11SAVSB0012	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: ARMY NATIONAL GUARD — LOCATION: SANDINGA

ELEVATION: — DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT USED: HAND AUGER

WATER LEVELS: — START: 7.5.11 — END: 7.5.11 — LOGGER: JMH

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0						
0.5		6	HA	1.7	0-1 ORGANIC; PEAT MOIST	DRO
1.0						
1.5					REDDISH; FINE GRAIN	
2.0						
					END OF BORING 1.0	
					0-1 @ 1430 DRO	
					24 JULY 2011	
				<1	2-3 SANDY SILT - BLACK	
					SAMPLED DRO @ 0810	
						GOOD SOIL
						(0-1) DRO/RARE
						(2-3) DRO/RARE
						(4-5) DRO/RARE
						@ REDDISH OR GRAY INTERFACE
						HEADSPACE > 5PPM OR SIGNIFICANT ODOR
						NO MOIST

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 1
403507	11SAVSB0013	

SOIL BORING LOG

PROJECT: ARMY NATIONAL GUARD
LOCATION: SAVOONGA
ELEVATION:
DRILLING CONTRACTOR:
DRILLING METHOD AND EQUIPMENT USED: HAND AUGER
START: 7.5.11 END: 7.5.11 LOGGER: JMH
WATER LEVELS:

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): %G %S %F
0						
0.5		6	HA	<1	0-1 ORGANICS, MOIST BLACK	DRO
1.0		6	HA	1-3	1-1.5 SILTY CLAY BLACK MOIST	
2.5					FROZEN, REFUSAL	
					END OF BORING 1.5 DRO (0-1) @ 1415	
					24 JULY 2011 SANDY CLAY FROZEN ~3 FEET	
						GRAB SOIL (0-1) DRO/RRO (2-3) DRO/RRO (4-5) DRO/RRO @ REFUSAL OR GW INTERFACE
						HEADSPACE > SPOON OR SITE NO ADDL INVESTIGATION

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: GW1

Project: U.S. Army National Guard FSRC Gap Analysis — Date: 2/24/2011

Project #: 403507 — Start Time: _____

Field Team: _____ — End Time: _____

Sample ID: _____ Time: _____ primary dup other: _____

Sample ID: _____ Time: _____ primary dup other: _____

Sample ID: _____ Time: _____ primary dup other: _____

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):		Depth to Water (FTOC):	4.10
Depth to Oil/Water Interface (FTOC):		Total Depth (FTOC):	5.54
Casing diameter:	1 in / 2 in.	Water Column (Ft):	
gal/Ft of casing:	0.041 / 0.163	Casing Volume (gal)	
Pump Intake Depth		Screen Interval	
Stable DTW (FTOC):		Measured Stickup	

Method of Purging (circle one)

Pump: SUB BLDR PERIST OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: Flow Rate (gpm):	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: Vol. Purged (gals):	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*
Temperature	>0.00 °C	± 1.0 °C	Time DTW
pH	0-14	± 0.1	
Conductivity	0-9.99 S/m	± 3%	
Dissolved Oxygen	0-19.99 mg/L	± 10% or 0.2 mg/L	
Turbidity	0-800 NTU	± 10% or <10 NTU	

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1643	5.51	0.1	6.44	757	NA	32.8	4.63	81.2
2	1648	purged dry	0.2	5.93	742	—	28.6	4.87	110.5
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, Brown, Grey, Milky White, Other:

Odor: None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: None, Low, Medium, High, Very Turbid, Heavy Silts

Comments:

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: GW2

Project: U.S. Army National Guard FSRC Gap Analysis — Date: 7/24/20

Project #: 403507 — Start Time: 1708

Field Team: — End Time:

Sample ID: — Time: ____ primary dup other: ____

Sample ID: — Time: ____ primary dup other: ____

Sample ID: — Time: ____ primary dup other: ____

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):	NA	Depth to Water (FTOC):	
Depth to Oil/Water Interface (FTOC):		Total Depth (FTOC):	4.47
Casing diameter:	1 in 2 in.	Water Column (Ft):	
gal/Ft of casing:	0.041 0.163	Casing Volume (gal)	
Pump Intake Depth		Screen Interval	
Stable DTW (FTOC):		Measured Stickup	

Method of Purging (circle one)

Pump: SUB BLDR (PERIST) OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: Geopump 2 Flow Rate (gpm):	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: Vol. Purged (gals):	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*
Temperature	>0.00 °C	± 1.0 °C	Time DTW
pH	0-14	± 0.1	
Conductivity	0-9.99 S/m	± 3%	
Dissolved Oxygen	0-19.99 mg/L	± 10% or 0.2 mg/L	
Turbidity	0-800 NTU	± 10% or <10 NTU	

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*	
1	1708	4.06	0.1	6.36	1142	NA	11.33	5.36	-44.5	purge dry
2	1723	4.38	0.2	6.49	1108	—	11.0	5.55	-46.9	purge dry
3										
4										
5										
6										
7										
8										
9										

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, (Brown), Grey, Milky White, Other:

Odor: None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: None, Low, Medium, High, (Very Turbid), Heavy Silts

Comments:

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: SBGW4

Project: U.S. Army National Guard FSRC Gap Analysis — Date: 7/24/20

Project #: 403507 — Start Time: 1530

Field Team: Rit, ML — End Time:

Sample ID: _____ Time: _____ primary dup other: _____

Sample ID: _____ Time: _____ primary dup other: _____

Sample ID: _____ Time: _____ primary dup other: _____

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):		Depth to Water (FTOC):	3.90
Depth to Oil/Water Interface (FTOC):		Total Depth (FTOC):	5.44 BTOC
Casing diameter:	1 in 2 in.	Water Column (Ft):	
gal/Ft of casing:	0.041 0.163	Casing Volume (gal)	
Pump Intake Depth		Screen Interval	
Stable DTW (FTOC):		Measured Stickup	

Method of Purging (circle one)

Pump: SUB BLDR PERIST OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: Geop 4/ Flow Rate (gpm):	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: Vol. Purged (gals):	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*
Temperature	>0.00 °C	± 1.0 °C	Time DTW
pH	0-14	± 0.1	
Conductivity	0-9.99 S/m	± 3%	
Dissolved Oxygen	0-19.99 mg/L	± 10% or 0.2 mg/L	
Turbidity	0-800 NTU	± 10% or <10 NTU	

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm) µ*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1535	4.35	0.1	6.35	867	NA	24.8	4.58	58.0
2	1540	4.86	0.2	6.29	858	—	12.6	4.24	34.2
3	1545	5.40 Purged dry	0.3	6.29	851	—	14.0	3.87	16.0
4	1601	5.86	0.4	6.40	781	—	13.7	4.44	1.3
5									
6									
7									
8									
9									

purged dry

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color:	Clear, Amber, Tan, Brown, Grey, Milky White, Other:
Odor:	None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity:	None, Low, Medium, High, Very Turbid, Heavy Silts

Comments:

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: SB7 GW

Project: U.S. Army National Guard FSRC Gap Analysis — Date: 7/24/2011

Project #: 403507 — Start Time: 1735

Field Team: RH, ML — End Time: _____

Sample ID: 11SAVSB007_GWOX — Time: 1540 primary dup other: _____

Sample ID: 11SAVSB907_GWOX — Time: 1525 primary dup other: _____

Sample ID: _____ — Time: _____ primary dup other: _____

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):		Depth to Water (FTOC):	4.06
Depth to Oil/Water Interface (FTOC):		Total Depth (FTOC):	
Casing diameter:	1 in 2 in.	Water Column (Ft):	
gal/Ft of casing:	0.041 0.163	Casing Volume (gal)	
Pump Intake Depth		Screen Interval	
Stable DTW (FTOC):		Measured Stickup	

Method of Purging (circle one)

Pump: SUB BLDR (PERIST) OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: Geopump 2 Flow Rate (gpm):	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: Vol. Purged (gals):	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*
Temperature	>0.00 °C	± 1.0 °C	Time DTW
pH	0-14	± 0.1	
Conductivity	0-9.99 S/m	± 3%	
Dissolved Oxygen	0-19.99 mg/L	± 10% or 0.2 mg/L	
Turbidity	0-800 NTU	± 10% or <10 NTU	

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1739	4.13	0.1	6.78	514	NA	3.6	5.06	-13.1
2	1745	4.13	0.2	6.67	510	—	3.3	5.51	-21.8
3	1749	4.21	0.3	6.68	508	—	2.7	5.91	-25.7
4	1754	4.30	0.4	6.66	500	—	2.9	6.59	-26.1
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, (Brown), Grey, Milky White, Other:

Odor: None, (Low), Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: None, Low, Medium, High, (Very Turbid), Heavy Silts

Comments:

Appendix B
Laboratory Reports and Data Quality Evaluation

(laboratory reports provided electronically only)

Alaska Federal Scout Readiness Center - Savoonga
Soil and Groundwater Sampling – July 2011
Data Quality Evaluation Report

Introduction

The objective of this data quality evaluation (DQE) report is to assess the data quality of analytical results for soil and groundwater samples collected from the Alaska Federal Scout Readiness Center – Savoonga. Samples were collected to address data gaps in the characterization of total petroleum hydrocarbon contamination at the site. Individual method requirements and guidelines from the Work Plan for Site Characterization at 21 Alaska Federal Scout Readiness Centers, Alaska Army National Guard, April 2011 (ANG QAPP) were used in this assessment.

This report is intended as a general data quality assessment designed to summarize data issues.

Analytical Data

This DQE report covers 21 normal soil samples , four normal groundwater samples, one groundwater field duplicate (FD), five trip blanks (TB) and one equipment blank (EB). All samples were collected July 5 through July 24, 2011. A list of samples associated with this DQE is included in Attachment A. The sample results were reported as three sample delivery groups (SDG) presented in Table 1. The analyses were performed by TestAmerica in Sacramento, California (SVLS) and TestAmerica in Tacoma, Washington (SVTT). Samples were collected and shipped by overnight carrier to SVLS. SVLS was responsible for shipment of samples to SVTT.

Table 1
Sample Delivery Groups

G1G120514
G1G260466
G1G270477

Five methods were used to analyze the environmental samples. Selected samples were analyzed for one or more of the following analytes/methods in Table 2.

Table 2
Analytical Parameters

Parameter	Method	Laboratory
Diesel Range Organics (DRO)	AK102	SVLS
Extractable Petroleum Hydrocarbon Speciation (EPH)	NWEPH	SVTT
Purgeable Petroleum Hydrocarbon Speciation (VPH)	NWVPH	SVTT
Volatile Organic Compounds	SW8260B	SVLS
Polynuclear Aromatic Hydrocarbons	SW8270C-SIM	SVLS

The assessment of data includes a review of: (1) the chain-of-custody documentation; (2) holding-time compliance; (3) the required quality control (QC) samples at the specified frequencies; (4) method blanks; (5) laboratory control sample/laboratory control sample duplicates (LCS/LCSD); (6) surrogate spike recoveries; (7) matrix spike/matrix spike duplicate (MS/MSD) samples; and (8) initial and continuing calibration information and other method-specific criteria as defined by the ANG QAPP.

Field samples were also reviewed to ascertain field compliance and data quality issues. This included a review of FDs, TBs and an EB.

Data flags were assigned according to the ANG QAPP. Multiple flags are routinely applied to specific sample method/matrix/analyte combinations, but there will be only one final flag. A final flag is applied to the data and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample impacts.

The data flags are those listed in the ANG QAPP and are defined below:

- J = The analyte was positively identified, and the quantitation is an estimation because of discrepancies in meeting certain analyte-specific QC criteria. Or the analyte was positively identified, but the associated concentration is estimated above the method detection limit and below the limit of quantitation (LOQ).

- R = The data are rejected because of deficiencies in meeting QC criteria and may not be used for decision making.

- B = The analyte was detected in the sample at a concentration less than or equal to five times (10 times for common laboratory contaminants) the blank concentration.

- U = The analyte was analyzed for, but the analyte was not detected.

- UJ = The analyte was not detected; however, the result is estimated because of discrepancies in meeting certain analyte-specific QC criteria.

Findings

The overall summaries of the data validation findings are contained in the following sections and Table 3.

Also included as documentation of data validation findings is the Alaska Department of Environmental Conservation Laboratory Data Review Checklist (Version 2.7, January 2010). A checklist is provided for each laboratory SDG and can be found in Attachment B to this DQE. Only QC exceedances that resulted in data qualifiers being applied are discussed in the text and laboratory checklists.

Holding Times

All holding-time criteria were met with the following exceptions:

Groundwater samples 11SAVSB007_GWOX and 11SAVSB907_GWOX were extracted three days past holding time for Method SW8260B due to laboratory oversight. Twelve associated non-detected results were qualified as estimated and flagged "UJ".

Calibration

All initial and continuing calibration criteria were met.

Method Blanks

Method blanks were analyzed at the required frequency and were free of contamination with the following exceptions:

C16-C21 aliphatics and C8-C10 aliphatics were detected below the LOQ in the method blanks for Method NWEPH. Four associated soil sample results, and one associated groundwater sample result, were detected less than five times the blank concentrations. The results were qualified as estimated and flagged "B".

C12-C13 aromatics, C5-C6 aliphatics, C6-C8 aliphatics, C8-C10 aromatics, and total VPH were detected below the LOQ in the method blanks for Method NWVPH. Seven associated soil sample results, and four associated groundwater sample results, were detected less than five times the blank concentrations. The results were qualified as estimated and flagged "B".

Field Blanks

Five TBs were collected and were free of contamination with the following exceptions:

C12-C13 aromatics and total VPH were detected below the LOQ in the TBs for Method NWVPH. Four associated groundwater sample results were detected less than five times the blank concentrations. The results were qualified as estimated and flagged "B".

One EB was collected and was free of contamination with one exception.

DRO was detected below the LOQ in the EB for Method AK102. Six associated soil sample results were detected less than five times the blank concentration. The results were qualified as estimated and flagged "B".

Field Duplicates

One FD set was collected. Precision was acceptable. A summary of FD precision is included in Table 4.

Matrix Spike Samples

The results of MS/MSD analyses provide information about the possible influence of the matrix on either accuracy or precision of the measurements. The field crew designated samples for MS/MSD analysis. All acceptance criteria were met with a few exceptions.

The recoveries of C10-C12 aliphatics, C21-C34 aliphatics, C21-C34 aromatics, and C8-C10 aliphatics were less than ANG QAPP criteria in the MS and/or MSD of soil sample 11SAVSB007_SO02-03 for Method NWEPH, indicating associated sample results are possibly biased low. Additionally, the RPDs of C10-C12 aliphatics and C12-C16 aliphatics were above ANG QAPP criteria in the MS/MSD set of this same sample. Five associated detected soil sample results were qualified as estimated and flagged "J".

Surrogates

Surrogates were added to all samples for the methods requiring their use. Surrogate recoveries met criteria with a few exceptions.

Surrogate recovery was less than ANG QAPP criteria in soil sample 11SAVSB001_SO02 for Method SW8260B, indicating associated sample results are possibly biased low. Six associated detected results were qualified as estimated and flagged "J".

Surrogate recovery was less than ANG QAPP criteria in groundwater sample 11SAVSB907_GWOX for Method SW8270C-SIM, indicating associated sample results are possibly biased low. Four associated detected results were qualified as estimated and flagged "J"; 14 associated non-detected results were qualified as estimated and flagged "UJ".

Surrogate recovery was greater than ANG QAPP criteria in groundwater sample 11SAVSB004_GWOX for Method AK102, indicating associated sample results are possibly biased high. One associated detected result was qualified as estimated and flagged "J".

Laboratory Control Samples

LCS/LCSDs were analyzed and all accuracy and precision criteria were met with one exception.

The recoveries of C8-C10 aliphatics and C8-C10 aromatics were less than ANG QAPP criteria in a LCS and/or LCSD for Method NWEPH, indicating associated sample results are possibly biased low. Two associated detected groundwater sample results were qualified as estimated and flagged "J"; two associated non-detected groundwater sample results were qualified as estimated and flagged "UJ".

Internal Standards

All internal standard acceptance criteria were met.

Chain of Custody

Groundwater sample 11SAVSB907_GWOX was received at the laboratory improperly preserved for Method SW8270C-SIM. Four associated detected sample results were qualified as

estimated and flagged "J"; 14 associated non-detected results were qualified as estimated and flagged "UJ".

Overall Assessment

The final activity in the DQE is an assessment of whether the data meet the data quality objectives. The goal of this assessment is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the decision making process. The precision, accuracy, representativeness, completeness and comparability are addressed in the ANG QAPP. The following summary highlights the data evaluation findings for the above defined events:

1. No data were rejected and the completeness objective of 90 percent for soil samples and 95 percent for aqueous samples for each matrix/method/analyte combination was met.
2. Approximately 28 percent of the AK102 soil data were qualified because of low-level field blank contamination. The degree to which blank contamination was observed is within reasonable method expectations considering the small size of the dataset.
3. Approximately 4 percent of the NWEPH soil data, and 20 percent of the NWEPH groundwater data, were qualified because of low-level laboratory blank contamination. The degree to which blank contamination was observed is within reasonable method expectations considering the small size of the dataset.
4. Approximately 30 percent of the NWVPH soil data, and 25 percent of the NWVPH groundwater data, were qualified because of low-level laboratory blank contamination. The degree to which blank contamination was observed is within reasonable method expectations considering the small size of the dataset.
5. Surrogate recovery exceedances were observed for Methods AK102, SW8260B, and SW8270C-SIM; 25 results were qualified as estimated.
6. LCS/LCSD recovery exceedances were observed for Method NWEPH; four results were qualified as estimated.
7. MS/MSD recovery and RPD exceedances were observed for Method NWEPH; five results were qualified as estimated.
8. Two groundwater samples were extracted outside of holding time for Method SW8260B due to laboratory oversight; 12 results were qualified as estimated.
9. One groundwater sample was received at the laboratory improperly preserved for Method SW8270C-SIM; 18 results were qualified as estimated.
10. Although data were qualified as estimated due to QC exceedances as noted, overall precision and accuracy of the data, as measured by field and laboratory QC indicators suggest that data are usable for projects objectives.

Table 3 – Validation Flags

Field ID	Method	Analyte	Final Result	Units	Final Flag	Reason
11SAVSB0004_SO0-02	AK102	Diesel Range Organics	2.6	mg/kg	B	EB<LOQ
11SAVSB001_SO02	NWVPH	C5-C6 Aliphatics	1.8	mg/Kg	B	LB<LOQ
11SAVSB001_SO02	SW8260B	Benzene	0.27	mg/kg	J	Sur<LCL
11SAVSB001_SO02	SW8260B	Ethylbenzene	11	mg/kg	J	Sur<LCL
11SAVSB001_SO02	SW8260B	m-Xylene & p-Xylene	29	mg/kg	J	Sur<LCL
11SAVSB001_SO02	SW8260B	o-Xylene	21	mg/kg	J	Sur<LCL
11SAVSB001_SO02	SW8260B	Toluene	1.1	mg/kg	J	Sur<LCL
11SAVSB001_SO02	SW8260B	Xylenes (total)	50	mg/kg	J	Sur<LCL
11SAVSB001_SO2.6	NWVPH	C5-C6 Aliphatics	1.7	mg/Kg	B	LB<LOQ
11SAVSB001_SO2.6	NWVPH	C6-C8 Aliphatics	22	mg/Kg	B	LB<LOQ
11SAVSB0010_SO00-01	AK102	Diesel Range Organics	2.4	mg/kg	B	EB<LOQ
11SAVSB0011_SO00-01	AK102	Diesel Range Organics	1.1	mg/kg	B	EB<LOQ
11SAVSB004_GWOX	AK102	Diesel Range Organics	18000	ug/L	J	Sur>UCL
11SAVSB005_SO01.8	AK102	Diesel Range Organics	2.9	mg/kg	B	EB<LOQ
11SAVSB007_GWOX	NWEPH	C16-C21 Aliphatics	7.9	ug/L	B	LB<LOQ
11SAVSB007_GWOX	NWEPH	C8-C10 Aliphatics	6.3	ug/L	B	LCSD<LCL
11SAVSB007_GWOX	NWEPH	C8-C10 Aliphatics	6.3	ug/L	B	LB<LOQ
11SAVSB007_GWOX	NWEPH	C8-C10 Aliphatics	6.3	ug/L	B	LCS<LCL
11SAVSB007_GWOX	NWEPH	C8-C10 Aromatics	15	ug/L	UJ	LCS<LCL
11SAVSB007_GWOX	NWVPH	C12-C13 Aromatics	15	ug/L	B	LB<LOQ
11SAVSB007_GWOX	NWVPH	C12-C13 Aromatics	15	ug/L	B	TB<LOQ
11SAVSB007_GWOX	NWVPH	Total VPH	41	ug/L	B	TB<LOQ
11SAVSB007_GWOX	NWVPH	Total VPH	41	ug/L	B	LB<LOQ
11SAVSB007_GWOX	SW8260B	Benzene	0.2	ug/L	UJ	HTa>UCL
11SAVSB007_GWOX	SW8260B	Ethylbenzene	0.2	ug/L	UJ	HTa>UCL
11SAVSB007_GWOX	SW8260B	m-Xylene & p-Xylene	0.8	ug/L	UJ	HTa>UCL
11SAVSB007_GWOX	SW8260B	o-Xylene	0.4	ug/L	UJ	HTa>UCL
11SAVSB007_GWOX	SW8260B	Toluene	0.4	ug/L	UJ	HTa>UCL
11SAVSB007_GWOX	SW8260B	Xylenes (total)	1.2	ug/L	UJ	HTa>UCL
11SAVSB007_SO02-03	NWEPH	C10-C12 Aliphatics	1	mg/Kg	J	SD<LCL
11SAVSB007_SO02-03	NWEPH	C10-C12 Aliphatics	1	mg/Kg	J	MSRPD
11SAVSB007_SO02-03	NWEPH	C12-C16 Aliphatics	2.4	mg/Kg	J	MSRPD
11SAVSB007_SO02-03	NWEPH	C21-C34 Aliphatics	7.2	mg/Kg	J	SD<LCL
11SAVSB007_SO02-03	NWEPH	C21-C34 Aliphatics	7.2	mg/Kg	J	MS<LCL
11SAVSB007_SO02-03	NWEPH	C21-C34 Aromatics	9.9	mg/Kg	J	SD<LCL
11SAVSB007_SO02-03	NWEPH	C21-C34 Aromatics	9.9	mg/Kg	J	MS<LCL
11SAVSB007_SO02-03	NWEPH	C8-C10 Aliphatics	0.4	mg/Kg	B	LB<LOQ
11SAVSB007_SO02-03	NWEPH	C8-C10 Aliphatics	0.4	mg/Kg	B	SD<LCL

Field ID	Method	Analyte	Final Result	Units	Final Flag	Reason
11SAVSB007_SO02-03	NWEPH	C8-C10 Aliphatics	0.4	mg/Kg	B	MS<LCL
11SAVSB007_SO02-03	NWVPH	C12-C13 Aromatics	0.17	mg/Kg	B	LB<LOQ
11SAVSB007_SO02-03	NWVPH	C5-C6 Aliphatics	0.13	mg/Kg	B	LB<LOQ
11SAVSB007_SO02-03	NWVPH	C8-C10 Aromatics	0.18	mg/Kg	B	LB<LOQ
11SAVSB007_SO02-03	NWVPH	Total VPH	0.7	mg/Kg	B	LB<LOQ
11SAVSB008_SO00-01	AK102	Diesel Range Organics	1.7	mg/kg	B	EB<LOQ
11SAVSB009_SO00-01	AK102	Diesel Range Organics	1.6	mg/kg	B	EB<LOQ
11SAVSB907_GWOX	NWEPH	C16-C21 Aliphatics	8.5	ug/L	B	LB<LOQ
11SAVSB907_GWOX	NWEPH	C8-C10 Aliphatics	6.3	ug/L	B	LCSD<LCL
11SAVSB907_GWOX	NWEPH	C8-C10 Aliphatics	6.3	ug/L	B	LCS<LCL
11SAVSB907_GWOX	NWEPH	C8-C10 Aliphatics	6.3	ug/L	B	LB<LOQ
11SAVSB907_GWOX	NWEPH	C8-C10 Aromatics	15	ug/L	UJ	LCS<LCL
11SAVSB907_GWOX	NWVPH	C12-C13 Aromatics	15	ug/L	B	LB<LOQ
11SAVSB907_GWOX	NWVPH	C12-C13 Aromatics	15	ug/L	B	TB<LOQ
11SAVSB907_GWOX	NWVPH	Total VPH	44	ug/L	B	TB<LOQ
11SAVSB907_GWOX	NWVPH	Total VPH	44	ug/L	B	LB<LOQ
11SAVSB907_GWOX	SW8260B	Benzene	0.2	ug/L	UJ	HTa>UCL
11SAVSB907_GWOX	SW8260B	Ethylbenzene	0.2	ug/L	UJ	HTa>UCL
11SAVSB907_GWOX	SW8260B	m-Xylene & p-Xylene	0.8	ug/L	UJ	HTa>UCL
11SAVSB907_GWOX	SW8260B	o-Xylene	0.4	ug/L	UJ	HTa>UCL
11SAVSB907_GWOX	SW8260B	Toluene	0.4	ug/L	UJ	HTa>UCL
11SAVSB907_GWOX	SW8260B	Xylenes (total)	1.2	ug/L	UJ	HTa>UCL
11SAVSB907_GWOX	SW8270C-SIM	1-Methylnaphthalene	0.25	ug/L	J	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	1-Methylnaphthalene	0.25	ug/L	J	PRES
11SAVSB907_GWOX	SW8270C-SIM	2-Methylnaphthalene	0.27	ug/L	J	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	2-Methylnaphthalene	0.27	ug/L	J	PRES
11SAVSB907_GWOX	SW8270C-SIM	Acenaphthene	0.052	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Acenaphthene	0.052	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Acenaphthylene	0.052	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Acenaphthylene	0.052	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Anthracene	0.052	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Anthracene	0.052	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Benzo(a)anthracene	0.052	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Benzo(a)anthracene	0.052	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Benzo(a)pyrene	0.052	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Benzo(a)pyrene	0.052	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Benzo(b)fluoranthene	0.1	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Benzo(b)fluoranthene	0.1	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Benzo(ghi)perylene	0.052	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Benzo(ghi)perylene	0.052	ug/L	UJ	PRES

Field ID	Method	Analyte	Final Result	Units	Final Flag	Reason
11SAVSB907_GWOX	SW8270C-SIM	Benzo(k)fluoranthene	0.052	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Benzo(k)fluoranthene	0.052	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Chrysene	0.052	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Chrysene	0.052	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Dibenz(a,h)anthracene	0.1	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Dibenz(a,h)anthracene	0.1	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Fluoranthene	0.052	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Fluoranthene	0.052	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Fluorene	0.027	ug/L	J	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Fluorene	0.027	ug/L	J	PRES
11SAVSB907_GWOX	SW8270C-SIM	Indeno(1,2,3-cd)pyrene	0.1	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Indeno(1,2,3-cd)pyrene	0.1	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Naphthalene	0.098	ug/L	J	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Naphthalene	0.098	ug/L	J	PRES
11SAVSB907_GWOX	SW8270C-SIM	Phenanthrene	0.052	ug/L	UJ	PRES
11SAVSB907_GWOX	SW8270C-SIM	Phenanthrene	0.052	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Pyrene	0.052	ug/L	UJ	Sur<LCL
11SAVSB907_GWOX	SW8270C-SIM	Pyrene	0.052	ug/L	UJ	PRES

Notes:
EB<LOQ =Equipment blank concentration less than the limit of quantitation
HTa>UCL = Analytical holding time exceeded
LB<LOQ = Laboratory blank concentration less than the limit of quantitation
LCS<LCL = Laboratory control sample recovery less than the lower control limit
LCSD<LCL = Laboratory control sample duplicate recovery less than the lower control limit
MS<LCL = Matrix spike recovery less than the lower control limit
MSRPD = Matrix spike relative percent difference criterion exceeded
PRES = Sample improperly preserved
SD<LCL = Matrix spike duplicate recovery less than the lower control limit
Sur<LCL = Surrogate recovery less than lower control limit
Sur>UCL = Surrogate recovery greater than upper control limit
TB<LOQ =Trip blank concentration less than the limit of quantitation

Table 4 – Field Duplicate Precision

Method	Analyte	Normal Sample	Normal Result	Field Duplicate	Duplicate Result	RPD	Criteria	Matrix
AK102	Diesel Range Organics	11SAVSB007_GWOX	1100	11SAVSB907_GWOX	940	16	20	WATER
NWEPH	C10-C12 Aliphatics	11SAVSB007_GWOX	8.7 J	11SAVSB907_GWOX	9.5 J	NC	20	WATER
NWEPH	C10-C12 Aromatics	11SAVSB007_GWOX	10 J	11SAVSB907_GWOX	9.2 J	NC	20	WATER
NWEPH	C12-C16 Aliphatics	11SAVSB007_GWOX	12 J	11SAVSB907_GWOX	14 J	NC	20	WATER
NWEPH	C12-C16 Aromatics	11SAVSB007_GWOX	28 J	11SAVSB907_GWOX	28 J	NC	20	WATER
NWEPH	C16-C21 Aliphatics	11SAVSB007_GWOX	7.9 B	11SAVSB907_GWOX	8.5 B	NC	20	WATER
NWEPH	C16-C21 Aromatics	11SAVSB007_GWOX	14 J	11SAVSB907_GWOX	15 J	NC	20	WATER
NWEPH	C21-C34 Aliphatics	11SAVSB007_GWOX	16 J	11SAVSB907_GWOX	17 J	NC	20	WATER
NWEPH	C21-C34 Aromatics	11SAVSB007_GWOX	37 J	11SAVSB907_GWOX	45 J	NC	20	WATER
NWEPH	C8-C10 Aliphatics	11SAVSB007_GWOX	6.3 B	11SAVSB907_GWOX	6.3 B	NC	20	WATER
NWEPH	C8-C10 Aromatics	11SAVSB007_GWOX	15 UJ	11SAVSB907_GWOX	15 UJ	NC	20	WATER
NWVPH	C10-C12 Aliphatics	11SAVSB007_GWOX	7.2 J	11SAVSB907_GWOX	7.5 J	NC	20	WATER
NWVPH	C10-C12 Aromatics	11SAVSB007_GWOX	14 J	11SAVSB907_GWOX	14 J	NC	20	WATER
NWVPH	C12-C13 Aromatics	11SAVSB007_GWOX	15 B	11SAVSB907_GWOX	15 B	NC	20	WATER
NWVPH	C5-C6 Aliphatics	11SAVSB007_GWOX	2.9 U	11SAVSB907_GWOX	3.9 J	NC	20	WATER
NWVPH	C6-C8 Aliphatics	11SAVSB007_GWOX	0.8 U	11SAVSB907_GWOX	0.8 U	NC	20	WATER
NWVPH	C8-C10 Aliphatics	11SAVSB007_GWOX	1.6 U	11SAVSB907_GWOX	1.6 U	NC	20	WATER
NWVPH	C8-C10 Aromatics	11SAVSB007_GWOX	5.2 U	11SAVSB907_GWOX	5.2 U	NC	20	WATER
NWVPH	Total VPH	11SAVSB007_GWOX	41 B	11SAVSB907_GWOX	44 B	NC	20	WATER
SW8260B	Benzene	11SAVSB007_GWOX	0.2 UJ	11SAVSB907_GWOX	0.2 UJ	NC	30	WATER
SW8260B	Ethylbenzene	11SAVSB007_GWOX	0.2 UJ	11SAVSB907_GWOX	0.2 UJ	NC	30	WATER
SW8260B	m-Xylene & p-Xylene	11SAVSB007_GWOX	0.8 UJ	11SAVSB907_GWOX	0.8 UJ	NC	30	WATER
SW8260B	o-Xylene	11SAVSB007_GWOX	0.4 UJ	11SAVSB907_GWOX	0.4 UJ	NC	30	WATER
SW8260B	Toluene	11SAVSB007_GWOX	0.4 UJ	11SAVSB907_GWOX	0.4 UJ	NC	30	WATER
SW8260B	Xylenes (total)	11SAVSB007_GWOX	1.2 UJ	11SAVSB907_GWOX	1.2 UJ	NC	30	WATER
SW8270C-SIM	1-Methylnaphthalene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.25 J	NC	30	WATER
SW8270C-SIM	2-Methylnaphthalene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.27 J	NC	30	WATER
SW8270C-SIM	Acenaphthene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.052 UJ	NC	30	WATER
SW8270C-SIM	Acenaphthylene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.052 UJ	NC	30	WATER
SW8270C-SIM	Anthracene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.052 UJ	NC	30	WATER
SW8270C-SIM	Benzo(a)anthracene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.052 UJ	NC	30	WATER

Method	Analyte	Normal Sample	Normal Result	Field Duplicate	Duplicate Result	RPD	Criteria	Matrix
SW8270C-SIM	Benzo(a)pyrene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.052 UJ	NC	30	WATER
SW8270C-SIM	Benzo(b)fluoranthene	11SAVSB007_GWOX	0.21 U	11SAVSB907_GWOX	0.1 UJ	NC	30	WATER
SW8270C-SIM	Benzo(ghi)perylene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.052 UJ	NC	30	WATER
SW8270C-SIM	Benzo(k)fluoranthene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.052 UJ	NC	30	WATER
SW8270C-SIM	Chrysene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.052 UJ	NC	30	WATER
SW8270C-SIM	Dibenz(a,h)anthracene	11SAVSB007_GWOX	0.21 U	11SAVSB907_GWOX	0.1 UJ	NC	30	WATER
SW8270C-SIM	Fluoranthene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.052 UJ	NC	30	WATER
SW8270C-SIM	Fluorene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.027 J	NC	30	WATER
SW8270C-SIM	Indeno(1,2,3-cd)pyrene	11SAVSB007_GWOX	0.21 U	11SAVSB907_GWOX	0.1 UJ	NC	30	WATER
SW8270C-SIM	Naphthalene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.098 J	NC	30	WATER
SW8270C-SIM	Phenanthrene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.052 UJ	NC	30	WATER
SW8270C-SIM	Pyrene	11SAVSB007_GWOX	0.11 U	11SAVSB907_GWOX	0.052 UJ	NC	30	WATER

NC = Not calculated because both results were not reported above the LOQ

Attachment A

Sample ID	Sample Type	Collection Date	Matrix
11SAVGW001_GWOX	N	7/24/2011	WATER
11SAVGW002_GWOX	N	7/24/2011	WATER
11SAVSB0001_SO00-01	N	7/6/2011	SOIL
11SAVSB0004_SO0-02	N	7/6/2011	SOIL
11SAVSB001_SO02	N	7/6/2011	SOIL
11SAVSB001_SO2.6	N	7/6/2011	SOIL
11SAVSB0010_SO00-01	N	7/5/2011	SOIL
11SAVSB0011_SO00-01	N	7/5/2011	SOIL
11SAVSB0012_SO00-01	N	7/5/2011	SOIL
11SAVSB0012_SO02-03	N	7/24/2011	SOIL
11SAVSB0013_SO00-01	N	7/5/2011	SOIL
11SAVSB003_SO2.5	N	7/6/2011	SOIL
11SAVSB004_GWOX	N	7/24/2011	WATER
11SAVSB004_SO02-03	N	7/6/2011	SOIL
11SAVSB005_SO01.8	N	7/6/2011	SOIL
11SAVSB006_SO02	N	7/6/2011	SOIL
11SAVSB007_GWOX	N	7/24/2011	WATER
11SAVSB007_SO00-01	N	7/5/2011	SOIL
11SAVSB007_SO02-03	N	7/23/2011	SOIL
11SAVSB008_SO00-01	N	7/5/2011	SOIL
11SAVSB008_SO02-03	N	7/24/2011	SOIL
11SAVSB009_SO00-01	N	7/5/2011	SOIL
11SAVSB009_SO02-03	N	7/23/2011	SOIL
11SAVSB011_SO02-03	N	7/24/2011	SOIL
11SAVSB013_SO02-03	N	7/24/2011	SOIL
11SAVSB907_GWOX	FD	7/24/2011	WATER
Equipment Blank_070611	EB	7/6/2011	WATER
Trip Blank_070611	TB	7/6/2011	WATER
Trip Blank_070611_2	TB	7/6/2011	WATER
Trip Blank_1_072411	TB	7/24/2011	SOIL
Trip Blank_2_072411	TB	7/24/2011	SOIL
TRIP BLANK_GWOX072411	TB	7/24/2011	WATER

Notes:
EB = equipment blank
FD= field duplicate
N = normal sample

TB = trip blank

Laboratory Data Review Checklist

Completed by:	Jamie Beckett		
Title:	Associate Chemist	Date:	Dec 13, 2011
CS Report Name:		Report Date:	Aug 2, 2011
Consultant Firm:	CH2M Hill		
Laboratory Name:	TestAmerica Sacramento	Laboratory Report Number:	G1G120514
ADEC File Number:		ADEC RecKey Number:	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

(•) Yes ( ) No ( ) NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

TestAmerica Seattle

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

b. Correct analyses requested?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

All samples received intact and within temperature.

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

( ) Yes ( ) No (•) NA (Please explain) Comments:

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable.

4. Case Narrative

a. Present and understandable?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

Detects in the method blank for method NWVPH.

c. Were all corrective actions documented?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Data qualified as estimated.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

b. All applicable holding times met?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

c. All soils reported on a dry weight basis?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

ii. All method blank results less than PQL?

( ) Yes (•) No ( ) NA (Please explain) Comments:

C5-C6 Aliphatics and C6-C8 Aliphatics for method NWVPH.

iii. If above PQL, what samples are affected? Comments:

11SAVSB001_SO02, 11SAVSB001_SO2.6

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain) Comments:

Associated sample results less than five times the blank concentration were flagged "B".

v. Data quality or usability affected? (Please explain) Comments:

Data qualified as estimated.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

○ Yes ○ No ◉ NA (Please explain) Comments:

No metals analyzed.

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain) Comments:

NA

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

NA

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain) Comments:

vii. Data quality or usability affected? (Please explain) Comments:

All data are usable.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

○ Yes ◉ No ○ NA (Please explain) Comments:

Surrogate recovery exceedances were observed for Method SW8260B.

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain) Comments:

For low recoveries, associated detected results were flagged "J".

iv. Data quality or usability affected? (Use the comment box to explain.). Comments:

Data qualified as estimated in sample 11SAVSB001_SO02.

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?

Comments:

NA

v. Data quality or usability affected? (Please explain.)

Comments:

NA

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain) Comments:

No FD in this SDG (see G1G270477)

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

No FD in this SDG (see G1G270477)

iii. Precision - All relative percent differences (RPD) less than specified DQOs?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute Value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

○ Yes ○ No ◉ NA (Please explain) Comments:

No FD in this SDG (see G1G270477)

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain) Comments:

No FD in this SDG (see G1G270477)

f. Decontamination or Equipment Blank (if applicable)

(•) Yes ( ) No ( ) NA (Please explain) Comments:

i. All results less than PQL?

( ) Yes (•) No ( ) NA (Please explain) Comments:

Diesel Range Organics for method AK102.

ii. If above PQL, what samples are affected?

Comments:

11SAVSB0004_SO0-02, 11SAVSB0010_SO00-01, 11SAVSB0011_SO00-01, 11SAVSB005_SO01.8, 11SAVSB008_SO00-01, 11SAVSB009_SO00-01

iii. Data quality or usability affected? (Please explain.)

Comments:

Detects less than five times the blank concentration were qualified as estimated and flagged "B".

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

( ) Yes ( ) No (•) NA (Please explain) Comments:

Reset Form

Laboratory Data Review Checklist

Completed by:	Jamie Beckett		
Title:	Associate Chemist	Date:	Dec 13, 2011
CS Report Name:		Report Date:	Aug 16, 2011
Consultant Firm:	CH2M Hill		
Laboratory Name:	TestAmerica Sacramento	Laboratory Report Number:	G1G260466
ADEC File Number:		ADEC RecKey Number:	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

(•) Yes ( ) No ( ) NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

TestAmerica Seattle

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

b. Correct analyses requested?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

One VPH sample received with inadequate methanol preservation (soil absorption of methanol).

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

All samples received intact and within temperature.

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

( ) Yes ( ) No (•) NA (Please explain) Comments:

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable.

4. Case Narrative

a. Present and understandable?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

Detects in the method blank for methods NWEPH and NWVPH. The matrix spike and matrix spike duplicate exceeded acceptance criteria for multiple analytes for method NWEPH.

c. Were all corrective actions documented?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Data qualified as estimated.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

b. All applicable holding times met?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

c. All soils reported on a dry weight basis?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

ii. All method blank results less than PQL?

( ) Yes (•) No ( ) NA (Please explain) Comments:

C8-C10 Aliphatics for method NWEPH. C5-C6 Aliphatics, C12-C13 Aromatics, C8-C10 Aromatics, and Total VPH for method NWVPH.

iii. If above PQL, what samples are affected? Comments:

11SAVSB007_SO02-03

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain) Comments:

Associated sample results less than five times the blank concentration were flagged "B".

v. Data quality or usability affected? (Please explain) Comments:

Data qualified as estimated.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

○ Yes ○ No ◉ NA (Please explain) Comments:

No metals analyzed.

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain) Comments:

NA

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

NA

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain) Comments:

vii. Data quality or usability affected? (Please explain) Comments:

All data are usable.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain) Comments:

iv. Data quality or usability affected? (Use the comment box to explain.). Comments:

All data are usable.

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?

Comments:

NA

v. Data quality or usability affected? (Please explain.)

Comments:

NA

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain) Comments:

No FD in this SDG (see G1G270477)

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

No FD in this SDG (see G1G270477)

iii. Precision - All relative percent differences (RPD) less than specified DQOs?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute Value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

○ Yes ○ No ◉ NA (Please explain) Comments:

No FD in this SDG (see G1G270477)

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain) Comments:

No FD in this SDG (see G1G270477)

f. Decontamination or Equipment Blank (if applicable)

(•) Yes ( ) No ( ) NA (Please explain) Comments:

i. All results less than PQL?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

ii. If above PQL, what samples are affected?

Comments:

NA

iii. Data quality or usability affected? (Please explain.)

Comments:

All data are usable.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

NWEPH: These MS's were out of control: C21-C34 Aliphatics (MS - 11SAVSB007_SO02-03MS), C21-C34 Aromatics (MS - 11SAVSB007_SO02-03MS), C8-C10 Aliphatics (MS - 11SAVSB007_SO02-03MS). These SD's were out of control: C10-C12 Aliphatics (SD - 11SAVSB007_SO02-03SD), C21-C34 Aliphatics (SD - 11SAVSB007_SO02-03SD), C21-C34 Aromatics (SD - 11SAVSB007_SO02-03SD), C8-C10 Aliphatics (SD - 11SAVSB007_SO02-03S flagged "J". These MS/SD RPD's were out of control: C10-C12 Aliphatics (11SAVSB C12-C16 Aliphatics (11SAVSB007_SO02-03). Detects flagged "J".

Reset Form

Laboratory Data Review Checklist

Completed by:	Jamie Beckett		
Title:	Associate Chemist	Date:	Dec 13, 2011
CS Report Name:		Report Date:	Aug 16, 2011
Consultant Firm:	CH2M Hill		
Laboratory Name:	TestAmerica Sacramento	Laboratory Report Number:	G1G270477
ADEC File Number:		ADEC RecKey Number:	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

(•) Yes ( ) No ( ) NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

TestAmerica Seattle

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

b. Correct analyses requested?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

○ Yes ◉ No ○ NA (Please explain) Comments:

The pH of sample 11SAVSB907_GWOX was two upon receipt at the lab, the lab added three mls of NaOH to adjust the pH to seven. Results qualified as estimated and flagged "J" and "UJ".

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain) Comments:

All samples received intact and within temperature.

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

○ Yes ○ No ◉ NA (Please explain) Comments:

e. Data quality or usability affected? (Please explain)

Comments:

Data qualified as estimated.

4. Case Narrative

a. Present and understandable?

◉ Yes ○ No ○ NA (Please explain) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ○ No ○ NA (Please explain) Comments:

Detects in the method blank for multiple methods, surrogates were outside of control limits for multiple methods, holding time exceeded for method SW8260B, and preservation exceedance for SW8270C-SIM.

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Data qualified as estimated.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

b. All applicable holding times met?

( ) Yes (•) No ( ) NA (Please explain) Comments:

These NativeIDs exceeded holding time: 11SAVSB007_GWOX, 11SAVSB907_GWOX for method SW8260B. Non-detects flagged "UJ".

c. All soils reported on a dry weight basis?

( ) Yes ( ) No (•) NA (Please explain) Comments:

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

e. Data quality or usability affected? (Please explain)

Comments:

Data qualified as estimated.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

(•) Yes ( ) No ( ) NA (Please explain) Comments:

ii. All method blank results less than PQL?

( ) Yes (•) No ( ) NA (Please explain) Comments:

C16-C21 Aliphatics, C8-C10 Aliphatics for method NWEPH. C12-C13 Aromatics, Total VPH for method NWVPH.

iii. If above PQL, what samples are affected? Comments:

11SAVSB007_GWOX and 11SAVSB907_GWOX

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain) Comments:

Associated sample results less than five times the blank concentration were flagged "B".

v. Data quality or usability affected? (Please explain) Comments:

Data qualified as estimated.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

○ Yes ○ No ◉ NA (Please explain) Comments:

No metals analyzed.

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

○ Yes ◉ No ○ NA (Please explain) Comments:

These LCS/LCSD analytes were out of control: C8-C10 Aliphatics (BD), C8-C10 Aliphatics (BS), C8-C10 Aromatics (BS) for method NWEPH.

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain) Comments:

NA

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

11SAVSB007_GWOX, 11SAVSB907_GWOX

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain) Comments:

Detects flagged "J"; non-detects flagged "UJ".

vii. Data quality or usability affected? (Please explain) Comments:

Data qualified as estimated.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

○ Yes ◉ No ○ NA (Please explain) Comments:

Surrogate recovery exceedances were observed for Methods AK102 and SW8270C-SIM.

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain) Comments:

For low and high recoveries, associated detected results were flagged "J". For low recoveries non-detects were flagged "UJ".

iv. Data quality or usability affected? (Use the comment box to explain.).

Comments:

Data qualified as estimated in samples 11SAVSB907_GWOX, 11SAVSB004_GWOX.

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Blank detects: C12-C13 Aromatics (TB), Total VPH (TB) for method NWVPH.

iv. If above PQL, what samples are affected?

Comments:

11SAVSB007_GWOX, 11SAVSB907_GWOX

v. Data quality or usability affected? (Please explain.)

Comments:

Detects less than five times the blank concentration were qualified as estimated and flagged "B".

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain) Comments:

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Precision - All relative percent differences (RPD) less than specified DQOs?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute Value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

◉ Yes ○ No ○ NA (Please explain) Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain) Comments:

All data are usable.

f. Decontamination or Equipment Blank (if applicable)

○ Yes ◉ No ○ NA (Please explain) Comments:

i. All results less than PQL?

○ Yes ○ No ◉ NA (Please explain) Comments:

ii. If above PQL, what samples are affected?

Comments:

NA

iii. Data quality or usability affected? (Please explain.)

Comments:

NA

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

○ Yes ○ No ◉ NA (Please explain) Comments:

Reset Form

Appendix C
Hydrocarbon Risk Calculator – Cumulative Risk Results

Table C-1 Source of Input Parameters for HRC
Savoonga FSRC, Savoonga, Alaska

Soil Conditions		
Parameter	**Model Input**	**Reference**
Bulk Density (lbs/ft^3)	93.6	ADEC default value
Specific Gravity	2.65	ADEC default value
Moisture Content (% by weight)	10%	ADEC default value
Organic Carbon Fraction -foc	0.001	ADEC default value
Soil Temperature (Celsius)	6	Conservative estimate (higher than the average annual air temperature and above typical average soil temperature at permafrost sites).

Hydrogeologic Conditions		
Parameter	**Model Input**	**Reference**
Source Length (ft)	60	Length of inferred source area scaled off of site maps.
Average Precipitation (in/yr)	10	Average of annual weather data
Aquifer Hydraulic Conductivity (cm/sec)	0.0027777	ADEC default value
Aquifer thickness (ft)	5	ADEC default value
Infiltration Rate (m/yr)	0.051	20 % of precipitation (equals the default assumption).
Hydraulic Gradient	0.002	ADEC default value
Potable or Non-potable Aquifer	1	Potable groundwater.

Exposure Routes Complete at Present Time		
Soil Direct Contact	Complete	Conceptual Site Model
Outdoor Air	Complete	Conceptual Site Model
Indoor Air	Incomplete	Elevated Buildings
Groundwater Ingestion	Incomplete	No wells or buildings present

Climate Related Outdoor Air Inhalation and Soil Direct Contact Exposure Parameters		
Parameter	**Model Input**	**Reference**
Climate Zone	2	Default for the <40 inch precipitation zone.

Groundwater Depth & Fluctuation and Source Depth		
Depth to Groundwater at Seasonal Low Water Level at Downgradient End of Source (ft)	2	Estimated depth to groundwater from site data
Seasonal Water Level Fluctuation (ft)	1	Estimated value.
Depth to Bottom of Source Zone at downgradient Edge of Source (ft)	3	Measured value based on sampling data
Depth to Top of Area wide Source Zone at Downgradient Edge of Source (ft)	0	Measured value based on sampling data

Chemical Concentration Sources		
COC	**Model Input**	**Reference**
PAH - Soil	Actual	Max detected or detection limit
PAH - GW	Actual	Max detected or detection limit
BTEX - Soil	Actual	Max detected
BTEX - GW	Actual	Max detected or detection limit
GRO - Soil	Actual	Max detected
DRO - Soil	Actual	Max detected
RRO - Soil	Actual	Max detected
GRO - GW	Actual	Max detected
DRO - GW	Actual	Max detected
RRO - GW	Actual	Max detected

TABLE C-2

Source Area Soil Results for BTEX, DRO, and GRO

Savoonga Federal Scout Readiness Center Data Gap Investigation

Location	Sample ID	Sample Depth (feet bgs)	Sample Date	Analyte>>	DRO	GRO	RRO	Benzene	Toluene	Ethylbenzene	Xylenes (Total)
				Units>>	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
				SL>>	250	300	10000	0.025	6.5	6.9	63
11SAVSB001	11SAVSB001_SO02-2.6	2 - 2.6	7/6/2011		**17000**	--	--	**3.1**	**35**	**48**	**250**
SAV-B-13	SAVB-13S1SS	0 - 0.5	9/2/1998		**17000**	--	--	--	--	--	--
SAV-B-12	SAVB-12S2SS	0.5 - 1	9/2/1998		**11000**	--	--	--	--	--	--
SAV-B-13	SAVB-13S2SS	1.5 - 2	9/2/1998		**8900**	--	--	--	--	--	--
11SAVSB001	11SAVSB001_SO02	1 - 2	7/6/2011		**4300**	--	--	**0.27 J**	**29 J**	**11 J**	**50 J**
SAV-B-06	SAVB-6S2SS	1.5 - 2	9/2/1998		**1500**	--	--	--	--	--	--
SAV-B-05	SAVB-5S2SS	1.5 - 2	9/2/1998		**1300**	--	--	--	--	--	--
SAV-B-12	SAVB-12S1SS	0 - 0.5	9/2/1998		**1100**	--	--	--	--	--	--
SAV-B-14	SAVB-14S2SS	1 - 1.5	9/2/1998		**860**	--	--	--	--	--	--
09SAV-01-G105	09-SAV-01-G105-1_1	1.1 - 1.1	6/13/2009		**844**	--	--	--	--	--	--
11SAVSB006	11SAVSB006_SO02	2 - 2	7/6/2011		**660**	--	--	--	--	--	--
11SAVSB001	11SAVSB0001_SO00-01	0 - 1	7/6/2011		**630**	--	--	--	--	--	--
09SAV-01-F090	09-SAV-01-F090-0.7	0.7 - 0.7	6/13/2009		**606**	--	--	--	--	--	--
09SAV-01-G090	09-SAV-01-G090-0.7	0.7 - 0.7	6/13/2009		**491**	--	--	--	--	--	--
SAV-B-10	SAVB-10S3SS	1 - 1.5	9/2/1998		**400**	--	--	--	--	--	--
SAV-B-17	SAVB-17S2SS	2 - 2.5	9/2/1998		**310**	**6**	**57**	0.018 U	--	**0.04**	**0.062**
09SAV-01-F110	09-SAV-01-F110-0_8	0.8 - 0.8	6/13/2009		**301**	--	--	--	--	--	--

Notes:

1. All units in milligrams per kilogram.
2. Bold indicates that the analyte was detected.
3. Shading indicates that the result exceeded screening criteria.

-- = not analyzed

DRO = diesel-range organics

GRO = gasoline-range organics

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

RRO = residual-range organics

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

TABLE C-3

Groundwater Results for BTEX, DRO, and GRO

Savoonga Federal Scout Readiness Center Data Gap Investigation

		Analyte:	DRO	GRO	Benzene	Ethylbenzene	Toluene	Xylenes (Total)
		Screening Level:	1500	2200	0.5	70	100	1000
Location	**Sample ID**	**Sample Date**						
11SAVGW001	11SAVGW001_GWOX	7/24/2011	**660**	- -	- -	- -	- -	- -
11SAVGW002	11SAVGW002_GWOX	7/24/2011	**810**	- -	- -	- -	- -	- -
11SAVSB004	11SAVSB004_GWOX	7/24/2011	**18,000 J**	- -	- -	- -	- -	- -
11SAVSB007	11SAVSB007_GWOX	7/24/2011	**1100**	- -	0.2 UJ	0.2 UJ	0.4 UJ	1.2 UJ
SAV-ACL-015	SAV-ACL-015	8/25/2004	**30,200**	**2,110**	**80.5**	**166**	**127**	**581**
SAV-ACL-016	SAV-ACL-016	8/25/2004	**4,070**	50 U	0.5 U	0.5 U	**7.18**	**4.43**

Notes:

1. All units in micrograms per liter.
2. Bold indicates that the analyte was detected.
3. Shading indicates that the result exceeded screening criteria .

-- = Not analyzed

BTEX = benzene, toluene, ethylbenzene, and xylenes

DRO = diesel-range organics

GRO = gasoline-range organics

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

Table C-4A VPH Results from Non Source Area Samples --- Savoonga Federal Scout Readiness Center, Alaska

Site Name	Location Name	Sample Depth (ft)	Sample Date	Sample ID	Benzene Lab Result (mg/kg)	Benzene Method Detection Limit (mg/kg)	Benzene Stat Value (mg/kg)	Toluene Lab Result (mg/kg)	Toluene Method Detection Limit (mg/kg)	Toluene Stat Value (mg/kg)	Ethylbenzene Lab Result (mg/kg)	Ethylbenzene Method Detection Limit (mg/kg)	Ethylbenzene Stat Value (mg/kg)	Xylene (total) Lab Result (mg/kg)	Xylene (total) Method Detection Limit (mg/kg)	Xylene (total) Stat Value (mg/kg)	C8-C10 Aromatics Lab Result (mg/kg)	C8-C10 Aromatics Method Detection Limit (mg/kg)	C8-C10 Aromatics Stat Value (mg/kg)	C9-C10 Aromatics Calculated Value (mg/kg)	C10-C12 Aromatics Lab Result (mg/kg)	C10-C12 Aromatics Method Detection Limit (mg/kg)	C10-C12 Aromatics Stat Value (mg/kg)	C12-C13 Aromatics Lab Result (mg/kg)	C12-C13 Aromatics Method Detection Limit (mg/kg)	C12-C13 Aromatics Stat Value (mg/kg)	C5-C6 Aliphatics Lab Result (mg/kg)	C5-C6 Aliphatics Method Detection Limit (mg/kg)	C5-C6 Aliphatics Stat Value (mg/kg)	C6-C8 Aliphatics Lab Result (mg/kg)	C6-C8 Aliphatics Method Detection Limit (mg/kg)	C6-C8 Aliphatics Stat Value (mg/kg)	C8-C10 Aliphatics Lab Result (mg/kg)	C8-C10 Aliphatics Method Detection Limit (mg/kg)	C8-C10 Aliphatics Stat Value (mg/kg)	C10-C12 Aliphatics Lab Result (mg/kg)	C10-C12 Aliphatics Method Detection Limit (mg/kg)	C10-C12 Aliphatics Stat Value (mg/kg)	Total VPH Lab Result (mg/kg)	Total VPH Method Detection Limit (mg/kg)	GRO (calculated as sum of C5 to C10 A&A) (mg/kg)
Savoonga	11SAVSB007	2 - 3	7/23/2011	11SAVSB007_SO02-03	ND	0.0039	0.0039	0.008	0.0053	0.008	ND	0.0078	0.0078	ND	0.0059	0.0059	0.18	0.068	0.18	0.1663	0.18	0.068	0.18	0.17	0.068	0.17	0.13	0.068	0.13	ND	0.068	0.068	ND	0.068	0.068	0.1	0.068	0.1			0.46

GRO (mg/kg)	DRO (mg/kg)
	71

Table C-4B EPH Results from Non Source Area Samples --- Savoonga Federal Scout Readiness Center, Alaska

Site Name	Location Name	Sample Depth (ft)	Sample Date	Sample ID	C8-C10 Aromatics Lab Result (mg/kg)	C8-C10 Aromatics Method Detection Limit (mg/kg)	C8-C10 Aromatics Stat Value (mg/kg)	C9-C10 Aromatics Calculated Value (mg/kg)	C10-C12 Aromatics Lab Result (mg/kg)	C10-C12 Aromatics Method Detection Limit (mg/kg)	C10-C12 Aromatics Stat Value (mg/kg)	C12-C16 Aromatics Lab Result (mg/kg)	C12-C16 Aromatics Method Detection Limit (mg/kg)	C12-C16 Aromatics Stat Value (mg/kg)	C16-C21 Aromatics Lab Result (mg/kg)	C16-C21 Aromatics Method Detection Limit (mg/kg)	C16-C21 Aromatics Stat Value (mg/kg)	C21-C34 Aromatics Lab Result (mg/kg)	C21-C34 Aromatics Method Detection Limit (mg/kg)	C21-C34 Aromatics Stat Value (mg/kg)	C8-C10 Aliphatics Lab Result (mg/kg)	C8-C10 Aliphatics Method Detection Limit (mg/kg)	C8-C10 Aliphatics Stat Value (mg/kg)	C10-C12 Aliphatics Lab Result (mg/kg)	C10-C12 Aliphatics Method Detection Limit (mg/kg)	C10-C12 Aliphatics Stat Value (mg/kg)	C12-C16 Aliphatics Lab Result (mg/kg)	C12-C16 Aliphatics Method Detection Limit (mg/kg)	C12-C16 Aliphatics Stat Value (mg/kg)	C16-C21 Aliphatics Lab Result (mg/kg)	C16-C21 Aliphatics Method Detection Limit (mg/kg)	C16-C21 Aliphatics Stat Value (mg/kg)	C21-C34 Aliphatics Lab Result (mg/kg)	C21-C34 Aliphatics Method Detection Limit (mg/kg)	C21-C34 Aliphatics Stat Value (mg/kg)	DRO Aromatics C10 to C21 (mg/kg)	DRO Aliphatics C10 to C21 (mg/kg)	DRO (Sum of C10 to C21 A&A) (mg/kg)	RRO (sum of C21 to C34 A&A) (mg/kg)	Sum of all EPH Fractions Stat Values (mg/kg)	Extractable Petroleum Hydrocarbons (mg/kg)
Savoonga	11SAVSB007	2 - 3	7/23/2011	11SAVSB007_SO02-03	ND	1.3	1.3	1.2863	ND	0.096	0.096	ND	1.3	1.3	ND	1.3	1.3	9.9	1.3	9.9	0.4	0.035	0.4	1	0.13	1	2.4	1.3	2.4	ND	1.3	1.3	7.2	1.3	7.2	2.696	4.7	7.396	17.1	26	

DRO (mg/kg)	RRO (mg/kg)
	71

Table C-4C Source Area BTEX and VPH Data --- Savoonga Federal Scout Readiness Center, Alaska
NAPL Contaminated Soil Source Area Hydrocarbon Characterization --- Savoonga Federal Scout Readiness Center, Alaska

Site Name	Location Name	Sample Depth (ft)	Sample Date	Sample ID	Benzene Lab Result (mg/kg)	Benzene Method Detection Limit (mg/kg)	Benzene Stat Value (mg/kg)	Toluene Lab Result (mg/kg)	Toluene Method Detection Limit (mg/kg)	Toluene Stat Value (mg/kg)	Ethylbenzene Lab Result (mg/kg)	Ethylbenzene Method Detection Limit (mg/kg)	Ethylbenzene Stat Value (mg/kg)	Xylene (total) Lab Result (mg/kg)	Xylene (total) Method Detection Limit (mg/kg)	Xylene (total) Stat Value (mg/kg)	C8-C10 Aromatics Lab Result (mg/kg)	C8-C10 Aromatics Method Detection Limit (mg/kg)	C8-C10 Aromatics Stat Value (mg/kg)	C9-C10 Aromatics Calculated Value (mg/kg)	C10-C12 Aromatics Lab Result (mg/kg)	C10-C12 Aromatics Method Detection Limit (mg/kg)	C10-C12 Aromatics Stat Value (mg/kg)	C12-C13 Aromatics Lab Result (mg/kg)	C12-C13 Aromatics Method Detection Limit (mg/kg)	C12-C13 Aromatics Stat Value (mg/kg)	C5-C6 Aliphatics Lab Result (mg/kg)	C5-C6 Aliphatics Method Detection Limit (mg/kg)	C5-C6 Aliphatics Stat Value (mg/kg)	C6-C8 Aliphatics Lab Result (mg/kg)	C6-C8 Aliphatics Method Detection Limit (mg/kg)	C6-C8 Aliphatics Stat Value (mg/kg)	C8-C10 Aliphatics Lab Result (mg/kg)	C8-C10 Aliphatics Method Detection Limit (mg/kg)	C8-C10 Aliphatics Stat Value (mg/kg)	C10-C12 Aliphatics Lab Result (mg/kg)	C10-C12 Aliphatics Method Detection Limit (mg/kg)	C10-C12 Aliphatics Stat Value (mg/kg)	Total VPH Lab Result (mg/kg)	Total VPH Method Detection Limit (mg/kg)	GRO (calculated as sum of C5 to C10 A&A) (mg/kg)
Savoonga	11SAVSB001	2 - 2	7/6/2011	11SAVSB001_SO02	0.27	0.032	0.27	1.1	0.043	1.1	11	0.063	11	50	0.048	50	190	1.3	190	129	330	1.3	330	290	1.3	290	1.8	1.3	1.8	40	1.3	40	160	1.3	160	220	1.3	220			393.17
Savoonga	11SAVSB001	2.6 - 2.6	7/6/2011	11SAVSB001_SO2.6	3.1	0.14	3.1	35	0.2	35	48	0.29	48	250	0.22	250	140	1.5	140	0	230	1.5	230	200	1.5	200	1.7	1.5	1.7	22	1.5	22	57	1.5	57	100	1.5	100			416.80
							1.685			18.050			29.500			150.000			165.000	64.500			280.000			245.000			1.750			31.000			108.500			160.000	#DIV/0!	

"ND" results are assumed to be the following fraction of the detection limit: 1

C6-C10 GRO	C10-C25 DRO	C25-C36 RRO
Stat Value (mg/kg)	Stat Value (mg/kg)	Stat Value (mg/kg)
	4300	
	17000	

Table C-4D Source Area EPH Data --- Savoonga Federal Scout Readiness Center, Alaska
NAPL Contaminated Soil Source Area Hydrocarbon Characterization --- Savoonga Federal Scout Readiness Center, Alaska

Site Name	Location Name	Sample Depth (ft)	Sample Date	Sample ID	C8-C10 Aromatics Lab Result (mg/kg)	C8-C10 Aromatics Method Detection Limit (mg/kg)	C8-C10 Aromatics Stat Value (mg/kg)	C9-C10 Aromatics Calculated Value (mg/kg)	C10-C12 Aromatics Lab Result (mg/kg)	C10-C12 Aromatics Method Detection Limit (mg/kg)	C10-C12 Aromatics Stat Value (mg/kg)	C12-C16 Aromatics Lab Result (mg/kg)	C12-C16 Aromatics Method Detection Limit (mg/kg)	C12-C16 Aromatics Stat Value (mg/kg)	C16-C21 Aromatics Lab Result (mg/kg)	C16-C21 Aromatics Method Detection Limit (mg/kg)	C16-C21 Aromatics Stat Value (mg/kg)	C21-C34 Aromatics Lab Result (mg/kg)	C21-C34 Aromatics Method Detection Limit (mg/kg)	C21-C34 Aromatics Stat Value (mg/kg)	C8-C10 Aliphatics Lab Result (mg/kg)	C8-C10 Aliphatics Method Detection Limit (mg/kg)	C8-C10 Aliphatics Stat Value (mg/kg)	C10-C12 Aliphatics Lab Result (mg/kg)	C10-C12 Aliphatics Method Detection Limit (mg/kg)	C10-C12 Aliphatics Stat Value (mg/kg)	C12-C16 Aliphatics Lab Result (mg/kg)	C12-C16 Aliphatics Method Detection Limit (mg/kg)	C12-C16 Aliphatics Stat Value (mg/kg)	C16-C21 Aliphatics Lab Result (mg/kg)	C16-C21 Aliphatics Method Detection Limit (mg/kg)	C16-C21 Aliphatics Stat Value (mg/kg)	C21-C34 Aliphatics Lab Result (mg/kg)	C21-C34 Aliphatics Method Detection Limit (mg/kg)	C21-C34 Aliphatics Stat Value (mg/kg)	DRO Aromatics C10 to C21 (mg/kg)	DRO Aliphatics C10 to C21 (mg/kg)	DRO (Sum of C10 to C21 A&A) (mg/kg)	RRO (sum of C21 to C34 A&A) (mg/kg)	Sum of all EPH Fractions Stat Values (mg/kg)	Extractable Petroleum Hydrocarbons (mg/kg)
Savoonga	11SAVSB001	2 - 2	7/6/2011	11SAVSB001_SO02				270	0.42	270	590	5.9	590	200	1.2	200	14	1.2	14							2500	5.6	2500	3000	59	3000	170	5.9	170	22	1.2	22	1060	5670	6730	36	6766	
Savoonga	11SAVSB001	2.6 - 2.6	7/6/2011	11SAVSB001_SO2.6				400	0.49	400	940	6.8	940	370	1.4	370	150	1.4	150							10000	6.4	10000	11000	68	11000	610	68	610	290	1.4	290	1710	21610	23320	440	23760	
								#DIV/0!		335.000			765.000			285.000			82.000					6250.0			7000.0			390.0			156.0							

C6-C10 GRO	C10-C25 DRO	C25-C36 RRO
Stat Value (mg/kg)	Stat Value (mg/kg)	Stat Value (mg/kg)
	4300	
	17000	

Table C-4E Source Area Hydrocarbon Characterization

Compounds and A&A EC Fractions	B	T	E	X	C9-C10 Aromatics	C10-C12 Aromatics	C12-C16 Aromatics	C16-C21 Aromatics	C21-C34 Aromatics	C5-C6 Aliphatics	C6-C8 Aliphatics	C8-C10 Aliphatics	C10-C12 Aliphatics	C12-C16 Aliphatics	C16-C21 Aliphatics	C21-C34 Aliphatics	TPH
Source of data used as input to the characterization were overlap exists (enter: max, VPH or EPH)					VPH												
Average concentration in A&A EC groups (mg/kg)	1.6850	18.0500	29.5000	150.0000	64.5000	335.000	765.000	285.000	82.000	1.75	31.00	108.50	6,250.00	7,000.00	390.00	156.00	15668
Fraction of TPH mass in A&A EC groups	0.000107544	0.001152	0.0018828	0.0095737	0.0041167	0.0213812	0.0488257	0.018189959	0.005233602	0.0001117	0.0019786	0.0069249	0.3989026	0.4467709	0.0248915	0.009956609	1.000
GRO, DRO & RRO A&A Groups	GRO aromatics					DRO aromatics			RRO aromatics	GRO aliphatics			DRO aliphatics			RRO aliphatics	
Sum of A&A EC mass fractions within GRO, DRO & RRO A&A Groups	0.016832732					0.0883968			0.005233602	0.0090152			0.870565			0.009956609	1.000
Mass fraction of A&A EC Groups within GRO, DRO & RRO A&A Groups	0.006388989	0.0684399	0.1118547	0.5687527	0.2445637	0.2418773	0.5523466	0.205776173	1	0.0123894	0.219469	0.7681416	0.4582111	0.5131965	0.0285924	1	
Sum of A&A EC mass fractions within GRO, DRO & RRO A&A Groups	1.000					1.000			1	1.000			1.000			1	

% of TPH that is GRO=	2.58%
% of TPH that is DRO=	95.90%
% of TPH that is RRO=	1.52%

GRO % aromatics	65.12%
GRO % aliphatics	34.88%
DRO % aromatics	9.22%
DRO % aliphatics	90.78%
RRO % aromatics	34.45%
RRO % aliphatics	65.55%

Table C-4E: HRC Input

input to cells C14 to C16 (4-phase, cumulative risk calcs)		input to cells D75 to D77 (4-phase, cumulative risk calcs)		input to cells D79 to D84 (4-phase, cumulative risk calcs)	
GRO: fraction aromatic	0.6512	Aromatic C_{10}-C_{12}	0.2418773	Aliphatic C_5-C_6	0.0123894
DRO: fraction aromatic	0.0922	Aromatic C_{12}-C_{16}	0.5523466	Aliphatic C_6-C_8	0.219469
RRO: fraction aromatic	0.3445	Aromatic C_{16}-C_{21}	0.2057762	Aliphatic C_8-C_{10}	0.7681416
				Aliphatic C_{10}-C_{12}	0.4582111
				Aliphatic C_{12}-C_{16}	0.5131965
				Aliphatic C_{16}-C_{21}	0.0285924

EC groups	fraction of DRO within EC groups
10 to 12	0.438269551
12 to 16	0.516805324
16 to 21	0.044925125

Notes: A&A EC = aliphatic and aromatic equivalent carbon

1 This spreadsheet has been developed to help HRC users calculate 1) the soil GRO, DRO and RRO aromatic fractions, which are input values in cells C14 to C16 of the HRC; and 2) the equivalent carbon mass fractions within the GRO aliphatic, DRO aromatic, and DRO aliphatic groups, which are input values to cells D75 to D77 and D79 to D84 of the HRC. The table number, title and data in this spreadsheet are presented as an example and should be changed by the user so that the data becomes specific to their site.

2 Enter the BTEX, EPH and VPH concentration data from the more heavily contaminated portions of the source area (sample results with GRO concentrations above 300 and DRO or RRO concentrations above 250 mg/kg) into the light yellows cells in Tables 6A and 6B (it is best if the lab results are reported to the detection limit and estimated or "J" results are used when they occur). The BTEX data should come from the 8021 or 8260 test methods (don't use the BTEX values produced by the VPH test method). If a lab result is non-detect, enter "ND" into the "Lab Result" column of Table 6A and/or 6B. By default the spreadsheet assigns a "statistical value" equal to the method detection limit to all non-detect concentration data (the fraction of the detection limit used in the statistical value calculation may be adjusted by changing cell H18) . The values needed by the HRC will be calculated automatically and displayed in Table 6D.

3 The spreadsheet calculates the average concentration value within each A&A EC fraction (e.g., C8 – C10 aromatics) as shown in the gray highlighted lines of Table 6A and 6B. The spreadsheet pulls the average concentrations in each A&A EC fraction from the VPH and EPH data into a summary table (line 3 of Table 6C).

4 For A&A EC fractions measured by both the VPH and EPH methods, the spreadsheet, by default, selects the higher of the two overlapping average concentrations. If the user has reason to believe that the either the VPH or EPH result of the overlapping ranges is a more representative value, then that value may be selected by entering "VPH" or "EPH" in the light yellow cells in line 2 of Table 6C (rational for the selection must be supplied in the report). In general, the VPH data is thought to be more representative of the C9-C10 fractions and the EPH data is thought to be more representative of the C10-C12 fractions (but the laboratory QA/QC data, and the correlation of the GRO and DRO data from the AK101 and AK102 tests with the VPH and EPH data may be used to help assess whether the VPH or EPH data is used as input to the hydrocarbon characterization).

5 The concentrations within the A&A EC fractions are added to get a total petroleum hydrocarbon (TPH) concentration (cell V40). Then the mass fraction within each A&A EC fraction is calculated by dividing the average concentration within the fraction by the TPH concentration as shown in the row labeled "Fraction of TPH mass within A&A EC groups".

6 The spreadsheet calculates the mass fraction of each A&A EC group within the larger GRO aliphatic, DRO aromatic and DRO aliphatic groups by dividing the mass fraction of each A&A EC group within the TPH, by the sum of the mass fractions within the larger GRO aliphatic, DRO aromatic and DRO aliphatic groups (as shown lines 6 and 7 of Table 6C) . These values are inputs for cells D75 to D77 and cells D79 to D84 of the HRC and are shown in Table 3.10D in a format where they can be readily copied and pasted into the HRC.

7 The GRO, DRO and RRO aromatic fractions are calculated (e.g. the sum of the GRO aromatic mass fractions divided by the sum of the GRO aromatic and aliphatic mass fractions) and are shown in Table 3.10D in a format where they can be readily copied and pasted into cells C14 to C16 of the HRC.

8 Note that the fractions used as input to cells D75 to D77, D79 to D81 and D82 to D84 must total to 1. Therefore it is recommended that the values in Table 6D be copied and pasted into the HRC (rather than manually entered into the HRC). When pasting the Table 6D values into the HRC use the "paste special values" option so that the formatting of the HRC is preserved.

9 The user can add rows to the middle of Table 6B and 6B as needed.

Table C-5 — Hydrocarbon Risk Calculator

Facility Location: **Savoonga, Alaska**

Facility Name: **Savoonga ARNG FSRC**

Page 1 — Model Input Parameters:

Version 1.1, Lawrence Acomb, Geosphere, Inc., March 4, 2011

Solver solution based on work of Hun Seak Park, 1999; VBA macro by Ted Cahalane, 2010

Site Specific and/or Field Data in Yellow Highlighted Cells			Chemical Concentrations in Site Groundwater (mg/L):	Calculate	Dissolved Phase Half Life (days; used in DAF calculations):	Soil Conditions:	Site Specific and/or Field Data in Yellow Highlighted Cells	ADEC Default Value (all climate zones)
Concentrations in Site Soils (mg/kg):			Benzene (mg/L)	0.085	400	bulk density (lbs/ft^3)	93.6	93.6
Benzene (c & nc)		3.1	Toluene (mg/L)	0.127	100	bulk density (g/cm^3)	1.50	1.5
Toluene (nc)		35.	Ethylbenzene (mg/L)	0.166	100	specific gravity	2.65	2.65
Ethylbenzene (c & nc)		48.	Xylene (mg/L)	0.581	100	porosity	0.434	0.43
Xylenes (total) (nc)		250.	GRO (mg/L)	2.11	100	moisture content (% by weight)	10	10
GRO (mg/kg)		73.	DRO (mg/L)	30.2	100	foc	0.0010	0.001
DRO (mg/kg)		17,000.	RRO (mg/L)	1.48E-05	100	water filled porosity	0.150	0.15
RRO (mg/kg)		360.	GRO aromatics (mg/L)	0.0443	100	air filled porosity	0.250	0.28
Total Petroleum Hydrocarbons (mg/kg)		17,721.561	DRO aromatics (mg/L)	0.0754	100	NAPL filled porosity	0.034	
GRO Aromatics Fraction (ADEC default=0.50)		0.65	RRO aromatics (mg/L)	1.48E-05	100	water saturation	34.57%	
DRO Aromatics Fraction (ADEC default=0.40)		0.09	GRO aliphatics (mg/L)	0.036	100	NAPL saturation	7.79%	
RRO Aromatics Fraction (ADEC default=0.40)		0.34	DRO aliphatics (mg/L)	4.34E-04	100	Soil temp (C)	6	25
See Note #1 regarding use of ND values			RRO aliphatics (mg/L)	4.35E-12	100	Soil Grain Size Description (USCS or other; used to label CSM)	Sand with Silt	
Acenaphthene (nc)		0.83	Acenaphthene (nc)	5.20E-05	10,000	**Hydrogeologic Conditions:**		ADEC Default Values <40" precip/yr
Acenaphthylene (nc)		0.41	Acenaphthylene (nc)	5.20E-05	10,000	Source length (ft)	60	105
Anthracene (nc)		0.49	Anthracene (nc)	5.20E-05	10,000	Average precipitation (in/yr)	10	25.59
Benzo(g,h,i)perylene (nc)		1.2	Benzo(g,h,i)perylene (nc)	5.20E-05	10,000	Default Estimated Infiltration Rate (20% of precip, m/yr)	0.051	0.13
Fluoranthene (nc)		0.36	Fluoranthene (nc)	5.20E-05	10,000	Aquifer hydraulic conductivity (cm/sec)	2.78E-03	2.78E-03
Fluorene (nc)		0.77	Fluorene (nc)	2.70E-05	10,000	Aquifer thickness (ft; below low water at downgradient edge of source)	32.8	32.8
Naphthalene (c & nc)		180.	Naphthalene (c & nc)	9.80E-05	10,000	Source length (m)	18	32
Phenanthrene (nc)		0.43	Phenanthrene (nc)	5.20E-05	10,000	Infiltration rate (m/yr)	0.051	0.13
Pyrene (nc)		0.43	Pyrene (nc)	5.20E-05	10,000	Hydraulic gradient	0.002	0.002
Benzo(a)anthracene (c)		0.37	**Benzo(a)anthracene (c)**	5.20E-05	10,000	Aquifer hydraulic conductivity (m/yr)	8.76E+02	8.76E+02
Benzo(b)fluoranthene (c)		0.62	**Benzo(b)fluoranthene (c)**	1.00E-04	10,000	Aquifer thickness (ft; below low water)	10.0	10.0
Benzo(k)fluoranthene (c)		0.92	**Benzo(k)fluoranthene (c)**	5.20E-05	10,000	Mixing Zone Depth minimum of (m)	5.5	5.5 maximum
Benzo(a)pyrene (c)		1.8	**Benzo(a)pyrene (c)**	5.20E-05	10,000	Dilution Factor (lower seasonal value)	5.1	minimum DAF (for all compounds)
Chrysene (c)		0.43	**Chrysene (c)**	5.20E-05	10,000	Vadose Zone or Smear Zone Source?	1	4 indicates vadose zone source, 1 indicates a saturated zone source
Dibenz(a,h)anthracene (c)		1.8	**Dibenz(a,h)anthracene (c)**	1.00E-04	10,000	Potable or Non-potable Aquifer?	1	Enter 1 for potable aquifer, 10 for non-potable aquifer (to b considered non-potable the groundwater must have been evaluated and determined to be non-potable by the ADEC as per 18 AAC 75.350
Indeno(1,2,3-cd)pyrene (c)		0.59	**Indeno(1,2,3-cd)pyrene (c)**	1.00E-04	10,000			
1-Methylnaphthalene (nc)	nc	230.	1-Methylnaphthalene (nc)	2.50E-04	1,000	ADEC Reckey No.:		
2-Methylnaphthalene (nc)	nc	360.	2-Methylnaphthalene (nc)	2.70E-04	1,000	ADEC File ID		
	nc					Latitude		
	nc					Longitude		
	nc					Width of Source (ft)	20	
	nc					Area of NAPL contaminated soil source (ft^2)	6,000	
	nc					Ground surface slope (ft/ft, assumed to be in direction of groundwater flow)	0.002	
	c							
	c							
	c							
	c							
	c							
	c							
	c							

FYI Unit Conversions	
bulk density conversion input (g/cm^3)	bulk density output (lbs/ft^3)
1.66	103.584
K (ft/day)	K (cm/sec)
400	0.141111111
Exposure Routes Complete at Present Time	
Exposure Routes	enter 1 for complete pathways; 0 for incomplete pathways
Soil Direct Contact	1
Outdoor Air	1
Indoor Air	0
Groundwater Ingestion	0

ADEC Default Values >40" precip/yr
105
118.11
0.6
2.78E-03
32
0.6
0.002
8.76E+02
10.0
5.5 maximum
6.0

Solver Instructions & Information:

"Solver" is an Excel add-in tool, installed from the program discs. In addition, the "macro" which performs the calculations must be "enabled" while the spreadsheet is opening.

1. Enter site specific hydrocarbon concentration data, and soil and groundwater conditions data.
2. Click on the "Calculate" button in cell D4. The phase partitioning equations are solved and the results are saved in the spreadsheet.
3. Any time data entry values are changed the spreadsheet should be re-calculated (click on the "Calculate" button again).

Molar density (mol/L)*NAPL filled porosity initial value=.0001	0.156352631
Initial air filled porosity (used to start iterations)	0.284
Conservation of volume equation (should be zero or close to zero, i.e. a very small number)	4.30E-12

Climate Related Outdoor Air Inhalation and Soil Direct Contact Exposure Parameters

Climate Zone of site (enter "1" for an arctic site; "2" for the <40" precip zone; and "3" for the >40" precip zone)	2

Soil Ingestion & Inhalation Exposure Frequency (days/yr)		ADEC Default Values
Residential	Industrial	arctic zone; precip <40"; precip >40"
270	250	Res 200; 270; 330 / Indus 200; 250; 250
Q/C for volatilization to Outdoor Air calcs.		
Residential	Industrial	
90.82	90.82	100.13; 90.82; 82.72

depth to groundwater at seasonal low water level at downgradient end of source (ft)	2
seasonal water table fluctuation (ft)	1
depth to bottom of source zone at downgradient edge of source (ft)	3
depth to top of area wide source zone at downgradient edge of source (ft)	0
saturated source thickness at low water level (ft; depth of NAPL source below low water table)	1
saturated source thickness at high water level (ft; thickness of saturated source zone below high water table)	2.00
total thickness of the source zone (ft)	3
seasonal water table fluctuation (m)	0.305
saturated source thickness at low water level (m; depth of source below low water table)	0.305
saturated source thickness at high water level (m; thickness of source zone below high water table)	0.610

Smear Zone Source--- NAPL source extends through zone of seasonal water table fluctuation

Source Depth input (cell N28) indicates that contaminated soil is present above the bottom of the floor slab or basement.

Source Depth input and J&E model input do not agree, check the input to cell N28 and/or cells C61, D61, E61 and G57 to be sure they match site conditions.

Enter the thickness of the uncontaminated soil immediately below the slab in cells C61, D61 and E61 . If you don't know the thickness of uncontaminated soil below the slab consider entering a relatively small thickness.

Table C-5	Migration to Indoor Air-- Data Entry	Savoonga, Alaska	Savoonga ARNG FSRC
Page 2	NAPL source area soil gas concentrations or measured soil gas concentrations used as input. Attenuation factor "alpha" calculated by the Johnson & Ettinger model following the EPA advanced soil gas solution to the J & E model. Incremental risk posed by NAPL source area soil gas concentrations via the migration to indoor air pathway shown in section 6 below and entered into the cumulative risk calculations.		

Site Specific and/or Field Data in Yellow Highlighted Cells

Soil Properties:	Upper most uncontaminated soil layer immediately below slab	Middle Layer (not contaminated)	Bottom Layer (not contaminated)	**Building Properties:**	input value	default input values: **basement**	default input values: **slab on grade**			**Human Health Exposure Criteria**		
bulk density (lbs/ft^3)	93.60	93.60	93.60	**Lb** = length of building (cm)	1000	1000	1000	**L_T** = total source-building separation distance (cm)	1		Residential	Industrial
bulk density (g/cm^3)	1.50	1.50	1.50	**Wb** = width of building (cm)	1000	1000	1000	**Acrack= area of total cracks (cm^2)** = Xcrack* Wcrack = Ab/n	400	Target Carcinogenic Risk (TRC; default = 10^-5)	1.00E-05	1.00E-05
specific gravity of solids	2.65	2.65	2.65	**Hb** = height of building (cm)	244	366	244	**Xcrack** = floor -wall seam perimeter (cm)	4000	THQ= target hazard quotient (default = 1.0)	1	1
porosity	0.43	0.43	0.43	**ER** = air exchange rate (1/hr)	0.25	0.25		**u** = viscosity of air (g/cm-sec)	1.74E-04	ATc= averaging time carcinogen (days), (=70 years)	25,550	25,550
moisture content (% by weight)	10.00	10.00	10.00	**Lf** = depth below grade of bottom of floor slab or basement (cm)	15	200	15	**Zcrack** = crack depth below grade (cm)	15	ATnc= averaging time non-carcinogen	30	30
foc	0.001	0.001	0.001	**Lf** = depth below grade of bottom of floor slab or basement (ft)	0.49212	6.5616	0.49212	**equation 16 r crack**= n /(Ab /Xcrack)	1.00E-01	ED= exposure duration (30 years)	30	25
water filled porosity	0.150	0.150	0.150	**Lcrack** = enclosed space foundation thickness or **slab thickness** (cm)	10	10	10	**n** = Acrack/Ab (0<=n<=1)	3.77E-04	EF= effective exposure frequency (350 days/year)	350	83.33333333
air filled porosity	0.284	0.284	0.284	**delta P** = pressure differential between building and soil (g/cm-s^2)	40	40 g/cm-s^2 = 4 pascals (Pa)	typical conservative values = 4 or 5 Pa; max range = 0 to 20 Pa	**equation 14 Q building**=building ventilation rate (cm^3/sec) = (Lb*Wb*Hb*ER)/3,600s/h	1.69E+04	Industrial Scenario Exposure Frequency input values	days per week	5
Thickness of uncontaminated soil layers above source at building location (ft; upper most layer must extend below the depth of foundation; used to define the source-building separation distance)	0.1	0.1	0.1	**kv** = soil vapor permeability= top soil layer (cm^2)	2.40E-09	1.00E-08		**equation 14 Q building**=building ventilation rate (cm^3/sec; if a value is input it will be used in the alpha calculation--optional)			hours per day	8
layer thickness (cm)	15.34	3.05	3.05	**A_B**= surface area of enclosed space below grade (cm^2)	1.06E+06	=area of basement walls+ basement floor... or area of slab on grade		**equation 15 Q soil** = (2* pi * delta P* kv* Xcrack)/u ln (2 Zcrack/ r crack)	2.43E+00		weeks per year	50
Ls (ft) = Total depth to contaminant or to soil gas sample if soil gas data used as input to model	0.3	**Ls** (cm)	9.14	**Q building**=building ventilation rate (cm^3/sec)	1.69E+04			Rc (gas constant, cal/mol-degree K	1.9872	C cancer =	[(TCR*ATc)/(EF*ED*URF)]	
kv = soil vapor permeability (cm^2; est. values in cells Q65 to S65)	2.40E-09	2.40E-09	2.40E-09	**Wcrack** = floor-wall seam crack width (cm)	0.1			R (gas constant, atm-m^3/mol-degree K	8.2057E-05	C non-cancer =	(TQH*Rfc*1000ug/mg)	

Source Depth input (cell N28) indicates that contaminated soil is present above the bottom of the floor slab or basement.

Source Depth input and J&E model input do not agree, check the input to cell N28 and/or cells C61, D61, E61 and G57 to be sure they match site conditions.

Enter the thickness of the uncontaminated soil immediately below the slab in cells C61, D61 and E61 . If you don't know the thickness of uncontaminated soil below the slab consider entering a thickness only slightly greater than the foundation depth.

Table C-5		Phase Partitioning Results			Savoonga, Alaska			Savoonga ARNG FSRC					
Page 3 column 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hydrocarbon Fractions		**Median Equivalent Carbon**	**Distribution of DRO & GRO into Aromatic & Aliphatic Equivalent Carbon Ranges (varies by fuel type)**	**Bulk Soil Concentration (mg/kg)**	**Fraction of TPH Mass**	**Xi (Mole Fraction in NAPL using 4-phase model; unique solution)**	**Concentration in Soil Water (mg of chemical/L of pore water)**	**Concentration in Soil Gas (mg/L pore air)**	**% of Hydrocarbon Mass in Dissolved Phase**	**% of Hydrocarbon Mass in Vapor Phase**	**% of Hydrocarbon Mass Adsorbed to Soils**	**% of Hydrocarbon Mass in NAPL**	**Sum of Dissolved, Vapor, Adsorbed and NAPL Phases**
Benzene C_6-C_7		6.50	from analysis	3.100	0.000175	3.59E-04	6.42E-01	6.09E-02	2.071%	0.328%	3.427%	94.17%	100.00%
Toluene C_7-C_8		7.58	from analysis	35.000	0.001975	3.57E-03	1.88E+00	1.89E-01	0.536%	0.090%	1.437%	97.94%	100.00%
Ethylbenzene C_8-C_9		8.50	from analysis	48.000	0.002709	4.29E-03	7.26E-01	7.73E-02	0.151%	0.027%	0.783%	99.04%	100.00%
Xylene C_8-C_9		8.63	from analysis	250.000	0.014107	2.25E-02	2.38E+00	2.10E-01	0.095%	0.014%	0.422%	99.47%	100.00%
Aromatic C_9-C_{10}		9.50	from analysis	0.000	0.000000	0.00E+00	0.00E+00	0.00E+00	0.000%	0.000%	0.000%	0.00%	0.00%
Aromatic C_{10}-C_{12}		11.00	0.24188	379.035	0.021388	2.78E-02	6.83E-01	2.38E-02	0.018%	0.001%	0.452%	99.53%	100.00%
Aromatic C_{12}-C_{16}		13.00	0.55235	865.557	0.048842	5.71E-02	5.33E-01	8.76E-03	0.006%	0.000%	0.245%	99.75%	100.00%
Aromatic C_{16}-C_{21}		17.00	0.20578	322.463	0.018196	1.79E-02	2.41E-02	1.02E-04	0.001%	0.000%	0.075%	99.92%	100.00%
Aromatic C_{21}-C_{35}		25.00	1.0000	124.034	0.006999	5.36E-03	1.51E-04	3.17E-08	0.000%	0.000%	0.008%	99.99%	100.00%
Aliphatic C_5-C_6		5.50	0.01239	0.315	0.000018	3.67E-05	1.32E-03	2.61E-02	0.042%	1.378%	0.336%	98.24%	100.00%
Aliphatic C_6-C_8		7.00	0.21947	5.588	0.000315	5.22E-04	2.80E-03	5.80E-02	0.005%	0.173%	0.191%	99.63%	100.00%
Aliphatic C_8-C_{10}		9.00	0.76814	19.558	0.001104	1.44E-03	6.13E-04	1.53E-02	0.000%	0.013%	0.095%	99.89%	100.00%
Aliphatic C_{10}-C_{12}		11.00	0.45821	7071.547	0.399036	4.28E-01	1.45E-02	4.47E-01	0.000%	0.001%	0.049%	99.95%	100.00%
Aliphatic C_{12}-C_{16}		13.00	0.51320	7920.133	0.446921	4.07E-01	1.10E-03	8.04E-02	0.000%	0.000%	0.026%	99.97%	100.00%
Aliphatic C_{16}-C_{21}		17.00	0.02859	441.265	0.024900	1.75E-02	2.97E-07	1.40E-04	0.000%	0.000%	0.008%	99.99%	100.00%
Aliphatic C_{21}-C_{35}		25.00	1.0000	235.966	0.013315	6.44E-03	4.35E-12	6.03E-08	0.000%	0.000%	0.001%	100.00%	100.00%
				17721.561	**100.0000%**	**1.00000**	**6.89E+00**	**1.20E+00**					

sum of GRO aromatic mass fractions must equal 1 7.069958E+00 361.561 sum of GRO concentrations should equal input GRO concentration

Note: GRO aromatics less than sum of BTEX

sum of GRO aliphatic mass fractions must equal 1 1.000000E+00 17000.000 sum of DRO concentrations must equal input DRO concentration

sum of DRO aromatic mass fractions must equal 1 1.000000E+00 360.000 sum of RRO concentrations must equal input RRO concentration

sum of DRO aliphatic mass fractions must equal 1 1.000000E+00

Table C-5 — Soil Direct Contact Risks

Page 4 — Savoonga, Alaska — Savoonga ARNG FSRC

1	2	3	4	5	6	7	8	9
Compounds		Sample Concentrations (mg/kg)	Soil Direct Contact Risk Based Level Residential Land Use	Residential Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)	Soil Direct Contact Risk Based Level Industrial Land Use	Industrial Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	3.1	406.	0.0076	0	8,176.	3.79E-04	0
Toluene (nc)	nc	35.	8,111.	0.0043	0	163,520.	2.14E-04	0
Ethylbenzene (c & nc)	nc	48.	10,139.	0.0047	0	204,400.	2.35E-04	0
Xylenes (total) (nc)	nc	250.	20,278.	0.0123	0	408,800.	6.12E-04	0
GRO Aromatics (nc)	nc	0.00E+00	20,278.	0.00E+00	0	408,800.	0.00E+00	0
DRO Aromatics (nc)	nc	1,567.	4,056.	**0.3864**	0	81,760.	0.0192	0
RRO Aromatics (nc)	nc	124.	3,042.	0.0408	0	61,320.	0.002	0
GRO Aliphatics (nc)	nc	25.4608	506,944.	5.02E-05	0	10,220,000.	2.49E-06	0
DRO Aliphatics (nc)	nc	15,433.	10,139.	**1.5222**	1	204,400.	0.0755	0
RRO Aliphatics (nc)	nc	236.	202,778.	0.0012	0	4,088,000.	5.77E-05	0
Acenaphthene (nc)	nc	0.83	2,798.	2.97E-04	0	18,765.	4.42E-05	0
Acenaphthylene (nc)	nc	0.41	2,798.	1.47E-04	0	18,765.	2.18E-05	0
Anthracene (nc)	nc	0.49	20,566.	2.38E-05	0	188,220.	2.60E-06	0
Benzo(g,h,i)perylene (nc)	nc	1.2	1,399.	8.58E-04	0	9,383.	1.28E-04	0
Fluoranthene (nc)	nc	0.36	1,865.	1.93E-04	0	12,510.	2.88E-05	0
Fluorene (nc)	nc	0.77	2,347.	3.28E-04	0	18,448.	4.17E-05	0
Naphthalene (c & nc)	nc	180.	1,394.	**0.1292**	0	12,998.	0.0138	0
Phenanthrene (nc)	nc	0.43	20,566.	2.09E-05	0	188,220.	2.28E-06	0
Pyrene (nc)	nc	0.43	1,399.	3.07E-04	0	9,383.	4.58E-05	0
Benzene (c & nc)	**c**	3.1	151.	0.0206	0	1,041.	0.003	0
Ethylbenzene (c & nc)	**c**	35.	No Sfo	0.00E+00	0	No Sfo	0.00E+00	0
Benzo(a)anthracene (c)	**c**	0.37	4.8866	0.0757	0	12.017	0.0308	0
Benzo(b)fluoranthene (c)	**c**	0.62	4.8866	**0.1269**	0	12.017	0.0516	0
Benzo(k)fluoranthene (c)	**c**	0.92	48.8656	0.0188	0	120.	0.0077	0
Benzo(a)pyrene (c)	**c**	1.8	0.4887	**3.6836**	1	1.2017	**1.4979**	1
Chrysene (c)	**c**	0.43	489.	8.80E-04	0	1,202.	3.58E-04	0
Dibenz(a,h)anthracene (c)	**c**	1.8	0.4887	**3.6836**	1	1.2017	**1.4979**	1
Indeno(1,2,3-cd)pyrene (c)	**c**	0.59	4.8866	**0.1207**	0	12.017	0.0491	0
Naphthalene (c & nc)	**c**	180.	No Sfo	0.00E+00	0	No Sfo	0.00E+00	0
1-Methylnaphthalene (nc)	nc	230	279.	**0.8252**	0	2,600.	0.0885	0
2-Methylnaphthalene (nc)	nc	360	279.	**1.2916**	1	2,600.	**0.1385**	0
	nc							
	nc							
	nc							
	nc							
	nc							
	c							
	c							
	c							
	c							
	c							
	c							
	c							
Carcinogenic Cumulative Risk				7.7308	1		3.1382	1
Non-carcinogenic Cumulative Risk				2.2771	1		0.2426	0

Values shown in the fourth and seventh columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table C-5 — Migration to Outdoor Air Vapor Inhalation Risks

Page 5 — **Savoonga, Alaska** — **Savoonga ARNG FSRC**

1	2	3	4	5	6	7	8	9
Compounds		Vapor Concentration in Sample (based on 3 or 4- phase partitioning, whichever is accurate, mg/L)	Residential Site Hypothetical Soil Vapor Concentration when HQ=1 or Target Risk =10^-5 (mg/L; from 3-phase equation)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)	Industrial Site Hypothetical Soil Vapor Concentration when HQ=1 or Target Risk =10^-5 (mg/L; from 3-phase equation)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	0.0081	56.5702	1.43E-04	0	167.	4.82E-05	0
Toluene (nc)	nc	0.0128	8,355.	1.53E-06	0	24,712.	5.17E-07	0
Ethylbenzene (c & nc)	nc	0.0177	1,442.	1.23E-05	0	4,266.	4.15E-06	0
Xylenes (total) (nc)	nc	0.0512	144.	3.57E-04	0	425.	1.21E-04	0
GRO Aromatics (nc)	nc	0.0045	282.	1.59E-05	0	834.	5.36E-06	0
DRO Aromatics (nc)	nc	0.0026	70.6108	3.73E-05	0	209.	1.26E-05	0
RRO Aromatics (nc)	nc	3.10E-09	No RfC	0.00E+00	0	No RfC	0.00E+00	0
GRO Aliphatics (nc)	nc	0.8987	47,488.	1.89E-05	0	140,454.	6.40E-06	0
DRO Aliphatics (nc)	nc	0.0134	1,083.	1.24E-05	0	3,202.	4.18E-06	0
RRO Aliphatics (nc)	nc	6.03E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Acenaphthene (nc)	nc	6.45E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Acenaphthylene (nc)	nc	5.22E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Anthracene (nc)	nc	1.52E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Benzo(g,h,i)perylene (nc)	nc	3.07E-11	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Fluoranthene (nc)	nc	1.98E-09	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Fluorene (nc)	nc	1.75E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Naphthalene (c & nc)	nc	4.25E-07	0.5641	7.54E-07	0	1.6685	2.55E-07	0
Phenanthrene (nc)	nc	1.27E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Pyrene (nc)	nc	2.49E-09	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Benzene (c & nc)	**c**	0.0081	5.6409	0.0014	0	20.0209	4.03E-04	0
Ethylbenzene (c & nc)	**c**	0.0177	30.5978	5.78E-04	0	109.	1.63E-04	0
Benzo(a)anthracene (c)	**c**	1.94E-09	3.65E-04	5.32E-06	0	0.0013	1.50E-06	0
Benzo(b)fluoranthene (c)	**c**	1.51E-10	1.64E-05	9.23E-06	0	5.81E-05	2.60E-06	0
Benzo(k)fluoranthene (c)	**c**	5.72E-11	1.21E-04	4.72E-07	0	4.30E-04	1.33E-07	0
Benzo(a)pyrene (c)	**c**	3.86E-11	6.46E-07	5.98E-05	0	2.29E-06	1.69E-05	0
Chrysene (c)	**c**	7.12E-10	0.022	3.24E-08	0	0.078	9.12E-09	0
Dibenz(a,h)anthracene (c)	**c**	2.64E-12	1.68E-08	1.57E-04	0	5.97E-08	4.42E-05	0
Indeno(1,2,3-cd)pyrene (c)	**c**	5.01E-11	3.00E-06	1.67E-05	0	1.06E-05	4.71E-06	0
Naphthalene (c & nc)	**c**	4.25E-07	0.129	3.30E-06	0	0.458	9.29E-07	0
1-Methylnaphthalene (nc)	nc	1.19E-06	2.397	4.95E-07	0	7.0897	1.67E-07	0
2-Methylnaphthalene (nc)	nc	9.41E-07	2.0734	4.54E-07	0	6.1324	1.53E-07	0
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Carcinogenic Cumulative Risk				0.0023	0		6.37E-04	0
Non-carcinogenic Cumulative Risk				5.15E-04	0		1.74E-04	0

Values shown in the fourth and seventh columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table C-5 — Migration to Indoor Air Vapor Inhalation Risks

Page 6 — **Savoonga, Alaska** — **Savoonga ARNG FSRC**

1	2	3	4	5	6	7	8	9	10
Compounds		Vapor Concentration in Sample (ug/m^3)	Building Vapor Concentration given site conditions (ug/m^3)	Residential Land Use Building Vapor Concentration when HQ=1 or Target Risk =10^-5 (ug/m^3; Value listed depends on whether C or NC risks are being evaluated)	Residential Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Residential Land Use check for compliance with risk levels (0= in compliance; 1= not in compliance)	Industrial Land Use Building Vapor Concentration when HQ=1 or Target Risk =10^-5 (ug/m^3; Value listed depends on whether C or NC risks are being evaluated)	Industrial Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Industrial Land Use check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	8,069.	1.156	31.2857	0.03695	0	157.7.	0.00733	0
Toluene (nc)	nc	12,779.	1.8307	5,214.	3.511E-04	0	26,280.0.	6.966E-05	0
Ethylbenzene (c & nc)	nc	17,686.	2.5324	1,043.	0.00243	0	5,256.0.	4.818E-04	0
Xylenes (total) (nc)	nc	51,222.	7.3331	104.	0.07032	0	525.6.	0.01395	0
GRO Aromatics (nc)	nc	4,475.	0.6415	417.	0.00154	0	2,102.4.	3.051E-04	0
DRO Aromatics (nc)	nc	2,634.	0.3776	209.	0.00181	0	1,051.2.	3.592E-04	0
RRO Aromatics (nc)	nc	0.0031	4.45E-07	No RfC	0.000E+00	0	No RfC	0.000E+00	0
GRO Aliphatics (nc)	nc	898,708.	129.	19,189.	0.00671	0	96,710.4.	0.00133	0
DRO Aliphatics (nc)	nc	13,381.	1.9181	1,043.	0.00184	0	5,256.0.	3.649E-04	0
RRO Aliphatics (nc)	nc	0.0603	8.65E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Acenaphthene (nc)	nc	0.0645	9.21E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Acenaphthylene (nc)	nc	0.0522	7.46E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Anthracene (nc)	nc	0.0152	2.17E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Benzo(g,h,i)perylene (nc)	nc	3.07E-05	1.11E-08	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Fluoranthene (nc)	nc	0.002	2.84E-07	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Fluorene (nc)	nc	0.0175	2.49E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Naphthalene (c & nc)	nc	0.4254	6.09E-05	3.1286	1.946E-05	0	15.768	3.860E-06	0
Phenanthrene (nc)	nc	0.0127	1.81E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Pyrene (nc)	nc	0.0025	3.56E-07	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Benzene (c & nc)	**c**	8,069.	1.156	3.1197	**0.37054**	0	15.72308	0.07352	0
Ethylbenzene (c & nc)	**c**	17,686.	2.5324	22.1212	**0.11448**	0	111.5.	0.02271	0
Benzo(a)anthracene (c)	**c**	0.0019	2.78E-07	0.2765	1.006E-06	0	1.39364	1.996E-07	0
Benzo(b)fluoranthene (c)	**c**	1.51E-04	2.69E-08	0.2765	9.727E-08	0	1.39364	1.930E-08	0
Benzo(k)fluoranthene (c)	**c**	5.72E-05	1.17E-08	2.7652	4.230E-09	0	13.93636	8.393E-10	0
Benzo(a)pyrene (c)	**c**	3.86E-05	1.39E-08	0.0277	5.027E-07	0	0.13936	9.974E-08	0
Chrysene (c)	**c**	7.12E-04	1.02E-07	27.6515	3.686E-09	0	139.4.	7.313E-10	0
Dibenz(a,h)anthracene (c)	**c**	2.64E-06	1.19E-08	0.0277	4.290E-07	0	0.13936	8.513E-08	0
Indeno(1,2,3-cd)pyrene (c)	**c**	5.01E-05	1.69E-08	0.2765	6.112E-08	0	1.39364	1.213E-08	0
Naphthalene (c & nc)	**c**	0.4254	6.09E-05	0.7157	8.505E-05	0	3.60706	1.688E-05	0
1-Methylnaphthalene (nc)	nc	1.1864	1.70E-04	14.6	1.162E-05	0	73.584	2.305E-06	0
2-Methylnaphthalene (nc)	nc	0.941	1.35E-04	14.6	9.215E-06	0	73.584	1.828E-06	0
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Carcinogenic Cumulative Risk					0.4851	0		0.0963	0
Non-carcinogenic Cumulative Risk					0.1101	0		0.0218	0

Values shown in the fifth and eighth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table C-5 Calculated Migration to Groundwater Levels

Page 7 Savoonga, Alaska — Savoonga ARNG FSRC

1	2	3	4	5	6	7	8	9	10	11	12
Compounds		Dissolved Concentration in Soil Sample (based on 3 or 4 phase partitioning, whichever is accurate, mg/l)	Maximum Contaminant Level (mg/L)	Residential Land Human Health Risk Based Drinking Water Concentration (mg/l)	Residential Land Soil Moisture Target Concentration (MCL or Risk Based Concentration Multiplied by the DAF.....MCLs values used for compounds with MCLs)	Hypothetical Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; MCLs not used; if water is non-potable then hypothetical risk is 0)	Check for compliance with regulatory levels (MCLs used for compounds with MCLs: 0= in compliance; 1= not in compliance; potability of groundwater not considered)	Industrial Land Human Health Risk Based Drinking Water Concentration (mg/l)	Industrial Land Soil Moisture Target Concentration (MCL or Risk Based Concentration Multiplied by the DAF.....MCLs values used for compounds with MCLs)	Hypothetical Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; MCLs not used)	Check for compliance with regulatory levels (MCLs used for compounds with MCLs & Residential RBCs used for compounds without MCLs: 0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	0.6419	0.005	0.146	4.000E-02	0.5495	1	0.2044	4.000E-02	0.3925	1
Toluene (nc)	nc	1.8761	1.	2.92	9.222E+00	0.0697	0	4.088	9.222E+00	0.0498	0
Ethylbenzene (c & nc)	nc	0.7258	0.7	3.65	6.545E+00	0.0213	0	5.11	6.545E+00	0.0152	0
Xylenes (total) (nc)	nc	2.3812	10.	7.3	6.804E+01	0.035	0	10.22	9.320E+01	0.025	0
GRO Aromatics (nc)	nc	0.00E+00		7.3	6.941E+01	0.00E+00	0	10.22	9.718E+01	0.00E+00	0
DRO Aromatics (nc)	nc	1.2396		1.46	1.390E+01	0.0892	0	2.044	1.946E+01	0.0637	0
RRO Aromatics (nc)	nc	1.51E-04		1.095	1.043E+01	1.45E-05	0	1.533	1.460E+01	1.04E-05	0
GRO Aliphatics (nc)	nc	0.0047		183.	1.738E+03	2.73E-06	0	256.	2.433E+03	1.95E-06	0
DRO Aliphatics (nc)	nc	0.0156		3.65	3.476E+01	4.49E-04	0	5.11	4.866E+01	3.20E-04	0
RRO Aliphatics (nc)	nc	4.35E-12		73.	6.951E+02	6.26E-15	0	102.	9.732E+02	4.47E-15	0
Acenaphthene (nc)	nc	9.507E-04		2.19	1.585E+01	6.00E-05	0	3.066	2.219E+01	4.28E-05	0
Acenaphthylene (nc)	nc	0.00188		2.19	1.585E+01	1.19E-04	0	3.066	2.219E+01	8.49E-05	0
Anthracene (nc)	nc	8.685E-05		10.95	9.448E+01	9.19E-07	0	15.33	1.323E+02	6.57E-07	0
Benzo(g,h,i)perylene (nc)	nc	3.443E-06		1.095	1.043E+01	3.30E-07	0	1.533	1.460E+01	2.36E-07	0
Fluoranthene (nc)	nc	2.927E-05		1.46	1.359E+01	2.15E-06	0	2.044	1.903E+01	1.54E-06	0
Fluorene (nc)	nc	6.472E-04		1.46	1.172E+01	5.52E-05	0	2.044	1.640E+01	3.95E-05	0
Naphthalene (c & nc)	nc	1.44654		0.73	4.372E+00	0.3309	0	1.022	6.120E+00	0.2363	0
Phenanthrene (nc)	nc	1.434E-04		10.95	9.466E+01	1.52E-06	0	15.33	1.325E+02	1.08E-06	0
Pyrene (nc)	nc	4.831E-05		1.095	1.019E+01	4.74E-06	0	1.533	1.426E+01	3.39E-06	0
Benzene (c & nc)	**c**	0.6419	0.005	0.0155	4.000E-02	5.1812	1	0.026	4.000E-02	3.0841	1
Ethylbenzene (c & nc)	**c**	0.7258	0.7	No Sfo	6.545E+00	0.00E+00	0	No Sfo	6.545E+00	0.00E+00	0
Benzo(a)anthracene (c)	**c**	3.027E-06	0.001	0.0012	9.514E-03	2.73E-04	0	0.002	9.514E-03	1.62E-04	0
Benzo(b)fluoranthene (c)	**c**	9.205E-07	0.001	0.0012	9.522E-03	8.29E-05	0	0.002	9.522E-03	4.93E-05	0
Benzo(k)fluoranthene (c)	**c**	2.226E-06	0.001	0.0117	9.522E-03	2.00E-05	0	0.0196	9.522E-03	1.19E-05	0
Benzo(a)pyrene (c)	**c**	3.543E-06	2.00E-04	1.17E-04	1.111E-03	0.0032	0	1.96E-04	1.866E-03	0.0019	0
Chrysene (c)	**c**	7.307E-06	0.1	0.1167	9.514E-01	6.58E-06	0	0.196	9.514E-01	3.92E-06	0
Dibenz(a,h)anthracene (c)	**c**	1.664E-05	1.00E-04	1.17E-04	9.522E-04	0.015	0	1.96E-04	9.522E-04	0.0089	0
Indeno(1,2,3-cd)pyrene (c)	**c**	9.261E-08	0.001	0.0012	9.522E-03	8.34E-06	0	0.002	9.522E-03	4.96E-06	0
Naphthalene (c & nc)	**c**	1.44654		No Sfo	No Sfo	0.00E+00	0	No Sfo	No Sfo	0.00E+00	0
1-Methylnaphthalene (nc)	nc	0.38609		0.146	1.309E+00	0.2948	0	0.2044	1.833E+00	0.2106	0
2-Methylnaphthalene (nc)	nc	0.73607		0.146	1.308E+00	0.5628	0	0.2044	1.831E+00	0.402	0
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Carcinogenic Cumulative Risk						5.1998	1			3.0951	1
Non-carcinogenic Cumulative Risk						1.8643	1			1.3316	1

Values shown in the sixth and tenth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

">1E+308" indicates that the DAF value is greater can be calculated in excel (i.e. compounds are essentially immobile) and "1/>1E+308" indicates that the risk and or equilibrium concentration is very low (inconsequential).

Table C-5 — Groundwater Ingestion Risk (Measured Concentrations)

Page 8 — **Savoonga, Alaska** — **Savoonga ARNG FSRC**

1	2	3	4	5	6	7	8	9	10	11	12
Compounds		Dissolved Concentration Measured in Water Sample (mg/l)	Maximum Contaminant Level (mg/L)	Residential Land Use Human Health Risk Based Water Concentration (mg/l)	Groundwater Compliance Concentration (MCL or Residential Land Use Health Based Water Concentration at down gradient edge of source area; mg/l)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; MCLs not used)	Check for compliance with regulatory levels (MCLs used for compounds with MCLs: 0= in compliance; 1= not in compliance)	Industrial Land Use Human Health Based Water Concentration (mg/l)	Groundwater Compliance Concentration (MCL or Industrial Land Use Health Based Water Concentration at down gradient edge of source area; mg/l)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; MCLs not used)	Check for compliance with regulatory levels (MCLs used for compounds with MCLs: 0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	0.085	0.005	0.146	0.005	**0.5822**	1	0.2044	0.005	**0.4159**	1
Toluene (nc)	nc	0.127	1.	2.92	1.	0.0435	0	4.088	1.	0.0311	0
Ethylbenzene (c & nc)	nc	0.166	0.7	3.65	0.7	0.0455	0	5.11	0.7	0.0325	0
Xylenes (total) (nc)	nc	0.581	10.	7.3	7.3	0.0796	0	10.22	10.	0.0568	0
GRO Aromatics (nc)	nc	0.0443		7.3	7.3	0.0061	0	10.22	10.22	0.0043	0
DRO Aromatics (nc)	nc	0.0754		1.46	1.46	0.0516	0	2.044	2.044	0.0369	0
RRO Aromatics (nc)	nc	1.48E-05		1.095	1.095	1.35E-05	0	1.533	1.533	9.65E-06	0
GRO Aliphatics (nc)	nc	0.036		183.	183.	1.97E-04	0	256.	256.	1.41E-04	0
DRO Aliphatics (nc)	nc	4.34E-04		3.65	3.65	1.19E-04	0	5.11	5.11	8.49E-05	0
RRO Aliphatics (nc)	nc	4.35E-12		73.	73.	5.96E-14	0	102.	102.	4.26E-14	0
Acenaphthene (nc)	nc	5.20E-05		2.19	2.19	2.37E-05	0	3.066	3.066	1.70E-05	0
Acenaphthylene (nc)	nc	5.20E-05		2.19	2.19	2.37E-05	0	3.066	3.066	1.70E-05	0
Anthracene (nc)	nc	5.20E-05		10.95	10.95	4.75E-06	0	15.33	15.33	3.39E-06	0
Benzo(g,h,i)perylene (nc)	nc	5.20E-05		1.095	1.095	4.75E-05	0	1.533	1.533	3.39E-05	0
Fluoranthene (nc)	nc	5.20E-05		1.46	1.46	3.56E-05	0	2.044	2.044	2.54E-05	0
Fluorene (nc)	nc	2.70E-05		1.46	1.46	1.85E-05	0	2.044	2.044	1.32E-05	0
Naphthalene (c & nc)	nc	9.80E-05		0.73	0.73	1.34E-04	0	1.022	1.022	9.59E-05	0
Phenanthrene (nc)	nc	5.20E-05		10.95	10.95	4.75E-06	0	15.33	15.33	3.39E-06	0
Pyrene (nc)	nc	5.20E-05		1.095	1.095	4.75E-05	0	1.533	1.533	3.39E-05	0
Benzene (c & nc)	**c**	0.085	0.005	0.0155	0.005	**5.4892**	1	0.026	0.005	**3.2674**	1
Ethylbenzene (c & nc)	**c**	0.166	0.7	No Sfo	0.7	0.00E+00	0	No Sfo	0.7	0.00E+00	0
Benzo(a)anthracene (c)	**c**	5.20E-05	0.001	0.0012	0.001	0.0446	0	0.002	0.001	0.0265	0
Benzo(b)fluoranthene (c)	**c**	1.00E-04	0.001	0.0012	0.001	0.0857	0	0.002	0.001	0.051	0
Benzo(k)fluoranthene (c)	**c**	5.20E-05	0.001	0.0117	0.001	0.0045	0	0.0196	0.001	0.0027	0
Benzo(a)pyrene (c)	**c**	5.20E-05	2.00E-04	1.17E-04	1.17E-04	**0.4457**	0	1.96E-04	1.96E-04	**0.2653**	0
Chrysene (c)	**c**	5.20E-05	0.1	0.1167	0.1	4.46E-04	0	0.196	0.1	2.65E-04	0
Dibenz(a,h)anthracene (c)	**c**	1.00E-04	1.00E-04	1.17E-04	1.00E-04	**0.8571**	0	1.96E-04	1.00E-04	**0.5102**	0
Indeno(1,2,3-cd)pyrene (c)	**c**	1.00E-04	0.001	0.0012	0.001	0.0857	0	0.002	0.001	0.051	0
Naphthalene (c & nc)	**c**	9.80E-05		No Sfo	No Sfo	0.00E+00	0	No Sfo	No Sfo	0.00E+00	0
1-Methylnaphthalene (nc)	nc	0.00025		0.146	0.146	0.0017	0	0.2044	0.2044	0.0012	0
2-Methylnaphthalene (nc)	nc	0.00027		0.146	0.146	0.0018	0	0.2044	0.2044	0.0013	0
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Carcinogenic Cumulative Risk						7.013	1			4.1744	1
Non-carcinogenic Cumulative Risk						0.7547	0			0.539	0

Values shown in the seventh and eleventh columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

If the groundwater is non-potable then groundwater ingestion risk is zero.

Table C-5	Potential Cumulative Risk Assuming All Pathways Complete												DRO, GRO and RRO not included in cumulative risk calculations
Page 9	Savoonga, Alaska					Savoonga ARNG FSRC							
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Compounds		Fraction of Soil Direct Contact Risk, Residential Site	Fraction of Outdoor Air Inhalation Risk, Residential Site	Fraction of Indoor Air Inhalation Risk, Residential Site	Fraction of Groundwater Ingestion Risk, Residential Site	Sum of Fraction of Risk Values for Residential Site	Residential Site Check for compliance with risk levels (0= in compliance 1= not in compliance)	Fraction of Soil Direct Contact Risk, Industrial Site	Fraction of Outdoor Air Inhalation Risk, Industrial Site	Fraction of Indoor Air Inhalation Risk, Industrial Site	Fraction of Groundwater Ingestion Risk, Industrial Site	Sum of Fraction of Risk Values for Industrial Site	Industrial Site Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	0.0076	1.43E-04	0.0369	**0.5822**	**0.6269**	0	3.79E-04	4.82E-05	0.0073	**0.4159**	**0.4236**	0
Toluene (nc)	nc	0.0043	1.53E-06	3.51E-04	0.0435	0.0482	0	2.14E-04	5.17E-07	6.97E-05	0.0311	0.0314	0
Ethylbenzene (c & nc)	nc	0.0047	1.23E-05	0.0024	0.0455	0.0527	0	2.35E-04	4.15E-06	4.82E-04	0.0325	0.0332	0
Xylenes (total) (nc)	nc	0.0123	3.57E-04	0.0703	0.0796	**0.1626**	0	6.12E-04	1.21E-04	0.014	0.0568	0.0715	0
GRO Aromatics (nc)	nc												
DRO Aromatics (nc)	nc												
RRO Aromatics (nc)	nc												
GRO Aliphatics (nc)	nc												
DRO Aliphatics (nc)	nc												
RRO Aliphatics (nc)	nc												
Acenaphthene (nc)	nc	2.97E-04	0.00E+00	0.00E+00	2.37E-05	3.20E-04	0	4.42E-05	0.00E+00	0.00E+00	1.70E-05	6.12E-05	0
Acenaphthylene (nc)	nc	1.47E-04	0.00E+00	0.00E+00	2.37E-05	1.70E-04	0	2.18E-05	0.00E+00	0.00E+00	1.70E-05	3.88E-05	0
Anthracene (nc)	nc	2.38E-05	0.00E+00	0.00E+00	4.75E-06	2.86E-05	0	2.60E-06	0.00E+00	0.00E+00	3.39E-06	6.00E-06	0
Benzo(g,h,i)perylene (nc)	nc	8.58E-04	0.00E+00	0.00E+00	4.75E-05	9.05E-04	0	1.28E-04	0.00E+00	0.00E+00	3.39E-05	1.62E-04	0
Fluoranthene (nc)	nc	1.93E-04	0.00E+00	0.00E+00	3.56E-05	2.29E-04	0	2.88E-05	0.00E+00	0.00E+00	2.54E-05	5.42E-05	0
Fluorene (nc)	nc	3.28E-04	0.00E+00	0.00E+00	1.85E-05	3.47E-04	0	4.17E-05	0.00E+00	0.00E+00	1.32E-05	5.49E-05	0
Naphthalene (c & nc)	nc	**0.1292**	7.54E-07	1.95E-05	1.34E-04	**0.1293**	0	0.0138	2.55E-07	3.86E-06	9.59E-05	0.0139	0
Phenanthrene (nc)	nc	2.09E-05	0.00E+00	0.00E+00	4.75E-06	2.57E-05	0	2.28E-06	0.00E+00	0.00E+00	3.39E-06	5.68E-06	0
Pyrene (nc)	nc	3.07E-04	0.00E+00	0.00E+00	4.75E-05	3.55E-04	0	4.58E-05	0.00E+00	0.00E+00	3.39E-05	7.97E-05	0
Benzene (c & nc)	**c**	0.0206	0.0014	**0.3705**	**5.4892**	**5.8818**	1	0.003	4.03E-04	0.0735	**3.2674**	**3.3443**	1
Ethylbenzene (c & nc)	**c**	0.00E+00	5.78E-04	**0.1145**	0.00E+00	**0.1151**	0	0.00E+00	1.63E-04	0.0227	0.00E+00	0.0229	0
Benzo(a)anthracene (c)	**c**	0.0757	5.32E-06	1.01E-06	0.0446	**0.1203**	0	0.0308	1.50E-06	2.00E-07	0.0265	0.0573	0
Benzo(b)fluoranthene (c)	**c**	**0.1269**	9.23E-06	9.73E-08	0.0857	**0.2126**	0	0.0516	2.60E-06	1.93E-08	0.051	**0.1026**	0
Benzo(k)fluoranthene (c)	**c**	0.0188	4.72E-07	4.23E-09	0.0045	0.0233	0	0.0077	1.33E-07	8.39E-10	0.0027	0.0103	0
Benzo(a)pyrene (c)	**c**	**3.6836**	5.98E-05	5.03E-07	**0.4457**	**4.1293**	1	**1.4979**	1.69E-05	9.97E-08	**0.2653**	**1.7632**	1
Chrysene (c)	**c**	8.80E-04	3.24E-08	3.69E-09	4.46E-04	0.0013	0	3.58E-04	9.12E-09	7.31E-10	2.65E-04	6.23E-04	0
Dibenz(a,h)anthracene (c)	**c**	**3.6836**	1.57E-04	4.29E-07	**0.8571**	**4.5409**	1	**1.4979**	4.42E-05	8.51E-08	**0.5102**	**2.0081**	1
Indeno(1,2,3-cd)pyrene (c)	**c**	**0.1207**	1.67E-05	6.11E-08	0.0857	**0.2065**	0	0.0491	4.71E-06	1.21E-08	0.051	**0.1001**	0
Naphthalene (c & nc)	**c**	0.00E+00	3.30E-06	8.51E-05	0.00E+00	8.83E-05	0	0.00E+00	9.29E-07	1.69E-05	0.00E+00	1.78E-05	0
1-Methylnaphthalene (nc)	nc	**0.8252**	4.95E-07	1.16E-05	0.0017	**0.8269**	0	0.0885	1.67E-07	2.31E-06	0.0012	0.0897	0
2-Methylnaphthalene (nc)	nc	**1.2916**	4.54E-07	9.21E-06	0.0018	**1.2934**	1	**0.1385**	1.53E-07	1.83E-06	0.0013	**0.1398**	0
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Carcinogenic Cumulative Risk						15.2312						7.4095	1
Non-carcinogenic Cumulative Risk						3.1423						0.8036	0

Values shown in the second through sixth and eighth through twelfth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table C-5	Cumulative Risk for Pathways Complete at Present Time												DRO, GRO and RRO not included in cumulative risk calculations
Page 10	Savoonga, Alaska					Savoonga ARNG FSRC							
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Compounds		Fraction of Soil Direct Contact Risk, Residential Site	Fraction of Outdoor Air Inhalation Risk, Residential Site	Fraction of Indoor Air Inhalation Risk, Residential Site	Fraction of Groundwater Ingestion Risk, Residential Site	Sum of Fraction of Risk Values for Residential Site	Residential Site Check for compliance with risk levels (0= in compliance 1= not in compliance)	Fraction of Soil Direct Contact Risk, Industrial Site	Fraction of Outdoor Air Inhalation Risk, Industrial Site	Fraction of Indoor Air Inhalation Risk, Industrial Site	Fraction of Groundwater Ingestion Risk, Industrial Site	Sum of Fraction of Risk Values for Industrial Site	Industrial Site Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	0.0076	1.43E-04	0.00E+00	0.00E+00	0.0078	0	3.79E-04	4.82E-05	0.00E+00	0.00E+00	4.27E-04	0
Toluene (nc)	nc	0.0043	1.53E-06	0.00E+00	0.00E+00	0.0043	0	2.14E-04	5.17E-07	0.00E+00	0.00E+00	2.15E-04	0
Ethylbenzene (c & nc)	nc	0.0047	1.23E-05	0.00E+00	0.00E+00	0.0047	0	2.35E-04	4.15E-06	0.00E+00	0.00E+00	2.39E-04	0
Xylenes (total) (nc)	nc	0.0123	3.57E-04	0.00E+00	0.00E+00	0.0127	0	6.12E-04	1.21E-04	0.00E+00	0.00E+00	7.32E-04	0
GRO Aromatics (nc)	nc												
DRO Aromatics (nc)	nc												
RRO Aromatics (nc)	nc												
GRO Aliphatics (nc)	nc												
DRO Aliphatics (nc)	nc												
RRO Aliphatics (nc)	nc												
Acenaphthene (nc)	nc	2.97E-04	0.00E+00	0.00E+00	0.00E+00	2.97E-04	0	4.42E-05	0.00E+00	0.00E+00	0.00E+00	4.42E-05	0
Acenaphthylene (nc)	nc	1.47E-04	0.00E+00	0.00E+00	0.00E+00	1.47E-04	0	2.18E-05	0.00E+00	0.00E+00	0.00E+00	2.18E-05	0
Anthracene (nc)	nc	2.38E-05	0.00E+00	0.00E+00	0.00E+00	2.38E-05	0	2.60E-06	0.00E+00	0.00E+00	0.00E+00	2.60E-06	0
Benzo(g,h,i)perylene (nc)	nc	8.58E-04	0.00E+00	0.00E+00	0.00E+00	8.58E-04	0	1.28E-04	0.00E+00	0.00E+00	0.00E+00	1.28E-04	0
Fluoranthene (nc)	nc	1.93E-04	0.00E+00	0.00E+00	0.00E+00	1.93E-04	0	2.88E-05	0.00E+00	0.00E+00	0.00E+00	2.88E-05	0
Fluorene (nc)	nc	3.28E-04	0.00E+00	0.00E+00	0.00E+00	3.28E-04	0	4.17E-05	0.00E+00	0.00E+00	0.00E+00	4.17E-05	0
Naphthalene (c & nc)	nc	**0.1292**	7.54E-07	0.00E+00	0.00E+00	**0.1292**	0	0.0138	2.55E-07	0.00E+00	0.00E+00	0.0138	0
Phenanthrene (nc)	nc	2.09E-05	0.00E+00	0.00E+00	0.00E+00	2.09E-05	0	2.28E-06	0.00E+00	0.00E+00	0.00E+00	2.28E-06	0
Pyrene (nc)	nc	3.07E-04	0.00E+00	0.00E+00	0.00E+00	3.07E-04	0	4.58E-05	0.00E+00	0.00E+00	0.00E+00	4.58E-05	0
Benzene (c & nc)	c	0.0206	0.0014	0.00E+00	0.00E+00	0.022	0	0.003	4.03E-04	0.00E+00	0.00E+00	0.0034	0
Ethylbenzene (c & nc)	c	0.00E+00	5.78E-04	0.00E+00	0.00E+00	5.78E-04	0	0.00E+00	1.63E-04	0.00E+00	0.00E+00	1.63E-04	0
Benzo(a)anthracene (c)	c	0.0757	5.32E-06	0.00E+00	0.00E+00	0.0757	0	0.0308	1.50E-06	0.00E+00	0.00E+00	0.0308	0
Benzo(b)fluoranthene (c)	c	**0.1269**	9.23E-06	0.00E+00	0.00E+00	**0.1269**	0	0.0516	2.60E-06	0.00E+00	0.00E+00	0.0516	0
Benzo(k)fluoranthene (c)	c	0.0188	4.72E-07	0.00E+00	0.00E+00	0.0188	0	0.0077	1.33E-07	0.00E+00	0.00E+00	0.0077	0
Benzo(a)pyrene (c)	c	**3.6836**	5.98E-05	0.00E+00	0.00E+00	**3.6836**	1	**1.4979**	1.69E-05	0.00E+00	0.00E+00	**1.4979**	1
Chrysene (c)	c	8.80E-04	3.24E-08	0.00E+00	0.00E+00	8.80E-04	0	3.58E-04	9.12E-09	0.00E+00	0.00E+00	3.58E-04	0
Dibenz(a,h)anthracene (c)	c	**3.6836**	1.57E-04	0.00E+00	0.00E+00	**3.6837**	1	**1.4979**	4.42E-05	0.00E+00	0.00E+00	**1.4979**	1
Indeno(1,2,3-cd)pyrene (c)	c	**0.1207**	1.67E-05	0.00E+00	0.00E+00	**0.1208**	0	0.0491	4.71E-06	0.00E+00	0.00E+00	0.0491	0
Naphthalene (c & nc)	c	0.00E+00	3.30E-06	0.00E+00	0.00E+00	3.30E-06	0	0.00E+00	9.29E-07	0.00E+00	0.00E+00	9.29E-07	0
1-Methylnaphthalene (nc)	nc	**0.8252**	4.95E-07	0.00E+00	0.00E+00	**0.8252**	0	0.0885	1.67E-07	0.00E+00	0.00E+00	0.0885	0
2-Methylnaphthalene (nc)	nc	**1.2916**	4.54E-07	0.00E+00	0.00E+00	**1.2916**	1	**0.1385**	1.53E-07	0.00E+00	0.00E+00	**0.1385**	0
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Carcinogenic Cumulative Risk						7.733						3.1389	1
Non-carcinogenic Cumulative Risk						2.2776						0.2427	0

Values shown in the second through sixth and eighth through twelfth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table C-5	Partitioning into Groundwater & Surface Water							
Page 11	Savoonga, Alaska					Savoonga ARNG FSRC		
1	2	3	4	5	6	7	8	9
Compounds		Calculated Equilibrium Conc. (from soil data & solver or goal seek) (mg/L)	Measured Dissolved Phase Conc. (mg/L)	Groundwater Compliance Concentration (MCL or Residential Land Use Health Based Water Concentration at down gradient edge of source area; mg/l)	Check for vadose zone fill potential (DAF of 3.3; 0 =suitable for vadose zone fill; 1 =not suitable for vadose zone fill; "ND" input concentrations not assessed)	Check for saturated zone fill potential (DAF of 1; 0 =suitable for saturated zone fill; 1 =not suitable for saturated zone fill; "ND" input concentrations not assessed)	Ambient Water Quality Criteria (mg/L)	Check for surface water body fill potential (DAF of 1; 0 =suitable for fill in surface water; 1 =not suitable for fill in surface water; "ND" input concentrations not assessed)
Benzene		0.6419	0.085	0.005	1	1	0.005	1
Toluene		1.8761	0.127	1.	0	0		
Ethylbenzene		0.7258	0.166	0.7	0	0		
Xylene		2.3812	0.581	7.3	0	0		
GRO Aromatics		0.00E+00	0.0443	7.3	0	0		
DRO Aromatics		1.2396	0.0754	1.46	0	0		
RRO Aromatics		1.51E-04	1.48E-05	1.095	0	0		
GRO Aliphatics		0.0047	0.036	183.	0	0		
DRO Aliphatics		0.0156	4.34E-04	3.65	0	0		
RRO Aliphatics		4.35E-12	4.35E-12	73.	0	0		
Acenaphthene		9.51E-04	5.20E-05	2.19	0	0		
Acenaphthylene		0.0019	5.20E-05	2.19	0	0		
Anthracene		8.68E-05	5.20E-05	10.95	0	0		
Benzo(g,h,i)perylene		3.44E-06	5.20E-05	1.095	0	0		
Fluoranthene		2.93E-05	5.20E-05	1.46	0	0		
Fluorene		6.47E-04	2.70E-05	1.46	0	0		
Naphthalene		1.4465	9.80E-05	0.73	0	0		
Phenanthrene		1.43E-04	5.20E-05	10.95	0	0		
Pyrene		4.83E-05	5.20E-05	1.095	0	0		
Benzo (a) Anthracene		3.03E-06	5.20E-05	0.001	0	0		
Benzo (b) fluoranthene		9.21E-07	1.00E-04	0.001	0	0		
Benzo (k) fluoranthene		2.23E-06	5.20E-05	0.001	0	0		
Benzo (a) pyrene		3.54E-06	5.20E-05	1.17E-04	0	0		
Chrysene		7.31E-06	5.20E-05	0.1	0	0		
Dibenz (a,h) anthracene		1.66E-05	1.00E-04	1.00E-04	0	0		
Indeno (1,2,3-cd) pyrene		9.26E-08	1.00E-04	0.001	0	0		
1-Methylnaphthalene (nc)		0.3861	2.50E-04	0.146	0	0		
2-Methylnaphthalene (nc)		0.7361	2.70E-04	0.146	0	0		
TAH		5.625	0.959				0.01	1
TAqH		7.0753	0.96				0.015	1
DRO sheen (mg/kg)							230	1
				sum	1	1	sum	4

These calculations may be used to assess the potential limitations on the off-site transport and placement of hydrocarbon impacted soil.

Table C-5	Site Status Summary					
Page 12	Savoonga, Alaska				Savoonga ARNG FSRC	

1	2	3	4	5	6	7	8
		Cumulative Risks for Residential Site (rounded to 1 significant digit)	soil ingestion check for compliance with risk criteria (0= in compliance; 1 or >1 = not in compliance; number is the number of carcinogenic and non-carcinogenic direct contact criteria exceeded)	migration to outdoor air check for compliance with risk criteria (0= in compliance; 1= not in compliance)	migration to indoor air check for compliance with risk criteria (0= in compliance; 1= not in compliance)	groundwater ingestion check for compliance with risk criteria (0= in compliance; 1 or >1 = not in compliance; number is the number of carcinogenic and non-carcinogenic direct contact criteria exceeded)	migration to groundwater check for compliance (0= in compliance; 1 = not in compliance)
Potential Carcinogenic Cumulative Fraction of Risk		**20**	2			1	
Potential Non-carcinogenic Cumulative Risk		**3**	1			0	
Existing Carcinogenic Cumulative Fraction of Risk		7.733					
Existing non-carcinogenic Cumulative Risk		2.2776					
GRO Aromatics			0	0	0	0	0
DRO Aromatics			0	0	0	0	0
RRO Aromatics			0	0	0	0	0
GRO Aliphatics			0	0	0	0	0
DRO Aliphatics			1	0	0	0	0
RRO Aliphatics			0	0	0	0	0
check for ultimate GRO, DRO, RRO compliance			**1**				

Site conditons do not meet the ADEC human health risk standard established in 18 AAC 75.325. Site conditions are not protective of human health under an unrestricted (residential) landuse scenario. **1**

Migration to groundwater criteria have not been attained in surface and subsurface soils. **4**

Site does not meet closeout criteria, eligible only for a 'cleanup complete with institutional controls' determination

A DRO polar fraction may be present, the risk posed by the polar fraction is not known.

Table C-6 — Hydrocarbon Risk Calculator

Facility Location: **Savoonga, Alaska**

Facility Name: **Savoonga ARNG FSRC Proposed ACLs**

Page 1 — Model Input Parameters:

Version 1.1, Lawrence Acomb, Geosphere, Inc., March 4, 2011

Solver solution based on work of Hun Seak Park, 1999; VBA macro by Ted Cahalane, 2010

Site Specific and/or Field Data in Yellow Highlighted Cells			Chemical Concentrations in Site Groundwater (mg/L):	Calculate	Dissolved Phase Half Life (days; used in DAF calculations):	Soil Conditions:	Site Specific and/or Field Data in Yellow Highlighted Cells	ADEC Default Value (all climate zones)	FYI Unit Conversions	
Concentrations in Site Soils (mg/kg):			Benzene (mg/L)	0.085	400	bulk density (lbs/ft^3)	93.6	93.6	bulk density conversion input (g/cm^3)	bulk density output (lbs/ft^3)
Benzene (c & nc)		0.13	Toluene (mg/L)	0.127	100	bulk density (g/cm^3)	1.50	1.5	1.66	103.584
Toluene (nc)		35.	Ethylbenzene (mg/L)	0.166	100	specific gravity	2.65	2.65	K (ft/day)	K (cm/sec)
Ethylbenzene (c & nc)		48.	Xylene (mg/L)	0.581	100	porosity	0.434	0.43	400	0.141111111
Xylenes (total) (nc)		250.	GRO (mg/L)	2.11	100	moisture content (% by weight)	10	10	**Exposure Routes Complete at Present Time**	
GRO (mg/kg)		73.	DRO (mg/L)	30.2	100	foc	0.0010	0.001	Exposure Routes	enter 1 for complete pathways; 0 for incomplete pathways
DRO (mg/kg)		11,015.	RRO (mg/L)	1.48E-05	100	water filled porosity	0.150	0.15	Soil Direct Contact	1
RRO (mg/kg)		360.	GRO aromatics (mg/L)	0.0443	100	air filled porosity	0.262	0.28	Outdoor Air	1
Total Petroleum Hydrocarbons (mg/kg)		11,733.591	DRO aromatics (mg/L)	0.0754	100	NAPL filled porosity	0.022		Indoor Air	0
GRO Aromatics Fraction (ADEC default=0.50)		0.65	RRO aromatics (mg/L)	1.48E-05	100	water saturation	34.57%		Groundwater Ingestion	0
DRO Aromatics Fraction (ADEC default=0.40)		0.09	GRO aliphatics (mg/L)	0.036	100	NAPL saturation	5.14%			
RRO Aromatics Fraction (ADEC default=0.40)		0.34	DRO aliphatics (mg/L)	4.34E-04	100	Soil temp (C)	6	25		
See Note #1 regarding use of ND values			RRO aliphatics (mg/L)	4.35E-12	100	Soil Grain Size Description (USCS or other; used to label CSM)	Sand with Silt			
Acenaphthene (nc)		0.83	Acenaphthene (nc)	5.20E-05	10,000	**Hydrogeologic Conditions:**		ADEC Default Values <40" precip/yr	ADEC Default Values >40" precip/yr	
Acenaphthylene (nc)		0.41	Acenaphthylene (nc)	5.20E-05	10,000	Source length (ft)	60	105	105	
Anthracene (nc)		0.49	Anthracene (nc)	5.20E-05	10,000	Average precipitation (in/yr)	10	25.59	118.11	
Benzo(g,h,i)perylene (nc)		1.2	Benzo(g,h,i)perylene (nc)	5.20E-05	10,000	Default Estimated Infiltration Rate (20% of precip, m/yr)	0.051	0.13	0.6	
Fluoranthene (nc)		0.36	Fluoranthene (nc)	5.20E-05	10,000	Aquifer hydraulic conductivity (cm/sec)	2.78E-03	2.78E-03	2.78E-03	
Fluorene (nc)		0.77	Fluorene (nc)	2.70E-05	10,000	Aquifer thickness (ft; below low water at downgradient edge of source)	32.8	32.8	32.8	
Naphthalene (c & nc)		180.	Naphthalene (c & nc)	9.80E-05	10,000	Source length (m)	18	32	32	
Phenanthrene (nc)		0.43	Phenanthrene (nc)	5.20E-05	10,000	Infiltration rate (m/yr)	0.051	0.13	0.6	
Pyrene (nc)		0.43	Pyrene (nc)	5.20E-05	10,000	Hydraulic gradient	0.002	0.002	0.002	
Benzo(a)anthracene (c)		0.37	**Benzo(a)anthracene (c)**	5.20E-05	10,000	Aquifer hydraulic conductivity (m/yr)	8.76E+02	8.76E+02	8.76E+02	
Benzo(b)fluoranthene (c)		0.62	**Benzo(b)fluoranthene (c)**	1.00E-04	10,000	Aquifer thickness (ft; below low water)	10.0	10.0	10.0	
Benzo(k)fluoranthene (c)		0.92	**Benzo(k)fluoranthene (c)**	5.20E-05	10,000	Mixing Zone Depth minimum of (m)	5.5	5.5 maximum	5.5 maximum	
Benzo(a)pyrene (c)		1.8	**Benzo(a)pyrene (c)**	5.20E-05	10,000	Dilution Factor (lower seasonal value)	5.1	minimum DAF (for all compounds)	6.0	
Chrysene (c)		0.43	**Chrysene (c)**	5.20E-05	10,000	Vadose Zone or Smear Zone Source?	1	4 indicates vadose zone source, 1 indicates a saturated zone source		
Dibenz(a,h)anthracene (c)		1.8	**Dibenz(a,h)anthracene (c)**	1.00E-04	10,000	Potable or Non-potable Aquifer?	1	Enter 1 for potable aquifer, 10 for non-potable aquifer (to b considered non-potable the groundwater must have been evaluated and determined to be non-potable by the ADEC as per 18 AAC 75.350		
Indeno(1,2,3-cd)pyrene (c)		0.59	**Indeno(1,2,3-cd)pyrene (c)**	1.00E-04	10,000					
1-Methylnaphthalene (nc)	nc	230.	1-Methylnaphthalene (nc)	2.50E-04	1,000	ADEC Reckey No.:				
2-Methylnaphthalene (nc)	nc	360.	2-Methylnaphthalene (nc)	2.70E-04	1,000	ADEC File ID				
	nc					Latitude				
	nc					Longitude				
	nc					Width of Source (ft)	20			
	nc					Area of NAPL contaminated soil source (ft^2)	6,000			
	nc					Ground surface slope (ft/ft, assumed to be in direction of groundwater flow)	0.002			
	c									
	c									
	c									
	c									
	c									
	c									
	c									

Solver Instructions & Information:

"Solver" is an Excel add-in tool, installed from the program discs. In addition, the "macro" which performs the calculations must be "enabled" while the spreadsheet is opening.

1. Enter site specific hydrocarbon concentration data, and soil and groundwater conditions data.
2. Click on the "Calculate" button in cell D4. The phase partitioning equations are solved and the results are saved in the spreadsheet.
3. Any time data entry values are changed the spreadsheet should be re-calculated (click on the "Calculate" button again).

Molar density (mol/L)*NAPL filled porosity initial value=.0001	0.103651463
Initial air filled porosity (used to start iterations)	0.284
Conservation of volume equation (should be zero or close to zero, i.e. a very small number)	2.11E-11

Climate Related Outdoor Air Inhalation and Soil Direct Contact Exposure Parameters

Climate Zone of site (enter "1" for an arctic site; "2" for the <40" precip zone; and "3" for the >40" precip zone)	2

Soil Ingestion & Inhalation Exposure Frequency (days/yr)		ADEC Default Values
Residential	Industrial	arctic zone; precip <40"; precip >40"
270	250	Res 200; 270; 330 / Indus 200; 250; 250
Q/C for volatilization to Outdoor Air calcs.		
Residential	Industrial	
90.82	90.82	100.13; 90.82; 82.72

depth to groundwater at seasonal low water level at downgradient end of source (ft)	2
seasonal water table fluctuation (ft)	1
depth to bottom of source zone at downgradient edge of source (ft)	3
depth to top of area wide source zone at downgradient edge of source (ft)	0
saturated source thickness at low water level (ft; depth of NAPL source below low water table)	1
saturated source thickness at high water level (ft; thickness of saturated source zone below high water table)	2.00
total thickness of the source zone (ft)	3
seasonal water table fluctuation (m)	0.305
saturated source thickness at low water level (m; depth of source below low water table)	0.305
saturated source thickness at high water level (m; thickness of source zone below high water table)	0.610

Smear Zone Source--- NAPL source extends through zone of seasonal water table fluctuation

Source Depth input (cell N28) indicates that contaminated soil is present above the bottom of the floor slab or basement.

Source Depth input and J&E model input do not agree, check the input to cell N28 and/or cells C61, D61, E61 and G57 to be sure they match site conditions.

Enter the thickness of the uncontaminated soil immediately below the slab in cells C61, D61 and E61 . If you don't know the thickness of uncontaminated soil below the slab consider entering a relatively small thickness.

Table C-6	Migration to Indoor Air-- Data Entry	Savoonga, Alaska	Savoonga ARNG FSRC Proposed
Page 2	NAPL source area soil gas concentrations or measured soil gas concentrations used as input. Attenuation factor "alpha" calculated by the Johnson & Ettinger model following the EPA advanced soil gas solution to the J & E model. Incremental risk posed by NAPL source area soil gas concentrations via the migration to indoor air pathway shown in section 6 below and entered into the cumulative risk calculations.		

Site Specific and/or Field Data in Yellow Highlighted Cells

Soil Properties:	Upper most uncontaminated soil layer immediately below slab	Middle Layer (not contaminated)	Bottom Layer (not contaminated)	**Building Properties:**	input value	default input values: **basement**	default input values: **slab on grade**			**Human Health Exposure Criteria**		
bulk density (lbs/ft^3)	93.60	93.60	93.60	**Lb** = length of building (cm)	1000	1000	1000	**L_T** = total source-building separation distance (cm)	1		Residential	Industrial
bulk density (g/cm^3)	1.50	1.50	1.50	**Wb** = width of building (cm)	1000	1000	1000	**Acrack= area of total cracks (cm^2)** = Xcrack* Wcrack = Ab/n	400	Target Carcinogenic Risk (TRC; default = 10^-5)	1.00E-05	1.00E-05
specific gravity of solids	2.65	2.65	2.65	**Hb** = height of building (cm)	244	366	244	**Xcrack** = floor -wall seam perimeter (cm)	4000	THQ= target hazard quotient (default = 1.0)	1	1
porosity	0.43	0.43	0.43	**ER** = air exchange rate (1/hr)	0.25	0.25		**u** = viscosity of air (g/cm-sec)	1.74E-04	ATc= averaging time carcinogen (days), (=70 years)	25,550	25,550
moisture content (% by weight)	10.00	10.00	10.00	**Lf** = depth below grade of bottom of floor slab or basement (cm)	15	200	15	**Zcrack** = crack depth below grade (cm)	15	ATnc= averaging time non-carcinogen	30	30
foc	0.001	0.001	0.001	**Lf** = depth below grade of bottom of floor slab or basement (ft)	0.49212	6.5616	0.49212	**equation 16 r crack**= n /(Ab /Xcrack)	1.00E-01	ED= exposure duration (30 years)	30	25
water filled porosity	0.150	0.150	0.150	**Lcrack** = enclosed space foundation thickness or **slab thickness** (cm)	10	10	10	**n** = Acrack/Ab (0<=n<=1)	3.77E-04	EF= effective exposure frequency (350 days/year)	350	83.33333333
air filled porosity	0.284	0.284	0.284	**delta P** = pressure differential between building and soil (g/cm-s^2)	40	40 g/cm-s^2 = 4 pascals (Pa)	typical conservative values = 4 or 5 Pa; max range = 0 to 20 Pa	**equation 14 Q building**=building ventilation rate (cm^3/sec) = (Lb*Wb*Hb*ER)/3,600s/h	1.69E+04	Industrial Scenario Exposure Frequency input values	days per week	5
Thickness of uncontaminated soil layers above source at building location (ft; upper most layer must extend below the depth of foundation; used to define the source-building separation distance)	0.1	0.1	0.1	**kv** = soil vapor permeability= top soil layer (cm^2)	2.40E-09	1.00E-08		**equation 14 Q building**=building ventilation rate (cm^3/sec; if a value is input it will be used in the alpha calculation--optional)			hours per day	8
layer thickness (cm)	15.34	3.05	3.05	**A_B**= surface area of enclosed space below grade (cm^2)	1.06E+06	=area of basement walls+ basement floor... or area of slab on grade		**equation 15 Q soil** = (2* pi * delta P* kv* Xcrack)/u ln (2 Zcrack/ r crack)	2.43E+00		weeks per year	50
Ls (ft) = Total depth to contaminant or to soil gas sample if soil gas data used as input to model	0.3	**Ls** (cm)	9.14	**Q building**=building ventilation rate (cm^3/sec)	1.69E+04			Rc (gas constant, cal/mol-degree K	1.9872	C cancer =	[(TCR*ATc)/(EF*ED*URF)]	
kv = soil vapor permeability (cm^2; est. values in cells Q65 to S65)	2.40E-09	2.40E-09	2.40E-09	**Wcrack** = floor-wall seam crack width (cm)	0.1			R (gas constant, atm-m^3/mol-degree K	8.2057E-05	C non-cancer =	(TQH*Rfc*1000ug/mg)	

Source Depth input (cell N28) indicates that contaminated soil is present above the bottom of the floor slab or basement.

Source Depth input and J&E model input do not agree, check the input to cell N28 and/or cells C61, D61, E61 and G57 to be sure they match site conditions.

Enter the thickness of the uncontaminated soil immediately below the slab in cells C61, D61 and E61 . If you don't know the thickness of uncontaminated soil below the slab consider entering a thickness only slightly greater than the foundation depth.

Table C-6		Phase Partitioning Results			Savoonga, Alaska			Savoonga ARNG FSRC Proposed ACLs					
Page 3 column 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hydrocarbon Fractions		**Median Equivalent Carbon**	**Distribution of DRO & GRO into Aromatic & Aliphatic Equivalent Carbon Ranges (varies by fuel type)**	**Bulk Soil Concentration (mg/kg)**	**Fraction of TPH Mass**	**Xi (Mole Fraction in NAPL using 4-phase model; unique solution)**	**Concentration in Soil Water (mg of chemical/L of pore water)**	**Concentration in Soil Gas (mg/L pore air)**	**% of Hydrocarbon Mass in Dissolved Phase**	**% of Hydrocarbon Mass in Vapor Phase**	**% of Hydrocarbon Mass Adsorbed to Soils**	**% of Hydrocarbon Mass in NAPL**	**Sum of Dissolved, Vapor, Adsorbed and NAPL Phases**
Benzene C_6-C_7		6.50	from analysis	0.130	0.000011	2.20E-05	3.94E-02	3.74E-03	3.033%	0.502%	5.020%	91.45%	100.00%
Toluene C_7-C_8		7.58	from analysis	35.000	0.002983	5.32E-03	2.80E+00	2.82E-01	0.800%	0.140%	2.144%	96.92%	100.00%
Ethylbenzene C_8-C_9		8.50	from analysis	48.000	0.004091	6.45E-03	1.09E+00	1.16E-01	0.227%	0.042%	1.175%	98.56%	100.00%
Xylene C_8-C_9		8.63	from analysis	250.000	0.021306	3.38E-02	3.58E+00	3.16E-01	0.143%	0.022%	0.635%	99.20%	100.00%
Aromatic C_9-C_{10}		9.50	from analysis	0.000	0.000000	0.00E+00	0.00E+00	0.00E+00	0.000%	0.000%	0.000%	0.00%	0.00%
Aromatic C_{10}-C_{12}		11.00	0.24188	245.592	0.020931	2.71E-02	6.66E-01	2.33E-02	0.027%	0.002%	0.681%	99.29%	100.00%
Aromatic C_{12}-C_{16}		13.00	0.55235	560.830	0.047797	5.57E-02	5.20E-01	8.56E-03	0.009%	0.000%	0.369%	99.62%	100.00%
Aromatic C_{16}-C_{21}		17.00	0.20578	208.937	0.017807	1.75E-02	2.36E-02	9.97E-05	0.001%	0.000%	0.113%	99.89%	100.00%
Aromatic C_{21}-C_{35}		25.00	1.0000	124.034	0.010571	8.09E-03	2.28E-04	4.78E-08	0.000%	0.000%	0.012%	99.99%	100.00%
Aliphatic C_5-C_6		5.50	0.01239	0.315	0.000027	5.49E-05	1.97E-03	3.89E-02	0.062%	2.153%	0.502%	97.28%	100.00%
Aliphatic C_6-C_8		7.00	0.21947	5.588	0.000476	7.86E-04	4.22E-03	8.74E-02	0.008%	0.273%	0.287%	99.43%	100.00%
Aliphatic C_8-C_{10}		9.00	0.76814	19.558	0.001667	2.17E-03	9.24E-04	2.31E-02	0.000%	0.021%	0.143%	99.84%	100.00%
Aliphatic C_{10}-C_{12}		11.00	0.45821	4581.947	0.390498	4.18E-01	1.42E-02	4.37E-01	0.000%	0.002%	0.074%	99.92%	100.00%
Aliphatic C_{12}-C_{16}		13.00	0.51320	5131.780	0.437358	3.98E-01	1.07E-03	7.86E-02	0.000%	0.000%	0.040%	99.96%	100.00%
Aliphatic C_{16}-C_{21}		17.00	0.02859	285.913	0.024367	1.71E-02	2.91E-07	1.37E-04	0.000%	0.000%	0.012%	99.99%	100.00%
Aliphatic C_{21}-C_{35}		25.00	1.0000	235.966	0.020110	9.71E-03	6.57E-12	9.10E-08	0.000%	0.000%	0.001%	100.00%	100.00%
				11733.591	**100.0000%**	**1.00000**	**8.74E+00**	**1.41E+00**					

sum of GRO aromatic mass fractions must equal 1	7.007483E+00	358.591	sum of GRO concentrations should equal input GRO concentration
sum of GRO aliphatic mass fractions must equal 1	1.000000E+00	11015.000	sum of DRO concentrations must equal input DRO concentration
sum of DRO aromatic mass fractions must equal 1	1.000000E+00	360.000	sum of RRO concentrations must equal input RRO concentration
sum of DRO aliphatic mass fractions must equal 1	1.000000E+00		

Note: GRO aromatics less than sum of BTEX

Table C-6 — Soil Direct Contact Risks

Page 4 — Savoonga, Alaska — Savoonga ARNG FSRC Proposed ACLs

1	2	3	4	5	6	7	8	9
Compounds		Sample Concentrations (mg/kg)	Soil Direct Contact Risk Based Level Residential Land Use	Residential Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)	Soil Direct Contact Risk Based Level Industrial Land Use	Industrial Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	0.13	406.	3.21E-04	0	8,176.	1.59E-05	0
Toluene (nc)	nc	35.	8,111.	0.0043	0	163,520.	2.14E-04	0
Ethylbenzene (c & nc)	nc	48.	10,139.	0.0047	0	204,400.	2.35E-04	0
Xylenes (total) (nc)	nc	250.	20,278.	0.0123	0	408,800.	6.12E-04	0
GRO Aromatics (nc)	nc	0.00E+00	20,278.	0.00E+00	0	408,800.	0.00E+00	0
DRO Aromatics (nc)	nc	1,015.	4,056.	**0.2504**	0	81,760.	0.0124	0
RRO Aromatics (nc)	nc	124.	3,042.	0.0408	0	61,320.	0.002	0
GRO Aliphatics (nc)	nc	25.4608	506,944.	5.02E-05	0	10,220,000.	2.49E-06	0
DRO Aliphatics (nc)	nc	10,000.	10,139.	**0.9863**	0	204,400.	0.0489	0
RRO Aliphatics (nc)	nc	236.	202,778.	0.0012	0	4,088,000.	5.77E-05	0
Acenaphthene (nc)	nc	0.83	2,798.	2.97E-04	0	18,765.	4.42E-05	0
Acenaphthylene (nc)	nc	0.41	2,798.	1.47E-04	0	18,765.	2.18E-05	0
Anthracene (nc)	nc	0.49	20,566.	2.38E-05	0	188,220.	2.60E-06	0
Benzo(g,h,i)perylene (nc)	nc	1.2	1,399.	8.58E-04	0	9,383.	1.28E-04	0
Fluoranthene (nc)	nc	0.36	1,865.	1.93E-04	0	12,510.	2.88E-05	0
Fluorene (nc)	nc	0.77	2,347.	3.28E-04	0	18,448.	4.17E-05	0
Naphthalene (c & nc)	nc	180.	1,394.	**0.1292**	0	12,998.	0.0138	0
Phenanthrene (nc)	nc	0.43	20,566.	2.09E-05	0	188,220.	2.28E-06	0
Pyrene (nc)	nc	0.43	1,399.	3.07E-04	0	9,383.	4.58E-05	0
Benzene (c & nc)	**c**	0.13	151.	8.64E-04	0	1,041.	1.25E-04	0
Ethylbenzene (c & nc)	**c**	35.	No Sfo	0.00E+00	0	No Sfo	0.00E+00	0
Benzo(a)anthracene (c)	**c**	0.37	4.8866	0.0757	0	12.017	0.0308	0
Benzo(b)fluoranthene (c)	**c**	0.62	4.8866	**0.1269**	0	12.017	0.0516	0
Benzo(k)fluoranthene (c)	**c**	0.92	48.8656	0.0188	0	120.	0.0077	0
Benzo(a)pyrene (c)	**c**	1.8	0.4887	**3.6836**	1	1.2017	**1.4979**	1
Chrysene (c)	**c**	0.43	489.	8.80E-04	0	1,202.	3.58E-04	0
Dibenz(a,h)anthracene (c)	**c**	1.8	0.4887	**3.6836**	1	1.2017	**1.4979**	1
Indeno(1,2,3-cd)pyrene (c)	**c**	0.59	4.8866	**0.1207**	0	12.017	0.0491	0
Naphthalene (c & nc)	**c**	180.	No Sfo	0.00E+00	0	No Sfo	0.00E+00	0
1-Methylnaphthalene (nc)	nc	230	279.	**0.8252**	0	2,600.	0.0885	0
2-Methylnaphthalene (nc)	nc	360	279.	**1.2916**	1	2,600.	**0.1385**	0
	nc							
	nc							
	nc							
	nc							
	nc							
	c							
	c							
	c							
	c							
	c							
	c							
	c							
Carcinogenic Cumulative Risk				7.7111	1		3.1354	1
Non-carcinogenic Cumulative Risk				2.2698	1		0.2422	0

Values shown in the fourth and seventh columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table C-6 Migration to Outdoor Air Vapor Inhalation Risks

Page 5 Savoonga, Alaska — Savoonga ARNG FSRC Proposed ACLs

1	2	3	4	5	6	7	8	9
Compounds		Vapor Concentration in Sample (based on 3 or 4- phase partitioning, whichever is accurate, mg/L)	Residential Site Hypothetical Soil Vapor Concentration when HQ=1 or Target Risk =10^-5 (mg/L; from 3-phase equation)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)	Industrial Site Hypothetical Soil Vapor Concentration when HQ=1 or Target Risk =10^-5 (mg/L; from 3-phase equation)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	0.0081	56.5702	1.43E-04	0	167.	4.82E-05	0
Toluene (nc)	nc	0.0128	8,355.	1.53E-06	0	24,712.	5.17E-07	0
Ethylbenzene (c & nc)	nc	0.0177	1,442.	1.23E-05	0	4,266.	4.15E-06	0
Xylenes (total) (nc)	nc	0.0512	144.	3.57E-04	0	425.	1.21E-04	0
GRO Aromatics (nc)	nc	0.0045	282.	1.59E-05	0	834.	5.36E-06	0
DRO Aromatics (nc)	nc	0.0026	70.6108	3.73E-05	0	209.	1.26E-05	0
RRO Aromatics (nc)	nc	3.10E-09	No RfC	0.00E+00	0	No RfC	0.00E+00	0
GRO Aliphatics (nc)	nc	0.8987	47,488.	1.89E-05	0	140,454.	6.40E-06	0
DRO Aliphatics (nc)	nc	0.0134	1,083.	1.24E-05	0	3,202.	4.18E-06	0
RRO Aliphatics (nc)	nc	6.03E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Acenaphthene (nc)	nc	6.45E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Acenaphthylene (nc)	nc	5.22E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Anthracene (nc)	nc	1.52E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Benzo(g,h,i)perylene (nc)	nc	3.07E-11	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Fluoranthene (nc)	nc	1.98E-09	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Fluorene (nc)	nc	1.75E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Naphthalene (c & nc)	nc	4.25E-07	0.5641	7.54E-07	0	1.6685	2.55E-07	0
Phenanthrene (nc)	nc	1.27E-08	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Pyrene (nc)	nc	2.49E-09	No RfC	0.00E+00	0	No RfC	0.00E+00	0
Benzene (c & nc)	**c**	0.0081	5.6409	0.0014	0	20.0209	4.03E-04	0
Ethylbenzene (c & nc)	**c**	0.0177	30.5978	5.78E-04	0	109.	1.63E-04	0
Benzo(a)anthracene (c)	**c**	1.94E-09	3.65E-04	5.32E-06	0	0.0013	1.50E-06	0
Benzo(b)fluoranthene (c)	**c**	1.51E-10	1.64E-05	9.23E-06	0	5.81E-05	2.60E-06	0
Benzo(k)fluoranthene (c)	**c**	5.72E-11	1.21E-04	4.72E-07	0	4.30E-04	1.33E-07	0
Benzo(a)pyrene (c)	**c**	3.86E-11	6.46E-07	5.98E-05	0	2.29E-06	1.69E-05	0
Chrysene (c)	**c**	7.12E-10	0.022	3.24E-08	0	0.078	9.12E-09	0
Dibenz(a,h)anthracene (c)	**c**	2.64E-12	1.68E-08	1.57E-04	0	5.97E-08	4.42E-05	0
Indeno(1,2,3-cd)pyrene (c)	**c**	5.01E-11	3.00E-06	1.67E-05	0	1.06E-05	4.71E-06	0
Naphthalene (c & nc)	**c**	4.25E-07	0.129	3.30E-06	0	0.458	9.29E-07	0
1-Methylnaphthalene (nc)	nc	1.19E-06	2.397	4.95E-07	0	7.0897	1.67E-07	0
2-Methylnaphthalene (nc)	nc	9.41E-07	2.0734	4.54E-07	0	6.1324	1.53E-07	0
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Carcinogenic Cumulative Risk				0.0023	0		6.37E-04	0
Non-carcinogenic Cumulative Risk				5.15E-04	0		1.74E-04	0

Values shown in the fourth and seventh columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table C-6 — Migration to Indoor Air Vapor Inhalation Risks

Page 6 — **Savoonga, Alaska** — **Savoonga ARNG FSRC Proposed ACLs**

1	2	3	4	5	6	7	8	9	10
Compounds		Vapor Concentration in Sample (ug/m^3)	Building Vapor Concentration given site conditions (ug/m^3)	Residential Land Use Building Vapor Concentration when HQ=1 or Target Risk =10^-5 (ug/m^3; Value listed depends on whether C or NC risks are being evaluated)	Residential Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Residential Land Use check for compliance with risk levels (0= in compliance; 1= not in compliance)	Industrial Land Use Building Vapor Concentration when HQ=1 or Target Risk =10^-5 (ug/m^3; Value listed depends on whether C or NC risks are being evaluated)	Industrial Land Use Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target)	Industrial Land Use check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	8,069.	1.156	31.2857	0.03695	0	157.7.	0.00733	0
Toluene (nc)	nc	12,779.	1.8307	5,214.	3.511E-04	0	26,280.0.	6.966E-05	0
Ethylbenzene (c & nc)	nc	17,686.	2.5324	1,043.	0.00243	0	5,256.0.	4.818E-04	0
Xylenes (total) (nc)	nc	51,222.	7.3331	104.	0.07032	0	525.6.	0.01395	0
GRO Aromatics (nc)	nc	4,475.	0.6415	417.	0.00154	0	2,102.4.	3.051E-04	0
DRO Aromatics (nc)	nc	2,634.	0.3776	209.	0.00181	0	1,051.2.	3.592E-04	0
RRO Aromatics (nc)	nc	0.0031	4.45E-07	No RfC	0.000E+00	0	No RfC	0.000E+00	0
GRO Aliphatics (nc)	nc	898,708.	129.	19,189.	0.00671	0	96,710.4.	0.00133	0
DRO Aliphatics (nc)	nc	13,381.	1.9181	1,043.	0.00184	0	5,256.0.	3.649E-04	0
RRO Aliphatics (nc)	nc	0.0603	8.65E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Acenaphthene (nc)	nc	0.0645	9.21E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Acenaphthylene (nc)	nc	0.0522	7.46E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Anthracene (nc)	nc	0.0152	2.17E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Benzo(g,h,i)perylene (nc)	nc	3.07E-05	1.11E-08	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Fluoranthene (nc)	nc	0.002	2.84E-07	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Fluorene (nc)	nc	0.0175	2.49E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Naphthalene (c & nc)	nc	0.4254	6.09E-05	3.1286	1.946E-05	0	15.768	3.860E-06	0
Phenanthrene (nc)	nc	0.0127	1.81E-06	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Pyrene (nc)	nc	0.0025	3.56E-07	No RfC	0.000E+00	0	No RfC	0.000E+00	0
Benzene (c & nc)	**c**	8,069.	1.156	3.1197	**0.37054**	0	15.72308	0.07352	0
Ethylbenzene (c & nc)	**c**	17,686.	2.5324	22.1212	**0.11448**	0	111.5.	0.02271	0
Benzo(a)anthracene (c)	**c**	0.0019	2.78E-07	0.2765	1.006E-06	0	1.39364	1.996E-07	0
Benzo(b)fluoranthene (c)	**c**	1.51E-04	2.69E-08	0.2765	9.727E-08	0	1.39364	1.930E-08	0
Benzo(k)fluoranthene (c)	**c**	5.72E-05	1.17E-08	2.7652	4.230E-09	0	13.93636	8.393E-10	0
Benzo(a)pyrene (c)	**c**	3.86E-05	1.39E-08	0.0277	5.027E-07	0	0.13936	9.974E-08	0
Chrysene (c)	**c**	7.12E-04	1.02E-07	27.6515	3.686E-09	0	139.4.	7.313E-10	0
Dibenz(a,h)anthracene (c)	**c**	2.64E-06	1.19E-08	0.0277	4.290E-07	0	0.13936	8.513E-08	0
Indeno(1,2,3-cd)pyrene (c)	**c**	5.01E-05	1.69E-08	0.2765	6.112E-08	0	1.39364	1.213E-08	0
Naphthalene (c & nc)	**c**	0.4254	6.09E-05	0.7157	8.505E-05	0	3.60706	1.688E-05	0
1-Methylnaphthalene (nc)	nc	1.1864	1.70E-04	14.6	1.162E-05	0	73.584	2.305E-06	0
2-Methylnaphthalene (nc)	nc	0.941	1.35E-04	14.6	9.215E-06	0	73.584	1.828E-06	0
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Carcinogenic Cumulative Risk					0.4851	0		0.0963	0
Non-carcinogenic Cumulative Risk					0.1101	0		0.0218	0

Values shown in the fifth and eighth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table C-6 Calculated Migration to Groundwater Levels

Page 7 Savoonga, Alaska — Savoonga ARNG FSRC Proposed ACLs

1	2	3	4	5	6	7	8	9	10	11	12
Compounds		Dissolved Concentration in Soil Sample (based on 3 or 4 phase partitioning, whichever is accurate, mg/l)	Maximum Contaminant Level (mg/L)	Residential Land Human Health Risk Based Drinking Water Concentration (mg/l)	Residential Land Soil Moisture Target Concentration (MCL or Risk Based Concentration Multiplied by the DAF.....MCLs values used for compounds with MCLs)	Hypothetical Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; MCLs not used; if water is non-potable then hypothetical risk is 0)	Check for compliance with regulatory levels (MCLs used for compounds with MCLs: 0= in compliance; 1= not in compliance; potability of groundwater not considered)	Industrial Land Human Health Risk Based Drinking Water Concentration (mg/l)	Industrial Land Soil Moisture Target Concentration (MCL or Risk Based Concentration Multiplied by the DAF.....MCLs values used for compounds with MCLs)	Hypothetical Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; MCLs not used)	Check for compliance with regulatory levels (MCLs used for compounds with MCLs & Residential RBCs used for compounds without MCLs: 0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	0.0394	0.005	0.146	4.000E-02	0.0338	0	0.2044	4.000E-02	0.0241	0
Toluene (nc)	nc	2.8005	1.	2.92	9.222E+00	0.104	0	4.088	9.222E+00	0.0743	0
Ethylbenzene (c & nc)	nc	1.0894	0.7	3.65	6.545E+00	0.0319	0	5.11	6.545E+00	0.0228	0
Xylenes (total) (nc)	nc	3.5822	10.	7.3	6.804E+01	0.0526	0	10.22	9.320E+01	0.0376	0
GRO Aromatics (nc)	nc	0.00E+00		7.3	6.941E+01	0.00E+00	0	10.22	9.718E+01	0.00E+00	0
DRO Aromatics (nc)	nc	1.2093		1.46	1.390E+01	0.087	0	2.044	1.946E+01	0.0622	0
RRO Aromatics (nc)	nc	2.28E-04		1.095	1.043E+01	2.19E-05	0	1.533	1.460E+01	1.56E-05	0
GRO Aliphatics (nc)	nc	0.0071		183.	1.738E+03	4.09E-06	0	256.	2.433E+03	2.92E-06	0
DRO Aliphatics (nc)	nc	0.0152		3.65	3.476E+01	4.38E-04	0	5.11	4.866E+01	3.13E-04	0
RRO Aliphatics (nc)	nc	6.57E-12		73.	6.951E+02	9.45E-15	0	102.	9.732E+02	6.75E-15	0
Acenaphthene (nc)	nc	0.00143		2.19	1.585E+01	9.02E-05	0	3.066	2.219E+01	6.44E-05	0
Acenaphthylene (nc)	nc	0.0028		2.19	1.585E+01	1.77E-04	0	3.066	2.219E+01	1.26E-04	0
Anthracene (nc)	nc	1.307E-04		10.95	9.448E+01	1.38E-06	0	15.33	1.323E+02	9.88E-07	0
Benzo(g,h,i)perylene (nc)	nc	5.171E-06		1.095	1.043E+01	4.96E-07	0	1.533	1.460E+01	3.54E-07	0
Fluoranthene (nc)	nc	4.400E-05		1.46	1.359E+01	3.24E-06	0	2.044	1.903E+01	2.31E-06	0
Fluorene (nc)	nc	9.713E-04		1.46	1.172E+01	8.29E-05	0	2.044	1.640E+01	5.92E-05	0
Naphthalene (c & nc)	nc	2.16367		0.73	4.372E+00	0.4949	0	1.022	6.120E+00	0.3535	0
Phenanthrene (nc)	nc	2.156E-04		10.95	9.466E+01	2.28E-06	0	15.33	1.325E+02	1.63E-06	0
Pyrene (nc)	nc	7.255E-05		1.095	1.019E+01	7.12E-06	0	1.533	1.426E+01	5.09E-06	0
Benzene (c & nc)	**c**	0.0394	0.005	0.0155	4.000E-02	0.3183	0	0.026	4.000E-02	0.1894	0
Ethylbenzene (c & nc)	**c**	1.0894	0.7	No Sfo	6.545E+00	0.00E+00	0	No Sfo	6.545E+00	0.00E+00	0
Benzo(a)anthracene (c)	**c**	4.559E-06	0.001	0.0012	9.514E-03	4.11E-04	0	0.002	9.514E-03	2.44E-04	0
Benzo(b)fluoranthene (c)	**c**	1.387E-06	0.001	0.0012	9.522E-03	1.25E-04	0	0.002	9.522E-03	7.43E-05	0
Benzo(k)fluoranthene (c)	**c**	3.352E-06	0.001	0.0117	9.522E-03	3.02E-05	0	0.0196	9.522E-03	1.80E-05	0
Benzo(a)pyrene (c)	**c**	5.337E-06	2.00E-04	1.17E-04	1.111E-03	0.0048	0	1.96E-04	1.866E-03	0.0029	0
Chrysene (c)	**c**	1.099E-05	0.1	0.1167	9.514E-01	9.90E-06	0	0.196	9.514E-01	5.90E-06	0
Dibenz(a,h)anthracene (c)	**c**	2.478E-05	1.00E-04	1.17E-04	9.522E-04	0.0223	0	1.96E-04	9.522E-04	0.0133	0
Indeno(1,2,3-cd)pyrene (c)	**c**	1.396E-07	0.001	0.0012	9.522E-03	1.26E-05	0	0.002	9.522E-03	7.48E-06	0
Naphthalene (c & nc)	**c**	2.16367		No Sfo	No Sfo	0.00E+00	0	No Sfo	No Sfo	0.00E+00	0
1-Methylnaphthalene (nc)	nc	0.58051		0.146	1.309E+00	0.4433	0	0.2044	1.833E+00	0.3167	0
2-Methylnaphthalene (nc)	nc	1.10555		0.146	1.308E+00	0.8453	0	0.2044	1.831E+00	0.6038	0
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Carcinogenic Cumulative Risk						0.346	0			0.2059	0
Non-carcinogenic Cumulative Risk						2.0063	1			1.4331	1

Values shown in the sixth and tenth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

">1E+308" indicates that the DAF value is greater can be calculated in excel (i.e. compounds are essentially immobile) and "1/>1E+308" indicates that the risk and or equilibrium concentration is very low (inconsequential).

Table C-6 Groundwater Ingestion Risk (Measured Concentrations)

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1	2	3	4	5	6	7	8	9	10	11	12
Compounds		Dissolved Concentration Measured in Water Sample (mg/l)	Maximum Contaminant Level (mg/L)	Residential Land Use Human Health Risk Based Water Concentration (mg/l)	Groundwater Compliance Concentration (MCL or Residential Land Use Health Based Water Concentration at down gradient edge of source area; mg/l)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; MCLs not used)	Check for compliance with regulatory levels (MCLs used for compounds with MCLs: 0= in compliance; 1= not in compliance)	Industrial Land Use Human Health Based Water Concentration (mg/l)	Groundwater Compliance Concentration (MCL or Industrial Land Use Health Based Water Concentration at down gradient edge of source area; mg/l)	Fraction of Risk Based Concentration (values greater than 1 exceed the risk based target; MCLs not used)	Check for compliance with regulatory levels (MCLs used for compounds with MCLs: 0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	0.085	0.005	0.146	0.005	**0.5822**	1	0.2044	0.005	**0.4159**	1
Toluene (nc)	nc	0.127	1.	2.92	1.	0.0435	0	4.088	1.	0.0311	0
Ethylbenzene (c & nc)	nc	0.166	0.7	3.65	0.7	0.0455	0	5.11	0.7	0.0325	0
Xylenes (total) (nc)	nc	0.581	10.	7.3	7.3	0.0796	0	10.22	10.	0.0568	0
GRO Aromatics (nc)	nc	0.0443		7.3	7.3	0.0061	0	10.22	10.22	0.0043	0
DRO Aromatics (nc)	nc	0.0754		1.46	1.46	0.0516	0	2.044	2.044	0.0369	0
RRO Aromatics (nc)	nc	1.48E-05		1.095	1.095	1.35E-05	0	1.533	1.533	9.65E-06	0
GRO Aliphatics (nc)	nc	0.036		183.	183.	1.97E-04	0	256.	256.	1.41E-04	0
DRO Aliphatics (nc)	nc	4.34E-04		3.65	3.65	1.19E-04	0	5.11	5.11	8.49E-05	0
RRO Aliphatics (nc)	nc	4.35E-12		73.	73.	5.96E-14	0	102.	102.	4.26E-14	0
Acenaphthene (nc)	nc	5.20E-05		2.19	2.19	2.37E-05	0	3.066	3.066	1.70E-05	0
Acenaphthylene (nc)	nc	5.20E-05		2.19	2.19	2.37E-05	0	3.066	3.066	1.70E-05	0
Anthracene (nc)	nc	5.20E-05		10.95	10.95	4.75E-06	0	15.33	15.33	3.39E-06	0
Benzo(g,h,i)perylene (nc)	nc	5.20E-05		1.095	1.095	4.75E-05	0	1.533	1.533	3.39E-05	0
Fluoranthene (nc)	nc	5.20E-05		1.46	1.46	3.56E-05	0	2.044	2.044	2.54E-05	0
Fluorene (nc)	nc	2.70E-05		1.46	1.46	1.85E-05	0	2.044	2.044	1.32E-05	0
Naphthalene (c & nc)	nc	9.80E-05		0.73	0.73	1.34E-04	0	1.022	1.022	9.59E-05	0
Phenanthrene (nc)	nc	5.20E-05		10.95	10.95	4.75E-06	0	15.33	15.33	3.39E-06	0
Pyrene (nc)	nc	5.20E-05		1.095	1.095	4.75E-05	0	1.533	1.533	3.39E-05	0
Benzene (c & nc)	**c**	0.085	0.005	0.0155	0.005	**5.4892**	1	0.026	0.005	**3.2674**	1
Ethylbenzene (c & nc)	**c**	0.166	0.7	No Sfo	0.7	0.00E+00	0	No Sfo	0.7	0.00E+00	0
Benzo(a)anthracene (c)	**c**	5.20E-05	0.001	0.0012	0.001	0.0446	0	0.002	0.001	0.0265	0
Benzo(b)fluoranthene (c)	**c**	1.00E-04	0.001	0.0012	0.001	0.0857	0	0.002	0.001	0.051	0
Benzo(k)fluoranthene (c)	**c**	5.20E-05	0.001	0.0117	0.001	0.0045	0	0.0196	0.001	0.0027	0
Benzo(a)pyrene (c)	**c**	5.20E-05	2.00E-04	1.17E-04	1.17E-04	**0.4457**	0	1.96E-04	1.96E-04	**0.2653**	0
Chrysene (c)	**c**	5.20E-05	0.1	0.1167	0.1	4.46E-04	0	0.196	0.1	2.65E-04	0
Dibenz(a,h)anthracene (c)	**c**	1.00E-04	1.00E-04	1.17E-04	1.00E-04	**0.8571**	0	1.96E-04	1.00E-04	**0.5102**	0
Indeno(1,2,3-cd)pyrene (c)	**c**	1.00E-04	0.001	0.0012	0.001	0.0857	0	0.002	0.001	0.051	0
Naphthalene (c & nc)	**c**	9.80E-05		No Sfo	No Sfo	0.00E+00	0	No Sfo	No Sfo	0.00E+00	0
1-Methylnaphthalene (nc)	nc	0.00025		0.146	0.146	0.0017	0	0.2044	0.2044	0.0012	0
2-Methylnaphthalene (nc)	nc	0.00027		0.146	0.146	0.0018	0	0.2044	0.2044	0.0013	0
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Carcinogenic Cumulative Risk						7.013	1			4.1744	1
Non-carcinogenic Cumulative Risk						0.7547	0			0.539	0

Values shown in the seventh and eleventh columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

If the groundwater is non-potable then groundwater ingestion risk is zero.

Table C-6	Potential Cumulative Risk Assuming All Pathways Complete											DRO, GRO and RRO not included in cumulative risk calculations	
Page 9	Savoonga, Alaska					Savoonga ARNG FSRC Proposed ACLs							
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Compounds		Fraction of Soil Direct Contact Risk, Residential Site	Fraction of Outdoor Air Inhalation Risk, Residential Site	Fraction of Indoor Air Inhalation Risk, Residential Site	Fraction of Groundwater Ingestion Risk, Residential Site	Sum of Fraction of Risk Values for Residential Site	Residential Site Check for compliance with risk levels (0= in compliance 1= not in compliance)	Fraction of Soil Direct Contact Risk, Industrial Site	Fraction of Outdoor Air Inhalation Risk, Industrial Site	Fraction of Indoor Air Inhalation Risk, Industrial Site	Fraction of Groundwater Ingestion Risk, Industrial Site	Sum of Fraction of Risk Values for Industrial Site	Industrial Site Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	3.21E-04	1.43E-04	0.0369	**0.5822**	**0.6196**	0	1.59E-05	4.82E-05	0.0073	**0.4159**	**0.4232**	0
Toluene (nc)	nc	0.0043	1.53E-06	3.51E-04	0.0435	0.0482	0	2.14E-04	5.17E-07	6.97E-05	0.0311	0.0314	0
Ethylbenzene (c & nc)	nc	0.0047	1.23E-05	0.0024	0.0455	0.0527	0	2.35E-04	4.15E-06	4.82E-04	0.0325	0.0332	0
Xylenes (total) (nc)	nc	0.0123	3.57E-04	0.0703	0.0796	**0.1626**	0	6.12E-04	1.21E-04	0.014	0.0568	0.0715	0
GRO Aromatics (nc)	nc												
DRO Aromatics (nc)	nc												
RRO Aromatics (nc)	nc												
GRO Aliphatics (nc)	nc												
DRO Aliphatics (nc)	nc												
RRO Aliphatics (nc)	nc												
Acenaphthene (nc)	nc	2.97E-04	0.00E+00	0.00E+00	2.37E-05	3.20E-04	0	4.42E-05	0.00E+00	0.00E+00	1.70E-05	6.12E-05	0
Acenaphthylene (nc)	nc	1.47E-04	0.00E+00	0.00E+00	2.37E-05	1.70E-04	0	2.18E-05	0.00E+00	0.00E+00	1.70E-05	3.88E-05	0
Anthracene (nc)	nc	2.38E-05	0.00E+00	0.00E+00	4.75E-06	2.86E-05	0	2.60E-06	0.00E+00	0.00E+00	3.39E-06	6.00E-06	0
Benzo(g,h,i)perylene (nc)	nc	8.58E-04	0.00E+00	0.00E+00	4.75E-05	9.05E-04	0	1.28E-04	0.00E+00	0.00E+00	3.39E-05	1.62E-04	0
Fluoranthene (nc)	nc	1.93E-04	0.00E+00	0.00E+00	3.56E-05	2.29E-04	0	2.88E-05	0.00E+00	0.00E+00	2.54E-05	5.42E-05	0
Fluorene (nc)	nc	3.28E-04	0.00E+00	0.00E+00	1.85E-05	3.47E-04	0	4.17E-05	0.00E+00	0.00E+00	1.32E-05	5.49E-05	0
Naphthalene (c & nc)	nc	**0.1292**	7.54E-07	1.95E-05	1.34E-04	**0.1293**	0	0.0138	2.55E-07	3.86E-06	9.59E-05	0.0139	0
Phenanthrene (nc)	nc	2.09E-05	0.00E+00	0.00E+00	4.75E-06	2.57E-05	0	2.28E-06	0.00E+00	0.00E+00	3.39E-06	5.68E-06	0
Pyrene (nc)	nc	3.07E-04	0.00E+00	0.00E+00	4.75E-05	3.55E-04	0	4.58E-05	0.00E+00	0.00E+00	3.39E-05	7.97E-05	0
Benzene (c & nc)	**c**	8.64E-04	0.0014	**0.3705**	**5.4892**	**5.8621**	1	1.25E-04	4.03E-04	0.0735	**3.2674**	**3.3415**	1
Ethylbenzene (c & nc)	**c**	0.00E+00	5.78E-04	**0.1145**	0.00E+00	**0.1151**	0	0.00E+00	1.63E-04	0.0227	0.00E+00	0.0229	0
Benzo(a)anthracene (c)	**c**	0.0757	5.32E-06	1.01E-06	0.0446	**0.1203**	0	0.0308	1.50E-06	2.00E-07	0.0265	0.0573	0
Benzo(b)fluoranthene (c)	**c**	**0.1269**	9.23E-06	9.73E-08	0.0857	**0.2126**	0	0.0516	2.60E-06	1.93E-08	0.051	**0.1026**	0
Benzo(k)fluoranthene (c)	**c**	0.0188	4.72E-07	4.23E-09	0.0045	0.0233	0	0.0077	1.33E-07	8.39E-10	0.0027	0.0103	0
Benzo(a)pyrene (c)	**c**	**3.6836**	5.98E-05	5.03E-07	**0.4457**	**4.1293**	1	**1.4979**	1.69E-05	9.97E-08	**0.2653**	**1.7632**	1
Chrysene (c)	**c**	8.80E-04	3.24E-08	3.69E-09	4.46E-04	0.0013	0	3.58E-04	9.12E-09	7.31E-10	2.65E-04	6.23E-04	0
Dibenz(a,h)anthracene (c)	**c**	**3.6836**	1.57E-04	4.29E-07	**0.8571**	**4.5409**	1	**1.4979**	4.42E-05	8.51E-08	**0.5102**	**2.0081**	1
Indeno(1,2,3-cd)pyrene (c)	**c**	**0.1207**	1.67E-05	6.11E-08	0.0857	**0.2065**	0	0.0491	4.71E-06	1.21E-08	0.051	**0.1001**	0
Naphthalene (c & nc)	**c**	0.00E+00	3.30E-06	8.51E-05	0.00E+00	8.83E-05	0	0.00E+00	9.29E-07	1.69E-05	0.00E+00	1.78E-05	0
1-Methylnaphthalene (nc)	nc	**0.8252**	4.95E-07	1.16E-05	0.0017	**0.8269**	0	0.0885	1.67E-07	2.31E-06	0.0012	0.0897	0
2-Methylnaphthalene (nc)	nc	**1.2916**	4.54E-07	9.21E-06	0.0018	**1.2934**	1	**0.1385**	1.53E-07	1.83E-06	0.0013	**0.1398**	0
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Carcinogenic Cumulative Risk						15.2114						7.4067	1
Non-carcinogenic Cumulative Risk						3.135						0.8032	0

Values shown in the second through sixth and eighth through twelfth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table C-6	Cumulative Risk for Pathways Complete at Present Time												DRO, GRO and RRO not included in cumulative risk calculations
Page 10	Savoonga, Alaska					Savoonga ARNG FSRC Proposed ACLs							
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Compounds		Fraction of Soil Direct Contact Risk, Residential Site	Fraction of Outdoor Air Inhalation Risk, Residential Site	Fraction of Indoor Air Inhalation Risk, Residential Site	Fraction of Groundwater Ingestion Risk, Residential Site	Sum of Fraction of Risk Values for Residential Site	Residential Site Check for compliance with risk levels (0= in compliance 1= not in compliance)	Fraction of Soil Direct Contact Risk, Industrial Site	Fraction of Outdoor Air Inhalation Risk, Industrial Site	Fraction of Indoor Air Inhalation Risk, Industrial Site	Fraction of Groundwater Ingestion Risk, Industrial Site	Sum of Fraction of Risk Values for Industrial Site	Industrial Site Check for compliance with risk levels (0= in compliance; 1= not in compliance)
Benzene (c & nc)	nc	3.21E-04	1.43E-04	0.00E+00	0.00E+00	4.63E-04	0	1.59E-05	4.82E-05	0.00E+00	0.00E+00	6.41E-05	0
Toluene (nc)	nc	0.0043	1.53E-06	0.00E+00	0.00E+00	0.0043	0	2.14E-04	5.17E-07	0.00E+00	0.00E+00	2.15E-04	0
Ethylbenzene (c & nc)	nc	0.0047	1.23E-05	0.00E+00	0.00E+00	0.0047	0	2.35E-04	4.15E-06	0.00E+00	0.00E+00	2.39E-04	0
Xylenes (total) (nc)	nc	0.0123	3.57E-04	0.00E+00	0.00E+00	0.0127	0	6.12E-04	1.21E-04	0.00E+00	0.00E+00	7.32E-04	0
GRO Aromatics (nc)	nc												
DRO Aromatics (nc)	nc												
RRO Aromatics (nc)	nc												
GRO Aliphatics (nc)	nc												
DRO Aliphatics (nc)	nc												
RRO Aliphatics (nc)	nc												
Acenaphthene (nc)	nc	2.97E-04	0.00E+00	0.00E+00	0.00E+00	2.97E-04	0	4.42E-05	0.00E+00	0.00E+00	0.00E+00	4.42E-05	0
Acenaphthylene (nc)	nc	1.47E-04	0.00E+00	0.00E+00	0.00E+00	1.47E-04	0	2.18E-05	0.00E+00	0.00E+00	0.00E+00	2.18E-05	0
Anthracene (nc)	nc	2.38E-05	0.00E+00	0.00E+00	0.00E+00	2.38E-05	0	2.60E-06	0.00E+00	0.00E+00	0.00E+00	2.60E-06	0
Benzo(g,h,i)perylene (nc)	nc	8.58E-04	0.00E+00	0.00E+00	0.00E+00	8.58E-04	0	1.28E-04	0.00E+00	0.00E+00	0.00E+00	1.28E-04	0
Fluoranthene (nc)	nc	1.93E-04	0.00E+00	0.00E+00	0.00E+00	1.93E-04	0	2.88E-05	0.00E+00	0.00E+00	0.00E+00	2.88E-05	0
Fluorene (nc)	nc	3.28E-04	0.00E+00	0.00E+00	0.00E+00	3.28E-04	0	4.17E-05	0.00E+00	0.00E+00	0.00E+00	4.17E-05	0
Naphthalene (c & nc)	nc	**0.1292**	7.54E-07	0.00E+00	0.00E+00	**0.1292**	0	0.0138	2.55E-07	0.00E+00	0.00E+00	0.0138	0
Phenanthrene (nc)	nc	2.09E-05	0.00E+00	0.00E+00	0.00E+00	2.09E-05	0	2.28E-06	0.00E+00	0.00E+00	0.00E+00	2.28E-06	0
Pyrene (nc)	nc	3.07E-04	0.00E+00	0.00E+00	0.00E+00	3.07E-04	0	4.58E-05	0.00E+00	0.00E+00	0.00E+00	4.58E-05	0
Benzene (c & nc)	c	8.64E-04	0.0014	0.00E+00	0.00E+00	0.0023	0	1.25E-04	4.03E-04	0.00E+00	0.00E+00	5.28E-04	0
Ethylbenzene (c & nc)	c	0.00E+00	5.78E-04	0.00E+00	0.00E+00	5.78E-04	0	0.00E+00	1.63E-04	0.00E+00	0.00E+00	1.63E-04	0
Benzo(a)anthracene (c)	c	0.0757	5.32E-06	0.00E+00	0.00E+00	0.0757	0	0.0308	1.50E-06	0.00E+00	0.00E+00	0.0308	0
Benzo(b)fluoranthene (c)	c	**0.1269**	9.23E-06	0.00E+00	0.00E+00	**0.1269**	0	0.0516	2.60E-06	0.00E+00	0.00E+00	0.0516	0
Benzo(k)fluoranthene (c)	c	0.0188	4.72E-07	0.00E+00	0.00E+00	0.0188	0	0.0077	1.33E-07	0.00E+00	0.00E+00	0.0077	0
Benzo(a)pyrene (c)	c	**3.6836**	5.98E-05	0.00E+00	0.00E+00	**3.6836**	1	**1.4979**	1.69E-05	0.00E+00	0.00E+00	**1.4979**	1
Chrysene (c)	c	8.80E-04	3.24E-08	0.00E+00	0.00E+00	8.80E-04	0	3.58E-04	9.12E-09	0.00E+00	0.00E+00	3.58E-04	0
Dibenz(a,h)anthracene (c)	c	**3.6836**	1.57E-04	0.00E+00	0.00E+00	**3.6837**	1	**1.4979**	4.42E-05	0.00E+00	0.00E+00	**1.4979**	1
Indeno(1,2,3-cd)pyrene (c)	c	**0.1207**	1.67E-05	0.00E+00	0.00E+00	**0.1208**	0	0.0491	4.71E-06	0.00E+00	0.00E+00	0.0491	0
Naphthalene (c & nc)	c	0.00E+00	3.30E-06	0.00E+00	0.00E+00	3.30E-06	0	0.00E+00	9.29E-07	0.00E+00	0.00E+00	9.29E-07	0
1-Methylnaphthalene (nc)	nc	**0.8252**	4.95E-07	0.00E+00	0.00E+00	**0.8252**	0	0.0885	1.67E-07	0.00E+00	0.00E+00	0.0885	0
2-Methylnaphthalene (nc)	nc	**1.2916**	4.54E-07	0.00E+00	0.00E+00	**1.2916**	1	**0.1385**	1.53E-07	0.00E+00	0.00E+00	**0.1385**	0
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Carcinogenic Cumulative Risk						7.7133						3.136	1
Non-carcinogenic Cumulative Risk						2.2703						0.2424	0

Values shown in the second through sixth and eighth through twelfth columns are the normalized fraction of the risk based level, and not the carcinogenic risk level. The fraction of risk multiplied by 10^ -5 equals the carcinogenic risk level for the carcinogenic compounds. Carcinogenic compounds shown in bold.

Table C-6 — Partitioning into Groundwater & Surface Water

Page 11 — **Savoonga, Alaska** — **Savoonga ARNG FSRC Proposed ACLs**

1	2	3	4	5	6	7	8	9
Compounds		Calculated Equilibrium Conc. (from soil data & solver or goal seek) (mg/L)	Measured Dissolved Phase Conc. (mg/L)	Groundwater Compliance Concentration (MCL or Residential Land Use Health Based Water Concentration at down gradient edge of source area; mg/l)	Check for vadose zone fill potential (DAF of 3.3; 0 =suitable for vadose zone fill; 1 =not suitable for vadose zone fill; "ND" input concentrations not assessed)	Check for saturated zone fill potential (DAF of 1; 0 =suitable for saturated zone fill; 1 =not suitable for saturated zone fill; "ND" input concentrations not assessed)	Ambient Water Quality Criteria (mg/L)	Check for surface water body fill potential (DAF of 1; 0 =suitable for fill in surface water; 1 =not suitable for fill in surface water; "ND" input concentrations not assessed)
Benzene		0.0394	0.085	0.005	1	1	0.005	1
Toluene		2.8005	0.127	1.	0	0		
Ethylbenzene		1.0894	0.166	0.7	0	0		
Xylene		3.5822	0.581	7.3	0	0		
GRO Aromatics		0.00E+00	0.0443	7.3	0	0		
DRO Aromatics		1.2093	0.0754	1.46	0	0		
RRO Aromatics		2.28E-04	1.48E-05	1.095	0	0		
GRO Aliphatics		0.0071	0.036	183.	0	0		
DRO Aliphatics		0.0152	4.34E-04	3.65	0	0		
RRO Aliphatics		6.57E-12	4.35E-12	73.	0	0		
Acenaphthene		0.0014	5.20E-05	2.19	0	0		
Acenaphthylene		0.0028	5.20E-05	2.19	0	0		
Anthracene		1.31E-04	5.20E-05	10.95	0	0		
Benzo(g,h,i)perylene		5.17E-06	5.20E-05	1.095	0	0		
Fluoranthene		4.40E-05	5.20E-05	1.46	0	0		
Fluorene		9.71E-04	2.70E-05	1.46	0	0		
Naphthalene		2.1637	9.80E-05	0.73	0	0		
Phenanthrene		2.16E-04	5.20E-05	10.95	0	0		
Pyrene		7.25E-05	5.20E-05	1.095	0	0		
Benzo (a) Anthracene		4.56E-06	5.20E-05	0.001	0	0		
Benzo (b) fluoranthene		1.39E-06	1.00E-04	0.001	0	0		
Benzo (k) fluoranthene		3.35E-06	5.20E-05	0.001	0	0		
Benzo (a) pyrene		5.34E-06	5.20E-05	1.17E-04	0	0		
Chrysene		1.10E-05	5.20E-05	0.1	0	0		
Dibenz (a,h) anthracene		2.48E-05	1.00E-04	1.00E-04	0	0		
Indeno (1,2,3-cd) pyrene		1.40E-07	1.00E-04	0.001	0	0		
1-Methylnaphthalene (nc)		0.5805	2.50E-04	0.146	0	0		
2-Methylnaphthalene (nc)		1.1055	2.70E-04	0.146	0	0		
TAH		7.5115	0.959				0.01	1
TAqH		9.6809	0.96				0.015	1
DRO sheen (mg/kg)							230	1
				sum	1	1	sum	4

These calculations may be used to assess the potential limitations on the off-site transport and placement of hydrocarbon impacted soil.

Table C-6	Site Status Summary					
Page 12	Savoonga, Alaska				Savoonga ARNG FSRC Proposed ACLs	
1	2	3	4	5	6	7	8
		Cumulative Risks for Residential Site (rounded to 1 significant digit)	soil ingestion check for compliance with risk criteria (0= in compliance; 1 or >1 = not in compliance; number is the number of carcinogenic and non-carcinogenic direct contact criteria exceeded)	migration to outdoor air check for compliance with risk criteria (0= in compliance; 1= not in compliance)	migration to indoor air check for compliance with risk criteria (0= in compliance; 1= not in compliance)	groundwater ingestion check for compliance with risk criteria (0= in compliance; 1 or >1 = not in compliance; number is the number of carcinogenic and non-carcinogenic direct contact criteria exceeded)	migration to groundwater check for compliance (0= in compliance; 1 = not in compliance)
Potential Carcinogenic Cumulative Fraction of Risk		**20**	2			1	
Potential Non-carcinogenic Cumulative Risk		**3**	1			0	
Existing Carcinogenic Cumulative Fraction of Risk		7.7133					
Existing non-carcinogenic Cumulative Risk		2.2703					
GRO Aromatics			0	0	0	0	0
DRO Aromatics			0	0	0	0	0
RRO Aromatics			0	0	0	0	0
GRO Aliphatics			0	0	0	0	0
DRO Aliphatics			0	0	0	0	0
RRO Aliphatics			0	0	0	0	0
check for ultimate GRO, DRO, RRO compliance			**0**				
Site conditons do not meet the ADEC human health risk standard established in 18 AAC 75.325. Site conditions are not protective of human health under an unrestricted (residential) landuse scenario.							**1**
Migration to groundwater criteria have not been attained in surface and subsurface soils.							**2**
Site does not meet closeout criteria, eligible only for a 'cleanup complete with institutional controls' determination							
A DRO polar fraction may be present, the risk posed by the polar fraction is not known.							

Appendix D
Response to Comments

DOCUMENT REVIEW RECORD

DOCUMENT PREPARER: CH2M HILL
DOCUMENT TITLE: *Savoonga Federal Scout Readiness Center, Draft Data Gap Investigation Report, April 2012*

REVIEWED BY: ADEC
REVIEWER: Deb Caillouet

Comment Number	Section, Paragraph, Page	Reviewer Comment	Preparer Response
1.	Section 5.3	The GRO results were not collected in 2011 from the most contaminated soil, therefore this is considered a data gap. Additionally, why was a GRO value of 6 mg/kg used as the HRC input rather than the maximum detected GRO level, 73 mg/kg (2004)?	As stated in the work plan, GRO was not considered a COPC; therefore, soil samples were not collected and analyzed for GRO. VPH results of the soil sample collected in 2011 from the area showing the highest amount of contamination (11SAVSB001) confirms only low levels of GRO exist. As shown in Table C-2, 6 mg/kg was the highest GRO detected in source area samples. However, the HRC will be re-run with an input GRO concentration changed to show 73 mg/kg.
2.	Section 5.5.1, Page 5-5	Explain why soil field duplicates were not collected and analyzed at the required frequency (10%) for all analyses.	As stated in Section 5.5.1 one duplicate soil sample was collected for DRO but was broken in transit. A second, deeper soil sample duplicate for all analytes was planned, achieving the 10% requirement; however, we were unable to collect this sample due to encountering frozen soil prior to reaching the necessary depth. The field crew did not re-sample, thus not meeting 10% duplicate criteria.
3.	Section 6.1, Page 6-1	The field notes/boring logs indicate very hard boring but only a couple mention frozen. The difficulty of hand augering was known prior to work plan development and should have been addressed in the selection of the field equipment. There is no indication of continuous permafrost at the site. Remove the statement. ADEC does not believe the	We agree that large cobbles within the gravel pad have limited vertical depth of sampling during all sampling events, but we still believe that permafrost nonetheless exists at depth across the entire site. The cobbles (local backfill) encountered at depth were likely partially frozen within the upper reaches of the frozen zone, limiting our ability to detect the permafrost directly. All historical data suggests permafrost is continuous

		site was characterized to depth completely. This can be addressed in the remedial action, but makes the risk assessment very questionable.	across all of Savoonga, including our site (Section 2.2.2). Why would our site not have continuous permafrost? Unless a very shallow layer of clay or silt exists uniformly across the site, we have no other explanation of the consistent layer of shallow groundwater (within the active layer) verified across the site.
4.	Section 6.2, Page 6-1	Sample SB004 is near the property line and at 18 mg/l. This is an indication that contamination has migrated off-site.	Accepted. Text will be revised to state this.
5.	Section 6.1, Page 6-1	Separate sources of soil contamination are documented. Per guidance, these should be evaluated separately OR documentation provided to support the assumption that the fuel type, spill date, etc. are similar enough to group as one data set.	Accepted. This will be further discussed. A second source sample was collected (11SAVSB007_SO02-03) adjacent location B-06, the highest contamination west of the New FSRC, but the DRO concentration in the sample was well below cleanup levels and the data deemed not very useful. However, we feel that the heating oil spilled is nearly identical (same fuel in both tanks) and is only a few years apart in age (both over 2 decades old). Therefore, the source sample collected is adequate to characterize both spills.
6.	Section 6.3, Page 6-17	A 350 determination is not appropriate, contaminated groundwater is migrating off-site.	Accepted. The request for a 350 determination will be removed.
7.	Section 8, Page 8-1	The first sentence of Section 1.1 "The goal of the DGI was to ensure that the Alaska Army National Guard (ARNG) has all the environmental data necessary to conduct remedial actions at St. Mary's FSRC to allow divestiture of the leased property without the use of institutional controls." has not been addressed by the recommended remedial actions. Please refer to the ADEC Site Closure Memorandum and the Institutional Control Guidance and provide the requirements that would be placed on the site under the recommended action. This will allow the Guard to determine if any of the requirements would be considered institutional controls under their land transfer policies.	Accepted. ICs have been identified for the management of the contaminated groundwater. However, for the contaminated soil, to be consistent with ADEC requirements, the following paragraph will be added to the end of Section 8.2.1 "As required by 18 AAC 75.325(i), approval from ADEC will be required prior to any future excavation or disturbance of soil at Akiak FSRC to prevent placement of petroleum-contaminated soil in environmentally sensitive areas."

8.	Page 8-2	Figure 8-1 missing	Figure 8-1 to be provided in final.
9.	Section 8.2.2, Page 8-2	18 AAC 75.380.c.2 requires groundwater concentrations to be stable or decreasing to obtain site closure. This has not been demonstrated.	This will be demonstrated with the LTM program. The spill is well over a decade old. We do not anticipate the GW concentrations to be increasing.
10.	Appendix B, ADEC Checklist G1G260466	3.b. The sample had excess soil, or not enough methanol for VPH.	Accepted. The checklist has been updated to reflect this.
11.	Section 7.2, Page 7-1	The department does not accept the submitted proposed values as valid 95%UCLs; 1) The plotted data is indicative of sub-populations; i.e. areas of higher (≥4300) and lower (<4300) concentrations.	Accepted. Only maximum concentrations will be used for calculating cumulative risk.
12.	Appendix C, Table C4	Why are the EPH/VPH results from "Non-Source Area Samples" included? These should not be used as HRC data inputs and removed from the table. As such, only the single EPH/VPH sample from the former storage van area is the basis of fractionization data and HRC input?	The non-source samples were not used as inputs in the HRC calculations. They are only presented to state that they existed but were not used. In point of fact, there were two EPH/VPH samples used as the basis of fractionization data and HRC input. These results were considered adequate to define the nature of the site contamination (see comment #5).
13.	Section 7.2 and Appendix C	The hypothetical scenario statistics are not accepted. Propose a site specific alternate cleanup level, use this as the HRC DRO input concentration and submit the results. All soils above this concentration would require remediation/removal.	Accepted. The hypothetical scenario statistics will be removed and a DRO ACL will be proposed.

REVIEWED BY: ARNG
REVIEWER: SGT Jennifer Nutt

Comment Number	Section, Paragraph, Page	Reviewer Comment	Preparer Response
1.	Section 5.3	Limited vertical extent due to gravel and permafrost: need regulator feedback. Past sampling shows limited	Accepted. This issue can be addressed through remedial action (future excavation).

		vertical delineation as well. If ADEC concurs with report and Section 8.2, then the site characterization is adequate. If not, then path forward will need to be reevaluated.	